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Measuring Corporate Bond Mortality and Performance

EDWARD I. ALTMAN*

ABSTRACT

This study develops an alternative way to measure default risk and suggests an appropriate method to assess the performance of fixed-income investors over the entire spectrum of credit-quality classes. The approach seeks to measure the expected mortality of bonds and the consequent loss rates in a manner similar to the way actuaries assess mortality of human beings. The results show that all bond ratings outperform riskless Treasuries over a ten-year horizon and that, despite relatively high mortality rates, B-rated and CCC-rated securities outperform all other rating categories for the first four years after issuance, with BB-rated securities outperforming all others thereafter.

THE RECENT EMERGENCE OF the high-yield corporate debt market in the United States has intensified interest in the relation between expected yield spreads of bonds of various credit quality and expected losses from defaults. In addition to default risk, investors also consider the effects of the two other major risk dimensions of investing in fixed-interest instruments, *i.e.*, interest rate risk and liquidity risk. The interaction among the three dimensions of risk has raised the analytic content of fixed-income assessment to an increasingly sophisticated level. The analysis of default risk, however, has probably been the area of most concern and empirical measurement over the years since the initial pioneering work by Hickman (1958).

The appropriate measure of default risk and the accuracy of its measurement are critical in the pricing of debt instruments, in the measurement of their performance, and in the assessment of market efficiency. Analysts have concentrated their efforts on measuring the default rate for finite periods of time—for example, one year—and then averaging the annual rates for longer periods. In almost all previous studies, the rate of default has been measured simply as the value of defaulting issues for some specific population of debt compared with the value of bonds outstanding that could have defaulted. Annual default rates are then usually compared with observed promised yield spreads in order to assess the attractiveness of particular bonds or classes of bonds. A corollary approach is to compare default rates with ex post returns to assess whether investors were compensated for the risks they bear.

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This study seeks to explore further the notion of default risk by developing an alternative way of measuring that risk and utilizes this measure to assess the performance of fixed-income investment strategies over the entire spectrum of credit-quality classes. Our approach seeks to measure the expected mortality of bonds in a manner similar to that used by actuaries in assessing human mortality. Our use of the term mortality refers specifically to a life expectancy or survival rate for various periods of time after issuance. Although it is informative to measure default rates and losses based on the average annual rate method, that traditional technique has at least two deficiencies. It fails to consider that there are other ways in which a bond dies, namely redemptions from calls, sinking funds, and maturation. Therefore, it fails to consider the surviving population of bonds; nor does it answer the question of the probability of default for various time periods in the future on the basis of an issue's specific attributes at issuance, summarized into its bond rating. This study does explicitly consider the surviving population as the relevant basis or denominator in the default calculation and addresses the initial default assessment by the following questions. Given an issue's initial bond rating:

(1) What is the estimated probability of default and loss from default over a specific time horizon of one year, two years, three years, or N years?
(2) What are the estimates of the cumulative annual mortality rates and losses for various time frames as well as the marginal rates for specific one-year periods?
(3) Given estimates of cumulative mortality losses suffered by investors and expected return spreads earned on the surviving population of bonds, what were the net return spreads earned or lost in comparison with returns on risk-free securities?

This paper is organized as follows. In Section I we review prior studies in the default risk area. In Section II we expand on traditional measures of default rates and losses. The new concept of mortality rates is then presented in Section III, indicating what we believe to be a more comprehensive and meaningful measure. Section IV presents empirical results including new-issue volume by bond rating, adjusted mortality rates and losses, and, finally, net return spreads received by investors in different risk categories of bonds. The final section reviews the paper's implications.

I. Prior Studies

Previous works in the area of default were of three general kinds. The first example, which might be called Hickman-style (1958) reports, usually presents statistics on annual default rates and actual returns to bond holders over various time frames.

A second kind of study emphasizes the default risk potential of individual-company debt by examining the determinants of risk premiums over risk-free securities, e.g., Fisher (1959), or by constructing univariate (Beaver (1966)) or multivariate classification models (Altman (1968) and others) based on the

combination of micro-finance measures and statistical classification techniques. Variants on those models were based on the gambler's ruin concept (Wilcox (1971)), recursive partitioning techniques (Frydman, Altman, and Kao (1985)), and market indicators of survival (Queen and Roll (1987)). The latter study is particularly relevant because it emphasizes the distinction between favorable and unfavorable disappearance. Our measure of mortality of bonds has similar qualities in that we adjust the population for various kinds of redemptions.

