Rating Changes and Information in the Bond Market

by

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Introduction

This study will attempt to gauge the extent to which changes in quality ratings by the major rating agencies affect the yields-to-maturity on corporate bonds. If such changes represent information that bond investors did not previously have, this study would be similar to studies of the effect of specific types of information in the market for equity securities. A partial list of such studies includes the examination of earnings announcements by Ball and Brown [2], the study of stock splits by Fama, Fisher, Jensen and Roll [4] and the study of dividend announcements by Pettit [8]. However, it is not at all obvious that rating changes in fact increase the information set upon which the investor bases his expectations since agencies might act primarily on information that is already available to the individual investor.

Bond Ratings

The studies of Hickman [6] and Atkinson [1] have demonstrated that a historical relationship exists between agency ratings and default experience. This indicates that the agencies are, at least to some extent, successful in evaluating information about the firm and the security. A casual examination of yield indices reveals that investors, in general, appear to ask for higher yields on lower rated securities. However, the causality in this relationship between yields and ratings is not clear in the light of studies by Horrigan [7], West [13], Pogue and Soldofsky [11], and Pinches and Mingo [10]. These studies reveal that multi-variate models using nothing more than readily available data on the firm and the characteristics of the security explain and predict on the order of 60% of the ratings of Moody's and Standard and Poor's.

Over the years, the agencies have revealed bits of the rating process. Various editions of Moody's Investors Service state that ratings reflect ".... 'worst' potentialities in the 'visible' future .... They are not statistical ratings but an appraisal of long term risks, such appraisal giving recognition to many non-statistical factors." However, statistical measures are clearly an explicit element in the rating decision. A Moody's spokesman has stated that:

> "We go beyond .... "(such tests as ordinary income statement and balance sheet analysis)" .... in testing the statistical position of bonds by the study of certain ratios ordinarily used for the purpose of credit determination, such as the sales to property account, the percent earned on net worth, percent earned on total assets, margins of profit, ..." [12]

Another Moody's spokesman revealed a little more of the statistical input.

> "The most common and universally used statistical measure of interest protection is 'Times Charges Earned.' Under ICC accounting procedures, Federal Income Taxes are deducted before arriving at the balance available for charges. We readjust the figures so that the coverage multiple is computed on the basis of earnings available for charges before deduction of income taxes."

He then continued:

> "Another major statistical rating determinant is 'safety factor' -- the percentage of operating revenues remaining after deduction of all operating expenses and fixed charges, but before deduction of Federal Income Taxes. It is pre-tax net income stated as a percentage of operating revenues." [3]

A Standard and Poor's representative has listed "five fundamental areas of bond rating." [5]

1. Issuing Documents. Although the indenture has a great bearing on a bond rating, it is regarded as far less important than the company's earning power, financial resources, and property protection.
2. Earnings. Historical and future potential earnings are considered the single most important factor in credit rating in most cases, although in some industries poor earnings records and potential can be partially offset by high asset protection. In projecting earning power S & P claims that it takes account of the industry, the company's historical share of the market, its products, research and development, its pricing policies, tax practices and any of the myriad of influences on profits.
3. Asset Protection. The following ratios are listed as being of primary importance: current proposed debt to net plant assets, working capital to debt, debt to equity, and total net tangible assets to debt. The relative importance of these ratios depends on the particular industry.
4. Management. Although it is acknowledged that there is great difficulty in evaluating a company's management, the results of such an evaluation "can have a great influence on its debt rating."
5. Financial Resources. In addition to looking at a company's cash position, S & P determines its ability to obtain cash, in particular those alternative sources of borrowing that a firm may use to raise cash for either long- or short-term debt repayment. They include: saleable receivables, short-term borrowing potential

(particularly bank line), the ease with which the company could sell stock, and the potential sale of assets.

Thus, there is a sufficient aura of both analysis and clairvoyance in the rating process to suggest that a change in rating might constitute a meaningful addition to the investor's information set.

