Bond Ratings And Their Determinants in a Changing Environment

Ms. Christina Ho, Finance, Lourdes College
Dr. Ramesh P. Rao, Finance, Wayne State University

Abstract

This study finds that bond rating agencies, to the extent that their behavior is captured in statistical rating models, tend to emphasize different variables over time and that this appears to be systematically related to the economic macro-environment. Specifically, the study finds that bond ratings are more sensitive to various measures of cashflow stability and solvency in an economically unstable period relative to a more stable period.

I. Introduction

Bond ratings assigned by such agencies as Moody's and Standard and Poor's provide a useful service to both investors and bond issuers. For investors, the ratings serve as a summary measure of the bond's relative default and marketability risk and, further, aid them in pricing the security in the market. For issuers, the ratings provide an indication of their capital costs and an external assessment of the quality of the firm.

Rating agencies in general contend that the rating process involves a significant amount of judgmental evaluation in addition to financial analysis, and that this cannot be reduced to a statistical model. However, numerous empirical studies show that statistical models with as few as four or five variables are able to predict reasonably well the agency assigned ratings. While previous studies focus primarily on the predictive ability of statistical models of bond ratings, this paper focuses on the issue of (1) whether agency assigned ratings are dependent upon a stable set of variables over time, and (2) whether the sensitivity of ratings to these variables changes with the economic environment. The issue of consistency of the rating process over time is important for several reasons. First, some researchers argue that the instability of rating models over time may imply inconsistencies in the rating agencies' behavior over time and consequent negative implications on the value of this service. This issue is further explored in this study by examining whether the temporal instability in rating agencies' behavior (as captured by a statistical bond rating model) may be ascribed to the economic environment. If so, the changing sensitivity of the ratings to various underlying financial dimensions may be a perfectly rational response on the part of rating

agencies to a systematic change in the economic macro-environment. Second, the findings of this study also have implications to corporate managers. To the extent that managers have a target bond rating in mind prior to raising additional capital, rating models such as those developed in this study will give management an indication of how to position the company to obtain the desired rating. In addition, the results of this study may indicate to management the differential emphasis placed by rating agencies on various financial dimensions relative to the economic environment. Finally, investors would also benefit from these ratings models as it would allow them to assess the riskiness of the many bonds that are not rated by one of the rating agencies. Further, if temporal changes are found to exist in the rating models, this would imply that bond rating models would have to be updated periodically to get the most out of them. The objective of the paper is accomplished by examining differences in the rating process as described by a logistic regression model for industrial bonds issued during a relatively stable economic period (1967-1968) and a relatively less stable economic period (1980-1981).

The rest of the paper is organized as follows. Section II reviews relevant prior research in the area. Section III is a description of the sample and methodology used. Section IV provides a discussion of the results and, finally, section V offers some conclusions and implications.

II. Literature Review

Much of the empirical literature focuses on the

development and ability of various statistical models to predict bond ratings. The studies are largely confined to industrial bonds, although a few do focus on specific industries, especially public utilities.(1) In general, the studies on industrial bond ratings find that a combination of variables measuring leverage, profitability, size or marketability, fixed coverage, earnings stability and subordination status could classify bond ratings assigned by Moody's and Standard and Poor's reasonably well. The various models are able to classify 50-75 percent of the original sample correctly.

The rating models have tended to evolve over time using progressively more refined statistical techniques. Initially studies utilized Ordinary Least Squares (OLS) regression to classify/predict bond ratings.(2) Subsequent research pioneered by Pinches and Mingo (1973) use the multiple discriminant analysis (MDA) approach to predict ratings. The MDA is deemed more appropriate because ratings are a categorical variable and are not characterized by an interval measurement which is presumed by the OLS regression methodology. More recently, Kaplan and Urwitz (1979), Gentry et al. (1985), and Winger and Watts (1982) used probit models to classify bond ratings. Kaplan and Urwitz argue that the MDA ignores the ordinal nature of bond ratings and therefore "leaves out the structure of the bond rating process." The probit model, on the other hand, allows for the fact that the dependent variable may be ordinal, i.e., AAA is less risky than AA, and AA is less risky than A, and so forth.

