Credit Risk and Yield Differentials for High Yield Bonds

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Abstract

This paper empirically examines the yield differential for high yield bonds using a theoretically based equation and pooled cross-section time series data over three years. Default risk is measured by Moody's company bond ratings and by estimated company failure probabilities based on an early warning model. When risk is measured by estimated failure probabilities, estimated parameters have the expected sign; by contrast, one estimated parameter has an unexpected sign when risk is measured by Moody's ratings. Both risk measures contain incremental information beyond that contained in the alternative measure. In some applications, failure probabilities may be preferred to agency bond ratings because they are continuous variables that can produce timely forecasts of default risk. Months to maturity, capital gains, and original yield are additional significant factors explaining yield differentials. The call premium also is a significant determinant when risk is measured with estimated probabilities.

Introduction

This paper examines the relationship between market yields and credit risk. Previous research follows two paths. Empirical studies (Fisher, 1959; West, 1973; Boardman and McEnally, 1981; McEnally and Boardman, 1979; and Ederington, Yawitz, and Roberts, 1987) demonstrate that the required risk differential is a positive function of a company's default risk, measured by Moody's or S&P ratings and/or company financial characteristics. Theoretical studies (Bierman and Hass, 1975; Yawitz, 1977; Jonkhart, 1979; Yawitz, Maloney, and Ederington, 1985; and Rodriguez, 1988) conclude that risk differential is related to the perceived probability of receiving promised payments.

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Two innovations are made in this paper. First, alternate measures of corporate default risk, bond ratings, and the probability of corporate failure obtained from an early warning model are compared empirically.[1] Second, the sample of bonds is restricted to high yield/high default risk securities. (See Altman, 1989.) Boardman and McEnally (1981) also studied bonds in specific rating categories Baa and above. High yield bonds are relatively default prone and have greater variations in the risk measures which reduces the standard error of these parameter estimates.

Previous Research

Theoretical Contributions

Rodriguez (1988) establishes a general model of the relationship between default risk and yield spreads in a risk-neutral environment, i.e., yields are evaluated on the basis of expected values. The implicit equation defining the relationship between the return on a risky bond, r, and the default free, tax free rate, i, differs for bonds sold above and below par value. For discount bonds Rodriguez finds that:

$$\text{(1a)}\quad C\sum_{t=1}^{n}[y^t(1-T)-x^t]+F[y^n(1-G)-x^n]+BG\left[y^n+\left(\frac{1-P}{P}\right)\sum_{t=1}^{n}y^t\right]=0$$

and for premium bonds he finds that:

$$\text{(1b)}\quad \left[C(1-T)+\frac{T(B-F)}{n}+\frac{BG(1-P)}{P}\right]y^t+F[y^n-x^n]-Cx^t$$

$$-\left[\frac{B-F}{n}\right]G\left[\frac{1-P}{p}\right]\sum_{t=1}^{n}(t-1)y^t=0$$

where:

$y = P(1+i)^{-1}$;
$x = (1+r)^{-1}$;

[1]Prior studies (e.g., Yawitz, et al., 1977) used a combination of accounting ratios and bond ratings to approximate corporate default risk. Alternatively, Fons (1987) regarded the probability of default as an unknown variable to be obtained using a numerical solution program.

C = Coupon payments;
T = Tax rate on ordinary income;
G = Tax rate on capital gains;
B = Bond's purchase price;
F = Par value;
P = Probability of default;
n = Years to maturity; and
t = Year (1, 2, ... , n).

