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THE INFORMATIONAL CONTENT OF BOND RATINGS

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ABSTRACT

This paper explores the risk structure of interest rates. More specifically, we ask whether yields on industrial and commercial bonds indicate that market participants base their evaluations of a bond issue's default risk on agency ratings or on publically available financial statistics. Using a non-linear least squares procedure, we relate the yield to maturity to Moody's rating, Standard & Poor's rating, and accounting measures of creditworthiness such as coverage and leverage. We find that market yields are significantly correlated with both the ratings and with a set of readily available financial accounting statistics. These results indicate (1) that market participants base their evaluations of an issue's creditworthiness on more than the agencies' ratings and (2) that the ratings bring some information to the market above and beyond that contained in the set of accounting variables. In addition, our results suggest that the market views Moody's and S&P's ratings as equally reliable measures of risk. Although the accounting measures also affect yields on new or recently reviewed issues, our analysis suggests that the market may pay more attention to the accounting measures and less to the ratings if the rating has not been reviewed recently.

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Publicly issued corporate bonds are normally rated by one or both of the two major rating agencies: Moody's and Standard and Poor's. Although there is clearly a demand for this service, several authors have concluded from the empirical evidence that these ratings contain little new information. For instance, it has been shown that approximately two-thirds of the ratings can be predicted on the basis of a handful of readily available financial statistics (see below). In addition, several studies have concluded that bond and stock prices adjust before, not after, rating changes on outstanding issues are announced (Hettenhouse and Sartoris, 1976; Weinstein, 1977).

On the other hand, extant statistical models have not been able to predict all ratings while other studies (Katz, 1974; Grier and Katz, 1976; Griffin and Sanvicente, 1982) indicate that markets do react to rating change announcements. Furthermore, there is some theoretical basis for the view that ratings provide an informational service. First, obtaining and properly evaluating public information is costly. It may be cheaper for a specialized agency to evaluate the creditworthiness of a firm or a bond issue than for all (or most) potential purchasers to do so. Second, ratings may provide a means of conveying relevant inside information to bondholders without providing full information to the entire marketplace (especially the firm's competitors). Standard and Poor's (1979), Belkaoui (1983) and Sherwood (1976) all claim that in fact rating agencies do receive a considerable quantity of sensitive information, including projections and plans, which are held in strictest confidence. Consequently, ratings may provide relevant information without providing the details. The final basis for believing that ratings may possess information is the fact that bond issuers and purchasers are willing to pay for rating services.[1]

This question of the informational content of bond ratings is the subject of the present paper. Specifically we seek to answer the following questions:

1. Do market yields (prices) on bonds indicate that market participants view ratings as reflecting only readily available information, i.e., as providing no new information?

2. Do market yields indicate that market participants view all relevant information regarding an issue's creditworthiness as adequately represented by its rating(s)?

3. If the market views ratings as important, do market participants rely relatively more on one rating agency than the other?

4. Does the information content of ratings decline over time, i.e., do market participants regard recently released ratings as better indicators of credit risk than ratings which have not been reviewed recently?

In the following section we review previous research which is particularly relevant to this question of the information content of bond ratings. This research may be divided into three groups: (1) studies of the determinants of bond ratings, (2) studies of market adjustments to rating changes, and (3) cross-sectional studies of bond yields. In section II, we explain our approach to these questions which involves estimating the cross-sectional relationship between the market yields on bond issues, Moody's and Standard and Poor's ratings, and readily available accounting measures of creditworthiness. Results are then presented and discussed in section III.

I. Previous Research

In this section several of the more important studies which have addressed questions germane to our study are discussed. This analysis is fairly thorough in order to provide the appropriate benchmark for evaluating our approach and contribution.

A. Investigations of Bond Ratings

While not explicitly examining the information content question, studies of the determinants of bond ratings do call into question the importance of these ratings. As noted above, numerous studies (surveyed in Altman, 1981 and Belkaoui, 1983) have found that roughly two-thirds of the ratings on new issues can be predicted on the basis of a handful of financial statistics. Of course, this also means that for approximately one-third of the bond issues actual ratings differ from what these models predict. If this disparity occurs because ratings reflect additional information which is not readily available, then ratings do bring information to the market. If they differ because the models do not adequately or accurately reflect the agencies' use of readily available information or because of random differences in judgment on borderline issues, then no new information is being provided.[2]

B. Market Adjustment to Rating Changes

Most recent studies of the informational content of ratings have focused on reactions in debt and equity markets to rating changes. While the measures of market reactions differ, all bond market studies have followed somewhat similar procedures in attempting to separate the effect of the rating change from other influences on bond prices and yields. Each uses an index or measure of the yield, price change, or holding period return on the rerated issue relative to some chosen benchmark. The various measures and benchmarks are summarized in Table 1 which also provides a description of the data and tests. For instance, Katz's (1974) measure was

$$I_{jt} = \frac{Y_{jt} - Y^{*0}_{jt}}{Y^{*N}_{jt} - Y^{*0}_{jt}} D_j$$

where Y_{jt} = yield to maturity on issue j as of time t

Y^{*0}_{jt} = estimated yield on an issue of the same coupon, maturity, and size as j but with issue j's original rating. The estimate was obtained by substituting values for coupon, etc. into a regression estimated for that rating and month.

Y^{*N}_{jt} = estimated yield for issue j given its new rating category.

D_j = 1 if downgraded, -1 if upgraded.

According to Katz, I_{jt} should equal zero before any adjustment to a change in the risk of default and one after the adjustment is complete. He found that indeed the average I_{jt} was approximately equal to zero before the rating change, to .3 the month of the rating change, and to one thereafter. Grier and Katz (1976) also concluded that the market reacts after, not before, a rating change though they performed no test of this hypothesis. However, with a different data set, index, and benchmark, Hettenhouse and Sartoris (1976) concluded that the adjustment occurs prior to the rating change.[3]

A somewhat different approach was taken by Weinstein (1977). Examining the difference between the holding period return on bonds with changed ratings and on bonds with the original unchanged rating from 18 months before the rating change to 6 months after with the signs reversed for bonds rated downward, he concluded that the adjustment generally occurred in the earlier period--well before the rating change was announced. However, none of the 23 excess holding period return averages which Weinstein presented in the paper were significantly different from zero.