Ederington (1985) in a comparison of the various prediction models finds that the unordered logit and ordered probit outperform the MDA and OLS regression models. The poor performance of the MDA and OLS regression is attributed primarily to violation of the joint multivariate normality assumption and the assumption of an interval scale dependent variable, respectively.

While there exist a number of studies on statistical models that successfully predict agency assigned ratings, there is a relative paucity of studies that deal explicitly with the sensitivity of bond ratings to various explanatory variables in a changing economic environment. Using a sample of bonds with unchanged ratings between 1968 and 1976, Peavy and Edgar (1982) examine the question of whether ratings measure absolute or relative risk. The bonds are assigned to different ratings groups and years, that is, AAA-1976, AAA-1968 and so on. The MDA model successfully classifies bonds into their respective ratings and also distinguishes between the two time periods. This suggests that ratings are not absolute but relative measures of risk. The study, however, does not look at the relative sensitivity of ratings to the underlying explanatory variables and how these might change over time. The literature on yield spread determinants (e.g., Jaffee (1975)) suggests that changes

in yield spreads over time may be attributed to the economic cycle in a systematic manner. By extension, this implies that bond rating determinants and the marginal weights placed on them may also vary over time.

III. Empirical Design

In keeping with the criticisms of the MDA and OLS regression techniques, a model that recognizes the ordinal nature of the bond ratings is used in this study. Specifically, the logistic regression model is utilized. The logistic regression model and the related probit model assumes that the ratings are characterized by an underlying probability distribution, that is, given a set of measurements a bond is more likely to belong to a particular rating than another.(3) In the case of bond ratings, Ederington (1985), and in a more general sense, Press and Wilson (1978), demonstrate that the logistic regression approach is preferable to MDA because of fewer assumptions, especially with respect to joint multivariate normality of the independent variables. Furthermore, the logistic regression model provides a convenient means of testing the significance of independent variable coefficients that is difficult to do with the MDA. This feature is especially important for the study under consideration given that the primary objective of the paper is to examine the consistency of the underlying bond rating determinants over time and how the sensitivity of ratings to the determinants might have changed over time.

The logistic regression model is estimated over two distinct economic time periods--1967 to 1968 and 1980 to 1981. By estimating the bond rating model over two different economic regimes it is hoped that the study will provide further insights on whether changes in the economic environment cause systematic changes in the underlying rating process in terms of the marginal weights placed on the various bond rating determinants. The period 1967-1968 may be described as a period of relative stability in terms of the macro-environment and the financial markets, while the period 1980-1981 was characterized by uncertainty in the economic and financial environment. Table 1 contrasts the differences between the two periods using several measures of economic performance. For instance, note that the unemployment rate, GNP growth rate, inflation rate, level and volatility of interest rates have all deteriorated between the two periods. As of 1968 the economy was still experiencing the longest postwar expansion phase as of that time, while by 1981 the economy had experienced two major oil shocks and levels and volatility of interest rates that were, heretofore, unknown.(4) The sample of bonds included in the study covers all newly issued industrial bonds rated by Moody's and are identified from various issues of *Moody's Industrial Manual*.(5) The final sample after meeting data require-

ments consists of 88 bonds for the 1967-1968 period and 146 bonds for the 1980-1981 period.

TABLE 1
MACRO-ECONOMIC DIFFERENCES BETWEEN
1967-1968 AND 1980-1981

Variable	1967-1968	1980-1981
Unemployment rate	3.5 %	7.1 %
GNP growth rate (real)	3.7 %	1.1 %
GNP Deflator	3.7 %	9.4 %
T-bill Yield, 3 month	4.84 %	12.82 %
Standard deviation of 3-month T-bill Yields	0.64 %	2.62 %
Utilization rate, manufacturing	84.52 %	78.85 %

Sources: Various issues of the Business Conditions Digest and the Federal Reserve Bulletin.