A salient feature to equations (1a) and (1b), also shown by Jonkhart (1979), is that return depends on time until maturity which conflicts with the well-known Bierman and Hass (1975) and Yawitz (1977) conclusion that the default premium is invariant with respect to maturity.[2] Maturity invariance is obtained from the above equations, however, by assuming that there are no taxes (that is, T = G = 0). Under these conditions, equations (1a) and (1b) reduce to equation (2):

$$(2)\ r = \frac{1 - P}{P} + \frac{i}{P}.$$

Assuming that bonds sell at par (i.e., B = F) converts Rodriguez's model into Yawitz, Maloney, and Ederington's (YME) model as shown in equation (3):

$$(3)\ r = \frac{(1 - P)*(1 - G)}{P(1 - T)} + \frac{(1 - T)i}{P}.$$

Although Rodriguez did not estimate his model empirically, similar theoretical frameworks are tested by YME and Fons (1987). In both cases, the probability of corporate default risk is derived rather than measured objectively. YME's empirical specification is a variant of equation (3) in which the yield on municipal bonds depends upon the government bond yield. Their data set of aggregate monthly yields on new bonds covers the period August 1965 to March 1981. Yield curve effects are removed by holding years to maturity constant across the study; values are assumed for G (first G = T and then G = .4(T)). Estimates of P and T are derived with nonlinear least squares. YME conclude that the theoretical model has a high degree of explanatory power.

[2] Jonkhart (1979) shows that the coupon rate does depend on time to maturity; by making three assumptions (constant probability of survival and failure recovery fraction over time as well as flat term structure of risk free interest rates), however, he shows that his formulation becomes equivalent with those proposed by Bierman and Hass (1975) and Yawitz (1977) that suggest maturity invariance.

Fons (1987) compares a monthly index of low rated bonds to an index of high grade corporate bonds. He chose corporate over government bonds because they are callable. Fons alters equation (3) to reflect the partial value received by investors after a bond default. Holding the values of i, T, G, and the in-default value of bonds constant, P is solved with a numerical solution program. His estimate of P exceeds the actual default experience of low rated bonds, leading Fons to conclude that a "well-diversified portfolio of low rated corporate bonds appears to be rewarded for bearing default risk."

This paper differs from previous empirical tests of theoretical models in two related ways. First, the risk of corporate default is measured objectively. Second, two potential measures of corporate default risk are compared empirically: an estimate of the probability of corporate default obtained from an early warning model (Platt and Platt, 1990) and agency bond ratings.

Empirical Contributions

Fisher's (1959) original study finds a positive association between the risk premiums on 366 bonds and default risk (measured by financial ratios) and a negative relationship with marketability. West (1973) analyzes the residuals in Fisher's study and finds them to be significantly related to agency bond ratings. He concludes that both bond ratings and financial ratios play a role in determining risk premiums.

Ederington, Yawitz, and Roberts (1987), hereafter EYR, directly test the relationship between yields and both financial accounting ratios and agency bond ratings, as shown in equation (4):

(4) $r_j = f\,(A_j, R_j, X_j, u_j)$

where:

r = Yield to maturity;
A = A set of publicly available financial accounting data pertaining to the firm and the security;
R = Agency ratings (Moody's and S&P);
X = Characteristics of the issue other than creditworthiness;
u = Random error term;
j = Individual company, $j = (1 \ldots n)$.

With a sample of 176 bonds in 1979 and 180 bonds in 1981, they conclude that both agency ratings and financial accounting data are used by market participants in evaluating bond creditworthiness. They also conclude that the market essentially views Moody's and S&P ratings as identical in terms of information content.

Boardman and McEnally (1981) considered the effect of other characteristics affecting yields (the X in equation (4)), specifically the security status and price volatility. Using a sample of 515 randomly chosen seasoned corporate bonds across four ratings categories and four years, they find that security raised the return in five of 16 cases and that bonds with higher betas had lower returns in six of 12 cases. Roberts and Viscione (1984) adopt a matched sample design and find security to be rationally priced with lower yields offered on secured bonds.

Reiter and Ziebart (1991) extend EYR's analysis using a simultaneous equation methodology to address potential model misspecification. Reiter and Ziebart estimate a two equation system, one for the offering yield and one for the bond rating. They find evidence that both financial information and rating information contained incremental real information.[3]

Reiter and Ziebart analyze less risky utility bond than this study's sample of high yield bonds. Consequently, this study is more concerned with the comparison between Moody's bond ratings and a measure of default risk based on an early warning model of corporate failure. If the comparison had rejected one of the measures of risk, then a simultaneous equation system could have been estimated.

