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On the information content of ratings: an analysis of the origin of Moody's stock and bond ratings

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John Moody published his first railroad security analysis and ratings manual in April 1909. This study analyzes several current issues by looking back at Moody's original intentions for constructing a ratings system. The study analyzes whether Moody intended his ratings to reflect his private information, or rather, to serve some alternative role, as with monitoring conflicts of interests or realizing informational economies of scale. The study uses an ordinal regression approach to evaluate a set of explanatory variables, constructed from both the manual itself and the panic months of 1907, to test the potential information content of Moody's ratings. At the time of Moody's first rating system, the illiquidity of the US Treasury market forced investors to seek alternative 'high-quality' securities. Indeed, Moody rated 38.94 percent of railroad bonds as Aaa, and rated 85.25 percent of railroad bonds as A, Aa or Aaa in his universe of railroad bonds rated. To further test the informational content of Moody's ratings, the study pursues a structural default analysis during the panic year of 1907, which yields results that indicate that the default risk of railroad securities was quite low at the time. These results provide justification for the high overall ratings that Moody assigned to railroad securities, and thus their role as near risk-free securities. Therefore, railroad securities, and Moody's ratings, played a particularly important role in the financial system at the time.

Keywords: John Moody, security ratings, panic of 1907, railroads, investment analysis, structural default analysis, ordinal regression, Interstate Commerce Commission

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I

In the aftermath of the panic of 1907, John Moody published his first railroad[2] security analysis and ratings manual in April 1909.[3] The Poor Company followed in rating

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[2] While Moody's 1909 manual focused on the analysis and rating of railroad securities, Moody's 1914 volume initiated coverage of public utility and industrial securities, Moody's 1918 manual initiated coverage of government and municipal securities, and Moody's 1928 manual initiated coverage of insurance, financial and investment securities.

[3] The full title of the first manual was: *Moody's Analyses of Railroad Investments Containing in Detailed Form; an Expert Comparative Analysis of Each of the Railroad Systems of the United States, with Careful*

securities in 1916 and merged with Standard Statistics in 1941 to form Standard & Poor's (Sylla 2002). Sylla credits the advent of the securities rating industry as 'a fusion of functions performed by' the credit-reporting agency, the financial press and the investment banker. In this article we find support for this view, but also provide additional rationales for Moody's ratings approach, rooted in the economic and financial-market conditions that characterized the pre-Federal Reserve financial system.[4]

Moody intended his first publication to be primarily a 'complete explanation of the proper principles to be employed for analyzing railroad investment values' (Moody 1909, p. 14), and only secondarily as a ratings-based system of security analysis. Moody's intended audience was the vast number of smaller investors in railroad securities, since control of railroad firms was highly concentrated by 1909. As Moody states:

> For the railroads are not owned by a small group of capitalists of great wealth, as is erroneously assumed in some quarters, but by a large number (between one and two millions) of individuals in this and other countries, whose average holdings range from $700 to $1,500 each. It is true that the railroad systems are 'controlled' by capitalists, and in recent years this element of control by small groups has become far more pronounced than was formerly the case; but the actual ownership lies with the investors themselves. Because of this concentrated control it is all the more necessary for the average holder of the stocks and bonds to have proper facilities for ascertaining the real values of investment holdings. (Moody 1909, p. 12)

Moody focused his 1909 analysis on railroad securities, in part due to the illiquidity of the US Treasury market at the time, and thus in response to the demand for alternative high-quality securities. The US federal debt had declined sharply post-Civil War from a peak of about 40 percent of GDP in the late 1870s to less than 5 percent of GDP by 1910. As well, federal regulation required banknote issues to be 100 percent backed by eligible US government securities, which absorbed much of the outstanding US government securities (Friedman and Schwartz 1993, p. 23). The lack of a liquid government bond market increased demand for railroad bonds, which generally were considered high quality (i.e. near risk-free) by investors, as discussed further below.

Railroad bonds were common bank reserve investments at the time. For example, Hogan (1913) cites 1912 Comptroller of the Currency data that, in the aggregate, national banks held $354,321,271 in railroad bonds, $179,322,004 in state, county, and municipal bonds, $195,452,530 in other public service corporation bonds, and

Deductions, Enabling the Banker and Investor to Ascertain the True Values of Securities; by a Method Based on Scientific Principles Properly Applied to Facts. Note the particular reference to the *Banker* as one target audience for the analysis.

[4] According to Calomiris and Gorton (2000), 'during the period from 1814-1914 the United States experienced 13 banking panics and among these, the Panic of 1907 was the worst'. These crises and panics occurred during a period before the US had adopted a formal lender-of-last-resort provider and before the advent of US Securities and Exchange Commission regulation of financial markets.

$223,500,814 in all other bonds, while their aggregate capital stock was $1,046,012,500. As well, Nelson (1907, p. 74) cites evidence from a 1905-6 survey of 7,000 banks and trust companies, which concluded that as much as 50 percent of individual bank reserves of eastern US banks were held in bonds, that eastern US banks preferred railroad bonds while western US banks preferred municipal bonds, and that all banks generally preferred listed bonds. Finally, A. G. Hoyt commented in Kemmerer's *National Monetary Commission* report (1910, p. 217) that:

> The writer was considerably surprised to note that the prices of the standard railroad securities which you selected reflected so accurately the variations in the time money market. My impression is that the explanation may be found in the fact that what might be termed the floating supply of bonds of the character you selected is largely held by banking institutions which carry such bonds as a secondary reserve. Naturally such institutions are sellers when money is in demand and rates are high and there is a consequent depression in the bond market at such times; when the rates for money are low, the converse obtains.

As well, railroad securities were preferred as margin collateral in the NYSE's call-loan market. Required margin on call loans was normally 25 percent of the loan amount, as long as (1) the securing collateral consisted of approximately two-thirds railroad and one-third industrial securities, and (2) these securities showed price stability and (more importantly) high liquidity (Griffiss 1925, pp. 16-26). Sources of call-loan funds included the New York City banks, and the interior banks through their correspondent accounts with the New York City banks (Griffiss 1925, pp. 11-14). These banks would pull funds from the New York call-loan market, and sell off secondary reserve holdings, as seasonal money-demand increased, causing call-loan rates to increase and pressuring bond and stock prices. For example, Seltzer and Horner (1922) showed an inverse correlation between the supply of call-loan market funds by banks and the call-loan rate. To be able to liquidate funds during times of crisis, such as the panic of 1907, the securities held as secondary reserves and as call-loan collateral needed to be of high *security* and *salability*.

The study addresses two interrelated issues with Moody's inaugural bond rating analysis. First, like other bond rating studies, the study investigates the extent to which Moody's ratings system reflected his personal information and judgment concerning the quality of railroad securities. For example, Pinches and Mingo (1973) remark that: 'In addition to quantifiable data, the rater's qualitative judgment concerning the future ability of a firm to make interest and principal payments also influences the bond ratings.' Pogue and Soldofsky (1969), in a study of corporate bond data from the 1960s, concluded that: 'Although intangibles of judgment undoubtedly enter into the determination of bond ratings, the results of this study suggest that differences in bond ratings can be explained to a significant degree by available financial and operating statistics.' The present study finds results comparable to Pogue and Soldofsky (1969), especially for the subsample of Moody's rated bonds which were followed in the financial press, but finds that Moody's analysis may have added

information value for the roughly two-thirds of bonds in Moody's sample that were not reported on in the financial press.

However, security ratings can play important roles in addition to, or in place of, a private information role. Sylla (2002) discusses the role that bond ratings might play in reducing agency conflicts, either between stakeholders and management, or between stakeholders, asset guarantors and asset managers. The Moody's quote above suggests a potential conflict between minority shareholders and the concentrated ownership of railroad firms, as will be further described in Section II below. Potential conflicts also existed between investors and other providers of railroad information and analysis, as with investment banker J. P. Morgan's controlling influence with many railroad lines. Finally, Smith and Walter (2002) hypothesize that rating agencies may provide informational economies by collecting and analyzing information for security investors more efficiently than investors could individually. The informational economics hypothesis is supported by the subscription model adopted by Moody, i.e. investors were the source of revenues to Moody's through their purchase of his manual.

Moody in 1909 rated 38.94 percent of railroad bonds in his sample as Aaa and 85.25 percent of railroad bonds as A, Aa or Aaa. Thus, the ratings helped investors identify which railroad bonds could be considered 'near risk free'. To test whether the large percentage of high-rated bonds was justified, the study pursues a structural default-risk analysis to estimate the probability of default of railroad securities. The analysis will confirm that default probabilities were quite low, even during the panic months of 1907. Accordingly, Moody's manual makes clear that his 1909 security analysis and ratings system was intended to reflect an investment analysis, rather than a credit or default analysis, of railroad securities. More specifically, Moody's 1909 manual makes virtually no mention of railroad security defaults and associated credit risks.

Section II below discusses the cartelization of US railroads in the 1870–80s, the railroad industry consolidation that occurred with the economic depression of 1893, and the railroad regulation that started with the passage of the Interstate Commerce Act of 1887 and the creation of the Interstate Commerce Commission. This section sets the historical context to the advent of Moody's ratings. Section III then presents Moody's explicit system for constructing bond ratings based on: (1) the *security* of the issue, reflecting its *security of principal and permanency of income*, and (2) the *salability* of the issue, reflecting its liquidity.[5] While the *security* factor is a type of interest-coverage ratio, the *salability* factor was intended to reflect a security's liquidity, that is, the ability to sell the security without loss of value. It also discusses Moody's construction of the physical-factor, income-factor and capitalization-factor tables, which completes Moody's presentation of railroad system data for investors.

[5] As stated by Moody, 'Small inactive issues, although well secured in lien and well backed up by heavy earnings, will not sell at as good prices, as a rule, as will those issues on the larger systems which have an established market, and which can be sold on exchanges or to bankers on short notice' (Moody 1909, p. 129). Note that Moody suggests that bankers played a dealer type of role in these securities.

