The Value of Ratings:
Evidence from their Introduction in Securities Markets

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Abstract: We study the effects of the first-ever ratings for corporate securities. In 1909, John Moody published a book that partitioned the majority of listed railroad bonds into letter-graded ratings based on his assessments of their credit risk. These ratings had no regulatory implications and were largely explainable using publicly available information. Despite this, we find that lower than market-implied ratings caused a rise in secondary market bond yields. Using an instrumental-variables design, we show that bonds that were rated experienced a substantial decline in their bid-ask spreads, which is consistent with reduced information asymmetries and improved liquidity. Our findings suggest that ratings can improve information transmission, even in settings with the highest monetary stakes, and highlight their potential value for the functioning of financial markets.

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1 Introduction

In this paper we analyze the introduction of one of the most important financial innovations in U.S. history—securities ratings. This watershed moment in 1909 established a new market, in which third-party risk assessments that partitioned securities into letter-graded ratings were sold to investors. In models of strategic communication (e.g., Crawford and Sobel 1982), choice architecture in experimental settings (e.g., Johnson et al., 2012), agricultural commodities markets (Zusman, 1967) and in consumer contexts (e.g., Michelin stars), partitioning is a foundational component of signal provision in markets with asymmetric information. Evaluations centered on the assignment of discrete ratings simplify comparisons and certainly seem useful for market participants with little information and low stakes. It is unclear, however, whether partitioning can have an impact in securities markets, where participants are highly skilled at information acquisition and have powerful incentives.

Over the decades following their introduction, securities ratings grew into one of the most economically significant examples of partitioned information, and also became inseparably intertwined with explicit and implicit financial regulations, investment mandates, and bond covenants.[1] It is therefore not possible to determine empirically whether the impact of modern ratings is the product of *information provision*, by which we mean that their risk assessments conveyed via partitioning would affect market participants' expectations in the absence of mandates and regulations.[2] Any variation in ratings in modern settings, including exogenous changes, would influence demand for a security, even if it conveyed no information regarding the likelihood of default, due to ratings-based mandates and regulations.[3]

By contrast, the first-ever ratings were not tied to any financial regulations, institutional investor provisions, or bond covenants. They were simply offered for sale by John Moody in a printed volume in April, 1909, as the product of a novel business venture that was not anticipated by in-

[1] As of Jan 2020 there was over $15 trillion in corporate debt worldwide rated by Standard & Poors (www.spglobal.com) and total revenues for all Nationally Recognized Statistical Ratings Organizations (NRSROs) in 2019 was $7 billion (SEC, 2020).

[2] This is distinct from whether ratings improve equilibrium information. A third-party evaluator might substantially impact markets using ratings, and yet happen to be mistaken ex-post, making prices less accurate.

[3] Any ratings change will lead investors to update the probability distribution over future ratings, distorting demand through future expected mandates and regulation, even if the change had no immediate regulatory implications. For example, a negative ratings watch, which has no regulatory implications, could increase the likelihood of falling below investment grade in the future.

vestors. We find that Moody's ratings caused changes in bond yields and a reduction in information asymmetries, as reflected in bid-ask spreads. These findings suggest an important role for ratings as tools for information provision, even in high-stakes settings. The effect of partitioning in particular is highlighted by another important feature of the origins of ratings. Moody had previously operated a business that produced 'investor manuals' that presented much of the accounting data he later used to produce the ratings, and had even published a volume that explained the evaluation of the credit risk of bonds using that data (Moody, 1906). His publication of ratings had significant market impacts above and beyond his earlier publications that conveyed much of the information on which the ratings were based. This suggests that what may have mattered was not only the level of information available, but the manner in which this information was presented to investors.

We analyze the effect of Moody's ratings using a difference-in-differences design surrounding their publication, which compares the bond yields of firms whose ratings were likely to have been interpreted as a negative surprise to the yields of bonds receiving the same rating, but whose rating was unlikely to have been a negative surprise. We define likely negative surprises as cases where Moody's assigned ratings were worse than implied by the risk assessments reflected in secondary market yields. In addition to providing a plausible design to estimate whether ratings surprises affect yields, this design also implicitly tests for convergence in yields within ratings levels, and whether the yields for bonds receiving negative surprises rose to the same levels as those of other bonds with the same rating. Our findings, however, are robust to the use of alternative empirical specifications in which we instead compare bonds with similar initial yields that did and did not receive negative surprises.

We find that negative surprises produced modest but appreciable changes in bond yields of about 14 to 26 basis points on an annualized basis, representing about a 2.9 to 5.3 percent increase relative to average yields. We show that there is no evidence of differential trends prior to the release of ratings and that yields rose steadily afterwards, consistent with a causal interpretation of our findings. Confirming the importance of ratings surprises, we also show that a few months after Moody published his ratings, the financial press began to publish tables that compared the yields of different bonds that received the same rating, and recommended trading based on the differences.

The relatively high-frequency nature of the yield response reduces concerns about confounding events, but it is still possible that the firms that received negative surprises were different from the others along unobservable dimensions. If those firms happened to have differential exposure to a shock that coincided with the release of the ratings, that could potentially confound identification. To help address such concerns, we provide similar estimates using only within-firm variation, by including firm fixed effects interacted with time trends, and utilizing differences in surprises among the bonds of the same company.

As with modern ratings (e.g., Benmelech 2017), we find that Moody's ratings were largely explainable from readily available information. His 1909 volume focused only on railroads, which were the dominant securities issuers of the time, and several competing firms published annual investor manuals containing those firms' financial statements. The data presented in those manuals were detailed enough to calculate the financial ratios and industry statistics that Moody used in compiling his ratings, and we show that his ratings are largely reproducible using these data. Yet the differential effects of negative ratings surprises on bond yields survive the inclusion of a wide variety of ratings determinants in our regressions, including the bonds' yields prior to the introduction of the ratings. If ratings were largely predictable, how could they have conveyed information to market participants? We posit that the most likely explanation is that the simplicity of a rating system with easy-to-interpret letter grades helped marginal investors become better informed.

Of course ratings were not the only mechanism available to manage issues related to asymmetric information. The reputations of public companies in the early twentieth century were bolstered by factors such as the presence of elite investment bankers on their boards of directors, who monitored managers and represented the interests of securities holders (Frydman and Hilt, 2017). One natural prediction, therefore, is that if ratings helped to moderate problems related to information asymmetries, then the bond yields of firms with elite financiers on their boards should see smaller effects. Consistent with this, we find that firms connected through their boards with top underwriting firms did not experience much of an increase in yields when they received a negative surprise. These heterogeneous impacts indicate that the effects of ratings may have been mediated by a firm's reputation, suggesting ratings may have helped to reduce information asymmetries.

We then more directly explore the extent to which ratings affect the degree of information asymmetries among market participants. To the extent that ratings are able to resolve these asymmetries, we would expect to see a decline in market-based proxies such as bid-ask spreads.

For bid-ask spreads to tighten, ratings must reduce the advantage of the most informed traders (e.g. Glosten and Milgrom, 1985). This is plausible if less-informed investors had higher costs of information acquisition, and benefited differentially from the publication of ratings.

To assess the impact of ratings on liquidity, the relevant question isn't the effect of worse-than-expected ratings, but rather how bid-ask spreads responded to the presence of any rating at all. We therefore need a different empirical strategy than what we used for yields. Fortunately, Moody's volume did not rate all listed railroad bonds, and we can compare changes in the bid-ask spreads of rated bonds to those of railroad bonds that were not rated. The bonds Moody rated were, however, a selected group, with low initial yields and narrow bid-ask spreads on average. We address this selection problem by constructing an instrument based on Moody's rating procedure. Moody's volume rated all of the bonds of railroads that had at least some high-quality, low-yield bonds outstanding; these were the issues that were of greatest interest to investors. The railroads that had no such bonds outstanding tended not to be rated. But due to their origins as amalgamations of many smaller carriers, the railroad systems of 1909 often had complex capital structures with large numbers of bonds outstanding, and sometimes railroads that had high-quality bonds also had some lower-quality bonds, with higher yields and bid-ask spreads.[4] These latter bonds were rated purely because they were part of the capital structure of a railroad that also had other, more important issues outstanding.

We therefore use the average yields of the other bonds issued by the same railroad as an instrument for whether a bond got rated. Results using this instrument in a two-stage least squares (2SLS) estimation show that the ratings resulted in substantially lower bid-ask spreads, consistent with more liquid and well-functioning financial markets. We also present suggestive evidence that ratings may have increased the trading of more illiquid securities by small investors, which is consistent with ratings helping marginal investors to become better informed.

Taken together, our results imply that Moody's letter-graded bond ratings constituted a valuable financial innovation that helped resolve problems related to asymmetric information. In the wake of the Great Recession, credit rating agencies came under harsh criticism, and serious concerns

[4] Railroad bonds were usually mortgage bonds; the bonds of the smaller railroads that were acquired by a larger system were backed by those railroads' specific railroad tracks, which could vary substantially in value. In many cases the smaller railroads' bonds remained outstanding after the railroad was acquired by a larger system, meaning that the larger system's capital stock consisted of many different bond issues with collateral of varying quality.

were expressed about the quality of the ratings they produce, as well as the heavy reliance on ratings by both investors and financial regulators. A substantial body of research concluded that the institutional structure governing the production of modern ratings, especially the issuer-pays business model that was adopted by ratings agencies beginning in the 1970s, created perverse incentives that distorted the ratings given to many securities (Benmelech and Dlugosz 2009, 2010; Becker and Milbourn, 2011; Bolton et al., 2012; He and Strahan 2012; Griffin and Tang 2012). The results of this paper suggest that when implemented in their earliest and purest form—as an evaluation of securities that were sold to investors, not issuers, and with no role in financial regulations—ratings were influential, and likely beneficial for bond markets.

We also contribute to the literature on the determinants and effects of bond ratings.[5] Recent contributions to this literature have focused on credit rating refinements—that is, the introduction of more finely graded ratings systems (Kliger and Sarig, 2000; Tang, 2009). Since the refinements can be treated as exogenous ratings changes, this empirical strategy isolates the impact of ratings from the impact of factors that influence ratings. However, this strategy cannot identify whether the effects of ratings are due to information provision as we have defined it. Given the importance of ratings in financial regulations and investment mandates, a change in a rating to a level closer to (or farther from) investment grade would change the current or future expected demand for a bond, even if it had no influence on investors' expectations of the likelihood of default.[6] It is therefore not possible to isolate any information-based effects of ratings in modern data. Our paper overcomes this identification challenge by studying the introduction of ratings in a historical environment in which there were no ratings-based regulations or investment mandates of any kind.

Our research is also related to a series of papers examining the effect of exogenous shocks to information production, via reductions in equity analyst coverage, on secondary markets and firm behavior (Derrien and Kecskes 2012; Kelly and Ljungqvist 2012; Irani and Oesch 2013). In these settings there are many forms of information production, beyond just partitioning firms, but our findings suggest those components are likely to be important when considering the effects of such

[5]See, for example, Kaplan and Urwitz 1979; Hand et al., 1992; Holthausen and Leftwich 1986; Graham and Harvey 2001; Dichev and Piotroski 2001; Vassalou and Xing 2005; Kisgen 2006; Jorion and Zhang 2007; Sufi 2009; Ellul et al. 2011; Kisgen 2012; Aslan and Kumar 2015; and Almeida et al 2017.

[6]See, for example, evidence of rating-related regulation affecting investor demand such as West 1973; Moreau 2008; Lemmon and Roberts 2009; Partnoy 2010; Kisgen and Strahan 2010; Chernenko and Sunderam 2012; Bongaerts et al. 2012; Flandreau and Sławatyniec 2013; White 2013; Bernstein 2017; Bao et al. 2018; and Baghai et al. 2022.

coverage on information provision. Similarly, our findings suggest the mapping of sustainability and ESG performance of firms into ratings is also likely to increase their impact. Whether that impact will affect prices, or just fund flows (e.g., Hartzmark and Sussman 2019), though, is likely to be complicated by the massive divergence in ESG scores, assesments, and goals (Berg et al. 2022).

Our paper also speaks to a theoretical literature that has sought to understand the use of ratings or grades by information intermediaries. In these models, a third party in possession of private information will choose to release only a coarse signal to maximize revenue from fees charged to rated firms (Lizzeri, 1999); to maximize outcomes of all graded students (Ostrovsky and Schwartz, 2010); to balance the value of the signal to rated firms and to investors (Goel and Thakor, 2015); or to expand participation in the rating system (Harbaugh and Rasmusen, 2018), often in the context of a cheap talk game (eg, Crawford and Sobel, 1982; Martel et al., 2022). Although these models help inform our analysis, none of them are consistent with the origin of securities ratings. Moody relied on publicly available data to construct his ratings, did not charge railroads for rating them, likely had no reason to seek to influence railroad outcomes, and did not need to induce railroads to participate in his ratings system. The influence of Moody's innovation suggests that discrete ratings may have simplified the interpretation of data that were accessible but difficult to evaluate, even in the context of a market in which participants had strong financial incentives to incorporate information into prices. Although we lack the data to test for these specific mechanisms, it is possible that by simplifying complex information Moody's ratings may have helped small investors overcome complexity aversion (Puri, 2022) or make better investment decisions in the face of a potentially overwhelming range of bonds and bond characteristics (e.g., Carpenter et al., 2021).

