Evidence Of Nonstationarity In The Bond Rating Process For Newly Issued Bonds: A Note

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Abstract

This study documents nonstationarity of the bond rating process. The empirical evidence suggests that not only the parameter estimates exhibit nonstationarity but also the bond rating process itself. The source of nonstationarity is found to be externally caused and not agency-specific. Further examination leads us to stipulate that rating agencies apply stricter standards to lower grade issues than to higher grade one when the economy is in a recession. The results have implications for bond investment strategies as well as for the utilization of bond rating prediction models.

I. Introduction

Traditionally, agency ratings have been utilized to maintain a certain level of bond portfolio default risk. Many portfolio managers rely on bond ratings for investment strategies, therefore, the efficacy of bond investment strategies depends upon the relative consistency of the default risk measures. It is not clear, however, that assigned agency ratings have similar risk characteristics over time. While past studies have addressed the specification of bond rating models and compared different methodologies for model estimation, the extant literature provides little evidence concerning the stationarity of the bond rating process.

This issue is interesting for two important reasons. First of all, if the investment community relies on agency ratings as an indicator of default risk and these ratings are nonstationary, then inefficiencies may result in the bond market with significant implications for investors. Secondly, the existence of nonstationarity implies that the application of one bond rating model may be inappropriate over different time periods. This study investigates whether the agencies apply the same standards over time when assigning ratings to new bond issues.

We address this issue by examining the stability of the variable coefficients in a bond rating model as well as the classification and prediction accuracies of a bond rating model over time. In doing so, we attempt to distinguish between two sources of nonstationarity. First, the *emphasis* placed on the determinants of bond ratings could vary over time thus introducing nonstationarity in the variable coefficients of bond rating models. Second, in the bond rating process, the variables (determinants) used to measure default risk might vary over time. This source of nonstationarity is expected to result in instability of classification and prediction accuracies.

II. Model and Sample

Since the financial literature on bond rating models is well established, the model that is used here draws heavily on prior work. Past studies have been able to explain between 50% and 80% of the variation in bond ratings using four to seven variables. The variables found to be most important in predicting bond ratings are the subordination status of the issue and measures of the firm's size. Other variables shown to be statistically significant include profitability, the firm's leverage and the sale-leaseback covenant. The model chosen consists of all five variables that have been found to be significant to bond ratings. We also control for convertibility of issue by using a dummy variable since the sample consists of straight debt issues as well as issues with convertibility features (1). The following model is used to estimate Moody's bond rating, R, of a new issue, i:

$$R_i=\beta_0+\beta_1 SIZE_i+\beta_2 LEV_i+\beta_3 PF_i+\beta_4 SUBS_i+\beta_5 SL_i+\beta_6 OPT_i+\tilde{e}_i$$

where

SIZE (+)	is the logarithm of book value of firm assets (2),
LEV (-)	is long term debt to total assets ratio,
PF (+)	is net income to total assets ratio,
SUBS (-)	is (0,1) variable indicating absence or presence of the subordination status,

SL (+)	is (0,1) variable indicating absence or presence of the sale and sale-leaseback covenant(3),
OPT (+)	is (0,1) variable indicating absence or presence of imbedded call options such as a warrant or a conversion feature, and
e	error term

The signs in brackets represent the *a priori* expected relationships between the independent variables and the bond rating. Ordinary least squares (OLS) regression was used to estimate the model. Despite the obvious theoretical shortcomings of OLS when dealing with a categorical dependent variable, numerous studies have shown that it is *at least as good as* the more econometrically sound method of probit. Comparing OLS to probit in our sample indicates that it does at least as well as probit in terms of classification and prediction accuracies.

The sample of 416 observations includes only newly issued U.S. industrial corporate bonds with a Moody's rating of *B* or better issued during the period January 1979 - June 1983. This period is chosen since it encompasses at least one full business cycle. Issues that are commodity-indexed, flexible-rate, or zero coupon are eliminated to render the sample more homogeneous. Only one issue per firm per year is retained. Bond rating data are obtained from Standard & Poor's Bond Guide and the financial data are retrieved from the COMPUSTAT tapes and supplemented by Moody's Industrial Manual.

III. Empirical Results

A. The stationarity of the variable coefficients

An instability of the variable coefficient estimates in the bond rating model would indicate that the emphasis on bond rating determinants has changed (4). To test stationarity of the variable coefficients, the bond rating model is estimated for the whole period (1979-1983) and also separately by year. To test the equality of the variable coefficients, a Chow test is performed (5). According to this test, we reject the hypothesis of coefficient stationarity with an F statistic of 4.33 which is significant at the 2.5% level.