Section IV discusses the analytical basis for Moody's ratings definitions and the resulting distribution of Moody's railroad bond ratings. Moody's ratings definitions were based on his analysis of the risk factors that affected the pricing of railroad securities at the time. In particular, Moody's rating system was based on the dichotomy between (1) high-quality securities, i.e. securities whose prices were affected almost exclusively by interest-rate risk, and (2) lower-quality securities, i.e. securities whose prices in addition were affected by changes in the earnings power of the issuing railroad. It also presents the construction of common and preferred stock ratings.

Section V then describes the study's ordinal regression approach to analyzing Moody's bond rating assignments, and presents the resulting regression results. In the present case, the regression approach is simplified, since Moody's ratings construction was explicitly based on a bond's *security* and *salability* factors. The study incorporates these two explicit factors, plus other accounting and financial factors to test judgmental aspects of the ratings, including whether the panic of 1907 might have shaped the 1909 bond ratings. Section VI then presents a structural default analysis of the study's railroad firms. The default analysis is used to establish whether the high overall railroad ratings assigned by Moody can be justified. Section VII concludes.

II

Railroad cartels were organized in the US in the nineteenth century to fix rates among member railroad lines. One prominent cartel was the Joint Executive Committee (JEC),[6] which was organized in 1879 to formalize rate setting among railroad lines operating from Chicago and St Louis to the eastern US ports north of Baltimore (Ulen 1980). The JEC collected data on railroad traffic, provided arbitration to resolve disputes, allowed price adjustments in response to members' cheating, and imposed sanctions on violating members. Porter (1983) analyzed data collected by the JEC over 1880-6, and characterized railroad behavior as switching between periods of collusive and non-cooperative behavior. The periodic breakdown in collusive behavior resulted in destructive price wars among railroad systems.

An economic depression in 1893 started another period of price wars and the failure of numerous railroads. The resulting reorganizations created consolidation within the industry (Kolko 1965, pp. 64-5). Moody (1904, pp. 431-3) describes how by 1904 some 95 percent of American railroad lines were controlled by the following six railroad groups:

(1) *The Vanderbilt Group* with $1,169 MM in capitalization and 21,888 miles of line,
(2) *The Pennsylvania Railroad Group* with $1,822 MM in capitalization and 19,300 miles of line,

[6] The Southern Railway and Steamship Association was established in 1876 by railroads and steamers in the southern US to control rates and market shares for the shipment of cotton from the interior to southern ports.

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(3) *The Morgan Group* with $2,265 MM in capitalization and 47,206 miles of lines,
(4) *The Gould-Rockefeller Group* with $1,369 MM in capitalization and 28,157 miles of line,
(5) *The Harriman-Kuhn-Loeb Group* with $1,321 MM in capitalization and 22,943 miles of line, and
(6) *The Moore Group* with $1,059 MM in capitalization and miles of line 25,092.

The financiers with dominant influence over these groups were: J. Pierpont Morgan, John D. & Wm. Rockefeller, W. K. & F. W. Vanderbilt, George J. Gould, A. J. Cassatt, James J. Hill, Edwin Hawley, H. H. Rogers, August Belmont, Thomas F. Ryan, and W. H. & J. H. Moore (Moody 1904). As well, Moody (1904, p. 441) states that:

> Not only is this enormous percentage of railway property dominated by these six groups, but these groups themselves are in many important ways, linked one to the other, and the various interests which control them overlap, as it were, into each other's group or circle … While nominally controlled and operated by nearly two thousand corporations, the steam railroads of the country really make up a mammoth transportation Trust, which is dominated by a handful of far-seeing and masterful financiers.

Railroad consolidation was intended to curtail the cheating behavior that had plagued the industry. Nonetheless, the rate wars continued. However, since the mid 1880s, the railroads had pursued federal help in controlling rate setting. Their political influence, and that of other railroad stakeholders, resulted in the passage of the Interstate Commerce Act (ICA) of 1887 and creation of the Interstate Commerce Commission (ICC).

The ICA was intended to regulate the monopolistic tendencies of the US railroad industry. Ulen (1980) concluded that the ICA and the ICC was, at least initially, ineffectual in regulating the cartelization of railroad rates. In contrast, Prager (1989) finds that passage of the ICA supported the interests of the railroads, using event-study methodology which examined the price reactions of railroad stocks to news events related to the legislation.

While the ICC struggled with its authority in its early years, the Elkins Act of 1903 allowed the agency to impose fines on railroads offering rebates and required railroad companies not to deviate from published rates. Essentially, the Act accomplished what the railroad cartels could not in terms of fixing rates (Kolko 1965, p. 100). As Kolko (1965, p. 117) states:

> Although the Elkins Act did not solve the rebating problem entirely, it had helped end what was equivalent to perhaps a 10 per cent drain on gross railroad revenues until 1903. From 1900 to 1905, railroad income rose for the first time in many years, both in freight revenue per ton mile and revenue per ton. Dividends nearly doubled.

Therefore, railroad consolidation and federal regulation had combined to restore stability and profitability to the railroad industry, which then set the stage for Moody's analysis of the railroad industry. These two factors – consolidation and federal regulation – were most likely important in contributing to the low default

risk of railroads at the time (see also the results of Section VI below), and thus the large number of highly rated railroad securities in Moody's rating universe.

III

Moody's 1909 railroad analysis focused on two primary characteristics of each railroad security: (1) the *security* of the issue and (2) the *salability* of the issue. The *security* factor is based on an analysis of a security's claim on railroad earnings relative to its required coupon interest (thus a type of interest-coverage ratio), and is intended to reflect the impact of railroad earnings fluctuations on security value.[7] The *salability* factor, on the other hand, was meant to reflect the security's liquidity, that is, the ability to sell the security without loss of value. These two characteristics – *security* and *salability* – were of particular importance to investors in 1909, as with the bank secondary reserve decisions and call-loan market conventions discussed above.

The construction of these two factors, and the related construction of bond ratings, is illustrated in Appendix I for the Cleveland, Cincinnati, Chicago & St Louis Railway. The first column in the table describes the particular issue. The second column (*Lien on miles*) describes the lien held by a particular issue, in terms of the priority of its claim and the miles of track held under the lien. Column 4 gives the *interest required per mile of system* (IR) for each particular security listed in the table. For example, in Appendix I securities (1)–(7) jointly required \$581 (that is, \$20 + \$155 + \$151 + \$100 + \$73 + \$15 + \$67) in interest payments against \$2,894 in *average income available* (AIA, column 3), leaving \$2,313 in *average income available* for more subordinate claims. The resulting *factor of safety* is given in column 5, which is calculated as (AIA-IR)/AIA (the interest coverage ratio) and equals 80 percent for the first seven securities listed in Appendix I.

The *security* and *salability* factors are then presented in Appendix I under the title *Basis for rating*. Bond ratings are given in the final column and are based on a security's *security* and *salability* factors. Of these two factors, the *security* factor appears to weigh more heavily in determining a particular security's rating, for example, as reflected in the ratings definitions given in Appendix III. As well, as emphasized by Moody:

> It must not be forgotten that arbitrary judgement is used to a large degree in making all these ratings. The percentages showing the factors of safety, etc., serve as a general guide, but the rating given is, in many cases, affected by other considerations not shown in the figures, such as character of management and of traffic, general position of the railroad system, policy of the company in maintenance and other expenses, and in other ways. (Moody's, 1909, p. 194)

An empirical analysis of these two explicit factors, plus factors introduced to reflect Moody's judgment, will be presented in Section V below. In the next section, the study will present the data series used in constructing the *physical factors*, *income*

[7] Interest coverage was a commonly used ratio at the time by investment bankers. For example, J. P. Morgan prominently displayed the ratio in his circulars for new security issues.

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factors and *capitalization factors*. These series were useful to investors for analyzing trends in railroad performance, since Moody presented ten years of annual data for each variable. As well, the *income factors* data were used to calculate the *average income available* variable, which was then used to construct the *security* factor, as given above. These data series then complete Moody's presentation of railroad data, which made his manual comparable to other data-intensive railroad manuals of the time.

Moody organized his fundamental railroad analysis into three additional tables for each railroad system: (1) *Table A. Physical factors* presenting data on the railroad's physical assets and revenue sources, (2) *Table B. Income factors* presenting income-statement information, and (3) *Table C. Capitalization factors* presenting data on capital sources and their performance. Each table presents a 10-year data history, along with 10-year averages from similar properties of other railroad systems for comparison. Moody emphasized that the 10-year histories lent *permanency and stability* to his rating system, stating:

> Many investors in both stocks and bonds were woefully misled by the 1906 and 1907 results of railroads, just as they have since been misled by considering only the bad figures of 1908, and the lack of pronounced improvement in most instances so far in 1909. (Moody 1909, p. 61)

An example of the construction of these tables is given in Appendix II, again for the Cleveland, Cincinnati, Chicago & St Louis Railway.

The 10-year data histories presented in these tables were abstracted from Interstate Commerce Commission reports, and thus were taken from a quite public data source. As Moody states: 'the records of the Interstate Commerce Commission embrace nearly all the facts that are necessary, but they are not presented in very satisfactory form for intelligent and accurate usage' (Moody's 1909, p. 65). His comment reflects on the issue of Moody's intention in creating his security analysis and ratings system, and appears to lend support to Smith and Walter (2002)-type information economies that Moody could realize by providing an analysis of publicly available data.

The *physical factors* table (panel A of Appendix II) provides a 10-year history on track mileage, ownership of locomotives and passenger and freight cars, level of annual traffic and the resulting revenues. The data presentation would allow the investor to analyze trends in the railroad's physical expansion and trends in passenger and freight rates and revenues. In the case of the Cleveland, Cincinnati, Chicago & St Louis Railway, railroad trackage and equipment expanded along with *train mile earnings*, while its passenger and freight rates remained relatively flat.

The *income factors* (panel B) presents a 10-year history on gross and net earnings, maintenance and other expenses, common and preferred dividends, and balance carried forward. More importantly, the calculated *total net income* is carried over to Appendix I to calculate the *factor of safety* for the securities with the highest priority lien. As well, the *margin of safety* measure, defined as 'the proportion of total net income remaining after payment of all current fixed obligations, including taxes, car trust principal and interest payments, miscellaneous items, etc.' (Moody 1909, p. 94), is a measure of the security of required interest and other charges.