Finally, our paper also contributes to a growing literature analyzing the origins and effects of historical financial innovations in the United States.[7] A number of related works have focused on early securities ratings agencies (Chandler, 1956; Sylla, 2002; White, 2010, 2013; Flandreau and Mesevage, 2013; Bernstein, 2017; Penet, 2019), and the predictive power of historical ratings has been the subject of particular interest (Harold, 1938; Hickman, 1958; Hempel, 1971; Flandreau et al, 2011). Yet surprisingly, Moody's 1909 ratings have not been the focus of much empirical

[7] Noteworthy examples include securities markets (Rousseau and Sylla, 2005; Atack and Neal, eds., 2009), bank clearinghouses (Gorton, 1985; Tallman and Moen, 2012; Jaremski, 2018), commercial paper markets (James, 1993; Calomiris et al., 1995), shadow banks (Gorton and Metrick, 2010; Rockoff, 2018; Frydman Hilt and Zhou, 2015), central banks (Sylla, 2010; Bordo and Roberds, eds., 2013), and collateralized banknotes (Rolnick and Weber, 1983; Gorton, 1996; Jaremski 2010).

analysis. One notable exception is Wilson (2011), who analyzes the determinants of Moody's 1909 ratings. Our paper focuses instead on empirically estimating the effects that those ratings had, and shows that ratings can improve the functioning of bond markets.

2 Origins of the First Letter-Graded Security Ratings

2.1 Early Twentieth Century Bond Markets

Well before the introduction of credit ratings, the corporate bond market in the United States grew to become quite extensive. Figure 1 presents data on the market's evolution from 1880 to 1910. The left panel shows that total outstanding corporate debt securities grew from $2 billion to $15 billion over this period (nominal GDP in 1910 was about $30 billion). Railroads dominated the market throughout the period, although after 1900 the volume of bond issues of utilities and industrials grew rapidly.

Whereas today, bonds are primarily traded over the counter, during this period they were generally listed on the NYSE and traded within a special section of the exchange floor. The right panel of the figure shows that the volume of trading in bonds on the NYSE grew substantially, but not as rapidly as the volume of outstanding bond issues. Retail investors accounted for a substantial share of the trades executed on the exchange (Meeker, 1930: 260), and single-lot trades, which were likely to have been ordered by retail investors, accounted for around 20 percent of trades.[8] Institutional investors, such as insurance companies, also traded through brokers on the exchange floor.[9] In general trading was concentrated on a relatively small number of well-known railroad bonds; the vast majority of NYSE-listed bonds traded only infrequently.

As the bond market expanded, information resources for investors proliferated as well. By the turn of the twentieth century, several competing firms produced annual volumes of financial data on major corporations, which included Henry Varnum Poor's *Poor's Manual of Railroads,* Standard Statistics Service's *Manual of Statistics,* and John Moody's *Moody's Manual.* However, these

[8]The face value of bonds at the time was typically $1,000, which was more than twice nominal GDP per capita at the time, so retail investors were wealthy individuals. We calculate the fraction of trades by size in our intraday trading data below; see Appendix Table A.5.

[9]There was also an over-the-counter market in which institutional investors transacted directly with one another or with a broker over the telephone; this market grew significantly in importance during the 1920s. See Meeker (1930).

investor manuals did not provide much assistance with interpreting the information they contained. They simply presented firms' financial statements, and offered little additional commentary or analysis. The volumes were sold at a relatively high price, and were marketed to sophisticated investors—most likely the bond departments of private banks, insurance companies, and commercial and savings banks—which possessed the requisite knowledge of accounting and finance to analyze the information presented.[10]

2.2 Moody's Innovation and its Reception

In the wake of the Panic of 1907, John Moody was forced to sell his Moody Manual Company. Over the following year, he established a new business focused on providing analysis, rather than just financial data, to investors. His new Analyses Publishing Company produced its first annual volume, *Moody's Analyses of Railroad Investments*, in April of 1909. The volume provided data summarizing the financial statements of every major railroad, and applied a letter-graded rating system to their bonds, nearly 1,300 in total. The volume was quite different from a typical investor manual, in that it included long chapters explaining railroad financial statements and how they should be evaluated. And whereas typical investor manuals included large amounts of advertising, with ad sales producing a significant source of revenue (Chandler, 1956), Moody's volume of ratings contained no advertisements at all, which eliminated any possibility that ad spending might influence its content.

At the time, credit reporting agencies such as R.G. Dun & Co. and Bradstreet's rated the creditworthiness of individuals and firms. Moody's innovation was to develop a quantitative system to rate the specific bond issues of railroads, in a volume that included clear descriptions of the data and methods used. Moody's ratings scale could take 11 different values ranging from Aaa to E, which offered investors a simple summary measure of the quality of a bond, in a hierarchy that was easily understood.

The methods Moody employed in his evaluation of the bonds were not new. Many published guides for investors available at the time noted that the safety of railroad bonds could be evaluated by comparing their interest obligations to the railroad's earnings, which, as we will show below, is

[10] The list price for most of these volumes was around $12 in 1909. Adjusting for inflation using the CPI, this is equivalent to more than $350 in today's money.

essentially what Moody did. In fact, Moody himself published a volume in 1906 that argued for doing this, and described the approach he would later adopt in his volume of ratings (Moody, 1906). What was new was that Moody painstakingly calculated these statistics for most railroads, and developed discrete thresholds characterizing different levels of safety—his ratings. Other sources had suggested rules of thumb for what constituted a safe bond or a risky bond, but no investor guide had ever developed a consistent rating system, much less actually applied it systematically.[11]

For each railroad in the manual, Moody presented ten years of earnings and expense data, and compared their values (scaled by mileage) to other railroads in the same region. Moody then presented simple tables that listed the railroads' bonds, and offered a rating based primarily on its 'factor of safety'—the share of earnings remaining after interest on the bond and all bonds senior to it had been paid.[12] Summary information on Moody's ratings is presented in Table 1. The overwhelming majority of the bonds rated in the volume received ratings of Aaa, Aa or A, reflecting the relatively high quality of the bonds of railroads, which were then the "blue chip" securities.

Moody advertised his volume in the financial press, in the same way that other investor manuals were advertised. But he also appealed directly to retail investors, taking out a series of ads in the *New York Times* that mentioned prominent railroads, and touted the volume's analysis of their securities.[13] The ratings offered a convenient and comprehensive guide to the quality of different railroad bonds that was independent from the securities dealers who marketed bonds. As many commentators noted, this was particularly valuable to small investors (e.g., Johnson, 1909).

Moody's 1909 volume received high praise in the press for the care with which its statistics were calculated.[14] Some commentary about the volume also noted that the ratings were based on publicly available information, and that the value of Moody's system was that it could help

[11]Nelson (1907) is an example of the former, and stated that "A first-class bond investment necessitates that a road should earn double its fixed charges." Another example is Hall (1906: 32), who stated that "from 60 to 65 percent of the profits should pay all fixed charges, that is to say, taxes and interest on the funded debt. If 80 percent is required, an investor should take advice as to the propriety of selling his bonds and going into some other security."

[12]See Appendix Table A.5 for an example.

[13]For example, on page 13 of the issue of 25 May 1909, Moody's ad states "The Great Northern Railway System and its Wonderful Earning Power—Lucidly and completely analyzed by JOHN MOODY, in 'Moody's Analyses of Railroad Investments,' just issued."

[14]For example, the *New York Times* praised its "complete original analyses of all the leading railroad systems," (30 April, 1909); the *Railroad Age Gazette* stated that "the work of calculation has been done in a careful and scholarly way" (30 April 1909); and *American Review of Reviews* called it "not a manual, but a commentary, ingenious, painstaking, and authoritative."

investors evaluate that information.[15] Other commentary characterized the ratings as "merely opinions," but noted that they "have the merit of being presented along with the facts that gave rise to them."[16]

Although we lack detailed sales data, we know the volume sold well, and that major public libraries and university libraries acquired it. Financial advice columnists commonly recommended that investors purchase Moody's volume in response to questions related to valuing securities.[17] The volume was also published in London, where insurance companies, which often held American railroad securities, reported that it was quite valuable.[18]

Moody's ratings quickly became influential. In contrast to his ads for the 1909 volume, his advertisements for later editions led with the question: "How Are Your Bonds Rated?" suggesting that the potential value of bond ratings had become well understood among investors.[19] In a sign of the success of the concept, in 1914 Moody began producing similar volumes rating public utility and industrial bonds as well. Another indication of the rapidly growing importance of ratings is that Moody's competitors also began to publish ratings in their volumes. The first was Poor's, which published its first ratings in 1916, then Standard Statistics followed in 1922, and finally Fitch began to publish ratings in 1923. Each of these firms rated securities according to a letter-graded scale similar to that of Moody, and each followed Moody in selling the ratings to investors (rather than having issuers pay for the ratings, as is done today).

The success of ratings also contributed to their use by financial regulators. This process began in the fall of 1931, when the Office of the Comptroller of the Currency (OCC) held that national banks could hold highly rated bonds on their balance sheets at their book values, whereas lower-rated bonds had to be marked down to their market values.[20] Over subsequent decades, ratings were

[15] "The book tries to give for each railway and for each bond the statement which would be asked from the statistician of a good private banking house by the partners, when the railway or the bond was under consideration. With the exception of certain kinds of transitory and confidential information which the statistician would probably possess, the record in this book is as complete as need be, and the book is far better adapted for the use of the intelligent private investor than is any railway manual that has come to our attention" (*Railroad Age Gazette*, 30 April 1909).

[16] *American Review of Reviews*, vol 39 (1909) p. 757.

[17] For example, the editors of the popular investing magazine *The Ticker* recommended the volume in many issues in 1909 and 1910.

[18] The *Insurance Record* of 3 December 1909 noted that "[Insurance companies] expecting a yield of at least 4 per cent. on foreign investments, would probably in future be disposed to invest in a somewhat lower, but nonetheless well-secured, class of American railway bonds, and the statistics in Mr. Moody's book were of great assistance in forming a fair estimate of their security" (p. 575).

[19] *Wall Street Journal,* 8 March 1912, p. 1.

[20] Flandreau and Sławatyniec (2013) argue, however, that U.S. courts began to rely on the judgments of ratings

incorporated into a wide variety of financial regulations, including rules governing money market mutual fund investments, the capital requirements of insurance companies, the investment criteria of pension funds, the investments of S&Ls, and computations of net capital for broker-dealers (Langohr and Langohr, 2009).

2.3 Empirical Predictions

We analyze two potential consequences of the introduction of ratings. The first focuses on the content of the ratings, and its effect on bond yields. As noted above, prior to the emergence of ratings investors had access to detailed financial data on all railroads; contemporary commentators noted that bond yields were influenced by reasonably well-informed assessments of their risks.[21] We therefore focus on cases where ratings conveyed negative information relative to investor expectations, as embodied in pre-ratings yields, and test for yield responses to the introduction of the ratings.

There is evidence that investors may have used Moody's ratings to guide their bond trading in ways that are consistent with this hypothesis. Beginning in November 1909, the popular investing magazine *The Ticker* began to publish a bond "Buyer's Guide" that compared the yields of different bonds with the same rating from Moody.[22] This suggests that investors may have accepted Moody's ratings as a measure of risk that they could compare with yields, and that lower-yielding bonds of a given rating may have been regarded as having unattractive prices.

Our second test focuses on the effects of the ratings on quoted bid-ask spreads for bonds. As in any financial market, it is likely that problems related to asymmetric information reduced liquidity, as reflected in the bid-ask spreads quoted by dealers. Trading in bonds on the NYSE was facilitated by dealers known as specialists, who would make a market in particular issues. Investors wishing to purchase or sell bonds would place their order with an NYSE-member firm, which would telephone the order to the NYSE floor, where one of the firm's brokers would receive it and go to the specialist who handled trading in that issue to try to negotiate a sale.[23]

agencies in the 1920s, giving them a form of legal authority at an earlier date.

[21]For example, Pratt (1908:173) noted that "The prevailing price of railroad bonds bears 4 percent interest, and if of undoubted standing they command a premium."

[22]November 1909 issue, p. 16. The table grouped all recently traded bonds by their rating levels, and was described as presenting data on "the relative cheapness of principal railroad issues." Similar tables were printed in each subsequent issue over the following year. An example is included in the Appendix as Figure A.1.

[23]In some cases the broker might transact directly with one of the other brokers who typically gathered near the

The dealers on the NYSE floor would have had an informational advantage over relatively uninformed investors, but on the other hand, there were also investors who possessed private information about market conditions or railroads who had an informational advantage over dealers. Dealers knew that trades with the former would likely be profitable, but trades with the latter would likely be unprofitable. The fundamental problem faced by the dealers was they they could not distinguish the two within the order flow they received.[24] This likely widened quoted bid-ask spreads, an implication that is largely consistent with modern theoretical underpinnings of drivers of the bid-ask spread (e.g. Glosten and Milgrom, 1985). The introduction of securities ratings may have improved liquidity by changing the expected value of the informational disadvantage dealers faced with regard to their counterparties trading on the exchange. If the ratings increased participation in the market by small investors, who were likely to have been less informed than the dealers, or if they improved the dealers' position relative to investors with private information, then quoted bid-ask spreads would have fallen.

3 Data and Descriptive Statistics

Our analysis is based on novel, hand-collected data from various sources. In this section, we briefly describe our main sources and variables.