Methodology

Rodriguez observed that equations (1a) and (1b) "are complex" and cannot be tested directly. An alternative is to approximate the equations using an estimable linear form as specified generally in equation (5):

(5) $r_{r,t} = f\,(p_{j,t}, n_{j,t}, G_t, T_t, C_{j,t}, B_{j,t}, F_{j,t}, i_t)$

where:

j = Companies; and
t = Time.

Following Miller (1977), the relationship between the yield on government bonds and the risk free, tax free yield, i,

[3]Their study may have a methodological flaw, however, which raises questions about the validity and generalizability of the results. In order to develop a continuous dependent variable for the bond rating equation, they assign numerical values to bond ratings in ascending order from B to AAA bonds. This methodology assumes that investors perceive equivalent intervals between bond rating categories. If the perceived differences between bond categories do not follow an interval scale, then the method suffers from measurement error.

$$(6)\ r_g = \frac{i}{(1 - T)}$$

is substituted for i in equation (5). Risk differential is obtained by subtracting r_g from both sides of equation (5) yielding the general linear equation (7):

$$(7)\ r_{j,t} - r_g = f\ (p_{j,t}, n_{j,t}, G_j, T_j, C_{j,t}, B_{j,t}, F_{j,t})\ .$$

Estimation of equation (7) is achieved using pooled cross section, time series data.[4]

Table 1 compares estimating equation (7) to EYR's equation (4). Both models generally attempt to measure the same concepts; both include measures of default risk, time to maturity, and differences between income and capital gains taxes. As seen in Table 1, a critical variable in the theoretical model, i, is omitted from EYR's equation. This omission results from their cross-sectional study design that condenses i into the constant. In addition, callability is not addressed in the theoretical model, yet EYR find the number of months until first potential call to be a significant determinant of yields, and Boardman and McEnally (1981) find call value to have a significant effect on yield in five of eight cases for high quality bonds.

Sample and Variable Specification

High yield securities bear high default risk and are thinly traded. Hence, market participants are uncertain that market efficiency has generated yield-to-maturity differentials between otherwise perfectly identical securities that reflect actual disparities between company default risks. Market participants therefore must pay close attention to agency bond ratings and financial reports.

Sample

Companies included in the Merrill Lynch High-Income Bond Fund with calendar fiscal years are selected for this study. This selection mechanism identified firms with three primary characteristics:

- Readily available financial accounting data;
- Above average default risk; and

[4]Pooled cross section, time series regression allows yields to vary both across companies and over time, resulting in more efficient parameter estimates due to the greater variation in the data. Ordinary least squares estimation yields unbiased and consistent parameters estimates. (See Kmenta, 1986.)

- A minimum degree of marketability.

One bond is selected per company:[5] the issue with the largest outstanding dollar total. Yields to maturity as of May 1 are obtained for the three years, 1985-1987. This date marked the first yield observation following market dissemination of financial accounting data submitted in 10K reports to the Securities and Exchange Commission.

Moody's (1987) may not report actual price quotes, but instead may report dealer bid quotes[6] for thinly traded issues. In some cases, Moody's reports no quote. Bonds without actual price quotes for the three May 1st time periods are excluded from the sample. This last constraint reduced the number of bonds/companies in the sample from 102 to 36 and permitted a sample size of 108 observations (3 time periods X 36 bonds).

Yield Differential

The dependent variable in the empirical test is the yield differential between a corporate high yield bond and the risk free, tax free rate. Corporate bond yield is measured with actual price quotes obtained from Moody's. The risk free, tax free rate is measured with the yield on ten year government bonds.

Default Risk: Using Probabilities

Theory provides little insight about which financial accounting statistic(s) best delineates a company's default risk.[7] A model specification not derived from a theoretical framework may include apparently significant independent variables that are surrogates for unmeasured determinants of the dependent variable. For example, default risk is approximated using one set of independent variables by EYR and a different set by Fisher (1959). This ambiguity is avoided in the current study by compressing all relevant financial ratios into a single statistic that

[5]EYR include up to two bonds per company, provided that both bonds had the same ratings and had traded recently. No new information pertaining to how market yields are determined is introduced with a second bond from the same firm; hence, the current selection is restricted to a single issue.

