THE JOURNAL OF FINANCE • VOL. LIII, NO. 4 • AUGUST 1998

The Declining Credit Quality of U.S. Corporate Debt: Myth or Reality?

MARSHALL E. BLUME, FELIX LIM, and A. CRAIG MACKINLAY*

ABSTRACT

In recent years, the number of downgrades in corporate bond ratings has exceeded the number of upgrades, leading some to conclude that the credit quality of U.S. corporate debt has declined. However, an alternative explanation of this apparent decline in credit quality is that the rating agencies are now using more stringent standards in assigning ratings. An ordered probit analysis of a panel of firms from 1978 through 1995 suggests that rating standards have indeed become more stringent, implying that at least part of the downward trend in ratings is the result of changing standards.

BOND RATINGS PLAY A KEY ROLE in corporate financing and investment decisions. A corporation that can issue higher rated bonds usually receives better terms than one that can issue only lower rated bonds. By law or policy, some investors can purchase only bonds with an investment-grade rating, a restriction which in some asset pricing models would affect the relative prices of financial assets.

Numerous articles in the popular press have presumed that the credit quality of the debt of U.S. corporations has been declining over the last couple of decades. The comprehensive study by Lucas and Lonski (1992) of Moody's rating changes of corporate debt is consistent with this presumption. To cite their statistics, in 1970 Moody's downgraded 21 issues and upgraded 23 issues, but over the following years the number of bonds downgraded began to exceed by substantial margins the number of bonds upgraded, and by 1990 Moody's downgraded 301 issues and upgraded only 61. Their study includes both investment and noninvestment grade bonds, but internal data from Donaldson Lufkin & Jenrette confirm that this trend also applies to investment grade bonds alone. In a somewhat different context, Grundy (1997) documents similar trends in the ratings of preferred shares over the 1965 to 1990 period.

As the credit quality of a firm's corporate debt decreases, that firm will face a greater probability of financial distress, which at the extreme translates into bankruptcy. There is some debate as to the effect of financial dis-

*Finance Department, Wharton School, University of Pennsylvania, Philadelphia, PA 19104-6367. We thank Gary Gorton, Bruce Grundy, Dennis Logue, Krishna Ramaswamy, and participants at the Queens University finance seminar, European Financial Management Association meetings, Berkeley Program in Finance, and American Finance Association meetings for helpful comments. The contents of this paper are the sole responsibility of the authors.

tress upon a firm's value and the overall level of economic activity. In the Miller–Modigliani paradigm, the credit quality of a firm's debt should have no impact. However, in a less than perfect world, an increased probability of financial distress may affect a firm's ability and willingness to undertake new investments. Froot, Scharfstein, and Stein (1993) present an excellent summary of the avenues through which financial policies can interact with the investment decisions of an individual firm. Gertler (1988) contains a comprehensive survey of the relation between financial structure and aggregate economic activity.

Those writing about the declining credit quality of U.S. corporate debt have generally accepted this decline in credit quality as fact; yet at least one writer has attributed the observed decline in credit ratings to the use of more stringent rating standards (see Pender (1992)). Under this alternative view, there may have been no real decline in credit quality, and even if there were, the real decline may be less than the data suggest.

The specific question addressed in this paper is the narrow one of whether there is any tendency for a company that maintains the same values for its accounting measures and equity risk measures over time to receive a lower rating today than in prior years. This question is examined using eighteen years of ratings for 1978 through 1995. The accounting variables examined in this study are a subset of those accounting variables that Standard and Poor's states that it utilizes, and the equity risk measures are those that previous researchers have found to have explanatory power.

The study does find that rating standards have become more stringent in terms of the specific variables used in this study. This finding does not rule out the possibility that the informational content of a specific variable itself has changed over time, however. For instance, it is possible that a firm that had maintained the same leverage ratio over time might still find it more difficult to service its debt in today's environment. Also, it is possible that other information, particularly that available privately to the rating agencies, indicates a decline in credit quality. In either of these cases, more stringent standards in terms of data used in this study would be warranted.

The organization of the paper is as follows: Section I contains a discussion of related literature, Section II sets forth the ordered probit model, and Section III presents the definitions of the variables used in estimating this model. Section IV describes the main empirical results, and Section V considers the robustness of these results. Section VI concludes the paper.

I. Related Literature

Moody's and Standard and Poor's (S&P) are the two major rating services for corporate debt. These services employ both publicly available information, such as accounting statements, and nonpublic information, such as confidential interviews with management, to assign quality ratings to individual corporate bonds. The intent of these quality ratings is to measure the "creditworthiness" of a corporation with "respect to a particular debt security" (Standard and Poor's (1996), p. 5).

The ratings from S&P in descending order of credit quality are: AAA, AA, A, BBB, BB, B, CCC, CC, and D. The rating of D is used for a bond that is in default, particularly in its payment of interest or principal. The rating of C is a special rating applied only to income bonds on which no interest is currently being paid. A bond with a rating of BBB or above is known as an investment grade bond; one with a rating of BB or lower is known variously as a high-yield bond, noninvestment grade bond, or junk bond. In an attempt to refine these ratings further, S&P now on occasion assigns a plus or minus to its ratings to indicate that the bond is at the upper or lower end of the rating category. Moody's ratings are similar.

Previous research on quality ratings divides logically into three branches: The first branch addresses the question of whether quality ratings measure what they are supposed to measure. Hickman (1958), one of the first to examine this question, finds generally positive relations between initial quality ratings and default. In another study, Ang and Patel (1975) find that S&P quality ratings have weak power in predicting what they term "financial distress" in the subsequent year. Kao and Wu (1990) find a positive relation between bond yields and quality ratings. These studies and others indicate that quality ratings do have some informational content.

Both the second and third branches examine the type of information contained in quality ratings. The second branch examines whether quality ratings convey information that the market has not already incorporated into prices from other available information. A recent study of this type by Hand, Holthausen, and Leftwich (1992) finds that bond and stock prices of an issuing company change in the expected direction when either Moody's or S&P publishes an actual or potential change in rating. From this result, they conclude that ratings do contain information beyond what is publicly available. Some previous studies, such as Katz (1974), Grier and Katz (1976), and Ingram, Brooks and Copeland (1983), reach similar conclusions, but other studies, such as Weinstein (1977) and Wakeman (1978), do not detect incremental informational effects.

The third branch analyzes how the rating agencies use public information in setting quality ratings. The early studies, such as Horrigan (1966), Pogue and Soldofsky (1969), and West (1970), assign ordinal numbers to the quality ratings and regress these numbers on accounting and other variables. Later studies, such as Pinches and Mingo (1973, 1975) and Altman and Katz (1976), use discriminant analysis in place of regression analysis. Kaplan and Urwitz (1979) employ an ordered probit model and find, like the earlier studies, that publicly available data predict with a fair degree of accuracy actual quality ratings. Ederington (1985) compares and contrasts these different statistical approaches.

The empirical results in our study fall into this third and last branch of research, and the methodology generalizes and extends that of Kaplan and Urwitz. In contrast to Kaplan and Urwitz, who analyze a single cross-section of firms, the analysis in this paper utilizes panel data covering the years 1978 through 1995. With panel data, one can examine whether, conditional on the included variables, rating standards have become more stringent over time and, if so, the importance of these more stringent rating standards in explaining the recent prevalence of downgrades over upgrades.