3.1 Bond Transactions

To analyze the impact of securities ratings on bond yields we collect weekly closing prices for all railroad bonds traded on the NYSE, as reported on the Monday edition of the *New York Times.*[25] Appendix Figure A.2 presents a partial example of one week's worth of transactions. We collect these data for a total of two years, centered on the date when ratings were introduced. We restrict the data to the railroad bonds for which we observe at least one traded price before and after the introduction of ratings, resulting in an unbalanced panel comprised of 531 bonds corresponding to 54 different railroads. Appendix Table A.1 presents simple summary statistics for these data.

specialists, but more typically the dealer would buy or sell the bond out of their inventory.

[24] Appendix Figure A.7 illustrates this issue; dealers transacted with brokers on the exchange floor, and the brokers executed orders sent to them by investors. But the dealers could not know whether particular investors placing orders were uninformed or possessed an informational advantage.

[25] The fact that bonds were listed on the exchange at the time enables us to observe prices for actual transactions. For a discussion of the later shift of bond trading off the exchange see Biais and Green (2005).

About 90 percent of the traded bonds were rated by Moody, corroborating our view that his 1909 volume assigned a credit rating for a large fraction of the railroad systems in the country.

3.2 Market Microstructure

In 1909, a relatively large number of bonds were listed on the NYSE. Each day at 11 AM, the exchange printed and distributed quotations sheets that included all bid and ask quotations for listed bonds. Unlike the transactions data, this information was, to the best of our knowledge, only published in the press at a low frequency, rendering these sources unsuitable for our study. Instead, we access the original quotation sheets at the archives of the New York Stock Exchange. See Appendix Figure A.3 for a partial example of these bid and ask quotations. We digitized these data at a weekly frequency, for the 12 Wednesdays before and after the introduction of the ratings. We compute bid-ask spreads with these bonds, which will serve as our principal measure of liquidity, and restrict our data to the 545 bonds for which we observe at least one non-missing spread in the 12-week period before and after the publication of Moody's ratings in April 1909.[26]

Summary statistics for these data are presented in Appendix Table A.3. About 94 percent of the quoted bond spreads in our sample were for bonds rated by Moody. There was a clear difference in liquidity and risk between rated and non-rated bonds. The mean bid-ask spread of the rated bonds was 1.1 percent, whereas it was 2.9 percent for the bonds that were not rated. In addition, the yields on the rated bonds were 4.3 percent on average, whereas they were 6.2 percent for the bonds that were not rated. Yet these differences in means mask substantial variation in the distribution of yields and spreads by rating status. For our analysis, it is important to note that there is substantial overlap in these distributions, with a high fraction of rated bonds having yields and spreads similar to those of non-rated bonds. For example the 25th percentile of unrated bonds had bid-ask spreads and yields of 69bps and 4.3 percent, respectively, which are close the median for rated bonds.

3.3 Ratings and Director Information

We utilize Moody's 1909 volume to collect the assigned rating, and all the information pertinent to how these ratings were assigned, at the bond level. We also collect the names of the directors of

[26]Specifically, we estimate the spread as $\frac{(ask-bid)\times 2}{(ask+bid)}$, and it is therefore expressed as a percentage.

all railroads in the sample from the 1909 edition of *Moody's Manual*, the investor manual formerly published by Moody. As emphasized by Frydman and Hilt (2017), board interlocks between railroad firms and main financial intermediaries were common and of importance for easing financial constraints in the early twentieth century. In our analysis, we study how these relationships affected the impact of the introduction of credit ratings, by matching the names of railroad directors to lists of financiers. We use bond underwriting data from the 1913 edition of the *Fitch Bond Book* to determine the financial institutions that were the top underwriters at the turn of the century, and match the directors and partners of those financial firms to the boards of railroads.[27] Most investment banks were partnerships and were members of the NYSE; we obtain the names of their partners in 1909 from the NYSE Directory. For commercial banks and trust companies, director names were obtained from the 1909 edition of *Rand McNally Bankers' Directory*.

4 Determinants of Ratings

We start by presenting simple summary statistics to illustrate the key determinants of Moody's ratings. The first four columns of Table 1 present the distribution of the ratings and their descriptions for all railroad bonds included in Moody's 1909 volume. Railroad bonds were considered to be relatively safe, with more than 80 percent of the issues being rated A or higher. Yet the specific rating assigned does appear to have been primarily a reflection of a bond's expected risk. While Aaa bonds were stated to be "not affected by any normal changes in the earnings capacity of the railroad," lower-rated bonds, like those rated B, were "[m]ore susceptible to fluctuations." This is consistent with simple summary statistics that we construct utilizing information for the securities that are included in our analysis, presented in the last four columns of the table. Better-rated bonds tended to have had a higher factor of safety (average percentage of earnings available after paying interest over the previous decade) and income per mile. They were also more senior and had a lower yield-to-maturity.

Not only were the ratings correlated with many simple measures of risk, but the ratings tables in Moody's 1909 volume suggest that some of these metrics, such as the factor of safety, were used in determining the ratings (e.g. Appendix Figure A.5). Moody based his assessment on many of

[27] Specifically, we collect the names of the lead underwriters (where available) for all outstanding debt issues of NYSE-listed corporations, and rank underwriters by volume in order to identify the top 10 firms.

these metrics using long-run data spanning primarily the decade prior to the issuance of the ratings volume (see Figure A.6). In Table 2 we analyze whether simple statistics help explain the observed variation in railroad ratings.

We start by converting bond-level ratings into mean ordinal rankings across all issues within a given firm, and then we take the average across all issues to estimate an issuer-specific rating. Similarly, we average other bond-level characteristics. We find that the absolute value of pairwise correlations between ratings and average factor of safety, pre-ratings bond yields, salability (a rough measure of the bonds' liquidity that was primarily determined by whether a security was listed on multiple exchanges), and average income per mile, are 75%, 74%, 67%, and 43% respectively. These are incredibly high pairwise correlations for simple linear measures of each of these factors, which are primarily based on averages of multi-year lagged data originally reported in firms' annual financial statements that were then disseminated in investor manuals.[28] Combinations of these factors easily explain more than 80% of the total variation in the firm-level ratings within simple additively separable linear models, leaving limited room for factors other than public information in explaining the vast majority of the variation. That the first-ever ratings largely relied on observable firm characteristics may not be shocking though since John Moody tasked himself with rating almost 1,300 bonds. Yet credit ratings today, though much transformed, are also highly predictable with linear combinations of a small set of firm characteristics (Benmelech, 2017).

The especially predictive nature of pre-rating yields also motivates our empirical design. Bond yields can be thought of providing a plausible pre-rating market-based proxy for perceived risk—all else equal, riskier bonds should have had higher yields. A priori, it is unclear whether ratings should have any influence on markets above and beyond the information already contained in yields. To assess this possibility, we first study deviations between Moody's ratings assessments from pre-existing market expectations.

[28]In unreported analysis we use two competing investor manuals to reconstruct measures of factor of safety and income per mile for the 10-year period ending on 1909. These manuals were broadly available at that time, and represent the type of public information that a prospective investor would have had access to. We find correlations ranging from 0.8 to 0.98 between these alternative sources and the data listed by Moody's in 1909; the differences are primarily due to variation in the number of years' data reported. This suggests that the data on which Moody based his ratings were generally known, or at least knowable.

5 The First Securities Ratings and the Cost of Capital

5.1 Empirical Methods and Predictions

We study whether Moody's ratings had any incremental effects beyond what the information already contained in bonds' yields. In order to test for this, we focus on cases in which the ratings may have surprised market participants. We define surprises as cases in which the rating assigned to a railroad was different from the ratings assigned to other railroads whose bonds had similar yields. This market-based approach enables us to compute a measure of the surprise content of the ratings.[29]

To construct a measure of the surprises, we first compute the median yield to maturity of each railroad's bonds. We then classify the railroads into quartiles of the distribution of median yields. Table 3 presents the resulting yield quartiles and their characteristics. Within each quartile, the railroads' bonds had very similar yields. In the second quartile, for example, yields ranged from 4.1 percent to 4.3 percent, indicating that the market regarded these securities as similar. We then look within each quartile, and identify any railroads whose median bond rating was higher or lower than the median bond rating within the quartile. We regard these as cases in which the rating assigned by Moody was likely to have been a surprise, or contained some new information. We then test whether railroads that received negative surprises in their ratings saw their yields change relative to other railroads with the same rating following the introduction of the ratings. Since bondholders are primarily concerned about downside risk—that is, they worry primarily about the probability of repayment and about recovery in default—we focus our analysis solely on negative surprises. If ratings conveyed new information to market participants, we would expect those investors updating negatively on their investments to be more likely to react to new information.[30]

The data in Table 3 indicate that there were many surprise ratings. Whereas 84 percent of the bonds in the lowest yield quartile ('Quartile 1') received the highest rating (Aaa), 12 percent received a rating of Aa, and 4 percent received a rating of Baa or lower. The median rating in that quartile was Aaa, so the latter two ratings were negative surprises. Similarly, in the third quartile,

[29] We do not take up the question of the accuracy of the ratings here, but instead focus on the ratings' effect on markets. Hickman (1958), however, uses longer-run data to show that ratings had strong predictive power for subsequent defaults.

[30] Our analysis is in relative terms, and so it would be equally valid to say that we look at whether yields fall for those firms that do not receive negative surprises, for which on average it is positive news.

in which the median rating was Aa, 29 percent received a rating of A and 20 percent were rated Baa or lower.

We study the effect of these surprises in the context of a model with bond and week fixed effects, and also controls for rating levels interacted with trends. This structure has the added benefit that it not only tests for effects of plausibly measured surprises relative to market expectations, but it also implicitly tests for convergence in yields within ratings levels.[31] Our initial estimating equation will therefore be:

$$y_{ijt} = \alpha_i + \gamma_t + \delta_1 negsurprise_{jt} \times \text{postRatings}_t + \sum_n \pi_n \text{RatingLevel}_{ni} \times \text{trend}_t + \epsilon_{it}, \quad (1)$$

where y_{ijt} is the yield to maturity of bond i issued by railroad j in week t; α_i and γ_t are bond and week fixed effects; $negsurprise_{jt}$ is an indicator for whether or not railroad j's rating was worse than the median rating of their yield quartile, and was therefore a negative surprise; postRatings_t is an indicator equal to one for all weeks following the introduction of Moody's ratings, which occurred on 23 April 1909; RatingLevel_{nj} are indicators for the railroad rating level assigned by Moody; and trend_t is a time trend measured as weeks since the start of the sample. Our key parameter of interest is δ. We cluster standard errors at the bond level.

If ratings conveyed information, we would expect the yields of railroads receiving a negative surprise (that is, the treated railroads) to increase relative to those issuers receive no surprise or a positive surprise, after the 1909 manual was released.

[31] Developments in the market for corporate debt that were ongoing at the time when ratings were introduced make it especially important to control for ratings levels interacted with trends. Appendix Figure A.9 illustrates the time path of the mean yields of bonds from April 1908 to April 1910, by the level of ratings they were eventually given. The yields of bonds at each rating level were clearly declining over the year prior to the introduction of the ratings, and the declines were greater for bonds that received lower ratings ex-post. This reflects a general pattern of declining credit spreads in the market for corporate debt during the recovery from the Panic of 1907 and the related economic downturn. Any empirical analysis that simply tests for differences in yield levels or credit spreads following the introduction of ratings would confound any effect of the ratings with the ongoing trend of declining yields.

5.2 Bond Market Response

5.2.1 Information Provision

We begin by comparing the week-by-week evolution in differential yields. Figure 2 plots the differences in yields between railroads that received a negative surprise and those that did not, over the two years of our data, as estimated from a regression like the one specified in equation (1) where δ is allowed to vary every week and all estimates are relative to the month when ratings were released (which is therefore the omitted group not shown in the figure).[32] The figure presents a clear indication that rating surprises did indeed change bonds' yields. Importantly, the difference between the average yield for the bonds of railroads that received a negative surprise in their rating, and those that did not (conditional on the rating level they would eventually receive) was stable over time and hovered around zero for the year prior to the introduction of the ratings. This suggests that there were no differential preexisting trends between the two groups, conditional on our controls. Yet immediately after the introduction of the ratings the difference begins to increase, with the railroads that received a negative surprise commanding higher yields. This differential increase in yields stabilizes at about six months after the publication of the ratings, with the yields on bonds whose ratings was a negative surprise being about 20 basis points higher relative to those of other rated bonds.

Notably, the effect displayed in the figure is not one of an instantaneous, discreet jump, but rather a gradual increase that starts just after ratings are introduced. This is consistent with the fact that it may have taken some time for Moody's volume to reach some institutions and traders (April 23 is the publication date of the volume, not necessarily the date when it was received), and that the significance of the ratings and the analysis underpinning the ratings may not have been understood immediately. Instead, the volume gradually became more influential over time, and its contents' influence over bond yields increased accordingly. Still the flat nature of the relative yield difference prior to ratings and the subsequent sharp change in the slope of the difference after ratings were introduced using relatively high frequency data, supports a causal interpretation of the effect of ratings surprises on bond yields.