B. The stationarity of the bond rating process

If classification and prediction accuracies of the bond rating model exhibit nonstationarity, then this implies a fundamental change in the bond rating process. Hence, prediction of bond ratings becomes more difficult. In general, sample periods used in prior research are selected with the implicit assumption that the larger the sample, the better the expected results. However, the existence of such nonstationarity implies that the application of one model is inappropriate over different periods.

In order to test for this type of nonstationarity, the model is estimated over small sample periods of equal length. Thirty seven moving window sample periods, each with eighteen-month time frame, are constructed (6). The first sample period extends from January 1979 to June 1980; the second sample period extends from February 1979 to July 1980, and so on. Subsequently, the observations in each sample period are divided randomly into an estimation sample (consisting of two thirds of the observations) and a cross-sectional holdout sample (containing the remaining third). The model is estimated separately for each of the 37 estimation samples, then the classification and prediction accuracies are computed.

As Table 1 demonstrates, both the classification and prediction accuracies seem to decrease somewhere between sample 23 and 25, an indication that the model's nonstationarity is not just limited to the parameter estimates; but it encompasses the whole bond rating process. This could explain the lack of consensus among researchers on any one bond rating model. There are a few examples in the literature that point to evidence of nonstationarity. For example, Kaplan and Urwitz (1979) testing Horrigan's (1966) older model on their 1971-1972 sample find that the model performed better during their sample period in terms of explanatory power (61%) than during Horrigan's period (47%).

C. Source of nonstationarity

Over time, it is possible that a rating agency reevaluates its rating policies, resulting in a change in the determining factors of default risk. This could be caused, for instance, by a change in agency management. Alternatively, nonstationarity could be economically driven whereby the rating agencies change their standards as the economy changes. Since the two major rating agencies--Moody's, and S&P's--presumably act independently in the process of assigning ratings, examining whether S&P's and Moody's nonstationarities coincide would shed some light on the source of nonstationarity. If it is agency-specific, there is no reason to believe that internal changes within both agencies should coincide. However, if the nonstationarity exhibits similar patterns in both rating agencies, then this would indicate a simultaneous adjustments of the rating process within the agencies prompted by changes in external conditions. In fact, both rating agencies claim that economic conditions have an indirect impact on a bond's rating. When the classification and prediction accuracies are examined for S&P's rated issues (a sample of 398 issues) vis-a-vis Moody's ratings, similar results are obtained. See Table 1.

D. The rating process in different economic environments

Further examination shows that rating nonstationarity

Table 1

Classification & Prediction Accuracies For Moody's & S&P's
Rated Issues For 37 Samples,
Each Sample Spanning 18 Month Period
Total Sample Period Covers January 1979-June 1983

Sample	Moody's % Correctly Classified	Moody's % Correctly Predicted	S&P's % Correctly Classified	S&P's % Correctly Predicted
1	76.2	78.1	83.6	72.7
2	83.8	67.6	83.3	79.5
3	82.9	65.9	78.8	79.1
4	82.8	69.8	79.1	71.7
5	84.8	69.6	83.2	78.0
6	80.6	76.6	81.4	82.4
7	80.9	71.1	85.7	77.6
8	84.9	74.5	87.5	71.4
9	87.4	64.6	84.1	75.5
10	85.6	79.6	82.7	81.8
11	82.4	80.4	80.9	77.2
12	81.3	79.2	79.0	81.7
13	82.0	76.8	77.2	79.0
14	85.8	75.0	80.8	72.6
15	85.2	73.7	78.4	68.3
16	85.2	69.0	82.5	69.8
17	84.7	76.8	78.5	73.8
18	86.3	64.7	79.5	71.4
19	84.5	79.6	76.9	66.7
20	87.5	81.8	81.6	65.3
21	89.9	77.5	78.7	72.7
22	85.3	84.2	74.7	73.8
23	84.1	70.6	76.7	75.0
24	84.1	68.6	73.3	43.2
25	81.4	65.7	72.0	67.6
26	77.8	64.5	71.2	57.6
27	78.5	71.9	76.5	47.1
28	73.1	70.6	71.0	57.1
29	74.6	55.9	66.7	57.1
30	65.8	56.8	69.3	59.5
31	60.0	62.2	66.2	46.2
32	70.1	43.6	72.5	37.5
33	65.0	56.1	66.7	61.9
34	64.0	56.8	67.4	48.9
35	58.6	54.0	59.6	57.1
36	58.9	54.7	65.1	45.3
37	57.3	48.1	61.4	51.0