Conditional Expectations

The studies of information in the market for equity securities have used a conditional expectations approach. That is, in the absence of the new information about the specific security, realized market condi at a particular point in time would lead one to expect the price or of that security to be a given amount. The actual price or yiel generally be some other amount. The difference is either sign. or insignificant and in the right or the wrong direction depending o. original hypothesis. Such conditional expectations models for equity secu. ies have been based upon the capital asset pricing model. However, the analysis of the relevance of the capital asset pricing model to the bond market is still in its infancy (See Percival [9]) and its use as the basis for a conditional expectations model in this study was deemed inappropriate. Therefore, a series of ad hoc conditional expectations models based upon yield indices were developed and tested here.

Methodology

In order to gauge the effect of a rating change, the yield performance of bonds which have been changed in rating will be examined for the periods immediately preceding and following the change. In particular, if one regards the required yield-to-maturity on a bond as an indication of the "market rating," an attempt can be made to specify the timing of any change in the market's perception of the security and relate that to the timing of the

agency change.

All bonds examined in this study were rated in the "investment grades" by Moody's (Aaa through Baa) and Standard and Poor's (AAA through BBB). A major problem in any study of bond prices and yields is trading inactivity in a major segment of the market. The sample was limited to investment grade securities in an attempt to minimize such problems since a major portion of the participants in the bond market are limited by law to trading in these securities.

Yield Regions

The largest yield differential between contiguous ratings within investment grades tends to exist between Baa and A rated securities by Moody's and BBB and A rated securities by Standard and Poor's.

As an initial sample, the fifteen non-convertible, industrial bonds which, during the 1963-1970 period were changed in their rating by Moody's from A to Baa or from Baa to A were chosen. This sample included six bonds upgraded from Baa to A and nine which were downgraded from A to Baa.

The ten bonds comprising Moody's index of industrial A rated bonds was chosen as a measure of the yield performance of typical A rated bonds over the time span from 1961-1971 and the ten bonds comprising the industrial Baa index were chosen to reflect typical Baa bonds. There is, of course, turnover in the bonds which comprise the A and Baa indices.

For each month from 1961 through 1971 the mean (equally weighted) yield-to-maturity and the standard deviation of the yields around the mean was calculated for the A and Baa indices based on end-of-the-month prices taken from Standard and Poor's Earnings and Ratings Bond Guide.[1] An upper region of typical Baa yields was then constructed as equal to the range from the

mean Baa yield to one standard deviation above the mean yield for each month. A lower region of A yields was similarly constructed as equal to the range from the mean A yield to one standard deviation below the mean for each month. The yields-to-maturity based on end-of-the-month prices for the 24 months preceding the rating change and the 12 months following the change were then plotted for each of the fifteen bonds on a graph with a plot of the constructed yield regions.

If a point in time could be isolated at which the yield on the bond moved from one region to another and tended to stay there, that point in time could be compared to the point at which the agency changed the rating. However, two problems arise in such an analysis, which made the results ambiguous. The first is that the two regions often overlap making discrimination impossible. The second is that even when there is no overlap of regions, it is extremely difficult to point to a particular point in time at which the market rating changes using this procedure.

Yield Relatives

The sample of fifteen industrial bonds was expanded by adding (without duplication) industrial bonds which were changed in rating by Standard and Poor's from BBB to A or from A to BBB from 1963-1970. The expanded sample contained fourteen upgraded and fourteen downgraded bonds. Yield relatives were then calculated for each of the twenty-four months up to and including the month of the announcement of the change and the twelve months subsequent. The yield relative on an upgraded security was calculated as in equation (1).

$$(1) \qquad R_{it} = \frac{Y_{it}}{I_{At}}$$

where: R_{it} is the yield relative on bond i at point in time t (t = 1,36)

Y_{it} is the end-of-the-month yield-to-maturity for bond i at point in time t

I_{At} is the mean yield on the Moody's index of A rated industrial bonds at point in time t

The yield relative on a downgraded bond was defined similarly except that the index used was the Moody's Industrial Baa index.