[32] The regression used to produce the estimates in the figure is like Equation (1), except rather than estimating an average post-ratings effect of a negative surprise, a series of negative surprise $\times$ date interactions are included, to estimate the difference-in-differences relative to the excluded date—the month of the introduction of ratings, April 1909. The interactions between the ratings levels and time trends are also included, as are the bond fixed effects.

Figure 2 also helps rule out the possibility that Moody was simply good at predicting future changes in yields, and that he rated bonds according to his expectations of these price changes. While the volume was published April 23, 1909, most of the information it contained and upon which the ratings were based was as of the end of the railroads' last fiscal year, which ended June 30, 1908. For some railroads, Moody included a brief description of changes in conditions that had occurred since the close of the fiscal year, which were likely added after the ratings tables had been created. These often stated that no events of significance had occurred, and even when some were described, the very latest date of the additional information was January 1, 1909. Since the ratings were computed well before April, the timing of the increase in yields following this date strongly points to a causal effect of the publication of the ratings on the market. By contrast the period during which the ratings were constructed but not yet released (depicted with the blue dashed lines), reveals no such response.

Next, we formalize the analysis from the figure in Table 4 where we present results from estimating variations of equation (1). In column (1), we start by regressing the yield to maturity on the interaction of a dummy variable equal to one if a firm received a negative surprise with a an indicator for the post-ratings period. Given that it took about six months for the effect of the ratings to be fully captured in yields, we present a 'donut' specification, where the post-ratings indicator is equal to one only for the second half of the post-ratings year to estimate the effects. The regression also includes bond and week fixed effects and rating fixed effects interacted with time trends. Consistent with the picture presented in Figure 2, we observe a 14 bps increase after 26 weeks in the yield of bonds among firms with negative ratings surprises.

These findings hold across a range of specifications, including utilizing alternative measures of yields, post-rating windows, and alternative measures of surprises. Focusing solely on the transactions that occur in the 6-12 months after ratings were released throws out a significant fraction of the observations, however, and can potentially affect estimates and standard errors. We next use a more flexible framework to incorporate the entire post-rating period. Specifically, in column (2) we interact the negative surprise indicator with a time trend, and then also include a time trend interacted with a post-ratings indicator. This specification allows for the effects of negative surprises to trend over time, instead of simply focusing on the average effect in the post period, and also estimates any preexisting differential trends in yields prior to the release of the ratings.

Reassuringly, the results indicate that there was no ongoing differential trend in the yields of bonds that received a negative surprise, but that a differential trend emerged following the publication of ratings.

In column (3), we estimate a more parsimonious version of the specification of column (2), and interact our negative surprise variable only with a variable that measures the weeks since the ratings were released, capturing the post-ratings differential trend. Yields differentially increased for firms that received a negative surprise; the estimates imply a 20 bps increase over 12 months. This is our preferred specification, in the sense that it achieves a good balance between parsimony and power.

A potential concern regarding these estimates could be that the firms that received negative ratings surprises also differed along some other dimensions we may only imperfectly observe. If those firms happened to have differential exposure to some unanticipated economic event that coincided with the publication of the ratings, its impacts could potentially confound our estimated effects of ratings. Although we believe this is unlikely, we cannot dismiss that possibility completely. To help address this concern, we exploit variation in ratings surprises among bonds issued by the same firm.

The bonds of a given railroad often differed in terms of their market yields as well as the ratings they received. Thus, within the same firm some bonds may have received ratings that were worse than expected given their pre-rating yields, while other bonds did not. We use this source of variation in column (4), by re-estimating our preferred specification from column (3), but include instead an indicator for a negative surprise at the bond level, rather than the firm level. To estimate this regression, we first recalculate the surprises at the bond level, rather than the firm level, which results in the loss of a very small number of observations ($< 2\%$) with insufficient liquidity prior to ratings to estimate a surprise. The results of this specification are very similar to the estimate reported in column (3), and addresses any concerns that our findings are influenced by the way we aggregate the data to estimate firm-level surprises.

In column (5), we investigate whether bonds that received negative surprise ratings saw differential changes in their yields after ratings were released, relative to other bonds of the same firm. In this specification we include firm fixed effects interacted with time trends, and therefore remove any potential time-varying confounds at the firm level. Again supporting a causal interpretation of our findings, the estimates indicate differential patterns in bond yields following rating surprises consistent with our prior estimates. In column (6) we show that results are essentially unchanged when we control for a major driver of bond-level yields, maturity, interacted in deciles of maturity with time trends.

The results thus far imply that the introduction of securities ratings did indeed change bond market yields. This is strong evidence that even in the absence of financial regulations based on ratings, and even in the presence of abundant information on bonds and bond issuers, letter-graded ratings can provide information that has a meaningful impacts on market prices. In Appendix Table A.2, we show that these results are robust to alternative specifications in which we control for the pre-rating yield quartiles (interacted with trends), rather than ratings (interacted with trends). That is, whereas our main specifications compare firms with similar ratings whose bonds had different yields, these alternative specifications compare firms whose bonds had the same yields, but received different ratings. Using this alternative source of variation, we obtain very similar results.[33]

Next, we further explore our main findings. Though the analysis of bond-level surprises in Table 4 helps address concerns that firm characteristics may be biasing our effects, one may still worry about these potential biases for our main analysis based on railroad-level surprises. To address this issue, we study the robustness of the effects of firm-level surprises to the inclusion of key railroad characteristics that were determinants of the ratings. To ease comparison, column (1) of Table 5 simply replicates column (3) of Table 4, our preferred specification based on weeks since. As we show in Table 2, factor of safety was the most important predictor of ratings of all the features that Moody's explicitly took into account in the Ratings Tables. In column (2) of Table 5 we add factor of safety, interacted with weeks since the ratings release. As one would expect, we find that railroads with a higher average factor of safety saw less of an increase in yields in the post period. Importantly, the effect of negative surprises is virtually unchanged. In column (3) we show that the estimated coefficient on negative surprise is also robust to controlling for average income and interest per mile. It is also possible that bonds more or less sensitive to interest rate risk may have seen yields change differentially. Yet our results are robust to controlling for the average duration

[33] Our calculations of yields to maturity are somewhat imprecise, and in appendix Table A.2 we also show that when we re-estimate our regressions using perpetuity yields (coupons divided by prices), rather than yields to maturity, our results become much stronger.

of the railroad's bonds (see column (4)). It is important to note that the variables we included thus far are on their own very strong predictors of the actual ratings assigned by Moody, which in turn are one of the two components we use to estimate surprises.

The results in columns (2)-(4) of Table 5 indicate that controlling for ratings predictors linearly does not have much of an impact of the effects of negative surprises. In column (5) we take this idea even further, by explicitly controlling for the railroads' pre-rating average yield, the other key piece of information we use to estimate surprises. Remarkably, including this measure, as well as the average pre-rating bid-ask spread as a measure of liquidity, makes barely any dent on the effect of negative surprises. These results are important because they suggest that credit ratings may affect markets beyond the information that would be contained in linear assessments of a bond's risk, either those formed from relevant firm or bond characteristics, or from market expectations (i.e., yields).

These findings are also not the result of ratings simply conveying soft or insider information about specific firms. In column (6) we use the same set of pre-rating observable control variables × *Weeks since* from column (5) to instrument for *Weeks since* × *Negative surprise* in a two-stage least squares regression. Consistent with these data explaining variation in surprises, even after all fixed effects, the regression has a reasonably strong first-stage: the surprises are partly predictable using information that was publicly available and generally accessible. In addition, the instrumented surprises have a statistically significant effect on post-rating yields that is similar in magnitude to the OLS estimate reported in column (5). This suggests that factors other than observable financial data, such as soft or insider information, could not have been entirely responsible for the observed market effects of the ratings surprises.

In which other way, then, can ratings convey information? One possibility is that the coarse nature of credit ratings, assigned to groups comprising substantial sets of securities, may be a more effective way to provide information to market participants, who would otherwise have to process complex information. In this sense, our results may be consistent with theoretical work that shows that in some contexts coarse signals can be more illuminating than precise ones, because they provide more clarity for interpreting the intended message sent (e.g., Martel et al., 2022), and with experimental work showing that simplifying complex information helps consumers make better financial decisions (e.g., Carpenter et al., 2021). Alternatively, the introduction of letter-graded ratings may have caused some investors to categorize particular bonds differently, and consider issues with the same rating, rather than issues that shared other attributes, as comparable (e.g., Ellis and Masatlioglu, 2022; Bordalo, Gennaoli and Shleifer, 2013). Although we cannot distinguish among these different potential mechanisms, our findings suggest that in the historical context of the introduction of the first-ever ratings, what may have mattered was not only the level of information disclosure, but the manner in which this information was actually packaged, simplified, and presented to the market.

5.2.2 Variation in the Impact of Ratings

The results presented in Tables 4 and 5 are remarkable for their consistency. Even when controlling for firm fixed effects, or for key determinants of the main components of the surprises themselves, the estimated effects of negative rating surprises are, while modest in magnitude, quite robust. They suggest that, even in an environment in which market participants have strong incentives to acquire information, ratings can still improve information provision. A natural question then arises: are there characteristics of firms where information provision via ratings is more or less impactful?

Surprises had an impact on yields when they updated market expectations downwards. This finding suggests, however, that negative surprises may have had less of an impact on firms with strong reputations. We study this possibility by analyzing whether connections to prominent financiers served as a substitute for credit ratings. As shown by Frydman and Hilt (2017), in the early twentieth century, top underwriters utilized their positions on railroad boards to monitor those firms, thereby alleviating their financial constraints and helping them grow. These tight relationships with bankers were observable by market participants—firms often advertised their directors and, importantly, the lists of board members were also published in investor manuals. In column (1) of Table 6 we therefore allow the effect of negative ratings surprises to vary by whether the railroad had many connections to the top underwriting firms of the time through their board of directors—specifically, that they were among the top quartile in such connections, with at least three elite financiers among their directors. We find that the negative effect of surprises on yields was essentially undone for the most connected firms. Next, we compare the effects of negative surprises on the most connected railroads (in column (2)) with those on moderately connected railroads (in column (3)), and with those that had no connections to top underwriting firms (in column (4)). Firms with no connections saw a 30 bps annualized increase in yields following a negative surprise, while the effect was much smaller (0.3 bps annualized) and insignificant for those railroads with a high number of top underwriters on their boards.

These results suggest the role of ratings does appear to have been mediated by a firm's reputation, such as the signal imparted by the quality of a their underwriters. If this reputation-enhancing mechanism helped resolve problems related to asymmetric information, then the fact that ratings surprises only impacted firms without the mechanism in place suggests the effects of ratings were also related to asymmetric information. We explore this connection in more detail below.

5.3 Interpretation of Effects of Ratings on Yields

We interpret the estimated effects of ratings on yields (Table 4) as evidence that securities ratings can be an effective tool for information provision. By making complex data easier to evaluate, ratings refined investors' expectations regarding the likelihood of defaults, which was then reflected in changes in those bonds' yields.

An alternative explanation of these effects might be that the ratings were inaccurate, yet nonetheless induced changes in yields because investors simply believed them and sold off the bonds that received negative surprises. If this were the case, the ratings could have produced the observed impacts on yields without actually improving investors' understanding of the risks of securities; ratings may have served merely as a focal point (e.g., Boot et al., 2006).

This interpretation would imply that ratings had powerful effects that increased the impact of the information being provided (i.e., it would still support our definition of information provision), although not through improving the equilibrium level of fundamental information in prices. Yet we believe that the lack of reversion in prices (Figure 2) suggests this is unlikely to be the most plausible explanation for the effects we observe. A full year after the release of ratings, which should have been a sufficiently long period for the inaccuracy of ratings to have been revealed, there was no indication of a weakening of the effects of negative surprises, much less a reversal.

Further evidence against this interpretation comes from the response to ratings from investment bankers. The acceptance of inaccurate ratings by investors should have created profitable trading opportunities for well-informed actors. Yet the best-informed and most sophisticated investors of the time, investment bankers, strongly opposed Moody's innovation of providing ratings (Stimpson and Mahoney, 2008). The response to the introduction of ratings was "in no circles...more hostile than among investment bankers," and their hostility was specifically attributed to the ratings' tendency to "narrow the price spread between trading points," and influence "the resale of bonds" as well as the "original sale of new issues" (Harold 1938: 16). By making ordinary investors better informed, ratings likely reduced the informational advantage of investment bankers and other sophisticated investors.[34] The bitterness with which investment bankers greeted the ratings is evidence supporting our preferred interpretation of their effects.

6 Ratings and the Functioning of Financial Markets

We next analyze the equilibrium response of the functioning of financial markets to the introduction of the ratings. If Moody's innovation did indeed help small investors to become better informed, or otherwise reduced the informational advantage of sophisticated investors, it may have resolved problems related to asymmetric information, and improved market liquidity. This effect would not have been produced by the particular ratings given to bonds, and whether they constituted surprises, but simply by the fact that bonds were given ratings at all. We therefore need a different empirical design than the one utilized above, focused on whether bonds were rated, rather than the ratings bonds received.

6.1 Empirical Method and Predictions

Moody's volume of ratings included the majority of large railroad systems and some smaller ones too, but it excluded a relatively small number of NYSE-listed railroad bonds. Though these unrated railroad bonds constitute a natural control group for the analysis of the effect of the ratings on liquidity, Moody's choices over which railroads to leave out were not random. To evaluate the effect of the presence of ratings on market liquidity, we need to examine plausibly exogenous variation in Moody's propensity to rate particular railroads' bonds.