There are several problems and limitations associated with investigations of market reactions to rating changes which make it difficult to draw conclusions from them regarding the information content of ratings.

1. While there should be no market adjustment if the rating change provides no new information, it is not clear that the size of the adjustment will be positively related to the information contained in the rating change. The problem here is that the magnitude of the adjustment depends on the rating house's promptness in revising ratings as well as on the informational content. If rating agencies are prompt, a

rating will be changed as soon as it crosses the borderline between the ratings. The informational content of this change is high but the market adjustment may be small because the market knows that the riskiness of the issue lies near this borderline between the old and new ratings. If, on the other hand, the rating agencies review issues only intermittently and are slow to react, the riskiness of the issue may lie well within the new rating interval. The informational content of the rating change is lower in this case but the price adjustment would tend to be larger.

2. The large price adjustments tend to occur in cases in which the companies are receiving extensive negative publicity at about the same time the rating change is announced. As a result it is difficult to distinguish between the two effects.[4]

3. Price adjustments observed before a rating change by one agency may be due to an earlier rating change by the other agency - not to public information which eventually leads to the second rating change.[5] When, for instance, Weinstein observed some adjustment over the 18 month period before Moody's changed its rating, it may have been because some issues were in the process of adjusting to a change in S&P's rating which occurred during this period. When Katz found that yields were still adjusting months after a S&P rating change, it may have been because of subsequent rating changes by Moody.

4. Obviously all of these studies concentrate on revisions in ratings. We feel the more important question is whether the overall body of ratings, some years old, bring information to the market - not whether the small sample of revised ratings provide information.

C. West's Cross-Sectional Study

West's (1973) is the only study of which we are aware which considers the effect of all ratings - new, old, and recently revised - on yields. Using the results of Fisher's yield to maturity study (1959)[6], West argued that if ratings mattered independently of "the underlying economic factors" then high (low) rated issues should tend to have lower (higher) yields than predicted i.e., negative (positive) residuals. While little pattern was observed in the residuals of the 1927, 1932, and 1937 regressions, a significant (5% level) majority of the issues rated Baa or lower had positive residuals in 1949 and 1953. West concluded that since this pattern was observed in '49 and '53 but not earlier, it probably was due to the regulations introduced in the late 1930s and 1940s requiring that bonds rated Baa or below be carried on banks' books at market value.[7]

There are problems with the West-Fisher approach as well. Important measures of default risk such as interest coverage and subordination status were not included in Fisher's equation, nor were call protection and the tax advantages of discount bonds considered. Moreover, it is not obvious that the yield relationship is log-linear as they assumed. If it is not, then ratings may appear to influence yields because of this specification error. Finally, as West acknowledges, the possibility that ratings are revised to reflect market rates cannot be ruled out, i.e., yields any influence ratings-not vice versa.

II. The Method and Data

A. Overview and Data

In this study we seek to determine the information content of ratings by regressing the yields to maturity of various bond issues both on dummy variables representing Moody's and Standard and Poor's ratings and on variables representing readily available information regarding the issuing firm and the bond issue itself. This approach avoids the previously discussed problems associated with rating change studies and our specification avoids most of the problems of the West-Fisher study though reverse causation cannot be completely ruled out. Implicit in this approach is the assumption that any information provided by ratings is primarily information concerning the issue's creditworthiness. While we do not rule out the possibility that information on marketability, etc. is also provided by ratings and that such information may affect bond yields, the rating agencies describe and sell their ratings as measures of creditworthiness or ability to pay.[8]

The relationship which we estimate is

$$Y_j = f\ (C_j,\ R_j,\ X_j,\ u_j) \qquad (1)$$

where

- Y_j is the yield to maturity on issue j,
- C_j represents a set of publicly available financial accounting data pertaining to the issuing firm and known characteristics of the bond issue which may be regarded as relevant in assessing its creditworthiness,
- R_j includes both Moody's and Standard and Poor's ratings of the issue,
- X_j represents characteristics of the issue, other than measures of creditworthiness, which might be expected to influence its yield, e.g., call protection and term to maturity, and
- u_j is a random error term.

The hypothesis that ratings provide no information beyond the publicly available information in C_j, and that ratings do not influence yields because of regulatory constraints that require or encourage certain bond buyers to hold only bonds rated above a certain level, implies that ratings can be suppressed in the estimation of equation (1), i.e.,

$$Y_j = f(C_j,\ X_j,\ u_j). \qquad (2)$$

The hypothesis that market participants base their evaluation of creditworthiness solely on ratings implies that the information set C_j can be suppressed or that

$$Y_j = f\ (R_j,\ X_j,\ u_j) \qquad (3)$$

In order to test these hypotheses and the relative importance of Moody's ratings versus Standard and Poor's, data were collected on a sample of bonds issued by industrial and commercial firms. Since it was feared that dealer quotes on thinly traded issues might not reflect true market equilibrium prices, the sample was restricted to bonds listed on the NYSE or ASE which traded during the three day period: February 27 - March 1, 1979.[9] The sample was also restricted to bonds or notes with at least five years to maturity, to bonds rated by both Moody's and S&P, and to issues of firms with five years of data on the COMPUSTAT tape prior to December 31, 1978. Finally, we included no more than two bond issues of any one firm.[10] The final sample consisted of 176 bond issues.

B. Characteristics Reflecting the Creditworthiness of the Issue and Issuer.

The specification of the components of C_j and of their relationship to Y_j is crucial to any test of the first hypothesis, i.e., that ratings possess no information content. Ideally C_j should include all publicly available information on both the bond issue and issuer which market participants view to be important in determining the issue's creditworthiness. While some evidence on this issue is presented below, there is no a priori assurance that our chosen C_j is exhaustive. Consequently, if the hypothesis that ratings do not influence yields is rejected by our data, we can only conclude that ratings add information over and above that contained in the chosen data set C_j.[11] This additional information may itself be readily available.[12] If, however, the R_j are insignificant for our chosen C_j, they should also be insignificant for the true C_j as well.