[6]Dealers often matrix price to generate bids. The routine works by adjusting the price of a nontraded issue by an amount related to the price change in comparable issues with similar characteristics that historically have similar trading patterns. The accuracy of matrix prices is uncertain, given the infrequency of updates and the possibility that substantive changes have occurred since historical observations.

[7]Chen and Shimerda (1981) report that corporate bankruptcy (which is conceptually similar to default risk) research has used more than 100 different financial ratios in various studies.

estimates a firm's failure probability derived from an early warning model.[8] (See Platt and Platt, 1990.) Variables in the early warning model have demonstrated an ability to discriminate between failing and nonfailing firms both within the sampled and forward time periods.

Default Risk: Using Ratings

EYR conclude that the market views Moody's and S&P's ratings as identical. Moody's ratings are used in this study because yield values are obtained from the same source. Moody's ratings are subsumed into five categories: A, Baa, Ba, B, and C bonds. Higher rated bonds in the Merrill Lynch High-Income Bond Fund are fallen angels whose changed financial circumstances are not yet reflected in Moody's ratings. Dummy variables are constructed for each year. Table 2 describes the composition of the sample in terms of Moody's ratings.

Months to Maturity

EYR adjust their dependent variable's yield to account for location on the yield curve. This approach is not followed. Instead, the time (months) to maturity enters as an independent variable, allowing for flexible pricing of duration in the market. This framework allows different yield curve relationships to be tested for each class of default-risk bonds. During the sample period, 1985-1987, yield curves are positively sloped. Hence, months to maturity is expected to be associated positively with risk differential.

Differences Between Tax Rates

Capital gains or losses are represented as the difference between par value and market price, as shown in equation (8):

(8) $CG = B - F$

where:

CG = Capital gains;
B = Current market price as of May 1; and
F = Par value (assumed to be $1000).

[8]Estimated failure probabilities can be viewed as a representation of the efficient market concept that investors review all available information in the process of investment selection.

The lower capital gains tax rate prior to 1988 is expected to result in lower yield differentials for bonds with capital gains.

EYR describe tax consequences using yield differences between current and when-issued yields, r – C/F. While r – C/F is conceptually similar to equation (8), the EYR variable places the dependent variable on the right side of the equation which risks a tautological equation.

Call Premium

EYR measure callability as the number of months until an issue can be called. A more important matter may be call price. The call premium is defined as the difference between the call price and the current market price:

(9) CP = Call Price – B

where:

CP = Call premium.

The call premium is expected to be negatively associated with risk differential.

Original Yield

The remaining variable in equation (7), the coupon rate, C, is divided by par value, F, to obtain the original yield, Ro, as shown in equation (10). Although

$$(10)\ Ro = \frac{C}{F},$$

the theoretical model is ambiguous on this point, risk premiums are expected to be associated positively with original yield because a bond is expected to maintain its reputation as a relatively high or low yielding bond.

The final form of the empirical equation[9] is found in equation (11):

[9]Two dummy variables were created representing bond security and seniority. It was expected that risk differentials would be related negatively to securitization and related positively to subordination. Neither variable was statistically significant and, therefore, both have been excluded from the analysis henceforth. One possible explanation for the insignificance of these variables is provided by Roberts and Viscione (1984). They assert that a matched sample design is necessary to control for other extraneous factors that affect yields, thereby allowing the independent effects of seniority/security to be assessed fairly. Concern with marketability and concomitant price accuracy led to the current choice of a sample from issues held in the Merrill Lynch High-Income Bond Fund. Although the fund held multiple issues for several companies, most securities in the High-Income Bond Fund cannot be matched. Finally, it commonly is believed that multiple regression coefficients discern differences across companies without resorting to a matched design.

$$(11)\ \ln(r_{j,t} - r_{g,t}) = A + B\ DEFAULT_{j,t} + C\ \ln(MTM)_{j,t} + D\ CG_{j,t}$$

$$+ E\ \ln(Ro)_{j,t} + F\ CP_{j,t} + e$$

where:

A	=	A constant;
B,C,D,E,F	=	Estimated model coefficients;
r	=	Yield to maturity;
rg	=	Yield on long-term governments bonds;
DEFAULT	=	Estimated probability of default or Moody's ratings (Dummy variables for A, Baa, Ba, B, and C rated bonds);
MTM	=	Months to maturity;
CG	=	Capital gains;
Ro	=	Original yield;
CP	=	Call premium;
j	=	Companies;
t	=	Time; and
e	=	A random error term.