Moody's ratings included all of the railroads with liquid, high-quality (low-yield) bonds, which were of the greatest interest to investors. However, some of the railroads rated by Moody had some

[34] When Moody discussed his books with traders he was informed by an "old Wall Street buccaneer...if you begin to flaunt too many facts, there won't be much inside knowledge left to work on; you will be spoiling our game" (Moody, 1933: pg. 91).

relatively lower-quality, less liquid issues outstanding—issues that were similar to the bonds that were not rated. Many of these small, riskier bond issues were originally the obligations of smaller railroads that had been acquired by a larger system, and were secured by collateral that was less valuable (per mile) than other bonds of the same system.

When Moody rated the bonds of a railroad, he rated all of its bonds, not merely the more liquid or safe issues.[35] This meant that lower-quality bonds of railroads that also had high-quality bonds outstanding received ratings simply because they were liabilities of a railroad with other high-quality bonds outstanding. In contrast, similar lower-quality bonds issued by railroads which had no high quality issues were less likely to be rated. We therefore use the average yields of the other outstanding bonds of the same issuer as an instrument for whether or not a bond was rated. If the average yield of the other bonds of the same issuer did indeed influence Moody's decision to rate a particular bond, but did not cause any changes to its bid-ask spread in the period after the ratings were introduced, then it represents a valid instrument for whether or not a bond was rated.

As with our analysis of the effects of ratings on yields, we will account for any ongoing trends in the differences between rated and unrated bonds using a linear time trend. We estimate the following regression via two-stage least squares:

$$liquidity_{it} = \alpha_i + \gamma_t + \theta_1 rated_{it} \times \text{postRatings}_t + \theta_2 rated_{it} \times \text{trend}_t + \beta X_{it} + \epsilon_{it} \tag{2}$$

where $liquidity_{it}$ is proxy for issue i's liquidity (such as bid-ask spread) in week t; α_i and γ_t are bond and week fixed effects; $rated_{it}$ takes a value of one for issues that were rated by Moody's for the weeks after the ratings' release; postRatings_t is an indicator equal to one for all weeks following the introduction of Moody's ratings, which occurred on the 23rd of April 1909; trend_t is a time trend; and X_{it} includes various characteristics of issue i, such as its average yield and bid-ask spread during the period prior to the introduction of the ratings, interacted with a post-ratings indicator. Since $rated_{it}$ appears twice in (2), our specification contains two endogenous regressors. We therefore use two instruments: the average yield of the other outstanding issues of the same railroad as issue i interacted with the post-ratings period ($\bar{y}_{-i} \times \text{postRatings}_t$) and the average

[35] As noted above, the analysis underpinning the ratings required Moody to create a seniority ranking of all outstanding bonds for the railroads he rated, and calculate the available income for each. It was therefore quite natural to rate all bonds and the marginal cost of doing so was likely low.

yield of other outstanding issues interacted with a trend ($\bar{y}_{-i} \times \text{trend}_t$). The main parameter of interest is θ_1. Our key identifying assumption is that comparing observationally equivalent bonds of different issuers, the bond belonging to an issuer with other bonds with lower yields is more likely to have been rated. We exploit that increase in likelihood of being rated to study whether receiving a rating has a causal impact on the bonds' market liquidity.

6.2 Effects of Getting Rated - IV Results

In Table 7 we present our estimates of the effects of being rated on bid-ask spreads. As a baseline in column (1) we present the results from an OLS regression of bid-ask spreads on a dummy variable equal to 1 if a bond was rated, after controlling for issue fixed effects, time fixed effects, the pre-rating mean bid-ask spread for that issue interacted with a post ratings dummy, and the pre-rating mean yield for that issue interacted with a post ratings dummy. We also allow for differential trends by rated status. The estimated value of the parameter θ_1 from equation (2) indicates that rated bonds saw their spreads fall by 54 bps in the weeks following the introduction of ratings. While this is suggestive of an effect of ratings on liquidity, as we noted previously it is subject to selection concerns.

Column (2) of Table 7 presents the same equation estimated via 2SLS, to alleviate bias caused by selection effects arising from Moody's choice of which bonds to rate, while the corresponding first stages (with matching column numbers) in their entirety are shown in Appendix Table A.4. Consistent with our expectations, the corresponding first stage regressions in column (2) of Appendix Table A.4 show that the estimated parameter on the instrument is large and negative, indicating that bonds issued by railroads whose other bonds had lower yields were much more likely to be rated. Specifically, we find that a one percentage point increase in the pre-ratings yields of the other bonds of a railroad reduced the likelihood that a bond was rated by about 11 percent, after controlling for the risk and liquidity of that bond prior to the ratings' release.

The parameters in column (2) Table 7 indicate that the 2SLS estimate of the effect of ratings on bid-ask spreads is considerably larger than OLS and large in absolute terms—298 bps. This is in fact larger than the mean value of the pre-ratings spread for rated bonds. It is important to note, however, that the local average treatment effect (LATE) is obtained from relatively illiquid bonds that were only rated because they were issued by railroads that had some high-quality issues. While these estimated treatment effects are substantial, they are actually plausible within this subgroup.

To illustrate this point more clearly in columns (3) and (4) of Table 7 we re-estimate our regressions focusing on only those issues with bid-ask spreads above the 60th and above the 80th percentile of the pre-ratings distribution, respectively. Despite having higher levels of initial spreads, we find very similar percentage point declines, implying much smaller percent declines than in column (2). In particular, these equate to about a 1.6 standard deviation decline in spreads among those more illiquid bonds. At the same time, the first stage F-stat rises substantially. This is because, just as we noted above, the LATE is the average treatment effect for compliers, and the compliers in our data are likely to be highly illiquid securities. Very liquid, frequently traded securities were rated no matter what was going on with the other outstanding securities in a firm. By contrast, illiquid securities, with less market interest, would have been marginal bonds, and may have been rated or not, depending on whether the firm had other, more prominent securities.[36]

These results are consistent with work by Kelly and Ljungqvist (2012), who show in modern data that proxies for increases in information asymmetry driven by reduced equity analyst coverage widen bid-ask spreads. The effect of ratings in our sample was likely quite small for the high-quality issues that were the focus of Moody's volume and of investors' interest, which had very low bid-ask spreads before the introduction of the ratings. But for the less liquid, higher-yielding issues that were rated for somewhat arbitrary reasons and had initially very wide spreads, the effect of the ratings was quite substantial. In summary then, what this evidence suggests is that among those securities most likely to benefit from improved liquidity (i.e. highly illiquid securities), ratings were actually able to tighten their bid-ask spreads substantially.

A potential source of concern regarding our IV estimates could be that they are driven by declining bid-ask spreads among the bonds of large railroad systems. Since those systems were most likely to have a high-quality (low-yield) bonds outstanding, any change in their bonds' bid-ask spreads would be conflated with the effects of being rated in our framework. In Table 8, we show that this is unlikely to be responsible for our results. In the table we present the reduced-form estimates of our IV, with columns (1) through (3) displaying the estimates from the samples of columns (2) through (4) in Table 7. As expected, the estimates are positive and statistically

[36]We address concerns regarding test size distortions caused by weak instruments by including weak-instrument robust confidence intervals, based on Andrews (2018) and discussed in Andrews, Stock and Sun (2019). These exclude 0 for all IV specifications.

significant—the lower the yields of the other bonds of the same railroad, the lower the bid-ask spread in the post-ratings period, which we ascribe to the greater likelihood of getting rated. Yet in columns (5) and (6), when we restrict the sample to the most liquid bonds, we find no effect. These falsification tests show that the instrument does not predict declines in bid-ask spreads for liquid bonds, and suggest that our main findings are not simply an artifact of comparing bonds in prominent railroad systems with those of small railroad systems. Only the most illiquid bonds of the rated systems saw their bid-ask spreads decline, which is inconsistent with the notion that changes in the spreads of all the bonds of large systems are driving our results.

Bid-ask spreads are, of course, not the only measure associated with liquidity and a well-functioning financial market. In Table 9 we use the same IV approach to study the effects of ratings on the block size of trades (the number of shares traded when a bond trades.)[37] We find that even though being rated doesn't seem to change the probability that a bond will trade on a given day among our compliers (column 1), the number (column 2) and probability (column 3) of single-lot trades increased (conditional on any trades for that security occurring). As the par value of most bonds was $1,000, at a time when nominal GDP per capita was less than $500, even a single lot trade was an immense amount of money. To the extent that small investors participated in this market, it would likely have been reflected in single-lot trades. Single lot trades were the most common transaction type in our data ($\sim$21%), and although not all of these trades were initiated by small investors, virtually all trades by small investors would have been in single lots. While not as strong or clear as our results on bid-ask spreads, these findings could suggest that ratings encouraged more trading in illiquid securities (our compliers) among retail investors. By contrast, we find no clear evidence of a such a rise among large ($\geq$10) lot trades (column 4), again suggesting that if ratings attracted increased trading interest for these illiquid securities it was probably most concentrated among retail traders.[38] Taken together, these results support the notion that ratings narrowed bid-ask spreads in bond markets and may have also opened up the trading of more illiquid securities to small investors.

[37] This data was compiled from the NYSE's daily reporting of bond transactions, which lists the block size of every trade. We collect this data for all bond trades for every Wednesday over the same interval of time for which we collected bid-ask data. See Appendix Figure A.4 for a partial example of intraday transactions for a single day.

[38] As noted above, institutional investors may have traded with one another in the over-the-counter market, making an effect on large trades difficult to detect in our data.

7 Discussion and Conclusion

This paper investigates the effects of the introduction of the first-ever bond ratings. In 1909, John Moody produced and sold to investors a volume containing letter-graded ratings for the majority of railroad bonds listed on the New York Stock Exchange. Utilizing a variety of newly collected data, our analysis shows that this financial innovation improved the liquidity of corporate bonds and, when ratings conveyed negative information relative to investor expectations, caused a modest but appreciable increase in their yields. Our findings therefore suggest that a system that summarizes the credit risk of individual securities in a small number of groups can help improve the allocation of capital and the functioning of capital markets, even in the absence of any effects induced by regulations or investment mandates.

We also show that, as they are today, the 1909 ratings were explainable with information that was public, and easily accessible. One has to wonder then why and how credit ratings had such an effect on markets. Importantly, the availability of information relevant to assess credit risk does not mean that investors, particularly those relatively less informed, understood how to fully utilize it. Our findings suggest the potential importance of simplifying complex and multidimensional information by partitioning securities into coarse groupings of ratings, as a more effective means of information provision.

Our results suggest that when implemented in their original, pure form—as an evaluation of securities sold to investors, with no role in regulations and no perverse incentives created by the modern issuer-pays business model—ratings can help improve information flows, and perhaps even broaden markets by increasing the participation of small, less informed investors. In the wake of the recent financial crisis, serious concerns were raised about the quality of credit ratings (Benmelech and Dlugosz 2009, 2010). Our analysis indicates that some of the problems identified with ratings following the crisis may be largely attributable to the particular institutional structure of the ratings industry as it evolved, rather than with ratings per se as a tool for information provision.

The introduction of securities ratings in the early twentieth century United States also offers valuable lessons for financial markets in developing countries today. Ratings were not necessary for the development of U.S. bond markets, which had large numbers of listed issues and active trading in some issues prior to their introduction. Yet in spite of the ample public information available regarding those bonds and the firms that issued them, the introduction of ratings had significant effects, influencing the cost of capital and improving liquidity, especially for less well-known firms. Importantly, Moody's had an established reputation and went to great lengths to convey the objective methods underlying the rating assessments. Small financial institutions and retail investors quickly came to rely on these ratings for their portfolio decisions, and we find suggestive evidence that participation by small investors increased. This historical episode suggests that the development of credible local ratings agencies in countries today that lack them holds the potential to help improve bond markets and, consequently, the allocation of capital in the economy.

References

Almeida, Heitor, et al. 2017. "The real effects of credit ratings: The sovereign ceiling channel," *The Journal of Finance* 72(1): 249-290.

Andrews, Isaiah. 2018. "Valid two-step identification-robust confidence sets for GMM." *Review of Economics and Statistics,* 100(2): 523-546.

Andrews, Isaiah, Stock, James, and Liyang Sun. 2019. "Weak instruments in instrumental variables regression: Theory and practice." *Annual Review of Economics,* 11: 727-753.

Aslan, Hadiye, and Praveen Kumar. 2016. "The product market effects of hedge fund activism," *Journal of Financial Economics* 119(1): 226-248.

Atack, Jeremy, and Larry Neal, eds. 2009. *The Origins and Development of Financial Markets and Institutions.* New York: Cambridge University Press.

Baghai, Ramin P., Bo Becker, and Stefan Pitschner. 2022. "The Use of Credit Ratings in the Delegated Management of Fixed Income Assets," *The European Corporate Governance Institute* Working Paper No. 612.

Bao, Jack, Maureen O'Hara, and Xing (Alex) Zhou. 2018. "The Volcker Rule and corporate bond market making in times of stress," *Journal of Financial Economics* 130: 95-113.

Becker, Bo, and Todd Milbourn. 2011. "How did increased competition affect credit ratings?," *Journal of Financial Economics* 101(3): 493-514.

Benmelech, Efraim. 2017. "Credit Ratings: Qualitative Versus Quantitative Information," Working paper.