Thus, at one extreme, if the information on which the agency changes the rating is unknown to the bond market, one might expect the yield relative on a downgraded security to fluctuate randomly below 1.0 up to and including the month of the announcement. Subsequent to the announcement one might expect the relative to increase perceptibly. If the market has access to the same information as the agency and the deterioration of the credit worthiness of the firm is a gradual process, the relative might be expected to increase gradually over time prior to and perhaps subsequent to the agency change.[2] With an upgraded bond, one might expect the relative to be above 1.0 initially and move perceptibly towards 1.0 after the announcement if the agency change is "informative."

Table I gives the end-of-the-month relatives for the 24 months prior to and the twelve months subsequent to the agency change. These are the mean relatives for 14 downgraded and 14 upgraded securities. The 36 months trend in the relatives is in the theoretically "correct" direction. The change from month 24 (last month preceding) to month 25 (first month subsequent) is noticeable and in the correct direction. However, there are changes in other months that are larger and in the correct direction.

Table I

End-of-the-Month Relatives

Month	14 Downgraded	14 Upgraded	Month	14 Downgraded	14 Upgraded	Month	14 Downgraded	14 Upgraded
1	.956	1.035	13	.946	1.058	25*	.976	1.047
2	.954	1.040	14	.944	1.056	26	.981	1.044
3	.963	1.044	15	.964	1.053	27	.985	1.028
4	.950	1.042	16	.957	1.061	28	.984	1.026
5	.956	1.042	17	.946	1.043	29	.971	1.037
6	.938	1.045	18	.944	1.028	30	.994	1.031
7	.953	1.038	19	.959	1.039	31	.981	1.044
8	.947	1.045	20	.946	1.038	32	.980	1.034
9	.952	1.066	21	.946	1.028	33	.976	1.002
10	.959	1.059	22	.941	1.031	34	.971	1.015
11	.969	1.059	23	.971	1.024	35	.992	1.033
12	.956	1.066	24	.969	1.052	36	1.004	1.028

*First month after change in rating.

To eliminate some of the "white noise" in the relatives and to get a better feel for the longer term movements, the quarterly, semiannual, and annual averages of the end of the month relatives were computed. These averages appear in Tables II, III and IV. The quarterly, semiannual and annual data reveal much more evidence of an announcement effect for downgraded securities and a gradual trend continuing well past the announcement for upgraded securities.

Table II

Quarterly (Average of Monthly Data) Relatives

Quarter	14 Downgraded	14 Upgraded
1.	.958	1.040
2.	.950	1.043
3.	.950	1.050
4.	.960	1.061
5.	.951	1.053
6.	.949	1.044
7.	.949	1.035
8.	.960	1.036
*9.	.981	1.040
10.	.983	1.031
11.	.979	1.027
12.	.989	1.025

*First quarter after rating change.

Table III

Semiannual Relatives

Period	14 Downgraded	14 Upgraded
1	.953	1.041
2	.956	1.056
3	.950	1.048
4	.955	1.035
*5	.982	1.036
6	.984	1.026

*First semiannual period after rating change.

Table IV

Annual Relatives

Year	14 Downgraded	14 Upgraded
1	.954	1.048
2	.952	1.042
*3	.983	1.031

*First year after rating change.

Of the fourteen bonds which were in the downgraded sample, 8 were also downgraded by the other agency during the 36 month time span. The other six bonds were not changed in rating by the other agency. Of the fourteen upgraded bonds, only two were also upgraded by the other agency. The other 12 were unchanged during the 36 month time period. There were no obvious differences in the time patterns of the yield relatives of the bonds which were changed by both agencies and the bonds which were changed by only one. However, no attempts to quantify any such differences were made.

T-Statistics

The examination of the trends in the relatives indicates merely that the market tends to agree with the direction of the agency change. The timing of the market change could not be specified however. In an attempt to isolate the timing aspect, a series of t-tests designed to find statistically significant changes were used.