Table 3 describes the correspondence between the estimating equation and Rodriguez's theoretical model. Rodriguez's variables are subsumed within the estimating variables plus one additional variable. Equation (11) is estimated with one measure of default risk (the estimated probability of failure or Moody's ratings) but not both; the two variables have identical interpretations.[10]

Empirical Results

Overall Results

Fisher (1959) and West (1973) specify a linear-in-logarithms empirical equation; Boardman and McEnally (1981) use a linear equation. Seeking to avoid specification error, EYR transform their equation with a Box-Cox adjustment and estimate parameters using nonlinear least squares. This approach cannot be achieved with pooled data. This analysis uses a linear-in-parameters functional form with natural logarithms taken of variables with positive values: risk

[10]Although the correlation between the the two measures cannot be determined due to the binary nature of the dummy variables, one might expect a weak relationship between the two measures. One reason for this expectation is that Moody's ratings are virtually time invariant. Over the three years only 11 ratings are changed. By contrast, the estimated failure probabilities can change from period to period based upon the most current quarterly financial information.

premium, original yield, and months to maturity. Ordinary least squares estimation yields unbiased and consistent parameter estimates of the two models with different measures of corporate default risk. (See Kmenta, 1986, pp. 609-610.)

Estimation results are contained in Table 4. Significant F-statistics for both equations support the hypothesis that risk differentials are related to default risk, months to maturity, original yields, call premiums, and capital gains. Individual t-tests for all variables but the call premium are generally consistent between the two models. That is, in both specifications of the model, default risk, months to maturity, capital gains, and original yield are related significantly to risk differentials. Estimated parameters have the expected sign.

The two models yield different conclusions pertaining to the relationship between call premium and risk differential. Specifically, the hypothesis that the call premium is not a significant determinant of risk differentials cannot be rejected when the Moody's ratings are used to measure default risk. Moreover, the estimated coefficient does not have the expected sign. In contrast, when default risk is measured by the estimated probability of failure, the call premium is found to be a significant determinant of risk differentials, with the expected negative sign.

Is Pooling Appropriate?

To test whether pooling across time series data is appropriate, the null hypothesis that the data should be pooled was tested. The null hypothesis can be represented in vector form as:

$$Z_1 = Z_2 = Z_3$$

where:

$$Zt \quad = \quad (A_t, B_t, C_t, D_t, E_t, F_t).$$

The F-statistic (Kmenta, 1986, p. 419) to test the hypothesis compares the model in equation (12) to that in which there are different constant terms and different partial regression coefficients for each independent variable for each year, as shown in equation (13),

$$(13)\ F = \frac{SSR_L - SSR_S}{SSE_L} * \frac{n - Q}{Q - k}$$

where:

Q = Number of independent variables in larger (L) equation;
k = Number of independent variables in smaller (S) equation.

Both the obtained $F(16, 84) = 1.29$, $\underline{p} > .05$ for Moody's ratings and that for the estimated default probabilities, $F(10, 93) = 1.19$, $\underline{p} > .05$, indicate that the model with time-dependent constants and slopes is not significantly different from the model specification found in equation (12). Thus, the three years of data can be pooled into a time series.

Missing Time Factors

A second pooling hypothesis tests the constant term for uniformity over time (what commonly is referred to as the *covariance model*). The null hypothesis posits the equality of the constant terms over time. For both model specifications, the null hypothesis was rejected ($F(2, 98)= 9.68$, $\underline{p} < .01$, for Moody's ratings and $F(2, 101) = 6.45$, $\underline{p} < .01$ for estimated default probabilities). Thus, time-related constants are warranted for both model specifications.