Finally, a study by Fons (1987) attempts to combine observed pricing and the inherent default risk premium with estimates of corporate bond default experience. He incorporates default experience measured by Altman and Nammacher (1985, 1987) and others with a risk-neutral investment strategy—that is, where the only factor that matters is the return distribution of debt with no relevance for volatility or liquidity factors. Fons did not believe, however, that default rates on particular bond-rating classes could be meaningfully addressed because the ratings are not permanent designations. Yet, it does appear to be relevant to measure losses to investors by original investment in specific bond-rating categories.

II. Traditional Measures of Default Rates and Losses

The corporate debt market has pretty much accepted the distinction between the so-called investment-grade and non-investment-grade categories. At the same time, bonds receive more precise ratings, with four classes of investment-grade debt and essentially three classes of lower quality junk bonds. Despite the finer distinctions, all published analytical works concentrate on either the entire corporate-bond universe or just the high-yield, non-investment-grade sector. Default rates are calculated on an average annual basis, with individual rates for each year combined with rates for other years, over some longer time horizon to form the estimate for the average annual rate.[1] Our own results show that the average annual default rate, measured in the traditional way, for the period 1978–1987 was 1.86 percent per year. See Altman (1989) for the complete year-by-year results.

A. Default Losses

The more relevant default statistic for investors is not the rate of default but the amount lost from defaults.[2] Altman and Nammacher (1987) measured the amount lost from defaults by tracking the price for the defaulting issue just after default and assuming that the investor had purchased the issue at par value and sold the issue just after default. The investor also is assumed to lose one coupon

[1] The rate for each year is based on the dollar amount of defaulting issues in that year divided by the total population outstanding as of some point during that year.

[2] An additional item of importance is the amount lost not just from defaults but also from other crisis situations, such as distressed exchange issues. Fridson, Wahl, and Jones (1988) did look at the loss on distressed exchange issues as well as losses from defaults and found that the overall average annual loss for the period 1978–1987 was 1.88 percent. Their base and reference population was only original-issue high-yield debt.

payment. The average annual default loss over the sample period has been approximately 1.2 percent per year. That lower percentage of loss compared with default rates stems from the fact that defaulting debt, on average, sells for approximately forty percent of par at the end of the defaulting month.

III. The Mortality Rate Concept

We retain the notion that default rates for individual periods—yearly, for example—are measured on the basis of defaults in the period in relation to some base population in that same period. The calculation, however, becomes more complex when we begin with a specific cohort group such as a bond-rating category and track that group's performance for multiple time periods. Because the original population can change over time as a result of a number of different events, we consider mortalities in relation to a survival population and then input the defaults to calculate mortality rates. Bonds can exit from the original population by means of at least four different events: defaults, calls, sinking funds, and maturities.

The individual mortality rate for each year (marginal mortality rate = MMR) is calculated by

$$\text{MMR}_{(t)} = \frac{\text{total value of defaulting debt in the year } (t)}{\text{total value of the population of bonds at the start of the year } (t)}.$$

We then measure the cumulative mortality rate (CMR) over a specific time period (1, 2, $\cdots$, T years) by subtracting the product of the surviving populations of each of the previous years from one (1.0), that is,

$$CMR_{(T)} = 1 - \prod_{t=1}^{T} SR_t,$$

where

$CMR_{(T)}$ = cumulative mortality rate in (T),
$SR_{(t)}$ = survival rate in (t); $1 - MMR_{(t)}$.

The individual year marginal mortality rates for each bond rating are based on a compilation of that year's mortality measured from issuance. For example, all of the one-year mortalities are combined for the seventeen-year sample period to arrive at the one-year rate; all of the second-year mortalities are combined to get the two-year rate, etc.

The mortality rate is a value-weighted rate for the particular year after issuance, rather than an unweighted average. If we were simply to average each of the year-one rates, year-two rates, etc., our results would be susceptible to significant specific-year bias. If, for example, the amount of new issues is very small and the defaults emanating from that year are high in relation to the amount issued, the unweighted average could be improperly affected. Our weighted-average technique correctly biases the results toward the larger-issue years, especially the more recent years.