Based on an examination of previous studies it appears that a relatively small number of independent variables could do a creditable job of predicting ratings. A fairly homogeneous set of explanatory variables are cited in the literature that include measures of earnings stability, profitability, financial leverage and solvency, marketability, and subordination status (see, for example, Horrigan (1966), Pogue and Soldofsky (1969), West (1970), Pinches and Mingo (1973), and Belkaoui (1980)). As noted in a number of these studies, the theoretical underpinning's for the choice of these explanatory variables (except subordination status) may be found in the literature on yield spread determinants as espoused in the now classic work of Fisher (1959). Further, the studies note that these same variables play an important part in the actual rating process.⁽⁶⁾ The specific model used in this study and a brief description of the independent variables follows.

$$\text{Ratings} = f(\text{SUB}, \text{LCAP}, \text{ICI}, \text{TA}, \text{PFT}, \text{CVNI})$$

SUB is a dummy variable equal to one if the issue is

subordinated, zero otherwise. This variable has been shown to be a particularly important determinant of bond ratings (see Pinches and Mingo (1973)). The importance of this variable is also stressed by the ratings agencies who consider the seniority of the claim over earnings and assets to be an important element of the rating process. Holding everything else constant, subordination should result in a lower rating.

LCAP is computed as the ratio of long-term debt to total long-term capital (long-term debt plus preferred stock plus common stockholders equity). The ratio is measured as the average over the five years before the bond was issued. A high LCAP ratio should result in a lower rating.

ICI is defined as the ratio of earnings before interest and taxes plus depreciation to total interest obligation. The interest coverage ratio is measured using data for the year preceding bond issuance. While LCAP serves as a measure of leverage, ICI captures the cashflow ability to service the debt. Higher coverage ratios should be associated with higher ratings.

TA is the total assets for the year preceding the issue date. It is used as a proxy for marketability and should have a positive relationship with ratings.

PFT is the profitability measure defined as net income divided by total assets. It is estimated as the average over the five years preceding the issue date. A higher profitability ratio should be associated with a higher rating.

CVNI is the coefficient of variation of net income divided by total assets. This is a measure of earnings stability and is estimated over the five year period ending the year before the bond is issued. Firms with high CVNI values are expected to have lower ratings.

IV. Discussion of Results

The estimates of the equation for the 1967-1968 and 1980-1981 periods are shown in Table 2, Panel A. The first two sets of coefficient estimates are based on variables measured in the raw form. For 1967-1968, except for ICI and CVNI all remaining variables carry the expected sign and are significant at the five percent level. In contrast, for the 1980-1981 period, all variables are significant except for the profitability ratio. Evidently, in the economically unstable period of 1980-1981, ratings are responsive to additional measures of solvency including interest coverage ratio (ICI) and stability of net income to total assets (CVNI). The ability of the model to classify the original sample is shown in Table 3 for the two time periods. The classification accuracy of the model for both time periods is similar, 59 percent for 1967-1968 and 62 percent for 1980-1981.

TABLE 2
ESTIMATES OF THE LOGISTIC REGRESSION MODEL

Panel A: Coefficient Estimates for the Independent Variables.

Variable ¹ Coeff.	Raw Form Variables (1967-1968)		Raw Form Variables (1980-1981)		Standardized Variables (1967-1968)		Standardized Variables (1980-1981)	
	Est. Coeff.	Std. error of Coeff.	Est. Coeff.	Std. error of Coeff.	Est. Coeff.	Std. error of Coeff.	Est. Coeff.	Std. error of
SUB	-5.195	1.118***	-2.942	0.472***	-5.195	1.118***	-2.943	0.472***
LCAP	-7.276	2.214***	-8.395	1.638***	-1.006	0.306***	-1.136	0.230***
ICI	-0.002	0.011	0.032	0.015***	-0.049	0.233	0.432	0.208***
TA	0.001	0.000***	0.003	0.000***	2.026	0.518***	1.387	0.296***
PFT	16.351	8.376**	-0.179	6.086	0.501	0.257**	-0.006	0.207
CVNI	-0.783	0.566	-3.663	0.911***	-0.327	0.236	-1.328	0.330***
Model Chi-Sq.	144.75		190.46		144.75		190.46	
Model P-value	<0.0001		<0.0001		<0.0001		<0.0001	

Panel B: Test of significant differences in coefficient estimates for the standardized variables between the two periods.

Variable	Diff. in Est. Coeff. ²	Statistic ³	Test p-values ⁴
SUB	2.252	-3.449	.063
LCAP	-0.130	0.115	.734
ICI	0.481	2.375	.123
TA	-0.639	1.148	.284
PFT	-0.507	2.367	.124
CVNI	-1.001	6.077	.014

Note: *** denotes significance at the 1 percent level, ** denotes significance at the 5 percent level, and * denotes significance at the 10 percent level.