Benmelech, Efraim, and Jennifer Dlugosz. 2009. "The alchemy of CDO credit ratings," *Journal of Monetary Economics* 56(5): 617-634.

Benmelech, Efraim, and Jennifer Dlugosz. 2010. "The Credit Rating Crisis," in *NBER Macroeconomics Annual* 2009, Volume 24, Acemoglu, Rogoff, and Woodford, eds.

Berg, Florian, Julian F. Koelbel, and Roberto Rigobon. 2022. "Aggregate confusion: The divergence of ESG ratings," *Review of Finance* 26(6): 1315-1344.

Bernstein, Asaf. 2017. "Costs of Rating-Contingent Regulation: Evidence from the Establishment of Investment Grade," Working paper.

Biais, Bruno, and Richard Green, 2005, "The microstructure of the bond market in the 20th century", Working paper, Carnegie Mellon University.

Bolton, Patrick, Freixas, Xavier, and Joel Shapiro. 2012. "The Credit Ratings Game," *Journal of Finance* 67(1): 85-112.

Boot, Andrew, Milbourn, Todd, and Anjolein Schmeits. 2006. "Credit Ratings as Coordination Mechanisms," *The Review of Financial Studies* 19(1):81-118.

Bongaerts, Dion, Cremers, K.J., and William N. Goetzmann. 2012. "Tiebreaker: Certification and Multiple Credit Ratings," *Journal of Finance* 67(1): 113-152.

Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer. 2013. "Salience and Consumer Choice," *Journal of Political Economy* 121(5): 803–843.

Bordo, Michael, and William Roberds, eds. 2013. *The Origins, History and Future of the Federal Reserve*. New York: Cambridge University Press.

Calomiris, Charles, Himmelberg, Charles, and Paul Wachtel. 1995. "Commercial paper, corporate finance, and the business cycle: a microeconomic perspective." *Carnegie-Rochester Conference Series on Public Policy* 42: 203-250.

Carpenter, Jeffrey, Emiliano Huet-Vaughn, Peter Hans Matthews, Andrea Robbett, Dustin Beckett, and Julian Jamison. 2021. "Choice Architecture to Improve Financial Decision Making," *Review of Economics and Statistics* 103(1): 102–118.

Chandler, Alfred. 1956. Henry Varnum Poor: Business Analyst, Editor, and Reformer. Cambridge, MA: Harvard University Press.

Chernenko, Sergey, and Adi Sunderam. 2012. "The real consequences of market segmentation," *Review of Financial Studies* 25(7): 2041-2069.

Crawford, Vincent and Joel Sobel. 1982. "Strategic Information Transmission," *Econometrica* 50(6):1431-1451.

Derrien, Francois and Ambrus Kecskes. 2013. "The Real Effects of Financial Shocks: Evidence from Exogenous Changes in Analyst Coverage" *The Journal of Finance* 68(4).

Dichev, Ilia D., and Joseph D. Piotroski. "The Long-Run Stock Returns Following Bond Ratings Changes." *The Journal of Finance* 56.1 (2001): 173-203.

Ellis, Andrew and Yusufcan Masatlioglu. 2022. "Choice with Endogenous Categorization," *Review of Economic Studies* 89(1): 240–278.

Ellul, Andrew, Chotibhak Jotikasthira, and Christian T. Lundblad. 2011. "Regulatory pressure and fire sales in the corporate bond market," *Journal of Financial Economics* 101(3): 596-620.

Faulkender, Michael, Flannery, Mark J., Hankins, Kristine Watson, and Jason M. Smith. 2012. "Cash flows and leverage adjustments," *Journal of Financial Economics* 103: 632-46.

Flandreau, Marc, Gaillard, Norbert and Frank Packer. 2011. "To err is human: US rating agencies and the interwar foreign government debt crisis," *European Review of Economic History* 15(03): 495-538.

Flandreau, Marc, and Gabriel Mesevage. 2013. "The separation of information and lending and the rise of rating agencies in the USA (1841-1907)," *Scandinavian Economic History Review* 62(3): 213-242.

Flandreau, Marc, and Joanna Kinga Sławatyniec. 2013. "Understanding Rating Addiction: US Courts and the Origins of Rating Agencies' Regulatory License (1900-1940)," *EHES Working Papers in Economic History*, number 44.

Frydman, Carola, and Eric Hilt. 2017. ‘Investment Banks as Corporate Monitors in the Early Twentieth Century United States,” *American Economic Review* 107(7): 1938-70.

Frydman, Carola, Hilt, Eric, and Lily Y. Zhou. 2015. “Economic Effects of Runs on Early “Shadow Banks”: Trust Companies and the Impact of the Panic of 1907” *Journal of Political Economy* 123(4): 902-940.

Glosten, Lawrence R. and Paul R. Milgrom. 1985. “Bid, ask and transaction prices in a specialist market with heterogeneously informed traders,“ *Journal of Financial Economics* 14(1): 71-100.

Goel, Anand M., and Anjan V. Thakor. 2015. “Information reliability and welfare: A theory of coarse credit ratings,” *Journal of Financial Economics* 115(3): 541-557.

Gorton, Gary B. 1985. “Clearinghouses and the Origin of Central Banking in the U.S.,” *Journal of Economic History* 45(2): 277-83.

Gorton, Gary B. 1996. “Reputation Formation in Early Bank Note Markets,” *Journal of Political Economy* 104(2): 346-397.

Gorton, Gary B., and Andrew Metrick. 2010. “Regulating the Shadow Banking System,” *Brookings Papers on Economic Activity* Fall: 261-312.

Graham, John R., and Campbell R. Harvey. “The theory and practice of corporate finance: Evidence from the field.” *Journal of financial economics* 60.2 (2001): 187-243.

Griffin JM, Tang DY. 2012. “Did subjectivity play a role in CDO credit ratings?” *Journal of Finance* 67:1293-1328

Hall, Herny. 1906. *How Money Is Made In Security Investments.* New York: De Vinne Press.

Hand, John R.M., Robert W. Holthausen, and Richard W. Leftwich. 1992. ”The effect of bond rating agency announcements on bond and stock prices,” *Journal of Finance* 47: 733-752.

Harold, Gilbert. 1938. *Bond Ratings as an Investment Guide.* New York: Ronald Press.

Hartzmark, Samuel M. and Abigail B. Sussman. 2019. “Do investors value sustainability? A natural experiment examining ranking and fund flows,” *The Journal of Finance* 74(6): 2789-2837.

Holthausen, Robert, and Richard Leftwich. 1986. “The effect of bond rating changes on common stock prices,” *Journal of Financial Economics* 17(1):57-89.

He J, Qian J, Strahan PE. 2012. “Are all ratings created equal? The impact of issuer size on the pricing of mortgage-backed securities.” *Journal of Finance* 67:2097-2137.

Hempel, George H. 1971. *The Postwar Quality of State and Local Debt.* New York: NBER.

Hickman, W .B. 1952. *Trends and Cycles in Corporate Bond Financing.* Cambridge, MA: NBER.

Hickman, W .B. 1958. *Corporate Bond Quality and Investor Experience.* Princeton, NJ: Princeton University Press.

Irani, Rustom and David Oesch. 2013. “Monitoring and corporate disclosure: Evidence from a natural experiment,” *Journal of Financial Economics* 109(2):398-418.

James, John A. 1993. "The Rise and Fall of the Commercial Paper Market, 1900–1930," in Bordo and Sylla, eds., *Anglo-American Finance: Financial Markets and Institutions in 20th-Century North America and the U.K.*. Homewood, IL: Business One Irwin.

Jaremski, Matthew. 2010. "Free Bank Failures: Risky Bonds versus Undiversified Portfolios," *Journal of Money, Credit and Banking* 42(8): 1565-1587.

Jaremski, Matthew. 2018. "The (Dis)Advantages of Clearinghouses Before the Fed" *Journal of Financial Economics* 127: 435-458.

Jorion, Phillippe, and Gaiyan Zhang. 2007. "Information effects of bond rating changes: The role of the rating prior to the announcement." *Journal of Fixed Income* 16.4: 45.

Johnson, Eric J., Suzanne B. Shu, Benedict G. C. Dellaert, Craig Fox, Daniel G. Goldstein, Gerald Häubl, Richard P. Larrick, John W. Payne, Ellen Peters, David Schkade, Brian Wansink, and Elke U. Weber. 2012. "Beyond nudges: Tools of a choice architecture." *Marketing Letters* 23: 487-504.

Johnson, Emory R. 1909. Review of "Moody's Analyses of Railroad Investments." *Annals of the American Academy of Political Science* 34: 10-11.

Kaplan, Robert S. and Gabriel Urwitz. 1979. "Statistical models of bond ratings: A methodological Inquiry," *Journal of Business* 52, 231-261.

Kelly, Bryan and Alexander Ljungqvist. 2012. "Testing Asymmetric-Information Asset Pricing Models," *The Review of Financial Studies* 25(5):1366-1413.

Kisgen, Darren J. "Credit ratings and capital structure." *The Journal of Finance* 61.3 (2006): 1035-1072.

Kisgen, Darren J., and Philip E. Strahan. "Do Regulations Based on Credit Ratings Affect a Firm's Cost of Capital?." *Review of Financial Studies* 23.12 (2010): 4324-4347.

Kisgen, Darren. "The Real and Financial Effects of Credit Ratings: Evidence from Moody's Adjustments." Working Paper (2012).

Kliger, Doron and Oded Sarig. 2000. "The information value of bond ratings," *Journal of Finance* 55: 2879-2902.

Langohr, Herwig and Patricia Langohr. 2009. *The Rating Agencies and Their Credit Ratings : What They Are, How They Work, and Why They Are Relevant.* New York: Wiley.

Lemmon, Michael, and Michael R. Roberts. 2010. "The response of corporate financing and investment to changes in the supply of credit," *Journal of Financial and Quantitative Analysis* 45(3): 555-587.

Lizzeri, Alessandro. 1999. "Information revelation and certification intermediaries," *The RAND Journal of Economics*: 214-231.

Martel, Jordan, Edward Dickersin Van Wesep, and Robert Van Wesep. 2022. "Ratings and Cooperative Information Transmission," *Management Science* 68(12): 9175-9197.

Meeker, J. Edward. 1930. *The Work of the Stock Exchange.* New York: Ronald Press.

Moody, John. 1906. *The Art of Wall Street Investing.* New York: Moody Publishing Co.

Moody, John. 1909. *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 Deductions, Enabling the Banker and Investor to Ascertain the True Values of Securities; By a Method Based on Scientific Principles Properly Applied to Facts.* New York: Analyses Publishing Co.

Moody, John. 1933. *The Long Road Home.* New York: Macmillan Company.

Moreau, Ludovic. 2009. "Regulatory versus Informational Value of Bond Ratings: Hints from History," *CELS 2009 4th Annual Conference on Empirical Legal Studies Paper.*

Nelson, S. A., ed. 1907. *The Bond Buyers' Dictionary.* New York: S.A. Nelson Co.

Ostrovsky, Michael, and Michael Schwarz. 2010. "Information disclosure and unraveling in matching markets," *American Economic Journal: Microeconomics* 2(2): 34-63.

Palyi, Melchior. 1938. "Bank Portfolios and the Control of the Capital Market," *Journal of Business* 11(1): 70 -111.

Partnoy, Frank. 1999. "The Siskel and Ebert of financial markets: two thumbs down for the credit rating agencies," Working Paper.

Pénet, Pierre. 2019. "Rhetorical Metrics: Building Securities Regulation in America's Era of Booms and Busts, 1890-1940." *European Journal of Sociology,* 60(1): 69-108.

Patt, Edmund S. 1909. *The Work of Wall Street.* New York: D. Appleton.

Puri, Indira. 2022. "Simplicity and Risk." Working paper.

Rockoff, Hugh. 2018. "It's Always the Shadow Banks," in Rockoff and Suto, eds., *Coping with Financial Crises: Some Lessons from Economic History.* New York: Springer.

Rolnick, Arthur J., and Warren E. Weber, "New Evidence on the Free Banking Era" *American Economic Review* 73(5): 1080-1091

Rousseau, Peter L., and Richard Sylla. 2005. "Emerging financial markets and early US growth," *Explorations in Economic History* 42(1): 1-26.

Schwartz, Barry. 2004. "The paradox of choice: Why more is less." New York: Ecco.

Simon, Herbert A. 1955. "A behavioral model of rational choice." *The quarterly journal of economics* 99-118.

Stedman, Stedman, Edmund C., ed. 1905. *The New York Stock Exchange.* New York: Stock Exchange Historical Co.

Stimpson, David and Christopher Mahoney. 2008. *Moody's: The First Hundred Years. New York: Moody's Investors Service.*

Sufi, Amir. "The real effects of debt certification: Evidence from the introduction of bank loan ratings." *Review of Financial Studies* 22.4 (2009): 1659-1691.

Sylla, Richard. 2002. "A historical primer on the business of credit rating." In Levich, Majnoni and Reinhart, eds., *Ratings, Rating Agencies and the Global Financial System.* Boston: Kluwer Academic Publishers.

Sylla, Richard. 2010. "Financial Foundations: Public Credit, the National Bank, and Securities Markets," in Sylla and Irwin, eds., *Founding Choices: American Economic Policy in the 1790s.* Chicago: University of Chicago Press.