While financial analysts have suggested that numerous measures are useful in assessing a firm or bond's creditworthiness, most seem to fall into four general categories (Altman, 1981; Standard & Poors, 1979): (1) measures of balance sheet leverage, (2) measures of interest coverage, (3) measures of profitability or cash flow and (4) characteristics of the bond contract, e.g. subordination status. In addition, rating studies have invariably found a strong correlation between firm size and ratings and market participants may well regard large firms as less risky, ceteris paribus. On this basis, the following variables were chosen for inclusion in data set C_j:

LEV - the ratio of long term debt to total capitalization,

COV - a five year average of interest coverage measured as the pretax income (before extraordinary items) plus interest charges divided by interest charges,

DCOV - deviations of coverage from a five year trend line measured as the square root of the sum of the squared deviations,

PRO - the ratio of pretax income to total assets - a five year average,

DPRO - deviations of profits from a five year trend line measured as for DCOV,

ASSET - the firm's total assets,[13]

SUB - a dummy which equaled one if the issue was subordinated and zero otherwise.

Except for SUB, all data were taken from the COMPUSTAT tapes for fiscal years ending before December 31, 1978, i.e., two months were allowed for release of the data. Since interest coverage and profitability often vary considerably from year to year, one would expect that analysts consider more than just the most recent figures. Accordingly, five years of data were collected on these two variables. Since we expected that the market would attach more importance to more recent years, we initially attempted to utilize a weighted average with geometrically declining weights where the rate of decline was estimated as part of our non-linear least squares estimation described below. Since the non-linear least squares could not converge on weights for PRO and choose approximately equal weights for COV in initial runs, simple averages were used for simplicity.[14] DCOV and DPRO were included because we expected that companies whose coverage and profitability deviated from trend would be viewed as more risky. These were calculated by regressing COV and PRO on time, squaring and summing the deviations from these trend lines, dividing by five and taking the square root.

The functional form of the relationship between the accounting measures and Y_j is important but unknown. Y_j should be positively related to leverage and the deviation measures and negatively related to the other variables but the exact form of this relation is uncertain. In such situations researchers, e.g. Fisher and West, normally assume a particular form - usually linear or logarithmic. Such a procedure is particularly dangerous here. If the specified relation between Y_j and a variable such as leverage differs from the true relation, ratings may appear as significant only because they are serving as proxies for the difference between the true and chosen forms. To minimize any specification error, a power transformation was applied to each continuous variable in C_j. In other words the specified form was

$$Y_j = f_1(C_j) + f_2(R_j) + f_3(X_j) + u_j \qquad (4)$$

where

$$f_1(C_j) = \beta_0 + \beta_1(LEV)^{\lambda_1} + \beta_2(COV)^{\lambda_2} + \beta_3(DCOV)^{\lambda_3} + \beta_4\ (ASSET)^{\lambda_4} + \beta_5 SUB \qquad (5)$$

Both the coefficients β and exponents λ were estimated using non-linear least squares which provides maximum likelihood estimates of both if u_j is normally distributed. This is a very flexible form yet one which - unlike say the polynomial - meets our requirement that the signs of the first derivatives not change. If $\lambda = 1$, the relation is linear and for λ close to zero it approximates the logarithmic.[15] Of course this specification also includes the reciprocal, square, and square root forms as special cases.

C. The Ratings

To capture the effect of ratings on Y, dummy variables were included to represent both Moody's and S&P's ratings of the issue. Separate dummy variables were defined for each rating except triple A, that is SPAA,SPA,..., SPB,SPCCC for S&P and MAA,MA,...MB for Moody's. [There were no Moody's ratings below B in the sample.] For instance $SPAA_j = 1$ if issue j was rated AA by S&P and $SPAA_j = 0$ otherwise.

We chose to express $f_2\ (R_j)$ in equation 4 as

$$f_2(R_j) = \gamma\ [\alpha_1\ MAA_j + \alpha_2\ MA_j + \alpha_3\ MBAA_j + \alpha_4\ MBA_j + \alpha_5\ MB_j] + (1 - \gamma)\ [\alpha_1\ SPAA_j + \alpha_2\ SPA_j + \alpha_3\ SPBBB_j + \alpha_4\ SPBB_j + \alpha_5\ SPB_j + \alpha_6\ SPCCC_j]. \quad (6)$$

This specification assumes that a given Moody's rating, e.g., A, is viewed as representing the same degree of risk on average as the same rating from S&P. There is evidence (Ederington, 1983) that this is the case.[16] However, it is not necessarily assumed that market participants view the two ratings as equally accurate or reliable. The third question we sought to answer in this study was whether the market attaches more weight to one agency's ratings than to the other. If the two ratings are viewed as roughly equal in accuracy and reliability, then γ should be approximately equal to .5. If Moody's rating is viewed as more (less) reliable than S&P's, then $\gamma > (<)\ .5$.

D. Other Factors Influencing Yields

While attention in the present study is focused on the effect on Y of variables associated with the risk of default, yield to maturity may also be affected by the issues' marketability, term to maturity, tax treatment, callability, and possibly other provisions of the bond indenture. Since all issues in our sample were listed on either the NYSE or ASE and all were actively traded during the observation period, the observations do not differ greatly in marketability and accordingly no variable to measure marketability was included.[17]

For the dates on which our sample was collected, the government security yield curve was continuously - but only slightly - downward sloping over the terms to maturity in our sample. Five year government bonds selling near par carried a yield about ten to fifteen basis points above those on the longest term bonds. Assuming, as Fisher did, that the slope of the yield curve for corporate bonds should be similar to that for government bonds, we chose to adjust the dependent variable, Y, to a 25 year bond basis, Y*, using the government bond yield curve.[18] These adjustments were generally quite small-averaging only four basis points.

At equal pretax yields, bonds selling at a discount are obviously more attractive to taxable investors than otherwise equivalent bonds selling at par both because they are less likely to be called and because taxation of the discount may be at a lower capital gains rate and/or deferred until maturity. If the difference in callability is ignored, the marginal investors' after tax expected yields over the holding period should be equal for discount bonds and for bonds selling at par. If the yield curve is fairly flat so that no change in the yields on par bonds is expected over the period, equation (7) expresses the equality in after tax returns on par and discount bonds.

$$\frac{C_p(1-t)}{P_p} = \frac{C_d\ (1-t) + E\ (\Delta P_d)\ (1-t_d)}{P_d} \qquad (7)$$

where

C_p, C_d = coupons on par and discount bonds respectively,

P_p, P_d = prices of par and discount bonds

t = the tax rate on interest income,

t_d = the effective tax rate on the discount.[19]

$E(\Delta P_d)$ = the expected price appreciation over the period on the discount bond.