¹ For the sake of brevity, the intercept values have been omitted.

² Differences in estimated coefficients are defined as the 1980-1981 sample estimated coefficient minus the corresponding estimate for the 1967-1968 sample.

³ The test statistic for the null hypothesis that the partial regression coefficients for both periods are equal is from Fisher (1959, page 722). The test statistic is calculated as: $S_t (b_{it} - b_{it}^2) / s_{it}^2$ where $b_{it} = (S_t (b_{it} / s_{it}^2)) / S_t (1 / s_{it}^2)$, b_{it} = partial regression coefficient for variable i estimated in regression model for time period t , s_{it} = standard error of estimate of regression coefficient i for time period t . This statistic is distributed as chi-square with $T-1$ degrees of freedom where T is the number of equations being compared.

⁴ P-value refers to the probability of obtaining a chi-square as large as the test statistic under the null hypothesis.

TABLE 3
CLASSIFICATION MATRICES FOR 1967-1968 AND 1980-1981

1967-1968								1980-1981							
Orig. Rating	Rating Classified by Model						Total	Orig. Rating	Rating Classified by Model						Total
	Aaa	Aa	A	Baa	Ba	B			Aaa	Aa	A	Baa	Ba	B	
Aaa	2 (50.0)	2 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (100.0)	Aaa	1 (20.0)	4 (80.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	5 (100.0)
Aa	2 (16.7)	5 (41.7)	4 (33.3)	1 (8.3)	0 (0.0)	0 (0.0)	12 (100.0)	Aa	2 (10.5)	6 (31.6)	11 (57.9)	0 (0.0)	0 (0.0)	0 (0.0)	19 (100.0)
A	0 (0.0)	2 (11.8)	13 (6.5)	2 (11.8)	0 (0.0)	0 (0.0)	17 (100.0)	A	0 (0.0)	1 (2.0)	44 (89.8)	3 (6.1)	1 (2.0)	0 (0.0)	49 (100.0)
Baa	0 (0.0)	0 (0.0)	5 (27.8)	6 (33.3)	7 (38.9)	0 (0.0)	18 (100.0)	Baa	0 (0.0)	0 (0.0)	5 (35.7)	6 (42.9)	3 (21.9)	0 (0.0)	14 (100.0)
Ba	0 (0.0)	0 (0.0)	0 (0.0)	2 (9.5)	16 (76.2)	3 (14.3)	21 (100.0)	Ba	0 (0.0)	1 (3.5)	3 (10.7)	0 (0.0)	15 (53.6)	9 (32.1)	28 (100.0)
B	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	6 (37.5)	10 (62.5)	16 (100.0)	B	0 (0.0)	0 (0.0)	1 (3.2)	0 (0.0)	11 (35.5)	19 (61.3)	31 (100.0)
Total	4	9	22	11	29	13	88	Total	3	12	64	9	30	28	146

Note: Figures in parentheses represent proportion of the total sample.

The regression model is also re-estimated with the predictor variables transformed into a standardized form. This allows us to gauge the relative sensitivity of the ratings to the different independent variables. Further, it enables us to conduct statistical tests on whether the sensitivity of the ratings to the independent variables has changed between the two time periods. All of the independent variables are standardized with the exception of the subordination (SUB) which is a dummy variable. This is accomplished by subtracting the respective mean from each variable and dividing by the standard deviation of the variable. The procedure is done for each period separately. The reason standardized variables are calculated separately for the two time periods is because a comparison of the means reveals that except for PFT there is a significant change in the means for the all other variables. Table 4 shows the results of the t-test. The test results indicate that the measurements on the continuous independent variables for the two periods, except PFT, arise from underlying populations with different means.

The standardized model estimates are presented in Table 2 Panel A. Excluding the subordination variable, the relative sensitivity of bond ratings to the predictor variables for 1967-1968 is TA, LCAP, PFT, CVNI and ICI. However, the last two variables are not statistically significant. In the case of the 1980-1981 period, the order is TA, CVNI, LCAP, ICI and PFT. Note, however, that the coefficients for TA, CVNI and LCAP are approximately the same magnitude.