II. The Ordered Probit Model

The empirical analysis in this paper utilizes an ordered probit model. This model relates the rating categories to observed explanatory variables through an unobserved continuous linking variable. The rating categories map into a partition of the range of the unobserved variable, which is in turn a linear function of the observed explanatory variables.

Define the following for bond i at year t: R_{it} is the rating category of bond i at time t, Z_{it} is an unobserved linking variable, and X_{it} and W_{it} are vectors of observed explanatory variables measured at time t or before. The number of time periods in the sample is denoted by T. The linking variable Z_{it} is continuous and its range is the set of real numbers. The vector X_{it} will be used in the linear part of the model, and the vector W_{it} will be used in modeling the variance of the disturbance terms. The vectors X_{it} and W_{it} may contain variables in common. The variable R_{it} is assigned the value of 4 if bond i at time t has a rating by S&P of AAA, 3 if AA, 2 if A, and 1 if BBB.

The ordered probit model consists of two parts. The first part maps the rating categories into a partition of the unobserved linking variable Z_{it} as follows:

$$R_{it} = \begin{cases} 4 & \text{if } Z_{it} \in [\mu_3, \infty), \\ 3 & \text{if } Z_{it} \in [\mu_2, \mu_3), \\ 2 & \text{if } Z_{it} \in [\mu_1, \mu_2), \\ 1 & \text{if } Z_{it} \in (-\infty, \mu_1), \end{cases} \tag{1}$$

where μ_i are partition points independent of t.

The second part relates the Z_{it}'s to the underlying observed variables as:

$$Z_{it} = \alpha_t + \beta' X_{it} + \epsilon_{it} \tag{2}$$

$$E[\epsilon_{it} | X_{it}, W_{it}] = 0 \tag{3}$$

$$E[\epsilon_{it}^2 | X_{it}, W_{it}] = [\exp(\gamma_o + \gamma' W_{it})]^2, \tag{4}$$

where α_t is the intercept for year t and β is the vector of slope coefficients. The random variable ϵ_{it} is a Gaussian disturbance term with a conditional expectation of zero. To allow for heteroskedasticity, the variance of ϵ_{it} is modeled as a function of W_{it}, where γ_o is a constant and γ is a vector of slope coefficients.

This specification allows the intercept to vary over time while constraining the slope coefficients β to be constant over time. Changes in the intercept over time can be viewed as a measure of changes in standards used in assigning ratings. If α_t is sufficiently less than α_{t-1}, a bond with the same vector of explanatory variables will be associated with a lower rating at year t than at year $(t-1)$ because the partition points, given by μ_i's, are held constant over time. Conversely, if α_t is sufficiently greater than α_{t-1}, the same vector of explanatory variables will be associated with a greater rating at year t than at year $(t-1)$. An analysis of the robustness of the empirical results to this particular specification, presented in Section V, finds that the main empirical results of the paper are virtually unchanged when the slope coefficients β are allowed to vary over time.

Since the Z_{it}'s are unique up to a linear transformation, identification of the model requires two restrictions. The first restriction in this paper is to set the intercept for the first year of the panel to zero. This means that the remaining $T-1$ intercepts can be interpreted as changes in rating standards relative to the rating standards of the first year of the panel. The second restriction is to set γ_o in equation (4) to zero. This restriction reduces to the usual restriction in a homoskedastic probit model if the slope coefficients γ in equation (4) are zero, in which case the variance of the error would be equal to 1.0.

The most probable category, and here the most probable rating category, is central to any probit analysis and in this paper plays a key role. It is customary to assign the maximum likelihood estimates as values to the parameters in the probit model in determining the most probable rating category, but in fact the most probable rating category can be determined for any arbitrary set of values assigned to these parameters. Specifically, for any observation given by X_{it} and W_{it}, the analyses below set the intercept in the linear part of the probit model to one of the estimates from earlier or later years, and the corresponding most probable category is calculated. In these calculations, all the other parameters of the probit model are equated to their maximum likelihood estimates.[1] Changes in the most probable rating categories as the intercepts vary are a direct measure of changes in rating standards.

Let a be the value assigned to the intercept in the linear part of the probit model, and define θ as the set of the parameters of the probit model with the intercept set to a and the other parameters set to their maximum likelihood estimates. Conditional on θ and the explanatory vectors X_{it} and W_{it}, the linking variable Z_{it} will be distributed as a normal variate with an expectation of $a + \beta' X_{it}$ and a standard deviation of $\exp(\gamma' W_{it})$. The probability that a bond falls in rating category j is then given by

$$\Pr(R_{it} = j \mid \theta) = \begin{cases} \Pr(a + \beta' X_{it} + \epsilon_{it} \geq \mu_3 \mid \theta) & \text{if } j = 4 \\ \Pr(\mu_j > a + \beta' X_{it} + \epsilon_{it} \geq \mu_{j-1} \mid \theta) & \text{if } j = 3,2 \\ \Pr(\mu_1 > a + \beta' X_{it} + \epsilon_{it} \mid \theta) & \text{if } j = 1. \end{cases} \tag{5}$$

[1] In subsequent analyses, the slope coefficients in the linear part of the model are also allowed to vary.

The value of j that maximizes equation (5) is the most probable bond rating category conditional on the parameter vector θ.

III. The Variables

As described in Standard and Poor's (1996), both the business risk and financial risk of a company are analyzed in assigning a credit rating. There are no fixed rules, and to use S&P's words, "subjectivity is at the heart of every rating." Nonetheless, it does publish ten financial ratios that are "key" ratios in its analysis of creditworthiness. Five of these ratios measure interest coverage, two measure profitability, and three measure leverage. Standard and Poor's uses three-year averages of these ratios, and this study follows that practice.

The 1995 annual COMPUSTAT is the source for the accounting ratios used in this paper, and this source includes the industrial, full coverage, and research files. The specific accounting ratios used here are: pretax interest coverage, operating income to sales, long-term debt to assets, and total debt to assets.[2] The first two ratios should be positively related to improvements in credit ratings; the last two ratios should be negatively related to improvements in credit ratings. These accounting ratios are similar to those used in the related studies cited above. The 1995 COMPUSTAT files contain twenty years of data (1976 through 1995), making 1978 the first year for which three-year averages are available; thus, the panel will cover the eighteen years from 1978 through 1995.

A number of studies also find a positive relation between credit ratings and firm size, and firm size is therefore included as an explanatory variable in the linear part of the probit model. The rationale is that larger firms tend to be older, with more established product lines and more varied sources of revenues. If so, the explanatory variables used in the linear part of the probit model may be more stable over time for larger firms, and thus for the same set of explanatory variables, a larger firm would tend to receive a higher credit rating.

This study extends this argument by examining explicitly whether the explanatory variables used in the linear part of the probit model are more informative for larger firms. If the explanatory variables for larger firms are more stable over time, the variance of the residuals of the probit model in equation (2) should be smaller for larger firms. To examine this conjecture, the variance of the residuals given by equation (4) is modeled as a function of firm size.

[2] The pretax interest coverage is defined as the ratio of [operating income after depreciation (178) + interest expense (15)] to [interest expense (15)], where the numbers in parentheses are the COMPUSTAT item numbers. The ratio of operating income to sales is defined as [operating income before depreciation (13)] to [sales—net (12)]. The ratio of long-term debt to assets is defined as [long-term debt—total (9)] to [assets—total (6)]. The ratio of total debt to capitalization is defined as [long-term debt—total (9) + debt in current liabilities (34) + short-term borrowings—average (104)] to [assets—total (6)].