IV. Empirical Results

Table I lists the dollar amount, by bond rating, issued for the period 1971–1986 according to statistics compiled from *Standard & Poor's Bond Guide.* Note that investment-grade categories dominated new listings over much of the sample period. During the 1971–1981 period, the below-investment-grade sector showed small, relatively consistent BB-rated issues ranging from a low of $20 million in 1975 to a high of $579 million in 1977. Since 1982, however, BB new issues exceeded $1 billion each year. Single-B debt had small, sporadic new issues from 1971 to 1976. Since 1977, volume has picked up, with more than $500 million issued in 1977, more than $1 billion issued in 1978, more than $6 billion in 1984–1985, and over $21 billion in 1986.[3] The number of issues in each year is also indicated for the junk bond sector (lower three categories of ratings) since 1977, showing its impressive growth.

A. Mortality Rates

The data in Table II show our mortality rate computations, adjusted for redemptions and defaults, for the entire period 1971–1987. The data include individual year and cumulative mortalities for up to ten years after issuance. It is possible to list the data for beyond ten years, but the number of observations obviously diminishes as the number of years after issuance increases.

The relative results across cohort groups are pretty much in line with expectations, with the mortality rates very low for the higher-rated bonds and increasing for lower rated issues. For example, AAA-rated debt had a zero mortality rate for the first five years after issuance and then only 0.13 percent from six to ten years (due to Texaco's 1987 bond default). AA-rated and A-rated debt mortalities reached just 2.46 percent and 0.93 percent, respectively, over a ten-year period. The mortality rates for BBB and lower bonds begin to increase almost immediately after issuance, with BBB (the lowest investment-grade debt level) showing a cumulative rate of 0.91 percent after five years and 2.12 percent after ten years.

The single-B mortality rates were relatively high throughout the period, particularly in the later years. The marginal mortality rates are fairly constant after year three. The single-B-rated debt, however, had relatively small issue amounts throughout the 1970's, and, when we calculate mortality rates for seven to ten years after issuance, the number of observations is quite small. For example, years 1971–1977 are the only years contributing to our ten-year results, 1971–1978 to nine-year results, and so on. Hence, we emphasize that the longer term mortality results should be analyzed with considerable caution with respect to expectations about future mortality rates and return spreads.[4] Despite the

[3] Nonrated debt is not included in our formal analysis because the risk nature of those issues appears to have shifted over the years, with the most recent data probably dominated by low-rated equivalent securities. The earlier nonrated debt data appear to have included all risk types.

[4] In addition, the later year results could be biased since a portion of the original population of bonds will be redeemed by then. If more creditworthy firms tended to be called earlier than more risky ones, then the later year mortality rates would be biased upward. Our results, however, did not show a great deal of difference when we did not exclude redemptions. (Results without redemptions are available from the author.)

Table I

Corporate Bond Total New Issue Amounts by S&P Bond Rating, 1971–1986 ($ Million)

Number of issues of low-rated bonds are in parentheses. Data are from S&P Bond Guides.

Bond Rating	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AAA	5125	3179	4046	7420	11,348	9907	11,046	7967	10,400	10,109	11,835	6197	3920	2350	9016	14,438
AA	5467	4332	3670	8797	9654	9560	7494	7374	5910	10,497	11,748	14,597	14,110	18,291	23,223	46,978
A	6688	4745	4254	8388	12,752	8103	5236	5330	6489	12,195	12,432	13,315	5516	12,252	23,381	34,173
BBB	2139	1198	937	1248	2367	2938	1558	1513	1225	2595	3900	5738	5827	5194	11,068	21,993
BB	292	258	105	250	20	397	579	408	359	418	290	1378	2894	4698	2041	7098
						(10)	(15)	(10)	(8)	(9)	(6)	(16)	(24)	(23)	(23)	(37)
B	112	101	140	18	27	59	526	1029	917	879	894	1122	3713	6485	5945	21,260
						(3)	(17)	(39)	(33)	(28)	(15)	(24)	(46)	(68)	(77)	(133)
CCC	0	0	0	0	14	75	78	34	91	25	0	145	285	1901	1668	4668
						(1)	(5)	(1)	(3)	(1)	(0)	(2)	(5)	(9)	(14)	(40)
Total Rated	19,823	13,813	13,152	26,121	36,182	31,039	26,517	23,655	25,391	36,718	41,099	42,492	36,205	51,171	76,342	150,608

Table II

Adjusted Mortality Rates by Original S&P Bond Rating Covering Defaults and Issues from 1971 to 1987

Mortality rates are adjusted for defaults and redemptions. Data were derived from S&P Bond Guides.