The two model specifications were tested with two dummy variables for 1985 and 1986 and yielded similar results. Only the 1986 dummy variable was significant; therefore, the models including just the 1986 dummy variable were tested as shown in equation (14):

$$(14)\ \ln(r_{j,t} - r_{g,t}) = A + B\ \mathrm{DEFAULT}_{j,t} + C\ \ln(\mathrm{MTM})_{j,t} + D\ \mathrm{CG}_{j,t}$$

$$+ E\ \ln(\mathrm{Ro})_{j,t} + F\ \mathrm{CP}_{j,t} + G\ 1986_j + e.$$

Table 5 contains model results with a dummy variable for 1986 and the constant term representing 1985 and 1987.[11] Parameter estimates for the independent variables are similar to those without the time dummy variable (Table 4) discussed above. Expected yield differentials are significantly higher in 1986 as compared to 1985 and 1987. Expected yield differentials are essentially equivalent in 1985 and 1987. The Morgan Stanley High Yield Composite Spread reports similar results; a group of 50 high yield bonds had an average yield 414 basis points above the yield of ten year Treasury bonds; the Composite Spreads for 1985 and 1986 are 423 and 485 respectively. Thus, Morgan Stanley reports a slight +9 basis point difference in spread from 1985 to 1987, whereas the difference in spread between 1986 to 1987 is +71 basis points. (See High Performance, 1990.)[12]

[11] Other conclusions pertaining to hypothesis tests are not changed by adding time-specific constants.

[12] Thomas Dzwil of Morgan Stanley graciously performed the 1985 and 1986 calculations.

Choosing Between Measures of Default Risk

In order to choose between the two model specifications, the choice is viewed as a comparison between the two hypotheses below:

H1: $E(LN(R_{i,t} - R_{g,t}) =$ Model I (Equation (14) with Moody's)

H2: $E(LN(R_{i,t} - R_{g,t}) =$ Model II (Equation (14) with estimated probabilities).

An F-test is constructed using artificial nesting (see Kmenta, 1986, p. 596) by estimating the combined regression model found in equation (15):

$$\ln(r_{j,t} - r_{g,t}) = A + B1\ DBa_{j,t} + B2\ DB_{j,t} + B3\ DC_{j,t} + B4\ P_{j,t} + C\ \ln(MTM)_{j,t} + D\ CG_{j,t} + E\ \ln(Ro)_{j,t} + F\ CP_{j,t} + G\ 1986_j + e$$

where:

A	=	A constant;
B1 … G	=	Estimated model coefficients;
DBa	=	Dummy for Ba rated bonds;
DB	=	Dummy for B rated bonds;
DC	=	Dummy for C rated bonds;
P	=	The estimated failure probability from the early warning system model;
j	=	Companies;
t	=	Time; and
e	=	A random error.

H1 is tested with a standard F-test of the null hypothesis, $B1 = B2 = B3 = 0$. The obtained $F(3, 98) = 7.21$ is significant beyond the .01 alpha level. Similarly, H2 is tested based on the null hypothesis that $B4 = 0$. The observed $F(1, 98) = 3.95$ is significant beyond the .05 alpha level. These statistical results suggest that both measures of default risk add incremental information over and above that contained in the alternative measure. Moody's ratings, which directly assess a corporation's ability to service its debt, include a qualitative assessment of management strength and industry outlook in addition to an assessment of corporate health obtained from financial statements. The probabilities from the corporate early warning system model statistically combine last period financial ratios as well as industry output figures. Neither risk measure includes all the information contained in the alternate measure.

Conclusions

This study examines factors to explain the yield differential of high yield bonds as compared to risk free, tax free government bonds. A pooled cross section time series model approximating earlier theoretical studies by Rodriguez (1988), Fons (1987), and YME (1985) is tested empirically. The results are generally consistent with prior empirical studies; yield differentials on high yield bonds are found to be related significantly to default risk, months to maturity, capital gains, and original yield. Call premiums are found to be related significantly to yield differentials only when estimated probabilities of failure are used to measure default risk. In addition, improved estimation results are obtained by pooling yield data over time, provided that separate yearly constants are used.