If no changes in market rates are expected during the period, then observed market yields on the two issues may be expressed as

$$i_p = \frac{C_p}{P_p} \text{ and } i_d = \frac{C_d + E(\Delta P_d)}{P_d}$$

After substituting these into equation 7, one obtains

$$i_d = i_p - \left(\frac{t-t_d}{1-t}\right)\left(i_d - \frac{C_d}{P_d}\right) \qquad (8)$$

Consequently, the variable TAX = $(Y - \frac{C}{P})$ was included as an independent variable in the estimated equation. Since TAX is a positive linear function of Y, spurious correlation may bias its coefficient toward 1.[20] However, since a negative coefficient is expected and unbiased estimation of this coefficient is not our primary interest, this is not expected to create serious problems.

Call protection may take the form of a stated restriction on callability and/or a difference between the market price and the call price. The latter is difficult to separate empirically from the tax advantages just discussed, and the TAX variable just defined undoubtedly represents both effects. Since only 20% of the issues in our sample carried an unexpired call restriction, the number of years to the first call date, CALL, was simply added to the equation in a linear form.

III RESULTS

A. Ratings

Before investigating the impact of both ratings and financial accounting variables on Y*, the effect of each was examined separately beginning with ratings. The distribution of Moody's and S&P's ratings is shown in Table 2 while the results of the regression of Y* on the ratings (in the manner described in equation 6) as well as on TAX and CALL are shown in the first column of Table 3. The results are generally as expected - the lower the rating, the higher the adjusted yield to maturity. While the estimated differences between yields on AAA, AA, and A rated issues are small and insignificant, Y* increases sharply when the rating falls below

A and further reductions lead to ever increasing yields. T statistics for the differences between adjacent ratings are shown in Table 4.

The coefficient of the TAX variable is of the expected sign and is significant at the .05 level. The positive coefficient for CALL was unexpected but the coefficient is miniscule and insignificant.

Since the weighting factor γ is significantly different from both 0 and 1, the null hypothesis that the market considers only S&P's rating and the null that it considers only Moody's rating can both be rejected. As explained above, $\gamma > (<)\ .5$ would indicate that market participants view Moody's (S&P's) ratings as the more accurate or reliable measure of risk. Since the estimated γ is quite close to .5, it appears that the market weights the two agencies' ratings roughly equally, though there is a suggestion of a slight preference for Moody's.

As explained above, our specification of the yield-rating relationship assumes that neither agency is viewed as assigning consistently higher or lower ratings than the other. Although there is evidence to support this assumption, S&P's ratings tended to be slightly lower in our sample than Moody's, as shown in Table 2, so this assumption merits investigation. In addition, our specification assumes that if one agency's ratings are viewed as more reliable than the other agency's, they will be so viewed across all rating levels. In other words, the specification does not allow one agency to be viewed as better in distinguishing among low rated issues and another as better in distinguishing among high rated issues. To test this specification, Y* was regressed on Moody's and S&P's ratings without these restrictions.[21] There were no significant differences between the coefficients for Moody's and those for S&P's ratings. Indeed, if anything, the results suggested that the market may view a given Moody rating as signifying a lower level of risk than the same S&P rating - the opposite of the suggestion from Table 2. Since the assumptions underlying the specification in equation 6 could not be rejected, we conclude that this specification is a reasonable model of the yield-rating relationship.[22]

B. Accounting Indicators of Creditworthiness

Next, the relationship between Y* and the accounting variables, as well as SUB, TAX, and CALL, was estimated. For each accounting variable both a coefficient, β, and an exponent, λ, were estimated as described above. Both profitability variables, PRO and DPRO proved insignificant, with extremely large standard errors. Indeed, the non-linear estimation procedure failed to converge after numerous iterations when they were included in the equation - apparently because of high correlation with the coverage variables.[23] Consequently, the equation was estimated without these variables with the results shown in the second column of Table 3.

We had hypothesized that risk of default and Y* would be directly related to LEV and DCOV and inversely related to ASSETS and COV. Since for a particular variable X, $\partial Y^* / \partial x = \beta\lambda X^{\lambda-1}$, the sign of the partial derivative depends on the sign of product of β and λ. This implies that for LEV and DCOV, β and λ should be of the same sign and for ASSETS and COV of opposite sign. These expectations were met for each variable except DCOV, deviations of coverage from trend, but its coefficient is not significant. However, it should be noted that, when a power form is estimated, t-statistics for a variable's β do not provide a complete or reliable test of the null hypothesis that Y* does not depend on that variable. The null hypothesis that Y* is independent of DCOV implies that $\beta_{DCOV} = 0$ and/or $\lambda_{DCOV} = -\infty$. This null may be tested by estimating the equation with and without DCOV and testing the hypothesis using a likelihood ratio test or an F test. The resulting F statistics for all four variables are shown in the first column of Table 5. The critical value of F with 2 and 166 degrees of freedom is about 3.05 at the .05 level of significance, so the null hypothesis that Y* is unrelated to DCOV can be rejected at the .05 level. Similar null hypotheses are clearly rejected for the other three variables.

Since our equation includes only four accounting measures of the firm's creditworthiness, the sufficiency of our chosen set, C_j, may be questioned. Fortunately, evidence on this issue is available. While we included no more than two bond issues for any one firm, our data set does contain multiple issues for forty firms. If important firm specific risk of default variables have been excluded, then one would expect that the residuals from our estimated regression would be positively correlated for issues of the same firm. If the market regards a firm as more (less) risky than our equation estimates, then both residuals will tend to be positive (negative). However, the r^2 between the two was only .04 - versus .66 for Y*. Consequently, it appears that if important risk of default variables have been excluded, they concern the specifics of the bond contract and not the firm's creditworthiness.

In section II we argued that the relationship between ADJY and the financial accounting variables was probably neither linear nor log-linear and, as a result, chose a more general form. Since each of the estimated exponents, λ, is significantly different from both zero and one, our supposition appears justified. For further comparison, the equation was estimated in linear form and again with the accounting variables in log form with the following results:

Specification:	Unexplained Sum of Squares:
linear form	147.2
logarithmic form	102.2
power form (Table 3)	56.5

Clearly our form results in a much closer fit.