The *capitalization factor* table (panel C) provides a 10-year history on major forms of financial capital outstanding, and several capital-performance measures, including margin-of-safety measures for preferred and common stock. The panel shows trends in the railroad company's capital structure decisions, along with trends in return-on-capital (*net income on net capitalization*).[8] Preferred and common dividends are listed next. Finally, the *margin of safety* measures are listed separately for preferred and common dividends, reflecting the extent that net income exceeded the level of preferred and common dividends paid, respectively. These dividend coverage ratios then apparently served as the basis for Moody's system of stock ratings, as further discussed below.

IV

Appendix III gives the ratings definitions used by Moody. Moody based the ratings definitions on an analysis of the risk factors that affected the pricing of railroad securities at the time. In particular, the rating system was based on a dichotomy between:

High-quality securities: securities whose prices were affected almost exclusively by interest-rate risk. Moody (1909, p. 122) describes these as 'Securities which are beyond or above the influences of fluctuating earning power', and

Lower-quality securities: securities whose prices in addition were affected by changes in the earnings power of the issuing firm. Moody's (1909, p. 122) describes these as 'Securities, the values of which are almost exclusively affected by changes in earning power.'

Accordingly, 'A'-rated (that is, A, Aa and Aaa) security prices were mostly affected by interest-rate risk and little affected by the railroad's earnings-power risk, much like a 'risk-free' security, while 'B' rated securities were somewhat affected, and 'C' rated were largely affected (and thus 'speculative') by changes in a railroad's earnings power. Within a particular letter classification, the distinctions become more minor. Thus,

> In fact, the three ratings, Aaa, Aa and A, can all be regarded as good, and the difference between them is not very great. In a general sense, they are in the class of securities which are affected more by general conditions and changing money rates, than by fluctuations in earning capacity. (Moody 1909, p. 193)

The distribution of ratings from Moody's 1909 rating system is given in panel A of Table 1. What is perhaps surprising is the large number of Aaa-rated securities: 38.94 percent of securities were rated as Aaa, the largest percentage of any rating category. In addition, 85.25 percent of securities were rated as A, Aa or Aaa. Panel A also shows the

[8] Railroad capitalization was a particular issue at the time. As Moody points out: 'No other question in connection with the railroads has agitated the public mind during the recent years as has that of the capitalization of the roads. It is held in many quarters that the railroads of the United States are enormously over-capitalized; that half their bonds represent speculative values and most of their stocks water. And yet a little demonstration can easily show that as measured by earning capacity (the ability to show profits) they are not over-capitalized at all.'

frequency distributions of the *security* factor and the *salability* factor. The overwhelming number of 'A'-rated securities is in contrast to the more recent paucity of such securities, for example, as discussed by Vazza and Cantor (2002).

Table 1. *Frequencies of ratings, security and salability*

Panel A The table below gives frequencies (Freq.) and percentages (%) for each category of bond ratings (Rating) and for the *security* and *salability* factors, which served as the basis for the bond ratings.

Rating	Freq.	%	*Security*	Freq.	%	*Salability*	Freq	%
Aaa	454	38.94	VH	570	48.89	VH	380	32.59
Aa	299	25.64	H	397	34.05	H	538	46.14
A	241	20.67	G	115	9.86	G	121	10.38
Baa	60	5.15	M	9	0.77	M	1	0.09
Ba	52	4.46	F	37	3.17	F	97	8.32
B	32	2.74	D	10	0.86	P	5	0.43
Caa	4	0.34	Unassigned	28	2.40	Unassigned	24	2.06
Ca	10	0.86						
C	9	0.77						
D	3	0.26						
E	2	0.17						
Total	1166			1166			1166	

Panel B Bond ratings versus the *security* factor

The table below gives the frequencies of bond rating versus the *security* factor, the levels of which are: VH (very high), H (high), G (good), M (moderate), F (fair) and D (doubtful).

	Security					
Rating	VH	H	G	M	F	D
Aaa	436	13	0	0	0	0
Aa	113	185	0	0	0	0
A	21	185	26	0	0	0
Baa	0	11	48	0	1	0
Ba	0	3	28	0	19	0
B	0	0	12	3	12	0
Caa	0	0	1	0	2	0
Ca	0	0	0	5	1	3
C	0	0	0	1	2	4
D	0	0	0	0	0	1
E	0	0	0	0	0	2

Continued

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Table 1. *Continued*

Panel C Bond ratings versus *salability* factor

The table below gives the frequencies of bond rating versus the *salability* factor, the levels of which are: VH (very high), H (high), G (good), M (moderate), F (fair) and P (poor).

	Salability					
Rating	VH	H	G	M	F	P
Aaa	278	171	0	0	0	0
Aa	63	209	25	0	1	0
A	32	111	71	0	18	0
Baa	4	32	7	0	17	0
Ba	1	10	10	0	29	0
B	1	5	5	0	17	0
Caa	0	0	1	0	3	0
Ca	1	0	0	1	7	1
C	0	0	2	0	5	1
D	0	0	0	0	0	1
E	0	0	0	0	0	2

This distribution of ratings would imply that Moody generally regarded railroad securities as of high quality. Moody's view is partially supported by Hickman (1958) (and as discussed in Sylla 2002), whose results showed that agency ratings (constructed as a composite average of the ratings of Moody's, Standard & Poor's and Fitch) performed quite well over the period 1900–43. The loss rates of Aaa, Aa, A and Baa (or their equivalents with other agencies), respectively, were -0.6, -0.4, -0.1 and -0.3 percent over the sample bonds' life spans. Therefore, bond ratings appear to have performed well in forecasting subsequent security performance in terms of loss rates. The topic of the default risk in railroad securities at the time of Moody's 1909 analysis will be formally analyzed in Section VI below and further discussion contained in the study's conclusions.

In addition to the ratings distribution, panel B and panel C of Table 1 show the cross-tabulation of the bond ratings with the *security* factor and the *salability* factor, respectively. As would be expected, the concentration of ratings lies along the diagonal of the two tables, with the diagonal clustering more concentrated with the *security* factor, reflecting its greater importance in Moody's bond-rating outcomes.

Moody's 1909 ratings approach was inclusive of all railroad securities, i.e. railroad bond, preferred stock and common stock issues. Moody's rationale was simple:

While bond and stock issues of corporate undertakings represent, technically, two absolutely distinct classes of obligations, yet through qualification of terms and modification of original

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forms, these two great classes of securities so blend and interlace in modern corporate finance, that their values as investments must be ascertained largely by the same methods of analysis. (Moody's 1909, p. 50)[9]

Much less discussion of the establishment of common and preferred stock ratings is given in Moody's 1909 manual. Apparently, these ratings were based on the *margin of safety* calculations (a dividend coverage ratio) for common and preferred stock in the capitalization section, discussed above. Appendix IV gives the common stock and preferred stock ratings for each railroad company (when available), along with the range of bond ratings for the company. In general, a railroad's common stock rating is at the same level, or lower, than the preferred stock rating, which in turn is at the same level, or lower, than the lowest of the company's bond ratings, reflecting the pecking order of the claims of these securities. However, several notable exceptions exist in the table, perhaps for the reason given above by Moody that the modification of the terms of debt and equity contracts can alter the usual rank ordering of these securities.

V

Studies of bond ratings, such as Kaplan and Urwitz (1979), Pinches and Mingo (1973) and Pogue and Soldofsky (1969), use various financial and accounting factors, such as security subordination, interest coverage, profitability, firm leverage and issue or firm size, to replicate the ratings system used by Moody's and other rating agencies. However, as discussed above, Moody based his 1909 bond ratings approach on two explicit factors: (1) the *security* of the issue, reflecting its *security of principal and permanency of income*, and (2) the *salability* of the issue, reflecting its liquidity. Our analysis first investigates the extent to which these two explicit factors – *security* and *salability* – explain Moody's assignment of bond ratings.

In addition, Moody based ratings assignments on his personal judgment concerning individual securities. The study analyzes what factors might have shaped his judgment by incorporating two sets of covariates. First, the study investigates three accounting variables: (1) *leverage*: the ratio of long-term obligations (bonds outstanding plus capitalized leases) to total capital, (2) *profit*: the ratio of net income to total capital, and (3) *size*: total railroad system capital. Similar accounting variables have been predictive in other bond ratings studies. In addition, construction of these

[9] The 1909 manual also discusses how preferred shareholders might: (1) hold voting rights, at times to the exclusion of other shareholders, (2) be given a lien on property, or (3) share in profits with common shareholders. As well, 'there are many railroad bond issues which provide for voting power under certain conditions; there are others which receive their interest only when currently earned by the corporation; there are still others which participate jointly with stock issues in division of certain income' (Moody 1909, p. 50). In Moody's opinion, a railroad's fixed-income securities, often secured by liens on particular trackage or other railroad property, benefitted by growth in railroad earnings, just as with common and preferred stock.

ratios is based on the 10-year average results presented in Moody's 1909 manual, to test whether Moody based his judgment on the long-run performance of these railroad lines.

Second, Moody's judgment also might have been shaped by how individual railroad securities reacted during the panic of 1907, since Moody's first ratings manual was published just some 18 months in the aftermath of the panic. The analysis examines whether bond ratings reflected the following characteristics of the 1907 panic year: (1) *spread*: a security's high minus low price during 1907 divided by the midpoint, a measure of the security's volatility, and (2) *volume*: the total volume of a security's trading activity during the panic months of October and November 1907. Data on (1) and (2) are taken from the January 1908 volume of the *Commercial and Financial Chronicle* (*CFC*). Note that these latter two variables are available only for bonds listed in the *CFC*.