	Years After Issuance									
Original Rating	1	2	3	4	5	6	7	8	9	10
AAA										
Yearly	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%
Cumulative	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.13%	0.13%	0.13%	0.13%
AA										
Yearly	0.00%	0.00%	1.81%	0.39%	0.14%	0.00%	0.00%	0.00%	0.13%	0.00%
Cumulative	0.00%	0.00%	1.81%	2.20%	2.33%	2.33%	2.33%	2.33%	2.46%	2.46%
A										
Yearly	0.00%	0.31%	0.39%	0.00%	0.00%	0.06%	0.12%	0.00%	0.04%	0.00%
Cumulative	0.00%	0.31%	0.71%	0.71%	0.71%	0.77%	0.89%	0.89%	0.93%	0.93%
BBB										
Yearly	0.04%	0.25%	0.17%	0.00%	0.45%	0.00%	0.17%	0.00%	0.23%	0.84%
Cumulative	0.04%	0.29%	0.46%	0.46%	0.91%	0.91%	1.07%	1.07%	1.30%	2.12%
BB										
Yearly	0.00%	0.62%	0.64%	0.31%	0.29%	4.88%	0.00%	0.00%	0.00%	0.00%
Cumulative	0.00%	0.62%	1.25%	1.56%	1.84%	6.64%	6.64%	6.64%	6.64%	6.64%
B										
Yearly	1.98%	0.92%	0.74%	4.24%	4.16%	4.98%	3.62%	4.03%	8.47%	4.33%
Cumulative	1.98%	2.88%	3.60%	7.69%	11.53%	15.94%	18.98%	22.24%	28.83%	31.91%
CCC										
Yearly	2.99%	2.88%	3.97%	22.87%	1.37%	N/A	N/A	N/A	N/A	N/A
Cumulative	2.99%	5.78%	9.52%	30.22%	31.17%	N/A	N/A	N/A	N/A	N/A

high cumulative mortality rate, we will show that the net return to investors in B-rated bonds remains very attractive.

The results for five years after issuance do provide more observations, but they too lack results for new issues in the most recent, high-growth years (1982–1987). The five-year cumulative rate of 11.5 percent for B-rated debt might also be considered to be surprisingly high, but is it really? Consider that the average annual default rate calculated in the traditional way is 1.86 percent per year for the period 1978–1987. If we simply sum the one-year rates, the result is 9.30 percent for five years compared with our *CMR* of 11.5 percent. In addition, the traditional default rates are calculated on the basis of the population on June 30, while our mortality rates use survival population data from the start of each year. Therefore, the "old" way probably understates default rates somewhat. As for the six- to ten-year results, only time will tell if the relatively large marginal one-year rates, especially for the ninth year, continue in the future.[5]

Since we adjust the population for all redemptions as well as defaults, the mortality rates listed in Table II will be higher than if the population data were

[5] If we begin our analysis in 1976, rather than in 1971, the five-year B-rated cumulative rate is slightly higher at 11.7 percent; the eight-year rate is 23.7 percent; and the ten-year rate is 36.4 percent. The latter is due to the relatively high nine- and ten-year defaults of 1977 new issues ($85.5 million and $26.7 million, respectively, from the $526 million issued).

unadjusted. For example, the B-rated cumulative mortality rate, unadjusted for redemptions, was 27.4 percent for ten years. I believe that both the adjusted and unadjusted methods of calculating the results are meaningful. The mortality figures over time should adjust for changing population size, while the unadjusted data could be helpful in examining the probability of default of a particular rating category from a given year's issuance. Strictly speaking, however, the unadjusted figures are not "rates". For a more in-depth discussion of this and a presentation of the entire unadjusted default amounts, see Altman (1989).