Firm size itself is measured in two steps: First, the market value of equity in millions of dollars is deflated by the CPI. Second, the natural logarithm of this deflated market value is taken.[3]

In addition to these accounting ratios, past studies have used beta coefficients and standard errors from the market model. The hypothesis is that a firm will be less able to service its debt for given accounting ratios as its equity risk increases. These equity risk measures take into account both the variability of the underlying cash flows from operations and the degree of leverage. Further separating equity risk into beta and nonbeta risk allows for the possibility that these two measures of risk might be related to the debt rating in different ways. For example, for a given degree of leverage, variability to nonmarket factors might provide more information about the competency of management than variability due to general market movements. Management may have some control over nonmarket variability, and the type of business itself may largely determine the volatility due to general market movements. If so, how the variability of total returns breaks down into these two sources may convey information. The expected signs on these two relative measures of equity risk are negative.

The CRSP daily stock files are the source of the daily returns used in estimating the betas and standard errors from the market model. For each calendar year in which a company is in the panel and in which it has at least 200 daily returns, a beta and a standard error from the market model are estimated. The market index is taken to be the CRSP value-weighted index. The beta estimates are adjusted for nonsynchronous trading effects using the Dimson (1979) procedure with one leading and one lagging value of the market return. There is some variation in the mean levels of the standard errors over time, particularly in 1987. To remove this variation, the standard errors in each year are divided by the cross-sectional mean standard error for that year. Although there is very little variation in the mean betas over time, the betas each year are also standardized in the same way.

The bond ratings themselves come from files of individual bonds that make up the Lehman Brothers Bond Index and were assembled by Professor Arthur Warga—thus, let us call this the "Warga file."[4] Specifically, the Warga file contains among other variables the S&P bond ratings for December of each year for all corporate bonds included in the Lehman Brothers Corporate Bond Index.[5] With a start date of January 1973, this index includes all "publicly issued, fixed rate, nonconvertible investment grade, dollar-denominated, SEC-registered corporate debt." Virtually all of these bonds represent senior debt.

[3] The study also measures firm size by the natural logarithm of total assets similarly deflated. When this variable is included in the same probit models with the market value variable, it is insignificant. Thus, the analyses reported in the text do not include this alternative measure of firm size.

[4] COMPUSTAT contains S&P bond ratings, but only for the last ten years. By using the Warga file, the panel can be extended back eight more years.

[5] The data for December 1984 are incomplete, so the ratings for November 1984 are substituted.

The merger of these files produces a panel of firms over the eighteen years from 1978 through 1995 ranging in number from a low of 367 in both 1978 and 1979 to a high of 457 in 1995 (Table I). The total number of firm-years is 7324. There is an evident shift in the distribution of quality ratings over these years. The proportion of firms with AAA begins at 8.2 percent in 1978 and declines to 2.8 percent in 1995, and the proportion of firms with BBB changes over the same time period from 15.8 percent to 40.3 percent.

Using 1978 as an example, the following time convention is used in merging these data sources: The bond ratings and market values are those for year-end 1978; the market model estimates are obtained from the daily returns in 1978; and the data for the last year of the three-year averages of the accounting ratios come from the yearly financial statements for 1978. Since many firms have year-end months other than December, COMPUSTAT has developed an algorithm for assigning a calendar year to each yearly financial statement and this paper uses that assignment.

IV. Empirical Results

The empirical results in this section are consistent with the hypothesis that over the years 1978 through 1995 S&P has applied more stringent standards in assigning rating categories, at least in terms of the firm characteristics used as explanatory variables in this study. Were it not for improvements in the values of these variables over time, the results suggest that the number of downgrades that occurred over these eighteen years would have been even greater.

A. Model Estimates

Estimation of the parameters of the probit model for the panel data covering the years 1978 through 1995 is based on standard maximum likelihood techniques.[6]

The probit model as given by equation (2) assumes that the linking variable Z_{it} is a linear function of the explanatory variables, but this assumption is implausible for the interest coverage variable because the distribution of this variable is extremely skewed with a skewness coefficient of 48.6. The mean is 12.1 and the median is 4.5. This skewness is due to a very few observations: four observations exceed 1000 and 14 exceed 100. In the sample, the median value for this variable is 10.1 for AAA ratings, 5.6 for AA, 4.5 for A, and 3.4 for BBB. A change from 3.0 to 6.0, which brackets the medians for different rating classes, might lead to an upgrade, but the same change from 97.0 to 100.0 would likely have no effect on the rating. Thus, the relation between the linking variable Z_{it} and interest coverage is likely to be monotonically increasing; yet when the interest coverage is extremely large, the effect of small changes in interest coverage should be negligible.

[6] See Maddala (1983) and Hausman, Lo, and MacKinlay (1992) for details on maximum likelihood estimation of the ordered probit model.

Table I

Companies with Rated Bonds Cross-Classified by S&P Quality Rating and Year, 1978–1995

This table is based on a panel of companies covering the eighteen years from 1978 through 1995. COMPUSTAT, the CRSP daily stock files, and the Warga file are the primary sources for the data on this panel of companies. Panel A gives the number of bonds cross-classified by S&P Quality Rating and year as well as the total by year, and Panel B gives the percentage breakdown by year.

	Rating				
Year	AAA	AA	A	BBB	Total
Panel A: Number					
1978	30	106	173	58	367
1979	37	104	173	53	367
1980	36	105	184	64	389
1981	31	97	180	76	384
1982	25	103	162	90	380
1983	20	107	166	96	389
1984	14	109	178	77	378
1985	11	103	182	98	394
1986	10	106	182	100	398
1987	13	104	181	108	406
1988	14	94	194	109	411
1989	16	94	185	122	417
1990	13	85	172	141	411
1991	16	82	195	126	419
1992	18	86	200	150	454
1993	16	80	186	170	452
1994	14	78	176	183	451
1995	13	78	182	184	457
Total	347	1721	3251	2005	7324
Panel B: Percentage					
1978	8.2	28.9	47.1	15.8	100
1979	10.1	28.3	47.1	14.4	100
1980	9.3	27.0	47.3	16.5	100
1981	8.1	25.3	46.9	19.8	100
1982	6.6	27.1	42.6	23.7	100
1983	5.1	27.5	42.7	24.7	100
1984	3.7	28.8	47.1	20.4	100
1985	2.8	26.1	46.2	24.9	100
1986	2.5	26.6	45.7	25.1	100
1987	3.2	25.6	44.6	26.6	100
1988	3.4	22.9	47.2	26.5	100
1989	3.8	22.5	44.4	29.3	100
1990	3.2	20.7	41.8	34.3	100
1991	3.8	19.6	46.5	30.1	100
1992	4.0	18.9	44.1	33.0	100
1993	3.5	17.7	41.2	37.6	100
1994	3.1	17.3	39.0	40.6	100
1995	2.8	17.1	39.8	40.3	100

Further, when the interest coverage variable is negative, the magnitude is not meaningful. Since earnings must be negative in this case, the magnitude of the interest rate coverage variable could be large due to either a small interest expense or large negative earnings.