Comparing the partial regression coefficients between the two time periods, it is interesting to note that the absolute size of the standardized coefficients for interest coverage (ICI), leverage (LCAP), and volatility of earnings (CVNI) has increased between the 1967-1968 and 1980-1981 periods but that the absolute values of the standardized coefficients for profitability (PFT), size (TA), and subordination (SUB) have declined between the two periods. Table 2 Panel B presents test results of whether the standardized coefficient estimates are significantly different between the two periods. The null hypothesis being tested is that the partial regression coefficient estimates for the two periods arise from the same underlying population. The test procedure is taken from Fisher (1959). The results reveal that the coefficients for SUB and CVNI are significantly different between the two periods. There is also weak evidence that the coefficients for ICI and PFT are also different between the two periods as indicated by the p-values of approximately 12 percent. Thus, the findings in panels A and B of Table 2 suggest that the sensitivity of ratings to measures of prospective solvency and cashflow risk such as ICI and CVNI is greater during the comparatively more volatile period of 1980-1981 in contrast to the more stable 1967-1968 period.

The practical significance of the above findings is evaluated by examining if there exists a systematic bias when the model estimated over a given period is used to classify the sample of bonds for the other time period. If the solvency measures are indeed more

TABLE 4
COMPARISON OF INDEPENDENT VARIABLES BETWEEN
1967-1968 AND 1980-1981

Variable	1967-1968 (n=88)	1980-1981 (n=146)	T-Statistic for difference in means ³
	Mean ¹ (Std. Err.) ²	Mean (Std. Err.)	
LCAP	0.439*** (0.015)	0.519*** (0.011)	-4.347***
ICI	17.683*** (2.321)	9.693*** (1.124)	3.458***
TA	782.438*** (147.398)	2261.322*** (347.102)	-3.202***
PFT	0.057*** (0.003)	0.062*** (0.003)	-1.012
CVNI	0.339*** (0.044)	0.428*** (0.030)	-1.720*

Note: ***significant at the 1 percent level, **significant at the 5 percent level, and *significant at the 10 percent level.

¹ The asterisks denote the significance level at which the mean value is different from zero.

² Figures in parentheses are the standard errors of estimate of the mean.

³ The asterisks denote the significance level at which the mean values between the two periods are different.

important in 1980-1981, it may be hypothesized that the 1967-1968 model would systematically overstate the ratings for the 1980-1981 sample of bonds compared to the 1980-1981 model. In a similar fashion that 1980-1981 would systematically under predict the ratings of the 1967-1968 sample compared to a model developed using 1967-1968 data. The results of this test are presented in Table 5. For the 1967-1968 sample of bonds, it appears that the 1980-1981 model underestimates the bond ratings compared to the model developed using 1967-1968 data. For instance, using the original model, of the 18 Baa rated bonds in the 1967-1968 sample period 7 were classified into Ba, 6 into Baa, and 5 into A. Applying the 1980-1981 model parameters results in corresponding numbers of 10, 3, and 5. This pattern is evident also for bonds with original ratings of Ba, Baa and Aa. Looking at the 1980-1981 sample of bonds, there is a slight tendency for the 1967-1968 model to over predict the ratings in the lower rating categories of B and Ba. This pattern, however, is

not evident for other ratings.

It is felt that the cross-validation method used above could have been more revealing if the letter grade ratings are further broken down into '-' and '+' categories as they are in practice. The rating groups without the finer '+' and '-' qualifiers are perhaps much too "discrete" to capture the sensitivity of ratings to changes in the relative importance of their determinants.

V. Conclusions

The logistic regression models developed over two distinct economic time periods show that the sensitivity of the rating process to various underlying factors changes with time in a systematic manner. Specifically, the study demonstrates that during the economically uncertain period of 1980-1981 ratings are more sensitive to default risk measures including interest coverage and stability of net income when compared to the more