An ordinal regression approach is adopted to account for the ordinal scale of the ratings. Let Y be the assigned bond rating (the ordinal response variable) with J = 11 potential categories: Aaa, Aa, A, Baa, Ba, B, Caa, Ca, C, D and E. The model assumes that values of Y are drawn independently from a multinomial distribution. Let $\gamma_{ij} = \text{Prob}(Y \leq j \mid x_i)$, j = 1 to J, be the cumulative probability of observation i being drawn from rating categories less than or equal to j, where x_i is a vector of independent variables. Note that $\gamma_{iJ} = 1$, hence only the first (J-1) γ's are needed in the model. Then γ_{ij} is given as:

$$\gamma_{ij} = \text{inv link}[\ (\theta_j - \boldsymbol{\beta}^{\mathbf{T}}\mathbf{x_i})/\sigma\ ]$$

where
inv link is the inverse function of the link function,
θ is a vector of threshold parameters,
$\boldsymbol{\beta}^{\mathbf{T}}\mathbf{x_i}$ is the 'regression' part of the model, and
σ is a scaling parameter.

In particular, a complementary log-log link function was used as the link function, and SPSS was used to perform the ordinal regression. In the ordinal regression analysis, the *security* and *salability* factors are categorical regression variables and the other financial variables are treated as continuous covariates.

The data analyzed by ordinal regression consists of the universe of railroad lines analyzed by Moody in the 1909 manual. A subsample of this universe was used to analyze the two panic variables: *spread* and *volume*, namely those securities listed in the January 1908 volume of the *CFC*, which published the high and low prices and NYSE trading volumes for railroad bonds over 1907. We refer to this subsample of securities as the: *CFC-rated bond sample*. The sample size of these two data samples, and the distribution of bond ratings for each, is given in Table 2. Table 3 then gives sample characteristics for the seven explanatory variables discussed above.

Finally, to make the regression analysis more robust and more comparable across data samples, some ratings and *salability* categories with few observations were combined. Specifically, ratings below single B (that is, Caa, Ca, C, etc.) are combined into

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Table 2. *Comparison of the Moody's bond universe and the CFC-rated bond sample*

Moody's bond universe that was rated covered a much larger sample of railroad bond's than the bond sample reported on by the *Commercial and Financial Chronicle* (*CFC*), a leading weekly investment news source of the day that reported bond quotes, sale prices and sales volume for selected securities. A bond's coverage in the *CFC* is most likely an important indicator of trade interest in the security.

Moody's bond universe				*CFC*-rated bond sample			
Rating	Frequency	Percent	Cumulative percent	Rating	Frequency	Percent	Cumulative percent
Aaa	449	39.5	39.5	Aaa	165	45.2	45.2
Aa	298	26.2	65.7	Aa	92	25.2	70.4
A	232	20.4	86.1	A	63	17.3	87.7
Baa	60	5.3	91.4	Baa	12	3.3	91.0
Ba	50	4.4	95.8	Ba	17	4.7	95.7
B	26	2.3	98.1	B	12	3.3	99.0
Caa	3	.3	98.4				
Ca	9	.8	99.2	Ca	2	.5	99.5
C	7	.6	99.8	C	2	.5	100.0
D	1	.1	99.9				
E	2	.2	100.0				
Total	1137	100.0		Total	365	100.0	

Note: Moody's bond universe includes all bonds rated by Moody as given in his 1909 manual. However, in contrast to Table 1, the *CFC*-rated bond sample is the sample of railroad bonds reported on in the *CFC* that were also rated by Moody in the 1909 manual.

a single 'sub-B' category. As well, for the *salability* factor, categories M (medium) and P (poor) are combined with the category F (fair).

The left-hand-side (panel A) of Table 4 presents results of an ordinal regression of Moody's bond ratings on the *security* and *salability* factors, on which Moody explicitly based his ratings assignments. The data analyzed are the universe of railroad firms rated by Moody. As the results show, the overall fit of the model is significant with chi-square value of 1916.441 (with 8 degrees of freedom). The pseudo R-square measures range from 0.563 to 0.858, depending on the measure used, indicating that these two factors appear to explain a significant amount of the variation in the ratings assignment.

In panel B of Table 4, three covariates are added to the ordinal regression analysis of panel A, namely (1) *size*, calculated as total capital, (2) *leverage*, calculated as bonds outstanding plus capitalized leases to total capital, and (3) *profit*, calculated as net income to total capital. All three covariates are constructed from data on 10-year averages presented in Moody's 1909 manual. With these three additional covariates, the model fit

Table 3. *Sample characteristics of the regression covariates*

Moody's rated bond universe					
	N	Minimum	Maximum	Mean	Std. Deviation
Size (net capital)	1137	$9,622	$174,460	$71,825	$39,906
Leverage	1137	21.68%	286.44%	81.56%	38.26%
Profit (income_to_capital)	1137	1.10%	18.00%	7.09%	2.63%
CFC-rated bond sample					
	N	Minimum	Maximum	Mean	Std. Deviation
Size (net capital)	365	$9,622	$174,460	$66,216	$36,461
Leverage	365	21.68%	286.44%	73.23%	27.47%
Profit (income_to_capital)	365	2.10%	12.70%	6.72%	2.59%
Volume	365	0	9,690	148.51	684.81
Spread	365	-3.88%	60.87%	8.59%	8.28%

Continued

Table 3. *Continued*

Sample means: Moody's rated bond universe

Rating	Sample size	Net capital	Leverage	Income to capital
Aaa	449	76,987	91.56%	8.81%
Aa	298	70,067	78.14%	6.69%
A	232	71,444	74.85%	5.72%
Baa	60	67,997	74.12%	5.85%
Ba	50	62,446	66.64%	4.49%
B	26	51,919	67.78%	4.64%
Caa	3	42,411	64.06%	3.87%
Ca	9	46,030	74.58%	4.92%
C	7	45,136	62.80%	3.99%
D	1	77,721	43.54%	1.10%
E	2	77,721	43.54%	1.10%
Total	1137			

Sample means: *CFC*-rated bond sample

Rating	Sample size	Net capital	Leverage	Profit	Volume	Spread
Aaa	165	70,990	74.57%	8.19%	165	6.76%
Aa	92	62,092	73.44%	6.20%	191	7.13%
A	63	66,062	75.15%	5.17%	50	10.24%
Baa	12	58,054	74.44%	5.06%	69	15.28%
Ba	17	58,079	61.93%	4.15%	152	15.64%

B	12	60,116	62.46%	4.71%	212	15.18%
Caa	0					
Ca	2	44,446	62.86%	4.40%	140	22.29%
C	2	43,505	55.73%	3.5%	29	22.27%
D	0					
E	0					
Total	365					

Note: Moody's bond universe includes all bonds rated by Moody as given in his 1909 manual. The *CFC*-rated bond sample is the sample of railroad bonds reported on in the *CFC* that were also rated by Moody in the 1909 manual.
Net capital is taken from Moody's (1909) table C for each railroad line, and is defined as stock outstanding plus bonds outstanding plus rentals capitalized at 5 percent minus the company's Treasury securities. *Leverage* is calculated as (bonds outstanding plus rentals capitalized at 5 per cent) divided by net capital. *Profit* is taken from Moody's (1909) table C for each railroad line, where it is listed as net income on net capital. *Volume* is calculated as the sum of the volume of bonds traded, as reported in the *CFC*, for the weekly reporting dates: 4 October – 29 November 1907. *Spread* is calculated as the security's high price minus its low price for the year 1907 divided by the midpoint of this range. The data are taken from the *CFC*. As the results above illustrate, the ratings' rank ordering roughly reflects the rank ordering of averages for size, leverage and profit variables, and inversely the rank ordering of averages for spread. Note also that the *CFC* subsample of bonds is about one-third of the size of Moody's rated bond universe, implying that roughly two-thirds of this universe is not reported on by the *CFC*.

Table 4. *Ordinal regression analysis of Moody's rated bond universe*

Panel A

Model fitting information

Model	-2 log likelihood	Chi-square	df	Sig.
Intercept Only	1916.441			
Final	.000	1916.441	8	.000

Goodness of fit

	Chi-square	df	Sig.
Pearson	350.255	112	.000.
Deviance	396.062	112	.000

Pseudo R-square

Cox and Snell	.815
Nagelkerke	.858
McFadden	.563

Parameter estimates

	Estimate	Std. error	Wald	df	Sig
Threshold:					
[Rating1909 = Aaa]	.516	.064	64.453	1	.000
[Rating1909 = Aa]	1.796	.089	407.156	1	.000
[Rating1909 = A]	3.199	.122	682.865	1	.000
[Rating1909 = Baa]	3.731	.135	769.264	1	.000
[Rating1909 = Ba]	4.357	.156	780.809	1	.000
[Rating1909 = B]	4.877	.179	745.626	1	.000
Location:					
[Security=D]	8.588	3.447	6.208	1	.013
[Security=F]	3.626	.254	204.048	1	.000
[Security=G]	2.886	.158	331.995	1	.000
[Security=H]	1.724	.099	302.719	1	.000
[Security=M]	4.715	.592	63.447	1	.000
[Security=VH]	0[a]	.	.	0	.
[Salability=F]	1.303	.167	60.672	1	.000
[Salability=G]	1.260	.131	92.871	1	.000
[Salability=H]	.526	.083	39.932	1	.000
[Salability=VH]	0[a]	.	.	0	.

a. This parameter is set to zero because it is redundant.

Panel B

Model fitting information

Model	-2 log likelihood	Chi-square	df	Sig.
Intercept Only	2999.058			
Final	1254.119	1744.939	11	.000

Goodness of fit

	Chi-square	df	Sig.
Pearson	2507.040	1417	.000
Deviance	1119.926	1417	1.000

Pseudo R-square

Cox and Snell	.784
Nagelkerke	.826
McFadden	.512

Parameter estimates

	Estimate	Std. error	Wald	df	Sig.
Threshold:					
[Rating1909 = Aaa]	-.423	.321	1.743	1	.187
[Rating1909 = Aa]	2.758	.354	60.868	1	.000
[Rating1909 = A]	6.852	.456	225.406	1	.000
[Rating1909 = Baa]	9.140	.535	291.985	1	.000
[Rating1909 = Ba]	11.418	.604	357.603	1	.000
[Rating1909 = B]	13.661	.732	348.480	1	.000
Location:					
Size	-1.053E-6	1.789E-6	.346	1	.556
Leverage	-.007	.002	9.497	1	.002
Profit	-.198	.034	33.124	1	.000
[Security=D]	34.353	.000		1	
[Security=F]	10.164	.568	320.413	1	.000
[Security=G]	7.923	.421	354.573	1	.000
[Security=H]	3.441	.209	270.275	1	.000
[Security=M]	13.566	1.004	182.602	1	.000
[Security=VH]	0	.	.	0	.
[Salability=F]	3.281	.332	97.818	1	.000
[Salability=G]	2.937	.267	121.001	1	.000
[Salability=H]	1.028	.171	36.098	1	.000
[Salability=VH]	0	.	.	0	.