For these reasons, the functional form of the interest coverage variable is modified in two steps: First, before taking the three-year average of the interest rate coverage, any annual component that is negative is set to zero. In the final sample, four observations have zero values for the interest rate coverage ratio. Also, any three-year average of the interest rate coverage greater than 100.0 is set to 100.0 on the assumption that increases in value beyond 100.0 convey no additional information.

Second, a change in the specification of the model permits the data to determine the shape of the nonlinearity. Specifically, let C_{it} be the interest rate coverage for firm i in year t and then include the interest rate coverage variable in equation (2) as

$$\sum_{j=1}^{4} \kappa_j c_{jit}, \tag{6}$$

where c_{jit} is defined as:

	c_{1it}	c_{2it}	c_{3it}	c_{4it}
$C_{it} \in [0, 5)$	C_{it}	0	0	0
$C_{it} \in [5, 10)$	5	$C_{it} - 5$	0	0
$C_{it} \in [10, 20)$	5	5	$C_{it} - 10$	0
$C_{it} \in [20, 100]$	5	5	10	$C_{it} - 20$

This specification allows different weights for each increment of the interest rate coverage ratio. If the conjecture that further increases in the interest rate coverage from some value provide no additional information is true, κ_j associated with higher values should be close to zero.

The probit model further assumes that the generalized residuals are uncorrelated amongst themselves. However, an examination of the generalized residuals from equation (2) suggests that the time series of the residuals of individual companies are autocorrelated, contrary to the assumption of zero correlation. If there is such autocorrelation, the maximum likelihood estimators are still consistent, but the standard errors of these estimators are not. Newey and West (1987) provide a general procedure to obtain consistent standard errors in the presence of such autocorrelation, and this paper utilizes their approach to calculate a second "adjusted" set of standard errors.[7]

[7] To calculate the Newey–West standard errors, the partial derivatives of the log likelihood function are interpreted as the moment conditions in Hansen's (1982) generalized method of moments technique. A lag length of 30 is used, with the data ordered first by firm and then by year. The standard errors are consistent as the number of firms increases. The appendix of Campbell, Lo, and MacKinlay (1997) provides further discussion of this approach.

The estimated coefficients on the firm characteristics all have the correct predicted signs (Table II) except for the coefficient on total debt leverage. If taken at face value, this exception means that for a given level of long-term debt leverage, a firm with more short-term debt in its capital structure will tend to receive a higher credit rating. However, once the standard error is adjusted for autocorrelation in the residuals, this coefficient does not differ significantly from zero. The coefficients on the interest coverage variables behave as conjectured. The coefficient on the increment of the interest rate coverage from 0 to 5, κ_1, is positive and large and differs significantly from zero. The coefficients on the increments of the interest rate coverage from 5 to 10, κ_2, and from 10 to 20, κ_3, are positive and small but differ significantly from zero. The coefficient on the increment above 20, κ_4, is not significantly different from zero.

In a probit model, there are no natural magnitudes for the linking variable, making it difficult to interpret the economic significance of the size of the estimated coefficients. To aid in interpreting these coefficients, Table II also presents for each explanatory variable the product of its estimated coefficient and the corresponding standard deviation of the independent variable itself. This product represents the change in the conditional expectation of Z_{it} in response to a change of one standard deviation in the value of this explanatory variable. A comparison of this change to the size of the partitions provides a measure of the economic importance of a variable. As a further aid in interpreting the probit model, Table III contains descriptive statistics of the distributions of the explanatory variables by rating category and overall.

The variance of the standard errors of the probit model, which can be interpreted as a measure of confidence of the prediction, decreases with increases in firm size as measured by deflated market equity. This result is consistent with the conjecture that firm characteristics are more informative for larger firms than for smaller firms. As mentioned before, this result—if correct—could have significant implications for regulatory issues and for determining a firm's cost of capital.

The intercepts display a steady downward trend over time (Figure 1 and Table II). The rank order correlation between the intercepts and time is -0.99, which is significant at the 1 percent level. This decline in the values of the intercept is consistent with the application of increasingly more stringent standards over time in assigning ratings in terms of the firm characteristics identified in this study.

A comparison of the most probable ratings to the actual ratings can be used to assess the goodness-of-fit of a probit model. For the model in this paper, the most probable rating is within plus or minus one rating category of the actual rating for most companies (Table IV). The model underpredicts both the high and low rating categories. In general, as the explanatory power of a probit model with multiple categories declines, the underprediction for some categories will become more pronounced with a corresponding overpre-

Table II

Ordered Probit Model Estimates for the Panel Data, 1978–1995

The estimates are for the ordered probit model parameters using a panel data sample of 7324 observations from 1978 through 1995. The betas are the coefficient estimates for the independent variables in the linear part of the model as defined in the text. The lower boundaries for rating category parameters are the estimates of the partition parameters for the rating categories. The variance parameter is the estimate of the coefficient associated with the market value of equity when the variance of the disturbances is modeled as a function of the deflated market value of equity. The first set of standard errors is calculated under the assumption that the disturbances are uncorrelated. The second, or adjusted set, is calculated using the Newey and West (1987) procedure to account for possible autocorrelation in the disturbances across time for individual firms in the pooled probit model.

	Coefficient	Standard Error	Z Statistic	Adjusted Standard Error	Adjusted Z Statistic	Coefficient × Variable Std. Dev.
Betas						
Interest coverage κ_1	0.205	0.019	11.05	0.066	3.11	0.206
κ_2	0.020	0.006	3.18	0.011	1.82	0.036
κ_3	0.022	0.005	4.15	0.011	2.07	0.045
κ_4	−0.004	0.002	−2.14	0.003	−1.41	−0.018
Operating margin	1.054	0.111	9.46	0.360	2.93	0.124
LT debt leverage	−1.958	0.158	−12.36	0.543	−3.61	−0.257
Total debt leverage	0.425	0.086	4.94	0.235	1.81	0.063
Market value	0.194	0.014	13.99	0.044	4.41	0.257
Market model beta	−0.198	0.025	−8.05	0.059	−3.36	−0.103
Standard error	−0.530	0.047	−11.36	0.191	−2.78	−0.177
Year dummies						
1978	0.000	—		—		
1979	0.007	0.048	0.14	0.020	0.32	
1980	−0.030	0.047	−0.64	0.027	−1.11	
1981	−0.036	0.048	−0.76	0.035	−1.05	

1982	−0.065	0.048	−1.35	0.041	−1.58
1983	−0.127	0.048	−2.64	0.052	−2.47
1984	−0.131	0.049	−2.70	0.050	−2.65
1985	−0.288	0.051	−5.65	0.081	−3.56
1986	−0.334	0.052	−6.39	0.091	−3.67
1987	−0.328	0.052	−6.32	0.091	−3.62
1988	−0.355	0.052	−6.80	0.095	−3.75
1989	−0.408	0.054	−7.54	0.106	−3.85
1990	−0.443	0.056	−7.95	0.119	−3.73
1991	−0.434	0.054	−7.97	0.112	−3.89
1992	−0.458	0.055	−8.36	0.123	−3.73
1993	−0.567	0.061	−9.36	0.151	−3.76
1994	−0.659	0.065	−10.15	0.175	−3.76
1995	−0.760	0.070	−10.79	0.205	−3.70
Lower boundary for rating category					
AAA	2.276	0.176		0.565	
AA	1.472	0.126		0.350	
A	0.573	0.087		0.167	
BBB and below	−∞	—		—	
Variance parameter market value	−0.089	0.011	−8.39	0.040	−2.19

Table III

Descriptive Statistics of the Variables Used in the Probit Analyses, 1978–1995

This table presents descriptive statistics for the seven variables used in the probit model for each rating class and overall. The statistics are calculated using a panel data sample of 7324 observations from 1978 through 1995.