TABLE 5
CROSS VALIDATION OF 1967-1968 AND 1980-1981 MODELS

Classification of 1967-68 Bonds Using 1980-1981 Estimated Model							Classification of 1980-1981 Bonds Using 1967-1968 Estimated Model									
Orig. Rating	Rating Classified by Model						Total	Orig. Rating	Rating Classified by Model						Total	
	Aaa	Aa	A	Baa	Ba	B			Aaa	Aa	A	Baa	Ba	B		
Aaa	2 (2)	2 (2)	0 (0)	0 (0)	0 (0)	0 (0)	4 (4)	Aaa	1 (1)	3 (4)	1 (0)	0 (0)	0 (0)	0 (0)	5 (5)	
Aa	1 (2)	4 (5)	7 (4)	0 (1)	0 (0)	0 (0)	12 (12)	Aa	2 (2)	6 (6)	9 (11)	2 (0)	0 (0)	0 (0)	19 (19)	
A	0 (0)	2 (2)	13 (13)	1 (2)	1 (0)	0 (0)	17 (17)	A	0 (0)	2 (1)	38 (44)	6 (3)	3 (1)	0 (0)	49 (49)	
Baa	0 (0)	0 (0)	5 (5)	3 (6)	10 (7)	0 (0)	18 (18)	Baa	0 (0)	0 (0)	5 (5)	6 (6)	3 (3)	0 (0)	14 (14)	
Ba	0 (0)	0 (0)	2 (0)	0 (2)	14 (16)	5 (3)	21 (21)	Ba	0 (0)	1 (1)	1 (3)	4 (0)	19 (15)	3 (9)	28 (28)	
B	0 (0)	0 (0)	1 (0)	0 (0)	4 (6)	11 (10)	16 (16)	B	0 (0)	0 (0)	1 (1)	3 (0)	11 (11)	16 (19)	31 (31)	
Total							88									146

Note: * Figures in parentheses are classification results where the estimation and classification sample belong to the same period.

stable 1967-1968 period. This implies that the changing weights placed by the rating agencies on various financial characteristics over time may be a perfectly rational response to systematic changes in the economic environment. Additionally, the study also implies that institutions relying on bond rating models should revise their models frequently not only to incorporate new variables but also to adjust the coefficients. Finally, the results suggest that future bond rating models may benefit by explicitly incorporating macro-environment variables into the model since the marginal weights placed on various financial characteristics appear to be a function of the economic cycle.

Suggestions For Future Research

This study examines two time periods, 1967-1968 and 1980-1981, to test for stability of bond ratings models over different economic regimes. As with studies of a similar nature, it would be interesting to see if the results can be generalized to other economically stable and unstable periods. This study also has important implications to researchers interested in predicting bond ratings. The study provides evidence that the emphasis placed by bond rating agencies on different variables changes systematically with the economic environment. This suggest that researchers conceivably could increase the predictive accuracy of bond rating models by explicitly incorporating macro-economic variables in their models. Finally, it would also be beneficial to see if similar findings can be documented for other asset

markets including preferred stocks and common stocks.

Footnotes

1. Studies that attempt to predict industrial bond ratings include Belkaoui (1980), Gentry et al. (1985), Horrigan (1966), Kaplan and Urwitz (1979), Peavy and Edgar (1982), Pinches and Mingo (1973), Pogue and Soldofsky (1969) and West (1970), among others. Bond rating prediction studies involving public utility issues include Altman and Katz (1976), Bhandari et al. (1979), Pinches et al. (1978) and Winger and Watts (1982).
2. See, for example, Horrigan (1966), Pogue and Soldofsky (1969), and West (1970).
3. The probit model assumes that the underlying probability distribution is normal, while the logistic model assumes a cumulative logistic function. The two probability distributions are similar and should yield results that are similar (see Ederington (1985)).
4. The choice of the two time periods may be considered arbitrary to the extent that there are other time periods that could qualify as stable and unstable economic periods. The goal in selecting the two time periods was to ensure that one of them may be clearly delineated as an economically stable regime and the other as a unstable period. As revealed by Table 1 the two selected time periods are distinctly different with respect to a number of economic

indicators. The seventies could also have been selected to represent the economically uncertain regime, however, it was felt that the instability during this period was largely due to the external shock of oil price increases. The uncertainty in the 1980-1981 period was considerably more widespread and not attributable to an external shock such as the oil price increases in the seventies. Furthermore, the volatility in the financial markets in 1980-1981 especially with respect to the levels of interest rates and inflation premiums was unprecedented.