could be caused by dissimilar rating processes for low and high grade issues. As the economic environment changes, it would seem reasonable to expect that rating standards applied to low and high grade issues would differ. Analysis of firm and issue variables indicates that the rating agencies evaluate high and low grade issues differently depending on the state of the economy. For example, firms issuing *low grade debt* in a recessionary period are definitely of higher quality than those firms issuing in boom periods. Many of the variables analyzed in Panel A of Table 2 indicate a higher quality firm during the recessionary period: the firm size is larger, leverage is lower, profitability is higher, indentures are more restrictive (for example, the sale and leaseback restriction and the option feature).

On the other hand, firms issuing *high grade debt* in a recession were not distinctly of higher quality than those issuing in a boom. Some of the variables in Panel B of Table 2 indicate lower quality issues during the recession period. For instance, high grade firms issuing in the recession period had lower profitability, higher leverage and a less restrictive indenture. Thus it seems that rating agencies are generally more strict with low grade firms in recessionary periods. This implies that the quality of low grade issues is higher in a recession whereas the quality of high grade issues is *relatively* lower. For example, a *BB* bond issued in a recessionary period may have a higher quality than a *BB* bond issued during a boom.

Table 2

Variable Statistics of Issuing Firms Over Different Economic Periods

Panel A: Low Grade Issues

Variables	Boom@ Mean (N=130)	Recession Mean (N=73)	t Statistics*
Assets	272.3M	1298.6M	-2.24**
Profitability	0.068	0.072	-0.30
Leverage	0.540	0.510	1.36
Subordination	0.962	0.901	1.77**
Option	0.638	0.643	-0.03
SL Covenant	0.015	0.080	-2.25**

Panel B: High Grade Issues

Variables	Boom Mean (N=113)	Recession Mean (N=82)	t Statistics
Assets	4170.6M	6182.7M	-2.04**
Profitability	0.086	0.075	2.27**
Leverage	0.443	0.484	-2.51**
Subordination	0.167	0.276	-1.85**
Option	0.158	0.189	-0.55
SL Covenant	0.803	0.621	2.79**

@ Economic periods of boom and recession were defined as those provided by the Federal Reserve Bulletin.

* t statistics test the difference between two means.

** Significant at the 5% level or better.

An indirect evidence of the change in stringency requirements is indicated by the percent of low versus high grade bonds issued in different economic periods. Firms with lower default risk tend to have a greater number of issuance in a recession, 53.8%, versus 46.2% in a boom. Conversely, firms with higher default risk tend to tap the bond market with less frequency during a recession, 46.1%, versus 53.9% in a boom. These results are similar to those obtained by Ferri and Martin (1980).

In summary, a number of implications result from this study. First, the longest sampling period is not necessarily the most optimal when predicting bond ratings due to nonstationarity in the bond rating process and the associated determinants. The evidence indicates that applicability of a bond rating model varies over time. Secondly, nonstationarity is not agency-specific as it occurs simultaneously for Moody's and S&P's rated issues. Finally, the evidence leads us to stipulate that rating agencies apply stricter standards to low grade issues than to higher grade issues when the economy is in a recession.

Footnotes

1 Comparison between this model and a more comprehensive model consisting of 17 variables indicates that the parsimonious model performs as well as the full model (with an adjusted R-squared of 81.2% for the parsimonious model versus 82.6% for the full model). The 17 variables in the comprehensive model are the six variables from the parsimonious model plus the following eleven variables: four dummy variables represent five major industry categories (manufacturing, mining, wholesale, service, retail), the coefficient of variation of earnings over five years prior to issue of debt, after tax coverage ratio, net tangible assets/total debt, maturity of debt issue, lien restriction, dividend restriction and debt restriction.

2 A logarithm function is used to normalize total assets.

3 See Smith and Warner (1979) for an analysis of bond covenants and their implications on *debt* agency costs.

4 With an adjusted R-squared of 81.2% for the period under study, it is reasonable to believe that this model captures the essence of the bond rating process.

5 See Maddala (1977), p. 198.

6 The eighteen-month window period was chosen as a compromise; it is long enough to allow for a sufficient number of observations for model estimation while short enough to detect nonstationarity.

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