		Fractiles		
Variables	Mean	0.25	Median	0.75
A. Interest coverage				
AAA	13.21	5.07	10.14	16.54
AA	8.14	4.38	5.60	8.89
A	5.91	3.53	4.45	6.51
BBB	4.34	2.70	3.42	4.68
All	6.35	3.37	4.50	6.77
B. Operating margin				
AAA	0.22	0.15	0.19	0.26
AA	0.21	0.12	0.18	0.29
A	0.19	0.12	0.16	0.24
BBB	0.19	0.10	0.14	0.26
All	0.20	0.11	0.16	0.26
C. LT debt leverage				
AAA	0.11	0.04	0.08	0.14
AA	0.19	0.09	0.19	0.30
A	0.22	0.14	0.22	0.31
BBB	0.28	0.19	0.28	0.37
All	0.22	0.12	0.22	0.32
D. Total debt leverage				
AAA	0.21	0.13	0.17	0.25
AA	0.27	0.17	0.27	0.34
A	0.30	0.21	0.29	0.38
BBB	0.35	0.26	0.35	0.43
All	0.30	0.20	0.30	0.38
E. Market value				
AAA	7.92	6.50	8.38	9.26
AA	7.03	6.13	7.11	7.97
A	6.53	5.72	6.60	7.38
BBB	6.21	5.54	6.30	6.97
All	6.63	5.76	6.64	7.46
F. Market model beta				
AAA	0.99	0.65	1.00	1.26
AA	0.96	0.58	0.94	1.29
A	1.00	0.60	0.97	1.33
BBB	1.04	0.65	1.00	1.35
All	1.00	0.61	0.97	1.33
G. Standard error				
AAA	0.87	0.67	0.83	1.02
AA	0.89	0.72	0.87	1.01
A	0.98	0.79	0.95	1.13
BBB	1.15	0.90	1.10	1.33
All	1.00	0.78	0.96	1.15

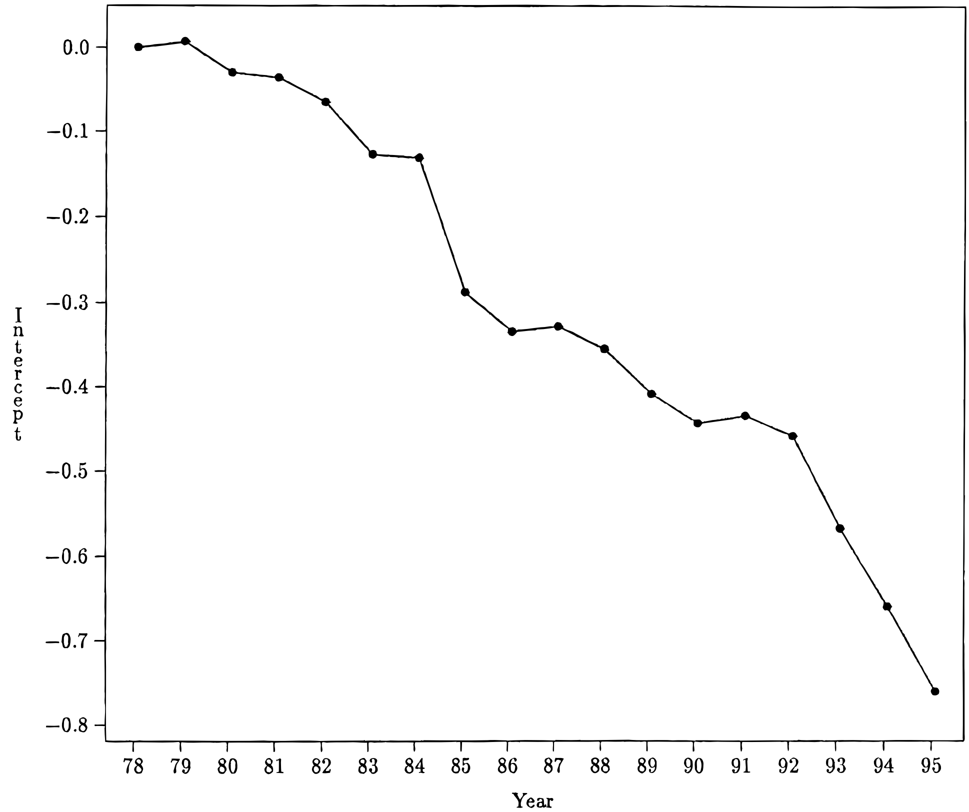

Figure 1. Plot of the Estimates of the Intercept from the Ordered Probit Model for the Panel Data, 1978–1995. The estimates of the intercept plotted over time come from the ordered probit model estimated on the panel data of 7324 observations from 1978 through 1995. The variance of the disturbances is modeled as a function of the deflated market equity. The intercept for 1978 is set to zero as part of the identification of the model. Lower values of the intercept imply more stringent grading standards, given the explanatory variables of the model.

diction for other categories. In the extreme case of no explanatory power, the most probable category will always be the same—namely, the category with the most observations.

B. Economic Importance

The decline in the intercepts is consistent with the application of more stringent standards in assigning ratings, but it provides no direct evidence of the economic importance of this statistical result. One way to ascertain the economic significance of this change is to compare the rating that the probit model would predict for a particular year using the firm character-

Table IV

Actual Ratings versus Predicted Ratings Using the Panel Probit Model, 1978–1995

A measure of the goodness of fit of the probit model that is estimated using a panel data sample of 7324 observations from 1978 through 1995. The coefficient estimates for the model are presented in Table II. Presented is the matrix of actual ratings versus predicted ratings. This matrix shows, for instance, that the panel contains 347 companies with bonds carrying a AAA rating. The predicted ratings for these bonds are: AAA for 90, AA for 161, A for 74, and BBB for 22.

	Predicted Rating				
Actual Rating	AAA	AA	A	BBB	Total Actual
AAA	90	161	74	22	347
AA	20	622	1022	57	1721
A	2	362	2399	488	3251
BBB	0	32	894	1079	2005
Total predicted	112	1177	4389	1646	7324

istics for that year with the rating that the probit model would predict for an earlier or later year but using the same firm characteristics (Table V). In short, keep the data the same, but vary the year of the rating standard.

As an illustration, the panel contains 378 companies in 1984. Consider first the predicted rating for a company using its 1984 firm characteristics and the 1984 rating standards, which is determined by the 1984 intercept—in short, the base year prediction. Consider next the predicted rating for that company using its 1984 firm characteristics but using the 1989 rating standards instead of the 1984 rating standards, which means using the 1989 intercept rather than the 1984 intercept. If the more stringent standards were economically important, a substantial portion of companies would have lower predicted ratings using the 1989 standards in comparison to the 1984 standards. In fact, 116 companies, or 30.7 percent, would have received lower predicted ratings. Also consistent with more stringent rating standards, 77 companies, or 20.4 percent, would have received higher predicted ratings using the standards of five years earlier, again applied to their 1984 firm characteristics.