Since the chosen form includes the linear as a special case and can approximate the logarithmic, exact and approximate tests (respectively) of hypotheses that the relation is linear and logarithmic can be constructed. Both hypotheses are rejected at the .05 level.[24]

The power transformation makes it difficult to estimate the impact on ADJY of a change in coverage, leverage, or firm size from the β coefficients in Table 3. Consequently, estimates of the partial impact of a change in each are provided in Table 6. Percentile values of each variable are shown in the first three columns of Table 6. In other words, 20% of the bond issues in our sample were from firms with less than \$594 million in assets and 20% from firms with more than \$7424 million. The fourth column presents the estimated change in Y* in basis points resulting from a rise in each variable from its 20th percentile value to its median value, holding the other three variables constant. Consider for instance two firms with identical values for COV, LEV, and DCOV. If one firm has assets of \$2.424 million (the median value) and the other assets of \$594 million, the parameter estimates in Table 3 indicate that the latter's bond issues will carry an adjusted yield to maturity approximately 48 basis points higher than the former's. The impact of a change in each variable from its median to its 80th percentile value is shown in the fifth column.

The non-linearity of the relationship between the accounting variables and yield is readily apparent from Table 6. Consider for instance the effect of changes in leverage. The 20th and 80th percentile values of leverage are approximately equidistant from the median. Yet, while an issue of a firm with the 80th percentile value of the ratio of long-term debt to total capitalization would have a market yield about 38 basis points above that of the median firm, there is only an 8 basis point difference between the median and 20th percentile firm. It appears that beyond a certain level, further decreases in the leverage ratio are regarded as relatively unimportant.

While there are many possible measures of the relative importance of various variables, the estimated difference in Y* between the 20th and 80th percentile values of each would provide one such indication. Using this yardstick, size would appear to be the most important followed in order by leverage and coverage. This is somewhat disconcerting since it suggests that small firms face substantially higher borrowing costs than large firms with identical coverage and leverage ratios.[25]

C. Comparing the Information Content of Ratings and Accounting Information

It is interesting and instructive that the adjusted R^2 for the second equation in Table 3 is slightly higher than the adjusted R^2 for the first equation. This suggests that these four accounting measures and the indication of subordination status have at least as much information content as Moody's and Standard and Poor's ratings combined. However, this does not necessarily mean that the ratings provide no additional information since they may reflect different aspects of creditworthiness.

In order to test the hypothesis that the ratings bring no information to the market beyond that contained in the four accounting measures and SUB, an equation including both ratings and accounting measures was estimated with the results shown in the third column of Table 3. Based on a comparison of the unexplained sums of squares of the second and third equations, the hypothesis that ratings provide no additional information is rejected at the .05 level. Of course the null hypothesis that the C_j set of variables adds no information beyond that contained in the ratings is also rejected.[26]

When the ratings and accounting variables are combined, the coefficients of both the ratings and the accounting variables are reduced. This was expected since ratings depend at least partially on these variables. The final pair of columns in Table 6 shows the estimated impact on Y* (in basis points) of changes in each independent variable using parameter estimates from the combined equation from Table 3. Since ratings were included in this regression, these may be interpreted as estimates of the impact on Y* of changes in each accounting variable given that the issue's rating does not change.

F statistics for the individual accounting variables are shown in the final column of Table 5. When ratings are added, leverage and subordination status (as well as DCOV) are no longer significant at the .05 level. This is not surprising since subordination status does not change over time and leverage probably changes very little, so old ratings continue to reflect this information. Coverage remains highly significant - possibly because it is more likely to have changed since the ratings were last reviewed. This may also be true of the measure of firm size, ASSET, or it may be significant because the market attaches more weight or importance to size (or coverage) than do the rating agencies.

The coefficients of the rating variables are also reduced when other measures of creditworthiness are included. Since the financial accounting variables are held constant, the coefficients of this expanded equation provide a more accurate estimate of the likely market reaction to a rating change than the coefficients from the earlier regression on ratings only (or, equivalently, than would be expected from differences between mean Y*,s of the various ratings classes). Indeed, according to our estimated equation, a change from an AAA rating to AA or even A would probably not to lead to a noticeable change in the market yield on the issue.[27] A change in Moody's rating from Baa to Ba should lead to a rise in the issue's market yield of $\gamma * (\beta_{BA} - \beta_{BAA}) = .44\ (1.35 - .51) = .37$ or 37 basis points. While not an inconsequential change, it is much smaller than the difference between the average Baa yield for our sample (10.15) and the average Ba yield (11.08). This is to be expected since only Moody's rating has changed - not S&P's or the accounting variables.

Finally, one will note that the estimated weighting factor, γ, remains insignificantly different from .5. However, it is now slightly less than .5 which would imply - if the difference were significant - that the market attaches slightly more weight to S&P's ratings than Moody's after considering the information in the accounting variables.

Having compared the explanatory power of ratings and accounting variables on an overall basis, a comparison of their ability to explain yield differences among issues at different ends of the risk spectrum appears warranted. It is possible that the non-accounting information supposedly embedded in ratings may be viewed by the market as more (less) important in distinguishing among the issues of small, less creditworthy firms than in distinguishing among the large, well-known, and generally less risky firms. It is clear from the equations in Table 3 that ratings explain very little of the observed differences in adjusted yield to maturity among Aaa, Aa, and A rated issues and much more of the differences among lower rated issues. The results in Table 6 suggest this pattern may hold for accounting variables as well, but the relative explanatory power of ratings and accounting variables at different ends of the risk spectrum is unclear.

In order to examine the relative ability of ratings and accounting variables to explain differences in Y* among high quality issues separately from their ability to explain differences among low quality issues, the sample was split into issues rated A or above and issues rated below A.[28] Intra-group variances in adjusted yields are shown in the first column of Table 7. For example, the variance of observed adjusted yields of the 98 issues rated A or above about the mean ADJY for those three ratings was .276 percentage points. Clearly this intra-group variance was much larger for the lower quality issues in our sample, i.e., there is a much greater variation to be explained.