B. Losses

As in the previous discussion on traditional measurements of default, the loss to investors from defaults is of paramount importance. In our ensuing analysis of net return spreads for each category of bond rating, we use the actual recovery amount for which investors were able to sell the defaulting issue and also assume that one coupon payment was lost. The average recovery rate was slightly below forty percent of par.

We did look at the relation between individual bond ratings at issuance and the subsequent average price that could be realized upon default and found essentially that no relationship existed. Table III lists those results and shows that the average retention rate was actually 44.6 percent including Texaco (39.2 percent without Texaco). Note that there is virtually no correlation between initial bond rating and average price after default.

There also does not appear to be a correlation between the price after default and the number of years that a bond is in existence before default (Table IV). Therefore, while the marginal default rate is relatively low in the first three years after issuance (Table II), the recovery rate is unaffected by the age of the issue.

Table III

Average Price After Default by Original Bond Rating (1971–1987)

Data are from S&P Bond Guides, 1971–1987.

Original Rating	Average Price After Default (Per $100)	Number of Observations
AAA	78.67	5
AA	79.29	13
A	45.90	19
BBB	45.30	22
BB	35.71	13
B	42.56	64
CCC	41.15	12
C	10.00	2
NR	31.18	23
Arithmetic Average or Total	44.58	173

Table IV

Average Price After Default by Number of Years After Issuance (1971–1987)

Data are from S&P Bond Guides, 1971–1987.

Number of Years After Issuance	Average Price After Default (Per $100)	Number of Observations
<1	45.41	10
1–2	44.74	19
2–3	63.43	27
3–4	38.97	18
4–5	41.70	17
5–6	50.46	15
6–7	43.50	11
7–8	37.17	6
8–9	28.33	6
9–10	43.52	7
>10	44.45	34

C. Net Return Performance

An important dimension to our analysis is the ability to track performance of bonds from issuance, across bond ratings and over relevant time horizons. This analysis enables us to compare the performance of various risky bond categories with default risk-free U.S. Treasury securities. By factoring into the analysis *actual* losses from defaults and yield spreads over Treasuries, a more complete analysis results. We calculate actual return-spread performance, but the algorithm used is sufficiently robust to handle any set of assumptions on the variables analyzed.

Table V and Figure 1 present the return spread results across bond ratings over the sample period 1971–1987. The spreads, expressed in terms of basis points compounded over a ten-year investment horizon, are based on actual yield spreads (Table VI) for the eighteen-year period. The average yield spreads were 0.47 percent (AAA), 0.81 percent (AA), 1.08 percent (A), 1.77 percent (BBB), 3.05 percent (BB), 4.09 percent (B), and 7.07 percent (CCC).[6]

The body of Table V represents returns realized above what would have been earned on risk-free Treasuries, measured in basis points. Table V uses actual long-term Treasury coupon rates, yield spreads at birth for the different rating categories, the sale of defaulted debt, the loss of one coupon payment, and the reinvestment of cash flows at the then prevailing interest rates for that bond-rating group. Cash flows are reinvested from coupon payments on the surviving population as well as the reinvestment of sinking funds, calls, and the recovery from defaulted debt. The results assume no capital gains or losses over the

[6] In an earlier version of this paper (Altman (1988)), we assumed yield spreads of 0.50, 1.0, 1.5, 2.0, 3.0, 4.0, and 5.0 percent for AAA, AA, A, etc., respectively. Except for the CCC rate, the actual average yield spreads (Table VI) are quite similar to these assumptions.

Table V

Return Spreads Earned by Corporate Bonds over Treasury Bonds (Measured in Basis Points (bp) Compounded over Time)

Return spreads are based on compound returns net of losses incurred from defaults. They reflect actual mortality rates and reinvestment rates derived from S&P Bond Guides and a number of securities firms.