On average, 22.6 percent of the firms would have had lower predicted ratings using the probit model five years forward in time in comparison to the base prediction, 46.5 percent ten years forward in time, 70.3 percent fifteen years forward in time, and 78.5 percent seventeen years forward in time. On average, going back in time, 25.1 percent of the companies would have had greater predicted ratings using a model five years earlier, 47.9 percent ten years earlier, 73.9 percent fifteen years earlier, and 84.7 percent seventeen years earlier.

Table V

Effect of Changing Rating Standards on Predicted Ratings Based on the Pooled Probit Model, 1978–1995

One way to measure the effect of changing standards on predicted ratings is, first, to ascertain the predicted rating for a company for the year of its financial and market risk characteristics using the rating standards of that year, termed the base-year prediction; and, second, to compare this predicted rating to the rating that would be predicted using an earlier or later standard. The prediction using an earlier or later standard is based on the financial and market risk characteristics of the base year. To summarize these comparisons, this table presents the net number of firms that would receive a predicted upgraded or downgraded rating as a percentage of the firms in the base year. Such percentages are shown for rating standards of 5 years, 10 years, 15 years, and 17 years later or earlier than the base year. The rating standards themselves come from the pooled probit model given in Table II.

Percentage Upgraded or Downgraded (Downgraded in Parentheses)								
Rating Standards					Rating Standards			
17 Years Earlier	15 Years Earlier	10 Years Earlier	5 Years Earlier	Base Year	5 Years Later	10 Years Later	15 Years Later	17 Years Later
				1978	(12.0)	(39.0)	(60.5)	(78.5)
				1979	(17.4)	(51.0)	(72.5)	
				1980	(32.9)	(47.8)	(77.9)	
				1981	(35.7)	(44.8)		
				1982	(26.6)	(40.3)		
			15.2	1983	(24.9)	(45.5)		
			20.4	1984	(30.7)	(55.0)		
			30.2	1985	(18.3)	(48.2)		
			36.2	1986	(7.3)			
			31.5	1987	(15.0)			
		41.6	28.7	1988	(19.5)			
		51.8	35.7	1989	(22.5)			
		46.0	16.8	1990	(31.6)			
		41.8	10.7	1991				
		42.7	12.8	1992				
	64.8	50.2	22.6	1993				
	75.4	59.0	29.5	1994				
84.7	81.6	50.3	35.7	1995				
84.7	73.9	47.9	25.1	Average	(22.6)	(46.5)	(70.3)	(78.5)

V. Robustness

There are two criticisms that could potentially invalidate the conclusion that rating standards have become more stringent over time: First, the specification that the slope coefficients in the probit model are constant over time is grossly incorrect. It could be that a model with constant coefficients would understate the values of the linking variable before adding in the intercept in early years and overstate the values in the later years. Such a time-dependent tendency could manifest itself in the observed decline over time in the intercepts, falsely pointing to more stringent rating standards over time. This criticism can be addressed directly by reestimating the model year-by-year and also by examining the time-series behavior of the firm variables themselves.

Second, the analysis omits an important variable whose mean increases or decreases monotonically over time. In this case, the monotonically declining intercept could be just an adjustment for such an omitted variable. This criticism can never be answered definitively without specifying the omitted variable itself. However, it is possible to validate the probit model with a specific prediction of the model: To maintain its rating over time, a firm would have had to improve continuously its firm characteristics.

A. The First Criticism

As the first step in analyzing whether constraining the slope coefficients to be constant over time results in the appearance of greater stringency, the probit model is reestimated year by year with no constraints on the values of the estimated coefficients between years. The general pattern of the signs of the coefficients that are significant matches the predicted signs most of the time (Table VI). The coefficient on the first increment of the interest rate coverage is positive in all 18 years and significantly different from zero in 15 of these years. With one exception, the coefficients on the third and fourth increments of the interest rate coverage, which are increments in excess of 10, could not be rejected as significantly different from zero. The coefficient on long-term debt leverage is negative and significantly different from zero in each of the eighteen years. The coefficient on total debt leverage varies from year to year, and in fifteen of the eighteen years it is not possible to reject the hypothesis that its value is zero at the 5 percent level. This randomness suggests that for this panel short-term debt itself has little incremental impact on a firm's rating, which is consistent with the pooled probit analysis. The signs on market value in the linear part of the model are all positive, and the signs on beta and standard error are all negative. Consistent with the overall model, the informativeness of the firm data increases with market values.

That the signs of the significant variables in the yearly probit models are similar to the signs in the pooled model is supportive of the pooled model, but it does not address the stability of the values of the coefficients themselves. To obtain a more direct measure of the presence of more stringent

Table VI

Signs of the Ordered Probit Model Estimates for Each Year of the Panel, 1978–1995

For each year from 1978 through 1995 using a sample of 7324 observations, a separate ordered probit model is estimated. Table I reports the number of observations each year. The variance of the disturbances in each year is modeled as a function of the deflated market equity. This table presents the signs of the estimated parameters for each year as well as the predicted sign and the number of years for which the estimated sign agrees with the predicted sign. A superscript "a" indicates that the corresponding estimated coefficient is significant at the 5 percent level, where the standard error is calculated on the assumption that the disturbances are uncorrelated.

	Linear Model										
	Interest Coverage				Operating Margin	LT Debt Leverage	Total Debt Leverage	Market Value	Beta	Standard Error	Variance as a Function of Market Value
	κ_1	κ_2	κ_3	κ_4							
Predicted sign	+	+/0	+/0	+/0	+	–	–	+	–	–	–
Number with sign	18				18	18	7	18	18	18	17
Year:											
1978	+	–	+	–[a]	+[a]	–[a]	–	+[a]	–[a]	–[a]	–
1979	+	–	+	–	+[a]	–[a]	–	+[a]	–[a]	–[a]	+
1980	+[a]	–	+	–	+[a]	–[a]	–	+[a]	–[a]	–	–
1981	+[a]	–	+	+	+[a]	–[a]	–[a]	+[a]	–	–[a]	–[a]
1982	+[a]	–	+	+	+[a]	–[a]	+	+[a]	–[a]	–[a]	–[a]
1983	+[a]	+	+	–	+[a]	–[a]	+	+[a]	–	–[a]	–
1984	+[a]	+	+	–	+[a]	–[a]	+	+[a]	–	–[a]	–
1985	+[a]	–	+	–	+[a]	–[a]	–	+[a]	–	–[a]	–
1986	+[a]	–	+	–	+[a]	–[a]	–	+[a]	–	–[a]	–[a]
1987	+[a]	+	+	–	+[a]	–[a]	–	+[a]	–[a]	–	–[a]
1988	+[a]	+	+	–	+[a]	–[a]	+	+[a]	–	–[a]	–[a]
1989	+[a]	+	–	+	+[a]	–[a]	+	+[a]	–[a]	–[a]	–
1990	+[a]	+	–	+	+[a]	–[a]	+	+[a]	–	–	–[a]
1991	+[a]	+	–	+	+[a]	–[a]	+	+[a]	–[a]	–[a]	–[a]
1992	+[a]	+	+	–	+	–[a]	+[a]	+[a]	–[a]	–[a]	–[a]
1993	+[a]	+[a]	+	+	+[a]	–[a]	+[a]	+[a]	–	–[a]	–[a]
1994	+[a]	+[a]	+	–	+[a]	–[a]	+	+[a]	–[a]	–[a]	–[a]
1995	+	+[a]	+	–	+	–[a]	+	+[a]	–	–[a]	–[a]

Table VII

Effect of Changing Rating Standards on Predicted Ratings Based on the Year-by-Year Probit Models, 1978–1995

One way to measure the effect of changing standards on predicted ratings is, first, to ascertain the predicted rating for a company for the year of its financial and market risk characteristics using the rating standards of that year, termed the base-year prediction, and, second, to compare this predicted rating to the rating that would be predicted using an earlier or later standard. The prediction using an earlier or later standard is based on the financial and market risk characteristics of the base year. To summarize these comparisons, this table presents the net number of firms that would receive a predicted upgraded or downgraded rating as a percentage of the firms in the base year. Such percentages are shown for rating standards of 5 years, 10 years, 15 years, and 17 years later or earlier than the base year. The rating standards themselves come from the year-by-year probit models.