5. The two principal agencies that provide corporate bond ratings are Moody's Investor Service, Inc. and Standard and Poor's Corporation. Fitch Investor's Service, Inc. and Duff and Phelps, Inc. are two other services that rate corporate bonds, however, their coverage is considerably smaller and tend to specialize in certain sectors. Most large corporate bonds are rated by both Moody's and Standard and Poor's. It is estimated that their respective ratings differ only on an estimated ten percent of all issues (see Belkaoui (1983)). Previous studies on bond prediction models restrict their sample to either Moody's or Standard and Poor's ratings exclusively with no preference for one over another. The one exception is Horrigan (1966) who estimated the bond rating prediction model for Moody's and Standard and Poor's ratings separately, but did not find and systematic differences between the two.
6. For a description of the rating process, including the financial and non-financial aspects, see Hawkins, Brown, and Campbell (1983) and *Standard and Poor's Ratings Guide* (1979).

References

1. Altman, E.I. and S. Katz, "Statistical Bond Rating Classification Using Financial and Accounting Data" in *Proceedings of the Conference on Topical Research in Accounting*, Michael Schiff and George Sorter, eds., (New York University School of Business), pp. 205-239, 1976.
2. Belkaoui, A., *Industrial Bonds and the Rating Process*, Quorum Books, Westport, Connecticut, 1983.
3. Belkaoui, A., "Industrial Bond Ratings: A New Look," *Financial Management*, Vol. 9, No. 3, pp. 44-51, 1980.
4. Bhandari, S.B., R.M. Soldofsky and W.J. Boe, "Bond Quality Rating Changes for Electric Utilities: A Multivariate Analysis," *Financial Management*, Vol. 8, No. 1, pp. 74-81, 1979.
5. Ederington, L.H., "Classification Models and Bond Ratings," *The Financial Review*, Vol. 20, No. 4, pp. 237-262, 1985.
6. Fisher, L., "Determinants of Risk Premium on Corporate Bonds," *Journal of Political Economy*, June, pp. 21-27, 1959.
7. Gentry, J.A., D.T. Whitford and P. Newbold, "Predicting Industrial Bond Ratings With a Probit Model and Funds Flow Components," Working paper No. 1198, College of Commerce and Business Administration, University of Illinois at Urbana-Champaign, 1985.
8. Hawkins, D.F., B.A. Brown, and W.J. Campbell, *Rating Industrial Bonds*, Financial Executives Research Foundation, Morristown, New Jersey, 1983.
9. Horrigan, J.O., "The Determination of Long-Term Credit Standing with Financial Ratios," *Journal of Accounting Research*, Vol. 4, Suppl., pp. 44-62, 1966.
10. Jaffee, D.M., "Cyclical Variations in the Risk Structure of Interest Rates," *Journal of Monetary Economics*, July, pp. 309-325, 1975.
11. Kaplan, R.S. and G. Urwitz, "Statistical Model of Bond Ratings: A Methodological Inquiry," *Journal of Business*, Vol. 52, No. 2, pp. 231-262, 1979.
12. Peavy III, J.W. and S.M. Edgar, "Long Run Implications of Industrial Bond Ratings as Risk Surrogates," *Journal of Economics and Business*, Vol. 34, pp. 331-341, 1982.
13. Pinches, G.E. and K.A. Mingo, "A Multivariate Analysis of Industrial Bond Ratings," *Journal of Finance*, Vol. 28, No. 1, pp. 1-18, 1973.
14. _____, J. C. Singleton and A. Jahankhani, "Fixed Coverage As a Determinant of Electric Utility Bond Ratings," *Financial Management*, Vol. 7, No. 2, pp. 45-55, 1978.
15. Pogue, T.F. and S.M. Soldofsky, "What's In A Bond Rating?," *Journal of Financial and Quantitative Analysis*, Vol. 4, No. 2, pp. 201-228, 1969.
16. Press, S.J. and S. Wilson, "Choosing Between Logistic Regression and Discriminant Analysis," *Journal of the American Statistical Association*, December, pp. 699-705, 1978.
17. *Standard & Poor's Ratings Guide*, McGraw Hill Book Company, New York, NY, 1979.
18. West, R.R., "An Alternative Approach to Predicting Corporate Bond Ratings," *Journal of Accounting Research*, Spring, pp. 118-127, 1970.
19. Wingler, T.R. and J.M. Watts, "Electric Utility Bond Rating Changes: Methodological Issues and Evidence," *Journal of Financial Research*, Vol.5, No. 3, pp. 221-235, 1982.