Tang, Tony. 2009. "Information asymmetry and firms' credit market access: Evidence from Moody's credit rating format refinement," *Journal of Financial Economics* 93(2): 325-51.

Tallman, Ellis W., and John R. Moen. 2012. "Liquidity creation without a central bank: Clearing house loan certificates in the banking panic of 1907," *Journal of Financial Stability* 8(4): 277-291.

Thaler, Richard H., and Cass R. Sunstein. 2009 *Nudge: Improving decisions about health, wealth, and happiness.* Penguin.

Vassalou, Maria, and Yuhang Xing. "Abnormal equity returns following downgrades." Working Paper, 2005.

West, Richard R. 1973. "Bond ratings, bond yields and financial regulation: Some findings," *The Journal of Law and Economics* 16(1): 159-168.

White, Lawrence J. 2010. "Markets: The credit rating agencies." *Journal of Economic Perspectives* 24(2): 211-226.

White, Lawrence J. 2013. "Credit Rating Agencies: An Overview" *Annual Review of Financial Economics* 5:93-122.

Wilson, Berry. 2011. "On the information content of ratings: an analysis of the origin of Moody's stock and bond ratings," *Financial History Review* 18(2): 155-90.

Zusman, Pinhas. 1967. "A Theoretical Basis for Determination of Grading and Sorting Schemes," *Journal of Farm Economics* 49(1), Part 1: 89-106.

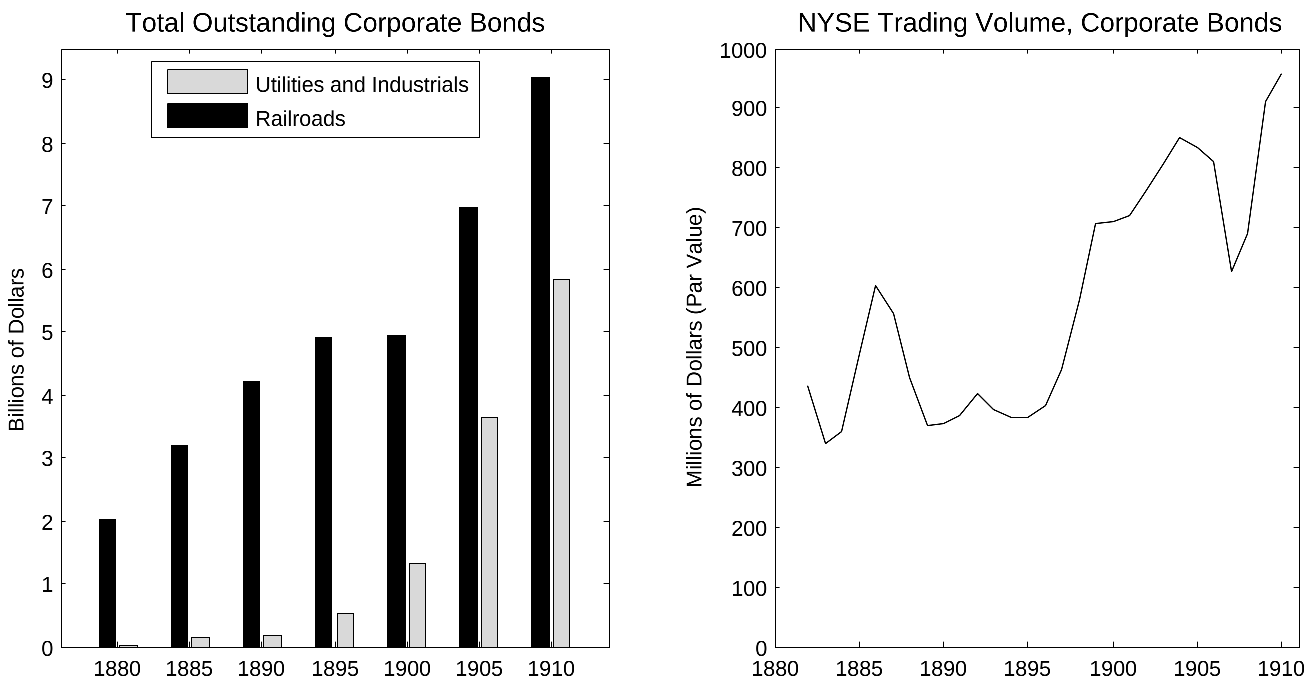


Figure 1:
Evolution of U.S. Corporate Bond Markets, 1880-1910

Note: The left panel presents the total value of outstanding corporate bonds, at five-year intervals, by sector. The right panel presents a 3-year trailing moving average of total NYSE bond transactions, expressed in millions of dollars of par value. *Sources:* Left panel: The data for utilities and industrials were compiled from the *Commercial Financial Chronicle*'s "Investors' Supplement," for years prior to 1900, and for later years, from Hickman (1952). The railroad data are from Hickman (1952). Right panel: for years after 1900, trading in "railroads and miscellaneous bonds" was recorded from the *New York Times* "Annual Financial Review." Data for earlier years was obtained from Stedman (1905).

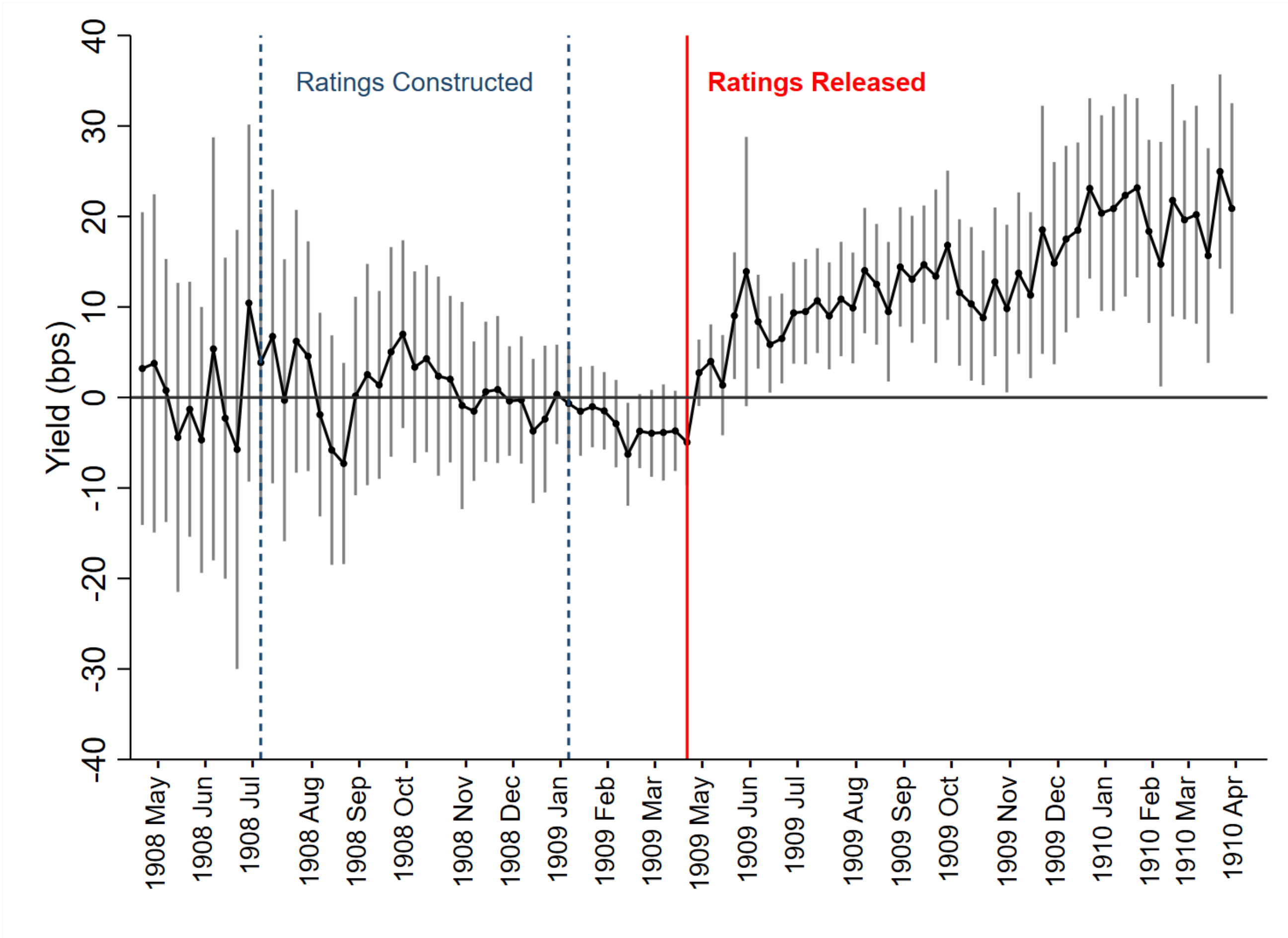


Figure 2:
Ratings Surprises and Bond Yields

Note: The figure presents the differences in yields between bonds whose ratings constituted a negative surprise and other rated bonds—those that either received a positive surprise, or no surprise. The differences plotted in the figure are estimated from regressions of yield-to-maturity on indicators for a negative surprise interacted with indicators for each week, with the week prior to the introduction of ratings excluded. The regressions also include bond fixed effects, as well as rating level fixed effects interacted with time trends (see text). The figure also includes lines representing 95 percent confidence intervals. The solid red vertical line indicates the release of ratings; the dashed blue lines denote the time period in which Moody constructed the ratings.

Table 1:
Moody's 1909 Ratings

				Mean			
Rating	Description	*N*	Percent	Factor of Safety (%)	Income Per Mile (000s)	Seniority Rank (1=highest)	Yield to Maturity (%)
Aaa	The highest class...their value is not affected by any normal changes in the earnings capacity of the railroad itself	461	39.47	83.60	58.94	7.69	4.39
Aa	While high-grade...slightly inferior to those having the first rating...in security or in salability	295	25.26	76.79	34.49	10.89	4.45
A	Although high-grade, ...affected, to a partial degree, by changing earning power	238	20.38	70.61	27.59	10.95	4.60
Baa	Generally good, but have a speculative tinge...good but second-grade issues	60	5.14	53.00	26.74	21.67	4.52
Ba	Make a moderately favorable showing and are regarded as well secured, but are affected by changing earning power	52	4.45	54.75	14.06	14.96	4.90
B	More susceptible to fluctuations, and are to be regarded as more speculative in position	35	3.00	44.07	14.22	15.59	4.84
Caa	Almost directly responsive to changes in earning power, and have not had the benefit of available income equal to more than double the interest	4	0.34	25.67	9.54	17.33	5.44
Ca	Approach more strongly to the field of speculative issues with but moderate security	10	0.86	20.00	11.57	16.50	7.13
C	Show but a slight margin in surplus above the amount required for their interest, and which are not well secured	8	0.68				
D	Of doubtful character and almost purely speculative value	3	0.26				
E	Defaulted issues..awaiting the results of reorganizations	2	0.17				

Note: Authors' calculations from data presented in *Moody's Analyses of Railroads Investments*, 1909, and from weekly bond prices reported in the *New York Times*. *N* represents the total number of bonds given each rating by Moody; the number of bond issues for which transactions were found was smaller (438 out of the 1168 bonds listed in Moody's volume). *Factor of safety* is the percent of earnings available after interest on the issue (and other issues with equal seniority) has been paid. Income per mile is average earnings available for interest, per mile. Seniority rank is the ranking by Moody of the bond among all issues from the same railroad, with 1 being the most senior bond. The yield to maturity is the average value calculated from closing prices as reported in the *New York Times* during the months prior to the publication of the ratings volume.

Table 2:
Ratings: Pairwise correlations with firm characteristics

Correlations (firm-level)	Rating (Aaa=1)	Factor of Safety	Avg. Income	Salability (high=1)	# Bankers on Board	# of Bonds	Bid-Ask Spread	Pre-Period YTM (mean)
Rating	1							
Factor of Safety	-0.75	1						
Avg. Income	-0.43	0.32	1					
Salability	0.67	-0.44	-0.21	1				
# Bankers on Board	-0.09	-0.002	0.22	0.01	1			
# of Bonds	-0.18	0.42	0.04	0.04	0.11	1		
Bid-Ask Spread	0.23	0.10	-0.23	0.36	-0.13	0.14	1	
Pre-Period YTM	0.74	-0.49	-0.34	0.43	-0.22	-0.01	0.27	1

Note: This table presents pair-wise correlations between firm-level characteristics that may be correlated with Moody's inaugural securities ratings for railroad companies in 1909. *Rating* is a simple ordinal ranking of a bond's rating in 1909, with the lowest risk group (Aaa) denoted as 1, and values increasing in increments of 1 from there (e.g. Aa=2, A=3,...). *Factor of safety* is the percent of earnings available after interest on the issue (and other issues with equal seniority) has been paid. *Avg. Income* is the average earnings available for interest, per mile. *Salability* is a simple ordinal ranking of a bond's salability rating in 1909, with the lowest risk group (High) denoted as 1, and values increasing in increments of 1 from there. This is Moody's measure of the ease of selling that bond given its liquidity. *# Bankers on Board* is number of top underwriters on firm's board. *# of Bonds* is the outstanding number of bonds for a given firm. *Bid-Ask spread* is the average difference in our sample pre-ratings period between the bid and ask prices from the same day at 11 AM, when the exchange printed and distributed quotations sheets that included all bid and ask quotations for listed bonds. *Pre-period YTM* is the average yield to maturity calculated from closing prices as reported in the *New York Times* during the months prior to the publication of the ratings volume. To map from bond characteristics to firms we compute the mean value of that variable for the firm across all bonds.