Percentage Upgraded or Downgraded (Downgraded in Parentheses)								
Rating Standards					Rating Standards			
17 Years Earlier	15 Years Earlier	10 Years Earlier	5 Years Earlier	Base Year	5 Years Later	10 Years Later	15 Years Later	17 Years Later
				1978	(15.5)	(39.2)	(59.1)	(85.6)
				1979	(14.4)	(53.1)	(72.8)	
				1980	(27.5)	(46.8)	(78.7)	
				1981	(38.5)	(49.0)		
				1982	(32.6)	(50.8)		
			24.9	1983	(29.3)	(54.5)		
			27.0	1984	(37.0)	(68.5)		
			34.3	1985	(24.9)	(70.1)		
			40.7	1986	(13.3)			
			39.9	1987	(20.0)			
		55.0	31.9	1988	(20.9)			
		55.9	41.7	1989	(32.4)			
		53.5	21.7	1990	(45.7)			
		49.6	17.4	1991				
		55.5	20.3	1992				
	74.8	60.2	27.4	1993				
	81.2	71.0	39.0	1994				
86.7	82.5	63.7	47.3	1995				
86.7	79.5	58.0	31.8	Average	(27.1)	(54.0)	(70.2)	(85.6)

standards over time, the analysis of the economic importance of the more stringent standards found in the pooled probit is replicated using instead the year-by-year probit models. Specifically, the predicted rating for a firm's financial and market risk characteristics for a base year is calculated using the estimated standards of that year and is compared to the predicted ratings using the standards for later and earlier years as determined by the unconstrained probit models; both of these predictions utilize the firm characteristics of the base year. Again, keep the data the same, but vary the year of the rating standard.

The results of this analysis (Table VII) are very similar to the earlier analysis using the pooled probit model (Table V). For example, using ten-year-later standards, the year-by-year probit models show that an average of 54.0 percent of the firms would have received lower predicted ratings. The corresponding per-

Table VIII

Time-Series Behavior of the Mean Values of the Accounting and Market Value Variables Used in the Probit Analyses, 1978–1995

This table presents the mean values of the four accounting variables and the market value variable used in the probit model for three periods: 1978–1983, 1984–1989, and 1990–1995. Because of the standardization of beta and the standard error from the market model, the mean values of these two variables are always one.

	Period		
Variable	1978–1983	1984–1989	1990–1995
Interest coverage	6.80	5.94	6.18
Operating margin	0.19	0.19	0.21
LT debt leverage	0.23	0.21	0.23
Total debt leverage	0.30	0.29	0.32
Market value	6.20	6.67	7.03

cent for the pooled probit model is similar, 46.5 percent. Using the ten-year-earlier standards, the year-by-year probit models show that an average 58.0 percent of the firms would have received greater predicted ratings. The corresponding percent for the pooled probit model is again similar, 47.9 percent.

Except for the steady increase in average market value, there are no obvious time trends in the variables (Table VIII). This time trend in average market values could conceivably cause the observed decline in the intercepts in the pooled regression. The argument is the following: Assuming that the correct explanatory variable is not the market value itself, but rather its deviation from the average market value in any year. Since the coefficient on the market value is constrained to be the same over time, the product of the coefficient and market value will be relatively low in the early years of the sample and relatively high in the later years. The relatively larger intercepts at the beginning of the sample and the relatively smaller intercepts at the end of the sample adjust for under- and overstatement.

To assess this argument, the pooled ordered probit model is rerun with the market value variable replaced by its deviation from the yearly average market value. The mathematical effect of this replacement is to shift each year's intercept upward by the product of the average market value for that year and 0.194, the coefficient from the ordered probit model. The new intercepts still decline steadily with time. The rank order correlation is -0.99, which is the same as before and is statistically significant at the 1 percent level.

B. The Second Criticism

The second criticism is that some critical variable is missing and that the mean value of the variable changes monotonically over time. This criticism can never be answered directly without defining the omitted variable itself. However, the model does contain an internal prediction that can be validated with other data. Specifically, to maintain its rating a firm would have to increase its creditworthiness over time as measured by the variables used in the probit model.

To check this prediction, firms are divided into three groups: those whose current rating is lower than the rating five years earlier, those whose current rating is equal to the rating five years earlier, and those whose current rating is higher than the rating five years earlier. This requirement that a firm have a current rating and a rating five years earlier introduces a potential postselection bias in the sample, but is unavoidable in validating the model through an analysis of what happens to an individual firm over time. To allow for both possible upgrades and downgrades, the sample for validation includes only bonds rated AA or A five years earlier.

If grading standards are becoming more stringent over time, the difference between the predicted rating using the standards of the current year and the predicted rating using the standards of five years earlier should on average be negative when these predictions are based on firm variables of five years earlier. Even if a firm were subsequently upgraded, the average should still be negative as the firm variables are those of five years earlier, not the improved current variables. As predicted, this average difference is negative regardless of the relation of the current rating to the rating five years earlier (Table IX).

For a firm to maintain or improve its ratings, it would have had to improve its creditworthiness as measured by the firm variables that are used in the probit model. Thus, the difference between the predicted rating on the basis of its current firm variables and the predicted rating on the basis of its firm variables five years earlier where the rating standards are the current standards should vary with the way its actual rating has changed. In fact, this difference is 0.21 when the bond ratings are upgraded. This difference should be 1.0 (or more if some firms are upgraded by two categories) if the model predicts the upgrades perfectly. This difference is 0.11 when the bond ratings are unchanged and -0.24 when the bond ratings are downgraded. These latter two differences would be 0.0 and -1.0 or less if the model predicted perfectly. Although the model is not perfect, it does predict in the correct direction according to the actual change in the rating.

An examination of the changes in the firm variables themselves are consistent with these predictions with the exception of beta. Those firms with upgraded debt show the greatest improvement in their firm characteristics over the five years. Those firms with no change in their debt ratings also show improvement in their firm characteristics, which is consistent with the hypothesis that a firm had to show some improvement just to maintain its rating in the environment of increasingly more stringent standards. Those firms with actual downgrades have worse firm data than five years earlier.

In sum, the predictions of the probit model, both conditional on the actual rating changes and unconditionally, are as expected, which provides validation of the model. Further, the changes in firm characteristics are consistent with actual changes in ratings and the predictions of the model.