First, the sample to be examined was expanded. The new sample originally included all corporate bonds which were changed in rating (within Aaa-Baa) by Moody's from 1963-1971. (No two bonds of the same rating from the same issuing firm were included). This original sample numbered 174 bonds. However, there was insufficient price data on 40 of these bonds which left 134 in the sample.

In addition, the results of the previous section revealed that looking at 36 months of data was excessive. Therefore, 18 months of end-of-the-month yields-to-maturity were collected from Standard and Poor's Earnings and Ratings Bond Guide. The 18 months include the twelve months prior to the announcement of the change and the 6 months subsequent.[3]

Then, for each bond the 18 corresponding yield relatives were computed as in equation (2). The example in equation (2) is a security upgraded from Aa to Aaa.

$$(2) \qquad R_{it} = \frac{Y_{it}}{I_{Aat}}$$

where: R_{it} is the yield relative on bond i at point in time t (t = 1, 18)

Y_{it} is the end-of-the-month yield-to-maturity for bond i at point in time t

I_{Aat} is the mean yield on the Moody's composite index of Aa rated bonds at point in time t

It should be noted that equation (2) differs from equation (1) in three ways. First it should be noted that the time span has been reduced from 36 to 18 months with the rating change coming after 12 rather than 24 months. Next, all indices are now Moody's composite indices rather than simply industrial bonds. Finally, the relative in (2) is based on the rating that the bond is changed from rather than the rating it is changed to, as in equation (1).

Ten t-tests were then performed for each bond. The alternative hypothesis tested were:

$$H_o: \ \mu_1 - \mu_2 = 0$$

i.e. that there was no difference in the population means, and

$$H_1: \ \mu_1 - \mu_2 \neq 0$$

i.e. that the population means were different. The μ_1 was defined as the average relative for the first n months and the μ_2 as the average relative for the last 18-n months. The ten t-tests were for values of n from 6 to 15.

For many bonds, more than one of the 10 t-values was statistically significant.[4] Table V summarizes the characteristics of the largest absolute value t-value for each bond.

The largest t-value is more often in the theoretically correct direction than not. However, it occurs before the agency change more often than after. When the difference is in the wrong direction it is twice as frequently before the agency change as after. The ratio of correct to incorrect signs is larger for upgraded bonds than for downgraded bonds. The ratio of correct to incorrect is particularly high for the change from Baa-A.

Table VI summarizes the signs of the t-values comparing the mean relative for the first 12 months (prior) with the mean for the last 6 months (subsequent). The signs are more often in the correct direction. The ratio of correct to incorrect is again particularly high for the change from Baa-A.

In addition, a simple count of the signs of the t-values was made for each bond. The signs for a bond were regarded as predominantly positive if no more than one t-value for that bond was negative. They were regarded as predominantly negative if no more than one was positive. In all other cases the signs were regarded as mixed. A summary of these signs appears in Table VII.

The theoretically correct sign for an upgraded bond (in the direction of the agency change) is positive and that for a downgraded bond is negative (given the construction of the t-test). There seems to be a significant number of bonds whose yields appear to change in the direction of the agency change throughout the 18 month period. This represents approximately

Table V

Highest Absolute Value t-value

	Total	Theoretically Correct Sign	After	Before	Theoretically Incorrect	After	Before	Insignificant
All Changed Bonds	134	60	27	33	43	14	29	31
Upgraded	66	34	13	21	21	6	15	11
Downgraded	68	26	14	12	22	8	14	20
Aa-Aaa	6	2	1	1	3	2	1	1
A-Aa	35	17	6	11	14	4	10	4
Baa-A	25	15	6	9	4	0	4	6
Aaa-Aa	12	4	0	4	4	3	1	4
Aa-A	37	16	12	4	13	4	9	8
A-Baa	19	6	2	4	5	1	4	8