Years After Issuance	Bond Rating at Issuance						
	AAA	AA	A	BBB	BB	B	CCC
1	45	76	104	171	326	382	519
2	100	168	223	366	684	861	1174
3	165	243	367	609	1129	1460	2062
4	246	359	556	923	1710	1746	496
5	344	515	782	1250	2419	2160	1561
6	457	710	1047	1700	2648	2676	NA
7	598	949	1366	2286	3585	3365	NA
8	772	1246	1778	2911	4725	4058	NA
9	987	1591	2278	3721	6073	3673	NA
10	1245	2028	2885	4577	7637	4467	NA

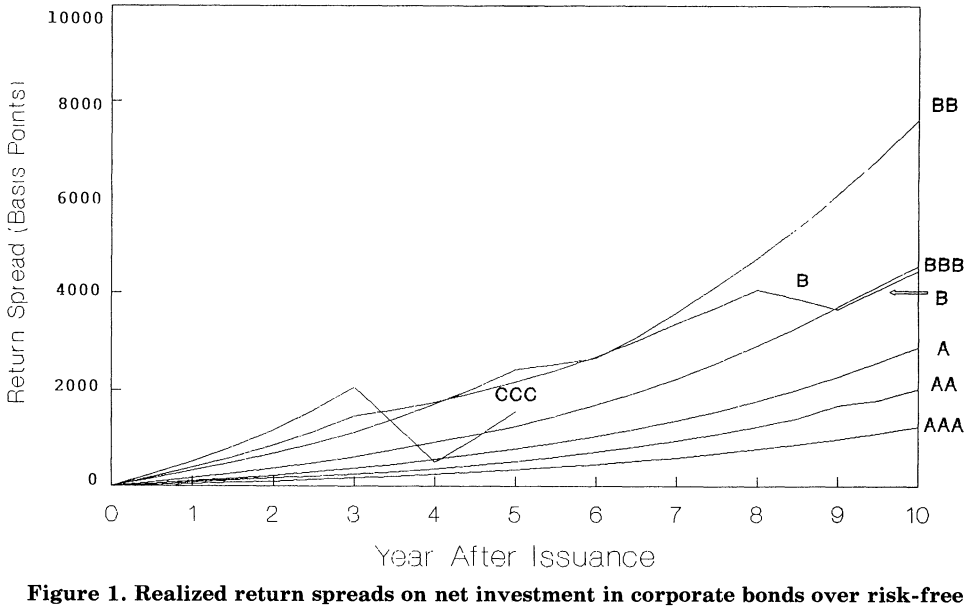

Figure 1. Realized return spreads on net investment in corporate bonds over risk-free governments. Return spreads are based on compounding cash flows received from coupon payments, redemptions, and default recoveries. Cash flows were reinvested in the same bond-rating class at prevailing interest rates at that time. Data points are from Table V.

measurement period, and the investor follows a buy-and-hold strategy for the various horizons.

Results show that AAA-rated bonds can be expected to earn forty-five basis points (0.45%) *more* than Treasuries over one year (two semiannual coupon payments) and 1245 basis points after ten years. BB-rated bonds earn 326 basis points more than Treasuries after one year and an impressive 7637 basis points

Table VI

Yield to Maturity on Various Bond Rating Categories: 1973–1987 (Yield is the Average for the Twelve Monthly Rates)

Data are from S&P Bond Guides supplemented by data from a number of securities industry firms, including Shearson Lehman for Treasury bonds and Drexel Burnham Lambert, Merrill Lynch, and Salomon Brothers for high-yield bonds.

Year	Treasury Bond	AAA	AA	A	BBB	BB	B	CCC
1973	7.15	7.56	7.71	7.87	8.40	NR*	NR	NR
1974	8.13	8.33	8.56	8.65	9.37	NR	NR	NR
1975	8.28	8.64	8.89	9.31	10.12	NR	NR	NR
1976	7.88	8.36	8.37	8.81	9.45	NR	NR	NR
1977	7.76	8.12	8.34	8.48	8.87	NR	NR	NR
1978	8.57	8.74	8.93	9.05	9.53	NR	NR	NR
1979	9.27	9.53	9.80	10.01	10.62	11.66	13.16	NR
1980	11.22	11.66	12.02	12.31	13.09	14.15	14.98	NR
1981	13.20	13.91	14.32	14.60	15.50	16.54	17.33	NR
1982	12.51	13.32	13.73	14.19	15.45	16.32	17.76	21.86
1983	11.09	11.66	11.86	12.17	12.79	13.63	14.61	18.62
1984	12.34	12.43	12.94	13.25	13.97	14.99	15.53	17.71
1985	10.74	10.94	11.41	11.66	12.16	13.65	14.52	16.75
1986	8.16	9.02	9.40	9.64	10.19	11.79	12.82	15.98
1987	8.76	9.32	9.66	9.92	10.42	11.46	12.96	16.12

* NR = not relevant due to small samples and unreliable data.

after ten years. Another way to put this is that an investment of $100 would return $76.37 more than Treasuries over ten years.