One of the primary interests of this study is to compare empirically two alternative measures of default risk: Moody's bond ratings and probability estimates of corporate failure obtained from a corporate failure early warning system model. The results indicate that the two measures are similar, but that one measure is not preferred to the other based upon statistical considerations. Both measures of default risk add incremental information beyond that contained in the alternative measure.

Although analysts long have used the rating service information to assess the relative risk of various corporate bonds and, hence, the probable default risk of the corporate issuer, the results of this study suggest that additional information can be obtained from estimated default probabilities from a corporate early warning model. For some applications, this alternative measure may be preferred to using agency bond ratings because of the continuous nature of the variable. Moreover, the probability forecasts are based on data obtained one year prior to the time period of interest; thus, they may be more timely and can reflect forecasted changes in the assessment of a company's future more than do bond ratings which tend to be changed on a less frequent basis.

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Table 1
Comparing Specifications in the EYR and the Theoretical Models

Concept	How Measured by Ederington, Yawitz and Roberts Equation (4)	How Measured in Theoretical Model Equation (7)
Default Risk	A, R	P
Time to Maturity	Adjusted r to reflect n	n
Inequality of Income and Capital Gains Taxes	(r – C/F) As an independent variable	T,G
Callability of Issue	Months until first potential call	-
Additional Variables	-	i*, C, B,F

*The default free, tax free rate, i, was not appropriate for the EYR study because the study design was cross-sectional

Table 2
Moody's Ratings*
1985-1987

Year	A Rated	Baa Rated	Ba Rated	B Rated	C Rated	No Rating
1985	6	5	6	14	1	4
1986	6	4	8	14	1	3
1987	3	3	7	18	2	3

*Source: Moody's Bond Record, May 1987, May 1986, May 1985

Table 3
Variable Correspondence Between the Theoretical and Estimation Equations

Theoretical Variables	Estimation Variables
P	Default Probability/Rating
n	MTM
G, T, B, F	CG
C, F	Ro
-	CP

Table 4
Estimation Results of Model to Explain LN
$(R_{i,t} - R_{g,t})$

Independent Variable	Measuring Default Risk With Moody's Ratings	Measuring Default Risk With Probability Estimates
Constant	-2.475**	-2.218**
	(-6.06)	(-5.69)
Estimated Probability	-	0.306**
		(3.05)
Dummy Ba	0.196*	-
	(2.10)	
Dummy B	0.215**	-
	(2.66)	
Dummy C	0.822**	-
	(4.16)	
LN (MTM)	0.278**	0.308**
	(9.42)	(10.46)
LN (Ro)	1.107**	1.279**
	(6.33)	(7.62)
CP	0.0001	-0.003*
	(0.07)	(-2.36)
CG	-0.015**	-0.021**
	(-4.82)	(-6.80)
Adjusted R-SQ	0.686	0.659
F-statistic	34.43** (7,100)	42.37** (5,102)

* Significant at the .05 level
** Significant at the .01 level
t-statistics in parentheses

Table 5
Estimation Results of Model to Explain LN $(R_{i,t} - R_{g,t})$
Including Time Dependent Constants

Independent	Measuring Default Risk With Moody's Ratings	Measuring Default Risk With Probability Estimates
Constant	-2.377** (-6.23)	-2.086** (-5.52)
1986	0.256** (3.97)	0.210* (2.99)
Estimated Probability	-	0.257** (2.62)
Dummy Ba	0.212* (2.43)	-
Dummy B	0.228** (3.02)	-
Dummy C	0.844** (4.57)	-
LN (MTM)	0.267** (9.66)	0.300** (10.55)
LN (Ro)	1.183** (7.20)	1.358** (8.29)
CP	0.0003 (.25)	-0.003* (-2.19)
CG	-0.017** (-5.92)	-0.023** (-7.52)
Adjusted R-SQ	0.727	0.684
F-statistic	36.54** (8,99)	39.55** (6,101)

* Significant at the .05 level
** Significant at the .01 level
t-statistics in parentheses