The table presents an ordinal regression analysis of bond rating on (1) the *security* and *salability* factors, which were the explicit basis for rating assignments, in the left-side panel, and (2) these two factors plus three accounting covariates: (a) leverage, calculated as bonds outstanding plus capitalized leases to total capital, (b) profit, calculated as net income to total capital and (c) size, calculated as total capital, in the right-side panel. The data analyzed are the universe of bonds rated by Moody in his 1909 analysis of railroad securities. Finally, to make the regression results more robust, and more comparable across panel A and panel B, some ratings and *salability* categories with few observations were combined. Specifically, ratings below single B (that is, Caa, Ca, C, etc.) are combined into a single 'sub-B' category, which is the default category in the table above. As well, for the *salability* factor, categories M (medium) and P (poor) are combined with the category F (fair). Finally, since the ordinal regression models the cumulative probability, the 'redundant parameter' occurs at a cumulative probability of unity, i.e. at the highest rating of VH.

is again statistically significant. The pseudo R-square measures range from 0.512 to 0.826, indicating approximately the same model explanatory power as with the previous regression model. The *profit* variable is significant at the 0.001 level and its negative coefficient indicates that more profitable firms achieved higher ratings (that is, ratings were coded in the analysis as 1 = Aaa, 2 = Aa, 3 = A, etc). The *leverage* variable

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is significant at the 0.01 level, and its negative coefficient indicates that more leveraged firms realized higher ratings. Finally, the *size* variable does not prove to be a statistically significant predictor of ratings assignment in this context.

The above two ordinal regressions are repeated in Table 5, but now using a subset of the study data that includes only those bonds that were rated and also listed in the *Commercial and Financial Chronicle* (*CFC*). This data subsample was selected to allow inclusion of two additional covariates related to the panic of 1907, namely (1) *spread*, which measures a security's volatility as the percentage spread of a security's high and low prices during the panic year of 1907, and (2) *volume*, which reflects a security's liquidity during the panic, measured as the total volume of a security's trading activity during the panic months of October and November of 1907. Data on these two variables are taken from the *CFC*.

In panel A of Table 5, the ordinal regression with just the *security* and *salability* variables is repeated with the *CFC* rated bond sample. Note in particular that the pseudo R-square measures now range from 0.642 to 0.891, indicating that these publicly followed and rated railroad bonds show somewhat more predictable behavior as reflected in the model's explanatory power. As shown in Table 2, the distribution of ratings is comparable in the two samples, so the ratings distribution is not a factor behind the greater explanatory power. Plausibly, the *CFC* sample is more transparent, in the sense that its published accounting and market information more accurately reflects the quality of these firms.

Finally, the regression analysis of panel A of Table 5 is repeated to include the three accounting covariates and the two *panic-of-1907* covariates. The results are presented in panel B. The pseudo R-square measures now range from 0.941 to 0.999, again indicating that the publicly followed and rated railroad bonds show more predictable behavior. While the *profit* covariate is still highly significant: the *size* covariate is now significant in place of the leverage covariate. As well, the *panic-of-1907* covariates are not significant predicators of rating assignment. One implication is that Moody based his ratings assignment on the two explicit factors: *security* and *salability* and the two 'judgmental' covariates: *profit* and *size* (in this case), while the performance of railroad bonds during the 1907 panic does not seem to have shaped Moody's judgment. All of these variables, except for the *salability* measure, are based on 10-year average results for each railroad system as presented in the manual. Thus Moody's rating assignments appear indeed to reflect the *permanency and stability* that Moody sought in his rating system.

VI

The large percentage of securities that were A-, Aa-, and Aaa-rated, as given in Table 1, suggests that Moody considered default probabilities of railroad securities to be too low to be the focus of his security analysis. Indeed, in Moody's 1909 manual virtually no attention was given to the issue of security default and the consequent losses. To further examine the issue of default probabilities, the study adopts

Table 5. *Ordinal regression analysis of the CFC rated bond sample*

Panel A

Model fitting information

Model	-2 log likelihood	Chi-square	df	Sig.
Intercept Only	668.318			
Final	.000	668.318	8	.000

Goodness of fit

	Chi-Square	df	Sig.
Pearson	167.139	106	.000
Deviance	159.094	106	.001

Pseudo R-square

Cox and Snell	.840
Nagelkerke	.891
McFadden	.642

Parameter estimates

	Estimate	Std. error	Wald	df	Sig.
Threshold :					
[Rating1909 = Aaa]	.557	.093	36.132	1	.000
[Rating1909 = Aa]	1.891	.162	136.152	1	.000
[Rating1909 = A]	3.147	.212	220.031	1	.000
[Rating1909 = Baa]	3.461	.224	238.687	1	.000
[Rating1909 = Ba]	4.015	.256	245.004	1	.000
[Rating1909 = B]	4.822	.330	214.094	1	.000
Location:					
[Security=D]	9.412	6.813	1.908	1	.167
[Security=F]	3.542	.390	82.569	1	.000
[Security=G]	3.029	.299	102.571	1	.000
[Security=H]	1.976	.191	107.317	1	.000
[Security=M]	6.083	1.450	17.596	1	.000
[Security=VH]	0[a]	.	.	0	
[Salability=F]	1.068	.446	6.001	1	.014
[Salability=G]	.928	.266	12.212	1	.000
[Salability=H]	.488	.143	11.578	1	.001
[Salability=VH]	0[a]	.	.	0	

a This parameter is set to zero because it is redundant.

Panel B

Model fitting information

Model	-2 log likelihood	Chi-square	df	Sig.
Intercept Only	1033.846			
Final	0.000	1033.846	13	.000

Goodness of fit

	Chi-Square	df	Sig.
Pearson	834.641	2093	1.000
Deviance	439.721	2093	1.000

Pseudo R-square

Cox and Snell	.941
Nagelkerke	.999
McFadden	.993

Parameter estimates

	Estimate	Std. error	Wald	df	Sig.
Threshold:					
[Rating1909 = Aaa]	-.903	.687	1.835	1	.176
[Rating1909 = Aa]	3.029	.756	16.063	1	.000
[Rating1909 = A]	7.144	.967	54.595	1	.000
[Rating1909 = Baa]	8.778	1.059	68.729	1	.000
[Rating1909 = Ba]	11.449	1.213	89.072	1	.000
[Rating1909 = B]	32.950	86.645	.145	1	.704
Location:					
Size	-1.299E-5	4.10E-6	10.021	1	.002
Leverage	.002	.005	.207	1	.649
Profit	-.305	.073	17.559	1	.000
PercentSpread	.029	.016	3.164	1	.075
TotalVolume	.000	.000	2.114	1	.146
[Security=D]	44.920	245.958	.033	1	.855
[Security=F]	10.946	1.074	103.918	1	.000
[Security=G]	8.656	.878	97.259	1	.000
[Security=H]	4.586	.506	82.222	1	.000
[Security=M]	21.461	59.105	.132	1	.717
[Security=VH]	0[a]	.	.	0	.
[Salability=F]	4.092	.912	20.136	1	.000
[Salability=G]	2.233	.556	16.120	1	.000
[Salability=H]	0.880	.288	9.341	1	.002
[Salability=VH]	0[a]	.	.	0	.

a This parameter is set to zero because it is redundant.

The table presents an ordinal regression analysis of bond rating on (1) the security and salability factors, which were the explicit basis for rating assignments, in the left-side panel, and (2) these two factors plus three accounting covariates: (a) *Leverage*, calculated as bonds outstanding plus capitalized leases to total capital, (b) *Profit*, calculated as net income to total capital and (c) *Size*, calculated as total capital, and two panic-of-1907 covariates: (1) *PercentSpread*, calculated as the percentage spread of a security's high and low prices during 1907, a measure of the security's volatility, and (2) *TotalVolume*, calculated as the total volume of a security's trading activity during the panic months of October and November of 1907, in the right-side panel. Data on these latter two variables were taken from the *CFC*. The data analyzed are those rated railroad bonds that were also listed in the *CFC*. Finally, to make the regression results more robust, and more comparable across panel A and panel B, some ratings and *salability* categories with few observations were combined. Specifically, ratings below single B (that is, Caa, Ca, C, etc.) are combined into a single 'sub-B' category, which is the default category in the table above. As well, for the *salability* factor, categories M (medium) and P (poor) are combined with the category F (fair). Finally, since the ordinal regression models the cumulative probability, the 'redundant parameter' occurs at a cumulative probability of unity, i.e. at the highest rating of VH.

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an options-based procedure by Vassalou and Xing (2004) to extract default risk measures from the common equity prices of railroad firms, using daily equity quotes listed in the *Commercial and Financial Chronicle*. To construct a robust test of whether default risk was a factor behind security ratings, the study focuses on the year 1907, in particular to examine how the panic of 1907 impacted default measures, and conversely, the extent to which the panic of 1907 involved a solvency crisis among listed railroad companies.

Two default risk measures are presented by Vassalou and Xing (2004), namely, the 'distance-to-default' (DD), which measures the number of standard deviations from the current value of $\ln(V_A/X)$ to a value of zero (where default occurs), and the default likelihood indicator (DLI), both as given next.

$$DD = [\ln(V_{A,t}/X_t) + (\mu - \tfrac{1}{2}\sigma_A^2)T]/(\sigma_A\sqrt{T})$$
$$DLI = N(-DD)$$

Where

$V_{A,t}$ is the value of assets,

X_t is the strike price, that is, the level of liabilities due at the end of the estimation period,

μ is the mean asset return,

σ_A is the volatility of assets,

T is the timeframe of the default likelihood estimation, here taken to be one year, and

N(x) is the cumulative normal distribution to the point x.