Of interest is that, for the first three years after issuance, the lower the bond rating the higher the net return spread, with triple-C- and single-B-rated bonds doing best. In the fourth year, the B-rated bonds do best as the CCC's drop off. After the fourth year, however, the BB-rated category begins to dominate (except in the sixth year) while the B-rated bonds lose ground. That crossover is illustrated in Figure 1. For all holding periods, all bond types do well and have positive spreads over Treasuries.

As indicated, the historical average 4.09 percent yield spread for B-rated debt provides an ample cushion to compensate for losses, but the performance relative to the BB-rated category is inferior in the later years. This changes, however, if we adjust our initial yield spread assumptions to reflect different market conditions, assuming the same default experience. For example, in the period October 1987 to early 1988, yield spreads on single-B rated bonds jumped to over 5.5 percent. Under this assumption, the resulting net return spreads over Treasuries are higher for the lower rated bonds, with B-rated debt dominating all others for the entire ten-year time frame. (These results are available from the author.)

V. Implications

The results indicate the expected adjusted mortality rates and losses, cumulated for a number of years after issuance, for all bond-rating categories. Despite somewhat higher than expected cumulative mortality rates over long holding periods, return spreads on all corporate bonds are positive, with impressive results for the high-yield, low-grade categories. If the analyst wishes to use higher (or lower) than historical mortality rates to reflect a number of macro- and microeconomic uncertainties or different yield spread assumptions, that is certainly feasible.

Why do we observe such relatively consistent positive return spreads for all rating categories? The results show that investors have been more than satisfactorily compensated for investing in high-risk securities. Indeed, if expected default losses are fully discounted in the prices (and yields) of securities, our return spread results should be insignificantly different from zero. The fact that the spreads are so positive has a number of possible explanations, none of them easily corroborated.

One possible explanation is that the fixed-income market has been mispricing corporate debt issues and the discrepancy has persisted, perhaps because of the lack of appropriate information. That implies market inefficiency. If default losses are consistently lower than yield spreads and this comparison is the only relevant determinant of future yield spreads, inefficiency is a reasonable conclusion.

If all other things are not equal, however, for determining yield spreads on corporate bonds, then the market inefficiency conclusion is difficult to reach. For example, liquidity risk is often mentioned as important to price determination. If liquidity risk increases with lower bond ratings, then the excess returns noted

earlier may in part be the returns necessary to bear this risk. Indeed, during the post-October 19, 1987 period, poor liquidity was cited as one cause of the precipitous drop in common stock prices and the rise in yields of certain high-yield debt issues.

The other risk element that is not isolated in our study is interest rate or reinvestment risk. Actual returns on bonds are obviously affected by interest rate changes. Our results include actual reinvestment rates over time, and we have not factored in any capital gains or losses, assuming a buy-and-hold strategy for investors. Blume and Keim (1987) and Altman and Nammacher (1985) have shown, however, that, if anything, lower grade bonds have lower volatility from interest rate changes than risk-free, lower coupon Treasuries.

Another explanation of the persistent positive return spreads attributed to lower rated bonds is the variability of retention values after default. Our observation of a recovery rate of an average of about forty percent of par value just after default is an expected value. Investors might require positive spreads based on the possibility that retention values will be below the forty percent average. In addition, the forty percent retention is relevant only for a portfolio of defaulting bonds. An investor may not be well diversified and may be vulnerable to higher than average mortality losses on specific issues. Therefore, if the market prices low-quality issues as individual investments and not as portfolios, required spreads are likely to be higher than is perhaps necessary. On the other hand, if defaults are correlated with market returns, risks may not be as diversifiable as we assume to be the case for equities.

Investors might also be restricted in relation to the risk class of possible investments, thereby creating an artificial barrier to supply-demand equilibrium. For instance, certain institutions are prohibited from investing in low-grade bonds or are limited in the amount that they can invest in such securities. That reduces demand and inflates yield and possibly return spreads.

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