The mean squared residuals from the rating and accounting measure regressions, respectively, are shown in columns 2 and 3 of Table 7. Clearly neither ratings nor accounting variables explain much of the variation in yields among higher quality issues. This suggests that the market may have viewed risk differences between these issues as insignificant at this time so that Y* basically varied among these issues for reasons unrelated to creditworthiness. On the other hand, accounting variables explain more of the variation among lower quality issues.[29] Indeed, it is apparent that the lower $\bar{R}^2$ of the accounting variables equation versus the ratings equation in Table 3 arises from the ability of the former to explain yield differences among lower quality issues rather than among higher quality issues or between the two groups.

For the combined regression, the average mean squared error is approximately 22 basis points and is approximately the same for high and low quality issues - slightly higher for the former surprisingly. While the source of this unexplained variation in yields is unclear, it appears that it does not represent unexplained differences in the perceived creditworthiness of various firms. If unexplained differences in creditworthiness remained, then one would expect a positive correlation between the residuals for issues of the same firm. In fact, the correlation is nil (adjusted r^2 = .001) and negative in sign.

D. Rating Depreciation

The rating agencies insist their analysts monitor all corporate ratings on an ongoing basis, and S&P (1979, p.18) maintains all its ratings are formally reviewed at least once a year. However, rating reviews are announced only intermittently and rating changes tend to be clustered around new offerings, exchange offers, etc. rather than continuously distributed across time. Consequently, one would expect that a new or recently reviewed rating would be viewed by the market as a more reliable indicator of an issue's creditworthiness than a rating which has not been reviewed recently. If a rating review has not been announced in years, bond purchasers may focus more on recent accounting information and less on the rating.

To test this hypothesis, data were collected on the length of time, t_j, since a rating change or review was last announced by Moody's. Only Moody's ratings were considered because dates of reviews which did not necessarily result in rating changes were available for Moody's but not S&P. We assumed that ratings five or more years old were viewed as equally reliable, i.e., $t_j = 5$ for all issues not formally reviewed within the last five years (14% of our sample).

Equation 4 was then respecified as

$$Y* = [B/(1+D)^{t_j}]f(R_j) + [1-\{B/(1+D)^{t_j}\}]f(C_j) + f(X_j) + u_j \qquad (9)$$

where R_j includes only Moody's ratings. In other words, a decay or depreciation rate, D, was estimated for Moody's ratings. A $D > 0$ implies that as time since review, t_j, increases less weight is attached to the rating information and more to the accounting information in determining market yields.[30]

When the revised equation was estimated using non-linear least squares, the estimated value of D was .054, a plausible, positive figure. This estimate would imply that the market attaches about 15% more weight to a new or just reviewed rating than to one set three years ago. However, the estimated asymptotic standard error of $\hat{D}$ was .063 so this estimate is not significantly different from zero. Consequently, the question of whether the information content of ratings declines over time cannot be viewed as settled.

Finally we would note that the estimated β in equation 9 is significantly less than 1.[31] This would imply that accounting measures affect yields on new as well as old issues. In other words, the accounting variables are not significant in the combined equation in Table 3 merely because the rating agencies are slow to adjust their ratings to reflect this new information. These results suggest that the market considers both ratings and accounting measures in evaluating the creditworthiness of new issues as well.

IV. CONCLUSIONS

In summary, we find:

1) Market participants base their evaluations of a bond issue's creditworthiness on more than Moody's and Standard and Poor's ratings. Specifically, it is clear that they consider recent financial statistics.

2) Market yields also vary with ratings independently of the financial accounting variables we consider.

3) The relationship between accounting measures of creditworthiness and market yields is not a simple one. Both linear and log linear forms are rejected.

4) The market apparently views Moody and S&P ratings as interchangeable and as equally reliable indicators of an issue's creditworthiness.

5) Though the relationship is a weak one, our data suggest that market participants pay less attention to ratings and more to publicly available accounting information if the rating has not been reviewed in some time. Nonetheless, both are important in the case of new and old issues.

Questions regarding bond ratings and creditworthiness or risk of default continue to fascinate financial market researchers. The number of studies seeking to relate ratings to accounting measures of risk is now legion [see Belkaoui (1983) or Altman, 1981)]. Strangely enough, however, few since Fisher (1959) have asked how market yields are related to measures of credit risk - either rating or accounting measures. We obviously feel that the latter question, which we have analyzed in this paper, is the more important one. We also feel it is the more fruitful field for further research. Certainly numerous questions remain which the general approach we have outlined above seems capable of answering. For instance, one might ask if other measures of creditworthiness are important? Or, do the unexplained yield differences represent additional differences in the perceived creditworthiness, differences in marketability, other systematic differences or random variations? Finally, are unrated issues viewed as more risky than rated issues with the same size, coverage, and leverage characteristics?[32] Perhaps our efforts will stimulate additional research in this area.

Footnotes

[1]Until 1968, publication sales to subscribers (presumably bond purchasers) constituted the rating houses' sole source of revenue. Currently, however, fees paid by the issuers constitute the major revenue source (Weinstein, 1977). According to Standard and Poor's (1979) these fees ranged from $500 to $15,000 per issue in the late 1970's. Weinstein (1977) has expressed some puzzlement at the fact that bond issuers rather than bond purchasers - "the users" - pay the major cost. One may conjecture that this occurs partially because the rating agencies find it difficult to restrict use of the ratings to subscribers only and partially because failure to obtain a rating may be taken as a negative signal by bond purchasers. Purchasers may suspect that the issuer did not seek a rating because a low rating was anticipated or because they had something to hide. While issuers would not be willing to pay for the establishment of rating houses, they may find it advantageous to have their debt rated once the houses are established.

[2]Moody's and S&P's ratings on new industrial issues differ about one-third of the time from what the models predict and about 15% of the time from each other. Ederington (1983) attributes these split ratings to random differences in judgment rather than to any systematic difference between the two agencies. Consequently, some of the misclassifications are probably due to random fluctuations in judgment on borderline cases but it isn't clear that all are.

[3]Whether their results warrant such a conclusion is debatable. The significant differences are generally from the index value six months before the rating change to the index value six months after - which leaves the timing of the shift unclear. Moreover, Hettenhouse and Sartoris show that their index should equal 1 before any market adjustment and 0 after it is complete. However, for issues which were subsequently downgraded, the index was <u>above</u> 1 before the change and only fell to 1 afterwards.