Table VI

12-6 t-values

	Total	Theoretically Correct Sign	Significant	Insig.	Theoretically Incorrect	Significant	Insig.
All Changed Bonds	134	80	34	46	54	23	31
Upgraded	66	43	19	24	23	14	9
Downgraded	68	37	15	22	31	9	22
Aa-Aaa	6	2	2	0	4	3	1
A-Aa	35	21	8	13	14	8	6
Baa-A	25	20	9	11	5	3	2
Aaa-Aa	12	5	2	3	7	2	5
Aa-A	37	22	11	11	15	5	10
A-Baa	19	10	2	8	9	2	7

Table VII

t-value Signs

	Total	Predominantly Positive	Predominantly Negative	Mixed
All Changed Bonds	134	49	45	40
Upgraded	66	30	20	16
Downgraded	68	19	25	24
Aa-Aaa	6	2	3	1
A-Aa	35	15	13	7
Baa-A	25	13	4	8
Aaa-Aa	12	5	4	3
Aa-A	37	10	15	12
A-Baa	19	4	6	9

45% of the upgraded and approximately 37% of the downgraded bonds. However, there is a surprisingly high frequency of securities which appear to change in yield in a direction opposite to that implied by the agency change. These securities represent approximately 30% of the upgraded and approximately 28% of the downgraded bonds.

The bonds for which the t-values are mixed in sign are worth some further analysis. In particular, it would be enlightening to know how many of these bonds have t-values in the theoretically correct direction for the comparison of the yields for the first 12 and last 6 months. A summary of these results appears in Table VIII.

Table VIII

12-6 t-values Where t-values are Mixed in Sign

	Total	Theoretically Correct Sign	Theoretically Incorrect
All Changed Bonds	40	25	15
Upgraded	16	13	3
Downgraded	24	12	12
Aa-Aaa	1	0	1
A-Aa	7	6	1
Baa-A	8	7	1
Aaa-Aa	3	1	2
Aa-A	12	7	5
A-Baa	9	4	5

When the t-values for the 18 month period are mixed in sign, there is a tendency for the t-value comparing the first 12 months with the last 6 months to be of the theoretically correct sign. That tendency is particularly marked for upgraded bonds.

Regression Analysis

Regression analysis was used as an alternative means of forming conditional expectations. The expectation of the individual bond's yield was again based upon the yield of a typical bond of the rating that the bond was changed from. The indices used were changed slightly from those utilized above. If the bond was an industrial,utility, or railroad bond, Standard & Poor's industrial, utility, or railroad index of the same rating was used rather than the Moody's composite index.

Using the 12 months of end-of-the-month yields previous to the agency change, the relationship between the bond's yield and the index yield was regression estimated according to equation (3).

$$(3) \quad Y_{it} = \alpha_i + B_i I_t + \varepsilon_{it}$$

where: Y_{it} is the yield to maturity for bond: at point in time t (t = 1, 12)

α_i is the constant for bond i

B_i is the regression coefficient for bond i

I_t is the yield for the appropriate index at point in time t

The conditional expectations of the yield for each bond of the yields for the 6 months subsequent to the agency change were then formed according to equation (4).

$$(4) \quad E(Y_{it}) = \alpha_i + B_i I_t$$

where: $E(Y_{it})$ is the expectation of the yield on bond it for period t ($t = 13, 18$)

α_i, B_i are as defined above

I_t is the actual yield on the index corresponding to the bond's rating, prior to the agency change, for period t.

These expectations of the bonds' yields were then compared with the actual values in an attempt to gauge any effect of the rating change. Thus, equation (4) is an attempt to estimate the yield on the bond in the absence of any effect of the agency change. For example, if the bond was downgraded by the agency, one might expect that, if the change has an informational impact, the actual yields after the change would be higher than those predicted by equation (4).

The t-statistics on the regression coefficients in equation (3) were significant at a 95% conficence level for 83 of the 133 bonds in the sample.[5] The regression results and the average differences between the actual and predicted yields (actual minus predicted) for months 13 through 18 appear in Table IX.

The signs of the differences are, in general, consistent with the direction of the agency changes. The absolute value of the differences does tend to increase from t = 13 to t = 18 but only slightly. This indicates that there is in general only slight further change in the "market rating" after t = 13.