Table 6 lists the sample of railroad firms used in this study and their Moody's bond ratings. The table also lists the minimum and maximum values of the distance-to-default (DD) measure over the study's sample period. Recall that DD measures the number of standard deviations of $\ln(V_A/X)$ to a value of zero As can be seen in the table, the default measure for most of the companies remained far from any solvency concerns throughout the crisis. The only railroad firm to reach within two standard deviations of default is Chicago & Alton Railroad, which in fact reached technical insolvency during the crisis. Therefore, these results appear to reject the hypothesis that railroad insolvency was a significant factor associated with the panic of 1907 and accordingly behind the construction of ratings by Moody in 1909.

VII

Moody's first publication of a security analysis and ratings system in 1909 spawned a highly successful ratings industry. Sylla (2002) credits the advent of this industry as *a fusion of functions performed by* the financial press, the investment banker and the credit-reporting agency. Moody's approach to security ratings featured: (1) an explicit security analysis system based on analyzing the *security* and *salability* of railroad securities, (2) a rating system which served to signal Moody's security appraisal to investors,

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Table 6. *Distance-to-default (DD) measure results*

Railroad company	Moody's 1909 bond rating	DD measure stated as the number of st. devs., over 29/6/1907-27/12/1907 Min	Max
(1) Atcheson Topeka & Santa Fe RR	A-Aaa	78	107
(2) Atlantic Coast Line RR	A-Aaa	46	75
(3) Baltimore & Ohio RR	A-Aaa	84	110
(4) Canadian Southern RR	A-Aa	38	47
(5) Central of New Jersey RR	Aaa-Aaa	78	93
(6) Chesapeake & Ohio RR	A-Aaa	28	44
(7) Chicago & Alton RR	A-Aaa	-0	8
(8) Chicago Mil & St Paul RR	Aaa-Aaa	104	135
(9) Chicago & North Western RR	Aa-Aaa	174	196
(10) Chicago St P Minn & Omaha RR	Aaa-Aaa	74	86
(11) Colorado & Southern RR	A-Aa	26	47
(12) Delaware & Hudson RR	Baa-Aaa	107	132
(13) Delaware Lack & Western RR	Aa-Aaa	159	172
(14) Denver & Rio Grande RR	B-Aaa	16	34
(15) Duluth So Shore & Atlantic RR	Unrated	5	15
(16) Erie RR	B-Aaa	19	48
(17) Illinois Central RR	Aa-Aaa	114	134
(18) Iowa Central RR	Caa-Ba	15	34
(19) Kansas City Southern RR	A-Aa	28	39
(20) Lake Erie & Western RR	Ba-A	12	22
(21) Louisville & Nashville RR	A-Aaa	92	118
(22) Minneapolis & St Louis RR	Ba-Aaa	12	36
(23) Minn St P & S S Marie RR	Aa-Aa	42	68
(24) Mo Kansas & Texas RR	Baa-Aa	31	59
(25) Missouri Pacific RR	Ca-Aaa	52	80
(26) Nash Chatt & St Louis RR	Aa-Aaa	63	77
(27) NY Central & Hudson River RR	Ba-Aaa	122	145
(28) NY Chic & St Louis RR	Unrated	14	32
(29) NY N Haven & Hartfort RR	Baa-Aaa	98	120
(30) NY Ontario & Western RR	A-Aaa	80	99
(31) Norfolk & Western RR	A-Aaa	81	103
(32) Pacific Coast Co	Unrated	43	62
(33) Pennsylvania RR	A-Aaa	253	276
(34) Pittsb Cin Chic & St L RR	Unrated	36	48
(35) Reading Co.	A-Aaa	72	95
(36) St Louis Southwestern RR	B-A	7	23

Continued

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Table 6. *Continued*

Railroad company	Moody's 1909 bond rating	DD measure stated as the number of st. devs., over 29/6/1907-27/12/1907 Min	Max
(37) Southern Pacific Co	A-Aaa	104	128
(38) Texas & Pacific RR	A-Aaa	14	26
(39) Union Pacific RR	Aa-Aaa	64	81
(40) Wabash RR	Ba-Aaa	7	24
(41) Wheel'g & Lake Erie RR	B-Aa	4	16
(42) Wisconsin Central RR	Baa-Aa	5	17

The table presents results from a Vassalou and Xing (2004) structural default-risk analysis to extract default risk measures from the common equity prices of railroad firms with daily equity quotes. Equity data on railroad firms are taken from *CFC*. The DD measure gives the estimated distance-to-default, in terms of the number of standard deviations (st. devs.) from the current value of $\ln(V_A/X)$ to a value of zero (where default occurs). DD is measured as $[\ln(V_{A,t}/X_t) + (\mu - \frac{1}{2}\sigma_A^2)T]/(\sigma_A\sqrt{T})$, where $V_{A,t}$ is the value of assets, X_t is the strike price, that is, the level of liabilities due at the end of the estimation period, μ is the mean asset return, σ_A is the volatility of assets, and T is the timeframe of the default likelihood estimation, taken to be one year.
Min is the minimum, and Max is the maximum, distance-to-default (DD) measure for each stock over the period: 29 June 1907 – 27 Dec. 1907.

and (3) a focus on 10-year data histories that allowed investors to analyze trends in the railroad industry, much as with other financial publications.

Moody may have intended his ratings to serve as a mechanism for conveying his private information to investors. As well, without relying on a private-information explanation, the ratings might have been intended to serve in an agency role, where 'the ratings solved a principal-agent problem between investors and company managers', or alternatively, that ratings 'help to resolve conflicts of interest that might otherwise exist among the owners of financial assets' (Sylla 2002, pp. 26-7). For example, Moody's ratings might have served to protect minority shareholders from the concentrated ownership of US railroads at the time. Finally, Smith and Walter (2002) hypothesize that rating agencies may provide informational economies by collecting and analyzing information for security investors more efficiently than investors could individually.

To test these hypotheses the study adopts an ordinal regression analysis of Moody's bond ratings. The basic regression analysis incorporates Moody's two explicit factors, *security* and *salability*. Moody based his ratings construction on these two explicit

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factors plus his judgment concerning the securities. In the resulting regression analysis with these two explicit factors, the resulting pseudo R-square measure ranged from 56.3 to 85.8 percent depending on the specific measure used. Therefore, these explicit factors account for a large portion of the ratings variability.

To test the basis of Moody's judgment, additional implicit factors were incorporated into the ordinal regression. The covariates: *size* (calculated as total railroad capital), *leverage* (calculated as bonds outstanding plus capitalized leases to total capital) and *profit* (calculated as net income to total capital) were constructed from 10-year average data presented in Moody's manual. The regression results indicate that the *profit* and *leverage* covariates were significant, while the *size* covariate was not a significant predictor of ratings, when combined with the two explicit factors. However, the regression pseudo R-square does not improve over the regression model with the two explicit covariates. Therefore, these additional accounting ratios do not add explanatory power.

To further test the basis of Moody's judgment, two additional variables are constructed that reflect financial-market conditions during the panic year of 1907. This panic occurred some 18 months prior to the publication of Moody's first manual, and security performance during the panic may have shaped Moody's judgment. These panic-of-1907 variables are (1) *spread*: a security's high minus low price during 1907 divided by the midpoint, which reflects the security's volatility during 1907, and (2) *volume*: the total volume of a security's trading activity during the panic months of October and November 1907, which reflects the security's liquidity during the panic months. These two covariates did not prove to be significant, suggesting that Moody's judgment was not shaped by the panic conditions of 1907. Moody's stated intention was to construct a system of ratings that reflected 'the element of permanency and stability' (Moody 1909, p. 61) and the lack of significance of the panic-of-1907 covariates gives support to the statement.

The regression results also show that bond-rating predictability is much greater for the subsample of rated bonds (365 out of 1,137 bonds or 32.1 percent of the total rated-bond sample) that also were quoted in the *Commercial and Financial Chronicle*. The pseudo R-square measures for this sample of 365 railroad bonds range from 94.1 to 99.9 percent, while for the universe of rated bonds the pseudo R-square measures range from 51.2 to 82.6 percent. The implication would seem to be that railroad bonds followed by the financial press were much more transparent in terms of the accounting and liquidity measures of the issuing company. Therefore, the advent of Moody's bond ratings most likely had less significance for securities followed in the financial press and greater impact on the much larger sample of securities without financial press coverage.

Furthermore, Moody based much of his explicit analysis on 10-year data histories that were abstracted from Interstate Commerce Commission reports, a very public data source. As Moody states: 'the records of the Interstate Commerce Commission embrace nearly all the facts that are necessary, but they are not presented in very satisfactory form for intelligent and accurate usage' (Moody's 1909, p. 65). His comment

would seem to indicate that Moody felt the contribution of his security analysis and rating system was: (1) the Smith and Walter (2002)-type information economies that accrued from aggregating and organizing the presentation of public data, and (2) his security-analysis approach which focused on the *security* and *salability* of each security issue as an explicit basis for assigning ratings. As discussed above, the *security* and *salability* factors do indeed account for a substantial amount of the variation in ratings.

Moody in 1909 rated 38.94 percent of railroad bonds in his sample as Aaa and 85.25 percent of railroad bonds as A, Aa or Aaa, underscoring his opinion that railroad bonds were generally high-quality securities. In choosing the railroad industry, Moody was able to identify a class of nearly 'risk-free' securities that could serve as substitutes for the illiquid Treasury market of the time. However, Hickman (1958) (and as discussed in Sylla 2002) presented results that indicate that the overall default rate of the railroad industry was higher than with other industries over the period until the time of the 1958 study. The higher default rate of railroad bonds may have reflected the many intervening events since Moody's 1909 analysis, such as a period during World War I when the railroads were nationalized, increased competition between trucking and railroads, the Great Depression, and regulatory changes that may have disadvantaged the railroads relative to other transportation modes.[10]

To better understand the issue of default risk and how it related to Moody's ratings construction, the present study employs a structural default analysis by Vassalou and Xing (2004). The analysis indicates that the majority of railroad securities faced negligible default risk, even during the panic months of 1907. These results lend support to the discussion above that the railroad industry had achieved a great deal of stability and profitability by 1909, through consolidation within the industry and through federal regulatory efforts to stabilize railroad rates.