[4]This is particularly true since none of these studies consider the price or yield just before and just after a rating announcement but at the beginning and end of the month.

[5]Altman found a median lag of six months between rating changes by the two agencies though it was quite variable. Hettenhouse and Sartoris (1976) considered market reactions to rating changes by both Moody's and Standard and Poor's - the only study to do so - but they did not distinguish between the initial and the second rating change. Along the same line, it should be noted that in recent years S&P has normally announced the ratings it is reviewing and the likely direction of any change before the rating is formally revised.

[6]For individual issues, Fisher had regressed the logarithm of the yield to maturity, adjusted for term structure, on the logs of (1) the coefficient of variation of the firm's earnings, (2) the number of years without any default, (3) the ratio of market value of equity to par value of debt and (4) the total market value of the firm's publicly traded bonds. Separate cross-sectional regressions were estimated for 1927, 1932, 1937, 1949, and 1953.

[7]However, examination of West's results suggests that the dividing line may have been between Baa and Ba issues, rather than between A and Baa issues as he argued. While the residuals on bonds rated Ba and below were strongly positive, the residuals on Baa bonds were split roughly 50-50 over the two sample years combined. In the 1949 sample, 8 of the Baa issues had positive residuals and 12 negative. In 1953 the split was 15 and 8. For bonds rated Ba and below the split was 12(+) and 2(-) in 1949 and 14(+) and 2(-) in '53.

[8]Our analysis is in terms of yields and yield spreads. While a price format might seem theoretically preferable and more consistent with the conventional approach to asset valuation, yield spreads are more meaningful intuitively and have some theoretical advantages as well. It has been shown elsewhere [Bierman and Hass (1975), and Yawitz (1977)] that under certain reasonable conditions the relationship between yields and default risk is independent of the bond's maturity and whether it sells above or below par. However, the impact of default risk on price is not independent of term to maturity for bonds not selling at par.

[9]The bond market was basically stable over these three days with declines approximately equaling advances. If the bond traded February 28, this price was used to calculate Y_j. If it did not, March 1 or February 27 prices were used. Small trades were excluded.

[10]If the firm had two bond issues with different ratings - invariably because of different subordination status - one of each was included. If there was a choice of issues with the same rating, the issue(s) with the longest term to maturity was chosen.

[11]Or that ratings influence yields because of government regulations.

[12]The inclusion of all possible measures in C_j is, however, to be avoided for theoretical as well as statistical reasons. If the true C_j is quite large then the processing of this information may be quite costly. In that case ratings would be useful simply because they are a more efficient source of the information.

[13]Total sales were also tried empirically as an alternative measure of size. The results were similar to those presented below but the goodness of fit was reduced.

[14]The weighted average form which was estimated was

$$COV' = (WC_t + W^2C_{t-1} + W^3C_{t-2} + W^4C_{t-3} + W^5C_{t-4}) \div (W + W^2 + W^3 + W^4 + W^5)$$

where C_t is the most recent coverage figure. Since the estimated W was .998, this is essentially a simple average, and that was used for computational ease.

[15]Closely related to the power transformation y^λ is the Box-Tidwell or Box-Cox transformation, $(y^\lambda - 1) / \lambda$. The latter has the advantage that it is continuous at zero and $\lim_{\lambda \to 0} [(y^\lambda - 1) / \lambda] = \ln (y)$, so it includes the log form as a special case. However, estimation of a large Box-Tidwell model where λ varies from variable to variable is difficult and proved to be impossible here. Consequently the power transformation was chosen. This form is not continuous at zero but can approximate the log form with suitable choices of the exponent and coefficients.

[16]Neither Moody's nor S&P consistently rates industrial bond issues higher than the other (Ederington, 1983) and neither seems to assign any particular rating more often. Moreover, several bond portfolio managers have indicated to the authors that they view them as representing roughly equal risk levels. Nonetheless this assumption is tested below.

[17]Remaining differences in marketability may however be reflected in the variable ASSET.

[18]Using government bonds selling within 5% of par value, we estimated the following yield curve:

yield = a + .088 [1/YEARS] + u = where YEARS represents years to maturity. We then adjusted all Y to a 25 year bond basis using:

$$Y^* = Y - .088\ [(1/\text{YEARS}) - .04].$$

[19]This is the effective rate faced by the marginal investor which may be lower than t because the discount is taxed as capital gains and/or because this tax is deferred until the issue is sold or matures. In the latter case, t_c will vary with the term to maturity but this is ignored.

[20]A rise (fall) in U_j after the bond is issued, i.e., the coupon rate is set, will cause an equal rise in both Y and TAX.

[21]In other words, γ of equation 6 was dropped and separate α's were estimated for Moody's and S&P's ratings with the following results:

Rating	Moody's Coefficient	S&P's Coefficient
AA or A_a	-.10	.18
A	-.08	.24
BBB or B_{aa}	.04	1.10
BB or B_a	.75	1.09
B	1.81	1.41
CCC		3.18

[22]The sum of the squared errors from the unrestricted equation was 59.46 which yields an F of 2.33 with 4 and 162 degrees of freedom.

[23]There were also a couple of issues for which PRO was negative. Since PRO^{λ} is an imaginary number for $-1 < \lambda < 1$, these had to be dropped from the sample when PRO was included.

[24]F statistics were constructed from the unexplained sum of squares shown in the paper. The two F statistics were 65.4 for the linear form and 33.2 for the log form while the critical value of F with 4 and 163 d. f. is 2.45 at the .05 level.

[25]Of course size may be correlated with measures of riskiness other than coverage and leverage and may be simply a proxy for these variables. This seems particularly likely since the smaller firms which turned to the bond market may have done so because they found it difficult to arrange private financing.

[26]For the hypothesis that the ratings provide no additional information beyond that contained in C_j, the F statistic is 9.35 while the critical value of F at the .05 level is 2.07. For the null hypothesis that the accounting measures and SUB add no information beyond that contained in C_j, the F statistic is 11.64 while the critical value is 1.94.