Table IX

Average Changes in Predicted Ratings and Firm Data from Current Year to Five Years Earlier Cross-Classified by Actual Rating Changes for Bonds Rated AA or A Five Years Earlier

The purpose of this table is to validate the pooled probit model according to the actual change in rating. Panel A shows that regardless of the actual change in rating, the predicted rating using the current standard is lower than the predicted rating using the five-year standard, where both predictions are based on the firm data of five years earlier. Panel B shows that using the current standard, the predicted rating using current firm data is greater than the predicted rating using firm data of five years earlier when there is an actual upgrade, and the reverse when there is an actual downgrade. Panel C shows the change in average values of the firm data from the current values to five years earlier as a function of the actual change in ratings. Those firms with downgrades have worsened firm data. Those with no change or upgrade in ratings have improved firm data.

	Current Rating in Comparison to Rating Five Years Earlier		
	Downgrade	No Change	Upgrade
Panel A: Predicted Rating Using Current Rating Standards Less Predicted Rating Using Ratings Standards of Five Years Earlier Based on Firm Data Five Years Earlier	−0.20	−0.23	−0.20
Panel B: Predicted Rating Using Current Firm Data Less Predicted Rating Using Firm Data of Five Years Earlier Based on Current Rating Standards	−0.24	0.11	0.21
Panel C: Firm Data Change from Five Years Earlier			
Interest coverage	−2.06	−0.38	3.03
Operating margin	−0.000	0.004	0.008
Long term debt leverage	0.027	−0.012	−0.035
Total debt leverage	0.029	−0.004	−0.035
Market value	0.120	0.369	0.576
Market model beta	−0.022	−0.044	0.006
Standard error	0.057	−0.026	−0.004
Number of firms	716	1867	212

VI. Conclusion

There is a widespread belief among practitioners that the credit quality of U.S. corporate debt has declined over the recent past, and trends in the actual bond ratings are consistent with this belief. However, part of this decline in the level of actual bond ratings could be due to the use of more stringent rating standards in assigning ratings. The empirical results of this paper, which are based on an analysis of a panel of firms over the eighteen years from 1978 through 1995, are consistent with this explanation. The data suggest that if it were not for the use of more stringent rating standards, the level of bond ratings might have actually been higher today than in the past.

As a word of caution, all of these results are conditional on the firm characteristics that this study utilizes. Another explanation of the empirical results is that this study has omitted a key variable or variables whose yearly average values display a time trend. In this case, the changing intercept in the model could be just compensating for such omitted variables. If this explanation is correct, then the firm characteristics used in this study and similar variants used in prior studies are inadequate to model the rating process. However, analyses in the text suggest that the results are robust to this criticism.

Another explanation of the results is that the meanings of the firm variables used in this study have changed over time. For example, it could be that an interest coverage of 5.0 ten years ago indicated a higher creditworthiness than the same value does today. But even so, the main conclusion of this study is unaltered. In terms of the explanatory variables used in the analysis, the rating standards have become more stringent. In this case, however, the greater stringency would be warranted, and historical comparisons of firm data would be misleading.

Although the main focus of this study is the changing standards used in assigning ratings, the study finds evidence, perhaps for the first time, that accounting ratios and market-based risk measures are more informative for larger companies than smaller companies. If true, the implications are broad. Depending on their design, cross-sectional empirical studies of corporations may need to model explicitly the informativeness of the explanatory variables. Regulatory agencies might wish to impose different reporting requirements on corporations as a function of their size.

REFERENCES

Altman, Edward, and Steven Katz, 1976, Statistical bond rating classification using financial and accounting data; in M. Schiff and G. Sorter, eds.: *Topical Research in Accounting* (NYU Press, New York).

Ang, James, and Kurwitkumar Patel, 1975, Bond rating methods: Comparison and validation, *The Journal of Finance* 30, 631–640.

Campbell, John Y., Andrew W. Lo, and A. Craig MacKinlay, 1997, *Econometrics of Financial Markets* (Princeton University Press, Princeton, NJ).

Dimson, Elroy, 1979, Risk measurement when shares are subject to infrequent trading, *Journal of Financial Economics* 7, 197–226.

Ederington, Louis, 1985, Classification models and bond ratings, *The Financial Review* 20, 237–262.

Froot, Kenneth, David Scharfstein, and Jeremy Stein, 1993, Risk management: Coordinating corporate investment and financing policies, *Journal of Finance* 48, 1629–1658.

Gertler, Mark, 1988, Financial structure and aggregate economic activity: An overview, *Journal of Money, Credit and Banking* 20, 559–596.

Grier, Paul, and Steven Katz, 1976, The differential effects of bond rating changes on industrial and public utility bonds by maturity, *Journal of Business* 49, 226–239.

Grundy, Bruce, 1997, Preferreds and taxes: The relative price of dividends and coupons, Working Paper, University of Pennsylvania.

Hand, John, Robert Holthausen, and Richard Leftwich, 1992, The effect of bond rating agency announcements on bond and stock prices, *The Journal of Finance* 47, 733–752.

Hansen, Lars, 1982, Large sampling properties of generalized method of moments estimators, *Econometrica* 50, 1029–1054.

Hausman, Jerry, Andrew Lo, and A. Craig MacKinlay, 1992, An ordered probit analysis of transaction stock prices, *Journal of Financial Economics* 31, 319–379.

Hickman, William, 1958, *Corporate Bond Quality and Investor Experience* (Princeton University Press, Princeton, NJ).

Horrigan, James, 1966, The determination of long-term credit standing with financial ratios, *Journal of Accounting Research* 4 (supp.), 44–62.

Ingram, Robert, LeRoy Brooks, and Ronald Copeland, 1983, The information content of municipal bond rating changes: A note, *The Journal of Finance* 38, 997–1003.

Kao, Chihwa, and Chunchi Wu, 1990, Two-step estimation of linear models with ordinal unobserved variables: The case of corporate bonds, *Journal of Business & Economic Statistics* 8, 317–325.

Kaplan, Robert, and Gabriel Urwitz, 1979, Statistical models of bond ratings: A methodological inquiry, *Journal of Business* 52, 231–261.

Katz, Steven, 1974, The price adjustment process of bonds to rating reclassifications: A test of bond market efficiency, *Journal of Finance* 29, 551–559.

Lucas, Douglas, and John Lonski, 1992, Changes in corporate credit quality 1970–1990, *The Journal of Fixed Income* 1, 7–14.

Maddala, George, 1983, *Limited Dependent and Qualitative Variables in Econometrics*, Econometric Society Monograph No. 3 (Cambridge University Press, Cambridge, UK).

Newey, Whitney, and Kenneth West, 1987, A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica* 55, 703–708.

Pender, K., 1992, Demystifying the ratings game, *The San Francisco Chronicle*, February 17.

Pinches, George, and Kent Mingo, 1973, A multivariate analysis of industrial bond ratings. *The Journal of Finance* 28, 1–18.

Pinches, George, and Kent Mingo, 1975, A note on the role of subordination in determining industrial bond ratings, *The Journal of Finance* 30, 201–206.

Pogue, Thomas, and Robert Soldofsky, 1969, What is in a bond rating? *Journal of Financial and Quantitative Analysis* 4, 201–228.

Standard & Poor's, 1996, *Standard & Poor's Corporate Ratings Criteria* (New York, NY).

Wakeman, Lee, 1978, Bond rating agencies and the capital markets, Working paper, University of Rochester.

Weinstein, Mark, 1977, The effect of a rating change announcement on bond price, *Journal of Financial Economics* 5, 329–350.

West, Richard, 1970, An alternative approach predicting corporate bond ratings, *Journal of Accounting Research* 7, 118–127.