Some analysis of the signs of the yield differences was done for the individual securities. These results are summarized in Table X according to the number of bonds which had a given number of negative differences and therefore 6-n positive yield differences. Negative is the theoretically

Table IX

Regression Results

Change	Sample	Average Adjusted R^2	Average t-statistic	Number Significant	Average Difference in Yields for Months 13-18					
					13	14	15	16	17	18
Aa-Aaa	6	.52	6.67	4	+.110	+.093	-.028	-.113	-.193	-.157
A-Aa	35	.28	4.39	18	-.093	-.068	-.063	-.080	-.001	-.069
Baa-A	24	.34	3.92	13	+.041	-.115	-.171	-.228	-.126	-.171
Aaa-Aa	12	.30	3.38	8	-.077	+.008	-.097	-.041	-.088	-.040
Aa-A	37	.51	5.33	27	+.135	+.021	+.156	+.146	+.139	+.141
A-Baa	19	.44	4.15	13	+.164	+.226	+.340	+.259	+.444	+.258
	133			80						

Table X

Signs of Yield Differences

		Number of Bonds Having n Negative Differences					
	Total	n=6	5	4	3	2	1	0
Upgraded	65	19	5	10	7	5	10	9
Downgraded	68	7	8	5	6	9	11	22
Aa-Aaa	6	1	0	1	0	1	2	1
A-Aa	35	12	4	5	4	0	2	8
Baa-A	24	6	1	4	3	4	6	0
Aaa-Aa	12	2	2	1	2	1	1	3
Aa-A	37	4	4	3	2	6	4	14
A-Baa	19	1	2	1	2	2	6	5

sign for an upgraded bond.

There is again a tendency for the signs to be in the theoretically correct direction. For example, approximately 52% of the upgraded bonds have 4 or more negative signs, while approximately 62% of the downgraded bonds have 2 or fewer negative signs.

The frequency of positive and negative signs on the yield difference for period 13 might be of particular interest. These frequencies appear in Table XI.

Table XI

Signs of Period 13 Yield Differences

	Total	Theoretically Correct	Theoretically Incorrect
Upgraded	65	31	34
Downgraded	68	38	30
Aa-Aaa	6	1	5
A-Aa	35	20	15
Baa-A	24	10	14
Aaa-Aa	12	6	6
Aa-A	37	22	15
A-Baa	19	10	9

There does not seem to be any marked tendency for these period 13 yield differences to be in the direction implied by the agency change.

Summary and Conclusions

This paper has presented a series of *ad hoc* conditional expectations models in an attempt to see if bond yields perform differently prior to and subsequent to a change in agency rating. The results suggest that the "typical" bond undergoes a change in "market rating" in the direction implied by the agency change both prior to and subsequent to the announcement. However, the typical bond also appears to change in market rating more dramatically subsequent to the announcement than prior to the announcement. This yield behavior is consistent with the hypothesis that there is an informational impact of an agency rating change on the typical bond. It should be pointed out that the yields on a number of bonds do not change in a manner which is consistent with the agency change. The number of bonds behaving in this atypical fashion varies depending on which conditional expectations model is being used.

Footnotes

*Assistant Professor of Finance, University of Pennsylvania. The author wishes to thank the Rodney L. White Center for Financial Research for financial support.

[1]In the absence of a transaction, the yields-to-maturity are based on bid prices, if available. In the absence of a bid price the ask price is used.

[2]The "market rating" (i.e. the required yield) is continuous while the agency ratings are discrete. Therefore, some threshold level of change has to take place in the firm before the agency change takes place.

[3]The ratings changes are published weekly by Moody's while the yields are published monthly by Standard and Poor's. However, the yield taken from Standard and Poor's for the month in which the rating change takes place is the month ending yield for the previous month. Therefore, it is the last yield prior to the change.

[4]There is of course autocorrelation in the yields which can cause autocorrelation in the relatives. Such autocorrelation was not dealt with in any formal manner.

[5]One bond was dropped from the sample of the previous section due to data problems.

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Table IX

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