[27]It is tempting to hypothesize that the AA and A dummies are insignificant because information on these firms is more readily available and that the lower ratings are significant because information on these is less readily available so market participants rely on ratings. However, this can not explain why the AA and A dummies are insignificant when Y* is regressed on ratings only.

[28]Issues rated A by one agency and B_{aa} or BBB by the other were excluded from this analysis.

[29]However, the hypotheses that the variance of the residuals is the same for the two groups cannot be rejected at the .05 level though it can be rejected at the .10 level. Since the difference in average yields between ratings is much larger for the lower ratings, ratings cannot be expected to capture all differences in risk of default so this result is not too surprising.

[30]On the other hand, a positive D could be observed because rating agencies use observed market yields as a guide to selling ratings so that recent ratings are more closely related to market yields.

[31]$\hat{\beta}$ = .52 with an estimated standard error of .24.

[32]Virtually all long-term industrial and commercial bond issues meeting our requirements (e.g., five years of historical data) are rated by at least one agency, so this question could not be addressed here. However, this may not be true for commercial paper and municipal bonds.

TABLE 1

Summary of Studies of Bond Market Reaction To Rating Changes

Study	Rating Changes Examined	Measurement of Market Adjustment	Benchmark	Major Hypotheses Tested Statistically
Katz (1974)	66 utility ratings changed by S&P between 1966 & 1972	Change in yield to maturity	Estimated yield on issue with same coupon and maturity as the old rating	Yields are different 1 to 15 months after the rerating than they were 1 to 12 months before: significant
Grier & Katz	96 industrial and utility issues downrated by S&P between 1966 and 1972	Dollar and percentage change in market price	Single issue with approximately the same coupon and maturity as the old rating	No statistical tests
Hettenhouse & Sartoris (1976)	71 utility ratings changed from or to Aa by Moody's and/or S&P in 1973 or 1974	Change in yield to maturity	S&P average for old rating	Yields change before rerating: significant; yields change after rerating: insignificant
Weinstein (1977)	100 utility and industrial, ratings changed by Moody's between 1962 and 1974	Holding period returns	Changing sample of the old rating	Positive holding period returns can be obtained before transaction costs by buying and selling at various points before and/or after the rerating: all insignificant.

TABLE 2

The Sample Stratified by Moody's and Standard & Poor's Ratings

MOODY'S RATING

STANDARD AND POOR'S RATING	Aaa	Aa	A	Baa	Ba	B
AAA	23	2	0	0	0	0
AA	5	24	5	1	0	0
A	0	4	35	3	0	0
BBB	0	0	5	16	0	0
BB	0	0	0	7	12	2
B	0	0	0	0	5	24
CCC	0	0	0	0	0	3

Table 3

Estimation Results

Estimated Parameters and (Asymptotic Standard Errors)

Variable	Ratings Only	Non-Rating Measures of Creditworthiness Only	Combined
AA or Aa rating	.077		-.016
	(.088)		(.076)
A rating	.179		.011
	(.079)		(.078)
BBB or Baa rating	1.116		.509
	(.094)		(.111)
BB or Ba rating	1.763		1.345
	(.097)		(.143)
B rating	3.204		2.300
	(.087)		(.183)
CCC rating	7.125		3.364
	(.615)		(.519)
ASSET: coefficient		.730	.160
		(.210)	(.125)
exponent		-.499	-.788
		(.085)	(2.39)
COV: coefficient		1.630	.481
		(.281)	(.310)
exponent		-1.342	-2.865
		(.272)	(1.011)
LEV: coefficient		2.668	1.209
		(.996)	(.957)
exponent		2.873	2.971
		(1.062)	(2.355)
DCOV: coefficient		.047	.216
		(.082)	(.376)
exponent		-1.828	-.814
		(1.152)	(.971)
SUB		.598	-.042
		(.108)	(.123)
TAX	-.059	-.164	-.085
	(.025)	(.080)	(.069)
CALL	.006	-.006	.049
	(.078)	(.025)	(.022)
γ weighting factor	.548		.438
	(.128)		(.161)
Intercept	9.120	8.708	8.963
	(.129)	(.183)	(.347)
Adjusted R^2	.799	.818	.869
Unexplained Sum of Squares	62.892	56.48	38.97

Table 4

Tests of Yield Differences Between Ratings

Null Hypotheses: No difference in Y* between issues rated*	Asymptotic t-statistics from regression: Without accounting variables	With accounting variables
Aaa & Aa	.88	-.21
Aa & A	1.29	.41
A & Baa	10.52	5.92
Baa & Ba	6.17	8.22
Ba & B	14.24	9.36
B & Caa	6.35	2.23

* Moody's symbols are used to represent both Moody's and Standard and Poor's ratings.

TABLE 5

Significance Tests on Accounting Variables

Variable	F Statistic for null hypothesis that Y* is unrelated to that variable: without ratings	with ratings
ASSET	67.368*	14.517*
COV	55.658*	60.230*
LEV	9.145*	2.108
DCOV	3.612*	1.857

*significant at .05 level

Table 6

Estimated Changes in Yield to Maturity Resulting From Changes in Each Accounting Variable

Variable	Percentile Values: 20th	Median	80th	Ratings not Held Constant — Change from: 20th percentile to median	Ratings not Held Constant — Change from: Median to 80th percentile	Ratings Held Constant — Change from: 20th percentile to median	Ratings Held Constant — Change from: Median to 80th percentile
				Estimated Changes in Y* in basis points resulting from changes in independent variables			
ASSET (billions)	.594	2.424	7.424	-47.7	-20.1	-16.1	-4.7
COV	2.794	5.291	10.368	-23.6	-10.4	-2.1	-.3
LEV	.206	.327	.552	8.0	37.8	3.3	16.4
STDCOV	.805	1.499	3.002	-4.7	-1.6	-7.0	-5.5

Table 7

The Explanatory Power of Ratings and Accounting Information Separated by Issue Quality

Groups	Intragroup Variance of Y*	Mean Squared Error* (and % of Variance Explained): Ratings Only	Accounting Measures Only	Both
Issues rated A or above	.276	.259 (.06)	.271 (.02)	.228 (.17)
Issues rated Baa or below	1.473	.492 (.67)	.352 (.76)	.204 (.86)

*In percentage points, i.e., .276 = 27.6 basis points.

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