An implication of the structural-default analysis results is that Moody was perhaps correct not to focus his analysis on the default or credit risk of the railroad bonds he rated. In fact, Moody makes virtually no mention of the default issue in his manual. As an alternative explanation, the results of Elton *et al.* (2001) show that much of a bond's yield spread is indeed unrelated to default risk, and is rather related to the same risk factors that affect equity pricing. Moody's security-analysis approach seems to capture the intuition of this result, since Moody focused on an investment (rather than a credit or default) analysis of railroad securities, which, as well, was conceived as a common framework for analyzing railroad bond, preferred stock and common stock issues. Moody's rationale was simple:

> While, in the abstract, the value of a mortgage bond depends on the value of the property back of it, and this is, as already pointed out, the first primary question to be determined by the prospective bond investor, still as a matter of practice in the great majority of cases the vital ques-

[10] The author thanks a referee for making this point.

tions of income results and possibilities of future growth and expansion in the property must come in for full consideration, just as they must in the cases of analyzing the ordinary stock issues. In railroads, above all other classes of enterprise, the maker of value is the earning power. (Moody 1909, p. 50)

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Appendix I. Construction of the security and salability factors and the resulting bond ratings

Name of issue	Lien on miles	Average income available	Interest required per mile of system	Factor of safety	Basis for rating		Rating
					Security	Salability	
1. 1st consol 6s	(1st) 175	$2,894	$ 20	80%	VH	H	Aaa
2. 1st 4s	(1st) 170	"	$155	80%	VH	H	Aaa
	(2nd) 175	"					
3. Consol 7s	(1st) 390	"	$151	80%	VH	H	Aaa
4. Gen 6s	(2nd) 390	"	$100	80%	VH	H	Aaa
5. 1st 7s	(1st) 72	"	$ 73	80%	VH	H	Aaa
6. 1st 6s	(2nd) 72	"	$ 15	80%	VH	H	Aaa
7. Consol 5s	(1st) 170	"	$ 67	80%	VH	H	Aaa
8. 1st 4s	(1st) 267	$2,313	$105	64%	H	H	Aa
9. 1st 4s	(1st) 45	"	$ 23	64%	H	H	Aa
10. 1st 4s	(1st) 63	"	$ 13	64%	H	H	A
11. 1st coll 4s	(1st) 194	"	$210	64%	H	H	Aa
12. 1st 4s	(1st) 204	"	$ 84	64%	H	H	Aa
13. Gen 4s	(Gen) 1,117	"	$503	64%	H	H	Aa
14. 1st gtd 5s	(1st) 44	$1,375	$ 63	65%	H	G	A
15. 1st pfd 4s	(1st) 202	"	$ 21	65%	H	G	A
16. 1st pfd 5s	(2nd) 202	"	$ 13	65%	H	G	Baa
17. 1st con 4s	(1st) 150	"	$172	65%	H	G	Baa
	(2nd) 202	"					
18. Income 4s	— —	—	$ 84	—	—	-	C
19. 5% notes	Not mtg	$975	$131	65%	—	-	B

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Name of issue	Lien on miles	Average income available	Interest required per mile of system	Factor of safety	Basis for rating: Security	Basis for rating: Salability	Rating
20. 1st 4s	(1st) 248	—	$ 21	—	—	-	B

Lien on miles gives the type of lien: first (1st), second (2nd), general (Gen) or not mortgaged (Not mtg), followed by the number of track miles covered by the lien. In the table, bond issues 1–7 hold the highest claims on *average income available* (AIA), issues 8–13 hold the second highest claims, followed by issues 14–18, and then by issues 19–20. AIA is the income available to cover the cumulative *interest required per mile of system* (CIR) under the same level of priority, where AIA is averaged over a 10-year historical period for the particular railroad. The *factor of safety* is then calculated as (AIA-CIR)/AIA, e.g. ($2894 - $20-$155-$151-$100-$73-$15-$67)/$2894 = 80%. Note that $2894-$20-$155-$151-$100-$73-$15-$67 = $2,313. The *security* factor is then assigned, in part based on the *factor of safety* value. The *security* factor takes on designations: *Very high, High, Good, Moderate, Fair and Doubtful*. The *salability* factor, which Moody based on the security's trading on the NYSE, takes on designations: *Very high, High, Good, Moderate, Fair and Poor*. Bond ratings are then assigned, in part, based on the *security* and *salability* factors.

Source: The table is abstracted from table D for the Cleveland, Cincinnati, Chicago & St Louis Railway of Moody (1909, p. 397).

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Appendix II. Construction of physical factor, income factor and capitalization factor tables

Panel A. Physical factors (mileage, equipment and operation)

Years ended	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1898	1838	60	467	380	13311	64%	109351	922851	278	$1.31	1.91c	.54c
1899	1838	60	457	381	13479	62	125455	927549	305	1.43	1.84	.54
1900	1891	60	447	384	15666	65	126911	984442	335	1.65	1.94	.58
1901	1891	80	447	392	18836	65	137101	1009564	332	1.63	1.92	.61
1902	1891	102	451	413	18848	64	154598	1064192	305	1.62	1.88	.59
1903	1891	105	479	422	18836	66	157364	1086783	333	1.68	1.94	.64
1904	1891	143	485	428	19491	62	174156	1029851	329	1.74	1.94	.67
1905	1983	218	558	480	22160	63	165486	1243160	353	1.70	1.90	.60
1906	1983	252	648	498	23857	63	180224	1396284	398	1.80	1.91	.59
1907	1983	301	634	496	23490	65	191084	1548224	425	1.86	1.84	.57

The headings for columns (1)–(12) are: (1) *Average miles operated*, (2) *Extra main track*, (3) *Locomotives owned*, (4) *Passenger cars owned*, (5) *Freight and company cars*, (6) *Freight to all traffic (%)*, (7) *Passenger density*, (8) *Freight density*, (9) *Average freight train load (tons)*, (10) *Train mile earnings*, (11) *Average rate per passenger per mile (cents)* and (12) *Average rate per ton per mile (cents)*.

Panel B. Income factors (earnings and their distribution, per mile of road)

Years ended	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1898	$7791	$1037	$1150	$2187	$3454	$2149	$2149	$1959	9%	$190	$204/..	$14
1899	8008	988	1076	2064	3414	2531	2531	1823	28	708	272/..	436
1900	8888	997	1354	2351	3553	2983	2983	1824	39	1158	708/..	451
1901	9154	1197	1369	2566	3854	3033	3100	1866	40	1239	777/247	210

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Continued

1902	9898	1329	1496	2825	4107	2965	3006	1816	39	1190	856/317	17
1903	10783	1525	1681	3206	4705	2869	2949	1876	37	1073	856/164	53
1904	11112	1440	1628	3068	5396	2678	2766	1899	31	867	856/529	518
1905	11355	1512	1710	3222	5290	2843	2965	2022	32	943	916/..	27
1906	12403	1657	1802	3459	5836	3108	3213	2172	32	1041	1014/..	27
1907	13338	1731	2123	3854	6330	3154	3278	2282	30	996	964/..	32

The headings for columns (1)–(12) are: (1) *Gross earnings*, (2) *Maintenance: way*, (3) *Maintenance: equipment*, (4) *Total maintenance*, (5) *Transportation general expenses, etc.*, (6) *Net earnings*, (7) *Total net income*, (8) *Fixed charges*, (9) *Margin of safety*, (10) *Surplus over charges*, (11) *Disposal of surplus: for dividends / For improvements, etc.* and (12) *Balance carried forward*.

Panel C. Capitalization factors (analysis and standing of property)

Years ended	(1) $/%	(2) $/%	(3)	(4) $	(5) $	(6) $	(7) %	(8) $/%	(9) $/%	(10) $/%
1898	20667/40	30911/60	Nom.	51578	2625	48953	4.4 204/3¾			
1899	20667/40	30909/60	"	51576	2665	48911	5.2	272/5		61/
1900	20088/40	30501/60	"	50582	1809	48780	6.1	264/5	444/3 77/50	
1901	20088/40	30088/60	"	50176	1793	48383	6.4	264/5	513/3½	79/47
1902	20316/40	30768/60	"	51084	2177	48907	6.1	264/5	592/4	78/36
1903	20320/39	31294/61	"	51614	2183	49431	6.0	264/5	592/4	75/30
1904	20320/39	31822/61	"	52142	2159	49983	5.5	264/5	592/4	70/
1905	22992/42	31575/58	"	54567	2494	52073	5.7	252/5	664/4	72/3
1906	25214/44	32079/56	"	57293	2516	54777	5.9	252/5	762/4	76/3
1907	28773/45	35105/55	"	63878	3010	60868	5.4	252/5	712/3	74/4

The headings for columns (1) through (12) are: (1) *Stock outstanding and percentage of whole*, (2) *Bonds outstanding and percentage of whole*, (3) *Rentals capitalized at 5 percent*, (4) *Total gross capitalization*, (5) *Owned by company as per balance sheet*, (6) *Net capitalization*, (7) *Net income on net capitalization*, (8) *Preferred dividend: amount per mile / rate*, (9) *Common dividend: amount per mile and rate*, (10) *Margin of safety preferred / margin of safety common*.

Source: These panels are taken from table A (Moody 1909, p. 394), table B (Moody 1909, p. 395) and table C (Moody 1909, p. 396) for the Cleveland, Cincinnati, Chicago & St Louis Railway.

Appendix III. Moody's 1909 bond and stock ratings definitions

Aaa: The bonds and stocks which are given this rating are regarded as of the highest class, both as regards security and general convertibility. Practically all such issues are dependent for their prices on the current rates for money, rather than the fluctuations in earning power. In other words, their position is such that their value is not affected, or likely to be affected (except in the cases of stocks not limited as to dividends), by any normal changes in the earning capacity of the railroad itself, either for better or worse.

Aa: This rating is given to those issues which, while high-grade, are, in a broad sense, slightly inferior to those having the first rating. Sometimes this inferiority may be in security and sometimes in salability. There is, however, but slight difference between these two classes of securities.

A: Bond and stock issues having this rating are affected, to a partial degree, by changing earning power, although they are generally of high grade. No security has been given this rating, which is not regarded, as shown by the results of the decade, as being entirely secure, with a permanent and substantial future. In fact, the three ratings, Aaa, Aa and A, can all be regarded as good, and the difference between them are not very great. In a general sense, they are in the class of securities which are affected more by general conditions and changing money rates than by fluctuations in earning capacity.

Baa: Bonds having this rating are generally good, but have a speculative tinge and often are affected to a degree by declines or increases in the earning capacity of the properties. In other words, they are to be regarded, from the investor's standpoint, as good, but second-grade issues.

Ba: This rating is given to those issues which make a moderately favorable showing and are regarded as well secured, but are more affected by changing earning power. They stand in danger of declining in value with a falling-off in earnings, but, on the other hand, with great improvements in earnings, are apt materially to advance in strength.

B: Issues having this rating are more susceptible to fluctuations, and are to be regarded as more speculative in position than those just mentioned.

Caa: Issues which are almost directly responsive to changes in earning power, and have not during the decade had the benefit of available income equal to more than double the interest requirements, are to be regarded in this speculative class.

Ca: These issues are less strong in position than those mentioned above, and approach more closely to the field of speculative issues with but moderate security.

C: Issues given this rating are those which usually show but a slight margin in surplus above the amount required for their interest, and which are not well secured, or perhaps have not any readily available markets.

D: All issues below C are of doubtful character and of almost purely speculative value. There are few such rated in this book, except in the case of stocks, and the differences between them are more those of degree than of character. It is not the purpose of the book to analyze to any pronounced extent the differences between purely speculative securities and, therefore, no attempt has been made to follow

the ratings lower than this figure. The vital point has been so to classify and rate the high-grade issues and the good stocks as to give the investor or user of the book an approximate idea of the general position, in a relative sense, of the different investment and semi-investment issues.

E: This rating has been given to a few defaulted issues, most of which are awaiting the results of reorganization.

The ratings definitions are taken from Moody (1909, pp. 193-4). Note that the same rating definitions apply to both stock and bond ratings.

Appendix IV. Common-stock, preferred-stock and range-in-bond ratings

	Company	Common stock rating	Preferred stock rating	Bond rating range Low	Bond rating range High	No. of rated bond issues
1	Alabama & Vicksburg	A	—	Aa	Aaa	3
2	Alabama Great Southern	D	A	A	Aa	3
3	Ann Arbor RR	—	—	Baa	Baa	1
4	Atchison Topeka & Santa Fe	A	Aa	A	Aaa	15
5	Atlantic Coast Line	A	—	A	Aaa	26
6	Baltimore & Ohio	Baa	Aa	A	Aaa	17
7	Bangor & Aroostook	B	—	A	Aa	9
8	Boston & Maine	A	Aa	Aa	Aaa	23
9	Buffalo, Rochester & Pittsburg	Ba	A	Aa	Aaa	7
10	Buffalo & Susquehanna	—	Ca	B	Aaa	3
11	Canadian Pacific	Aa	Aaa	Aa	Aaa	13
12	Canadian Southern	A	—	A	Aa	2
13	Central of Georgia	—	—	A	Aaa	14
14	Central RR & B of Ga	—	—	A	A	1
15	Central RR of New Jersey	Aa	—	Aaa	Aaa	7
16	Chesapeake & Ohio	Ba	—	A	Aaa	16
17	Chicago & Alton RR	Ca	A	A	Aaa	3
18	Chicago, Burlington & Quincy	—	—	Aa	Aaa	16

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	Company	Common stock rating	Preferred stock rating	Bond rating range Low	Bond rating range High	No. of rated bond issues
19	Chicago & Eastern Illinois	—	—	A	Aaa	7
20	Chicago Great Western	E	—	Ca	A	7
21	Chicago, Indianapolis & Louisville	B	Ba	A	Aaa	6
22	Chicago Milwaukee & St Paul	Aa	Aaa	Aaa	Aaa	22
23	Chicago & North Western	Aa	Aaa	Aa	Aaa	31
24	Chicago, R.I. & Pacific	—	—	Ca	Aaa	17
25	Chic St Paul Minn & Omaha	Aa	Aaa	Aaa	Aaa	6
26	Cincinnati, Hamilton & Dayton	—	—	C	Aa	12
27	Cincinnati & Muskingum Valley	—	—	Aaa	Aaa	1
28	Cincinnati, NO & Texas Pacific	Ba	A	B	A	4
29	Cleveland, Akron & Columbus	B	—	Aaa	Aaa	2
30	Clev, Cinn, Chicago & St Louis	B	A	C	Aaa	20
31	Cleveland, Lorain & Wheeling	—	—	A	Aa	3
32	Colorado & Southern	Ca	Baa (1st) and Ba (2nd)	A	Aa	6
33	Conn & Passumpaic Rivers	Aaa		Aaa	Aaa	1
34	Delaware & Hudson	Aa		Baa	Aaa	15
35	Delaware Lackawanna & Western	Aaa	—	Aa	Aaa	12
36	Denver & Rio Grande	C	B	B	Aaa	9
37	Detroit & Mackinac	D	A	Aa	Aa	2
38	Detroit Southern	—	—	E	Ba	4
39	Erie	D	Ca (1st) and C (2nd)	B	Aaa	48

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Continued

	Company	Common stock rating	Preferred stock rating	Bond rating range Low	Bond rating range High	No. of rated bond issues
40	Evansville & Ind	—	—	A	A	1
41	Evansville & Terre Haute	B	Baa	A	Aaa	8
42	Ft W & Den C	—	—	A	A	1
43	Ft W & Rio Gr	—	—	Ba	Ba	1
44	Georgia, Southern & Florida	C	B&Baa	A	Aa	2
45	Great Northern	Aa	—	Aaa	Aaa	1
46	Gulf & Ship Island	C	—	Baa	A	2
47	Hocking Valley	Baa	A	Aa	Aaa	6
48	Illinois Central	Aa	Aaa	Aa	Aaa	26
49	Iowa Central	D	C	Caa	Ba	3
50	Kansas City Southern	B	A	A	Aa	2
51	Lake Erie & Western	D	Ca	Ba	A	3
52	Lehigh Valley	Aaa	—	A	Aaa	22
53	Long Island	—	—	A	Aaa	17
54	Louisville, Henderson & St. Louis	—	—	A	A	1
55	Louisville & Nashville	Aa	—	A	Aaa	26
56	Maine Central	Aa	—	A	Aaa	28
57	Minneapolis & St Louis	D	B	Ba	Aaa	8
58	Minn St Paul & Sault Ste Marie	A	Aaa	Aa	Aa	3
59	M S S M & A	—	—	Aa	Aa	1
60	Missouri Kansas & Texas	D	Ba	Baa	Aa	16
61	Missouri Pacific	B	—	Ca	Aaa	23
62	Mobile & Ohio	Ba	—	Baa	Aaa	7
63	Nash Chattanooga & St Louis	Aa	—	Aa	Aaa	8
64	New Orleans & Northeastern	Ba	—	Aa	Aaa	4
65	NY Central & Hudson River	A	—	Ba	Aaa	75
66	NY New Haven & Hartfort	A	—	Baa	Aaa	62

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Continued

	Company	Common stock rating	Preferred stock rating	Bond rating range Low	Bond rating range High	No. of rated bond issues
67	NY Ontario & Western	Ba	—	A	Aaa	5
68	Norfolk & Western	Ba	A	A	Aaa	10
69	Northern Central	—	—	Aaa	Aaa	5
70	Northern Pacific	Aa	—	A	Aaa	12
71	Pennsylvania	Aa	—	A	Aaa	48
72	Pennsylvania Company	—	—	A	Aaa	39
73	Pere Marquette	D	C	D	Baa	16
74	Phil, Baltimore & Washington	—	—	A	Aaa	14
75	Reading Company	A	Aaa (1st), Aaa (2nd)	A	Aaa	35
76	St Joseph & Grand Island	D	C&Ca	Aa	Aa	1
77	St Louis & San Francisco	D	D&Ca	C	A	31
78	St Louis Southwestern	D	B	B	A	5
79	St Paul M & Man	—	—	Aaa	Aaa	13
80	Sante Fe Press & Ph	—	—	A	A	1
81	Seaboard Air Line	D	C	C	A	21
82	Southern Pacific	A	Aa	A	Aaa	41
83	Southern Railway	D	C	Caa	Aa	42
84	Texas & Pacific	D	—	A	Aaa	4
85	Toledo & Ohio Central	D	C	A	Aaa	5
86	Toledo Peoria & Western	—	—	B	B	1
87	Toledo St Louis & Western	C	Ba	Baa	Aa	2
88	Union Pacific	Aa	Aaa	Aa	Aaa	9
89	Vandalia	A	—	A	Aaa	6
90	Vicksburg, Shreveport & Pacific	A	—	Aa	Aa	2
91	Wabash	D	C	Ba	Aaa	12
92	West N Y & Pa	—	—	Aaa	Aaa	2
93	Wheeling & Lake Erie	E	C (1st) and D (2nd)	B	Aa	4

Continued

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Continued

	Company	Common stock rating	Preferred stock rating	Bond rating range Low	High	No. of rated bond issues
94	Wisconsin Central	C	Ba	Baa	Aa	6

Source: The stock ratings are taken from Moody's *Table of Stock Records and Ratings*, p.195, and the bond ratings aggregated from various tables in the 1909 manual. In general, a railroad's common stock rating is lower than or equal to its preferred stock rating, both of which are lower than or equal to the lower rating of the range of its bond ratings. However, there are several exceptions.