Table 3:
Railroad Bond Yield Quartiles

Pre-Rating Yield Quartile	Minimum Yield	Maximum Yield	Mean Yield	Percent Aaa	Percent Aa	Percent A	Percent Baa Or Lower	Mean Rating (1=Aaa)	Median Rating
1	0.036	0.041	0.040	0.838	0.121	0.000	0.040	1.242	Aaa
2	0.041	0.043	0.042	0.448	0.391	0.161	0.000	1.713	Aa
3	0.044	0.046	0.045	0.225	0.287	0.287	0.200	2.587	Aa
4	0.046	0.065	0.050	0.148	0.205	0.261	0.386	3.466	A

Note: This table presents the distribution of the median yields of the bonds of different railroads, sorted into quartiles, and the ratings received by the railroads in each yield quartile. Railroads that received a rating below the median for their quartile are designated as having received a negative surprise.

Table 4:
Effect of Ratings Surprises on Yields

Yield (Basis Points)	(1)	(2)	(3)	(4)	(5)	(6)
Neg Surprise × Post	14.4***					
	(4.6)					
Neg Surprise × Trend (Wks) × Post		0.51***				
		(0.19)				
Neg Surprise × Trend (Wks)		-0.08				
		(0.15)				
Neg Surprise × Weeks Since			0.39***	0.41***	0.30**	0.33**
			(0.11)	(0.11)	(0.15)	(0.13)
Implied 12-Month ATE	**14bps**	**26bps**	**20bps**	**22bps**	**16bps**	**17bps**
95% CI, bps	[5,23]	[7,46]	[9,32]	[7,36]	[1,31]	[4,31]
Bond FE	Y	Y	Y	Y	Y	Y
Rating FE × Trend	Y	Y	Y	Y	Y	Y
Week FE	Y	Y	Y	Y	Y	Y
Firm × Trend FE	-	-	-	-	Y	Y
Maturity × Trend FE	-	-	-	-	-	Y
Level of Surprise	Firm	Firm	Firm	Bond	Bond	Bond
Post-Period Duration, Weeks	26-52	52	52	52	52	52
R^2	0.890	0.886	0.886	0.887	0.900	0.904
Obs	11,423	15,478	15,478	15,220	15,220	15,220

Note: This table depicts the effects of "surprises" (i.e. deviations in ratings from the median for those in the same yield quartile based on their mean yield among all traded bonds prior to the introduction of ratings) on secondary market bond yields trading on the New York Stock Exchange. Column (1) presents a 'donut' specification; we regress yield to maturity in basis points on a dummy variable equal to one for a negative surprise (*Neg Surprise*) interacted with a dummy variable equal to one if the bond transaction occurs 26 weeks after Moody's securities ratings are released in April of 1909 (*Post*). This specification also includes bond and week fixed effects and rating fixed effects interacted with time trends. The pre-period includes the year prior to the release of ratings, while the post-period includes the period 6 months to 12 months following their disclosure. Implied 12-month average treatment effects for the primary coefficient of interest as well as 95% confidence intervals for those 12-month estimates are included below the specification. In column (2) we interact *Neg Surprise* with a time trend, and then also with a time trend interacted with an indicator variable for the post-ratings period. Unlike the 'donut' of column (1), it includes all 12 months following release of ratings in the post period. In column (3), *Neg Surprise*is interacted with a variable which equals 0 prior to ratings being released and then after is the weeks since they were released (*Weeks Since*). Column (4) is the same as column (3), but the surprises are calculated at the bond level, rather than the firm level. Column (5) is the same as column (4), but also includes Firm × Trend fixed effects, so that only the within-firm variation is used to estimate the effect of the surprises. Column (6) is the same as column (5), but also includes ten bond-level maturity group fixed effects interacted with a time trend. Standard errors clustered at the bond level are in parentheses.***, **, and * denote significance at 1%, 5%, and 10%, respectively.

Table 5:
Effect of Surprises, Controlling for Rating Predictors

Yield (Basis Points)	OLS (1)	OLS (2)	OLS (3)	OLS (4)	OLS (5)	2SLS (6)
Weeks since ×						
Negative surprise	0.39***	0.37***	0.37***	0.37***	0.34***	0.54**
	(0.11)	(0.12)	(0.11)	(0.11)	(0.13)	(0.22)
Factor of safety		-0.002	-0.002	-0.002	-0.004	
		(0.005)	(0.006)	(0.006)	(0.006)	
Average income			0.00001	0.00001	0.00001	
			(0.00002)	(0.00002)	(0.00002)	
Interest per mile			-0.00009	-0.00002	-0.00002	
			(0.00011)	(0.00011)	(0.00011)	
Duration				0.0023	0.0015	
				(0.0033)	(0.0034)	
Pre-rating bid-ask spread					7.3	
					(12.2)	
Pre-rating yield					-12.6	
					(13.7)	
Implied 12-Month ATE	**20bps**	**19bps**	**19bps**	**19bps**	**18bps**	**28bps**
95% CI, bps	[9,32]	[6,32]	[6,32]	[6,32]	[4,31]	[5,51]
Bond FE	Y	Y	Y	Y	Y	Y
Rating FE× trend	Y	Y	Y	Y	Y	Y
Week FE	Y	Y	Y	Y	Y	Y
Kleibergen-Paap F-Stat	-	-	-	-	-	14.7
R^2	0.886	0.886	0.886	0.881	0.882	0.011
Obs	15,478	15,478	15,478	15,478	15,478	15,478

Note: This table depicts the effects of "surprises" (i.e. deviations in ratings from the median for those in the same yield quartile based on their mean yield among all traded bonds prior to the introduction of ratings) on secondary market bond yields trading on the New York Stock Exchange after controlling for other potential observable confounds. Column (1) regresses yield to maturity in basis points on a dummy variable equal to one for a negative surprise (*Neg Surprise*) interacted with a variable which equals 0 prior to ratings being released and then after are the weeks since they were released (*Weeks Since*). This specification also includes bond fixed effects, week fixed effects, and rating fixed effects interacted with weeks since ratings were released. The pre-period includes the year prior to the release of ratings, while the post-period includes the 12-months following their disclosure. Column (2) is the same as column (1), but also interacts *Weeks Since* with a firm's average bonds' factor of safety (*Factor of safety*) as a control variable. Column (3) is the same as column (2), but also interacts *Weeks Since* with a firm's bonds' average earnings available to pay interest (*Average income*) and interest per mile (*Interest per mile*) as additional control variables. Column (4) is the same as column (3), but also interacts *Weeks Since* with a firm's average bonds' duration (*Duration*) as an additional control variable. Column (5) is the same as column (4), but also interacts *Weeks Since* with a firm's bonds' average pre-ratings release bid-ask spread percent (*Pre-rating bid-ask spread*) and yield-to-maturity (*Pre-rating yield*) as additional control variables. Column (6) uses all control variables in column (5) but instead as instrumental variables within a two-stage least squares regression where *Weeks since* x *Negative surprise* is the endogenous variable and yields are again the outcome variable of interest. In this case confidence intervals are weak instrument robust confidence sets based on the two-step identification robust 95% confidence sets proposed by Andrews (2018) based on linear combination tests, as implemented in the "twostepweakiv" package in Stata using 1,000 grid points. See also Andrews, Stock and Sun (2019). Standard errors clustered at the bond level are in parentheses.***, **, and * denote significance at 1%, 5%, and 10%, respectively.

Table 6:
Heterogeneity in Effect of Ratings Surprises on Yields

Yield (Basis Points)	All (1)	Many Bankers On Board (2)	Some Bankers On Board (3)	No Bankers On Board (4)
Weeks since ×				
Neg Surprise	0.48***	0.006	0.44***	0.58***
	(0.12)	(0.29)	(0.17)	(0.14)
Neg Surprise × Many Top Underwriters on Board	-0.53***			
	(0.18)			
All interactions	Y	Y	Y	Y
Bond FE	Y	Y	Y	Y
Rating FE × Trend (Wks)	Y	Y	Y	Y
Week FE	Y	Y	Y	Y
Underwriter Measure (Top 10 Bankers on Board)	≥3	≥3	$[1, 2]$	0
R^2	0.887	0.918	0.845	0.915
Obs	15,478	3,745	7,748	3,985

Note: This table depicts heterogeneity in the effects of "surprises" (i.e. deviations in ratings from the median for those in the same yield quartile based on their mean yield among all traded bonds prior to the introduction of ratings) on secondary market bond yields trading on the New York Stock Exchange. Column (1) regresses yield to maturity in basis points on a dummy variable equal to one for a negative surprise (*Neg Surprise*) interacted with a variable which equals 0 prior to ratings being released and then after are the weeks since they were released (*Weeks Since*) and interacted with a dummy variable equal to one if the firm is in the top quartile of the distribution of connections to elite underwriters, with three on their board (*Many Top Underwriters on Board*). This specification also includes bond fixed effects, week fixed effects, and rating fixed effects interacted with weeks since ratings were released. The pre-period includes the year prior to the release of ratings, while the post-period includes the 12-months following their disclosure. Columns (2)-(4) estimate the effect of the interaction of *Neg Surprise* and *Weeks Since*, only among the subset of firms where either more than 2, 1 or 2, or no top underwriters are on the board, respectively. Standard errors clustered at the bond level are in parentheses.***, **, and * denote significance at 1%, 5%, and 10%, respectively.

Table 7:
IV Results: Effect of Ratings on Bid-Ask Spreads

	OLS (1)	2SLS (2)	2SLS (3)	2SLS (4)
Post × Rated Issue	-0.0054*	-0.0298***	-0.0294***	-0.0314***
	(0.0031)	(0.0099)	(0.0099)	(0.0109)
Trend × Rated Issue	0.00003	0.0015	0.0016	0.00015
	(0.00041)	(0.0012)	(0.0013)	(0.0016)
Weak IV CI, Post × Rated	–	[-.056, -.012]	[-.053, -.014]	[-.048 ,-.014]
Bond FE	Y	Y	Y	Y
Week FE	Y	Y	Y	Y
Week FE × Pre-Rating Yield	Y	Y	Y	Y
Week FE × Pre-Rating Spread	Y	Y	Y	Y
Pre-period Iliquidity	-	-	≥ 60%	≥ 80%
Kleibergen-Paap F-Stat	-	17.5	20.7	47.0
Observations	5,085	5,085	2,076	1,042
Obs (Not rated)	6%	6%	11%	13%

Note: The table presents estimates of the effect of ratings on bid-ask spreads, using OLS and the IV approach of Equation (2), estimated via 2SLS. The regressions are estimated using 12 weeks of data before and after the introduction of ratings, for a total of 24 weeks of data. The weak instrument robust confidence sets are two-step identification robust 95% confidence sets proposed by Andrews (2018) based on linear combination tests, as implemented in the "twostepweakiv" package in Stata using 1,000 grid points. See also Andrews, Stock and Sun (2019). The pre-rating yield and the pre-rating spread are calculated as the mean yield and spread for each issue using all the observations 12 weeks before treatment. Column (1) is an OLS regression of a bond's bid-ask spread on a dummy variable equal to 1 if an issue (bond) is rated interacted with a dummy variable equal to 1 after ratings are released. It also includes bond, week, week × pre-rating yield, and week × pre-rating spread fixed effects. Column (2) is the same as column (1), but uses the IV approach from equation (2). In particular, after controlling for an issue's yield prior to the release of ratings, we use the yields of other bonds that are part of that same firm in the same period, as an instrument for being rated (because of Moody's propensity to rate all bonds of a given firm). The same-issuer pre-rating yield is calculated using observations over the 12 weeks before the introduction of ratings. Column (3) is the same as column (2), but restricts the analysis to only those issues with a mean bid-ask spread at or above the 60th percentile in the period prior to ratings being released. Column (4) is the same as column (3) but for those above the 80th percentile instead of the 60th. The corresponding first stages of the regressions in columns (2)-(4) are shown in appendix Table A4. Robust standard errors, clustered by bond, are in parentheses. ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

Table 8:
Reduced-Form Estimates

	RF (1)	RF (2)	RF (3)	Falsification (4)	Falsification (5)
Post × OtherBondsYields	0.346***	0.406***	0.458***	-0.053	0.184
	(0.114)	(0.119)	(0.140)	(0.189)	(0.245)
Trend × OtherBondsYields	-0.017	-0.023	-0.022	0.002	-0.002
	(0.015)	(0.019)	(0.024)	(0.013)	(0.008)
Bond FE	Y	Y	Y	Y	Y
Week FE	Y	Y	Y	Y	Y
Week FE × Pre-Rating Yield	Y	Y	Y	Y	Y
Week FE × Pre-Rating Spread	Y	Y	Y	Y	Y
Pre-period Iliquidity	-	$\geq$ 60%	$\geq$ 80%	$\leq$ 20%	$\leq$ 60%
Kleibergen-Paap F, First Stage	17.5	20.7	47.0	0.8	0.1
Observations	5,085	2,076	1,042	1,023	3,059
Obs (Not rated)	6%	11%	13%	3%	2%

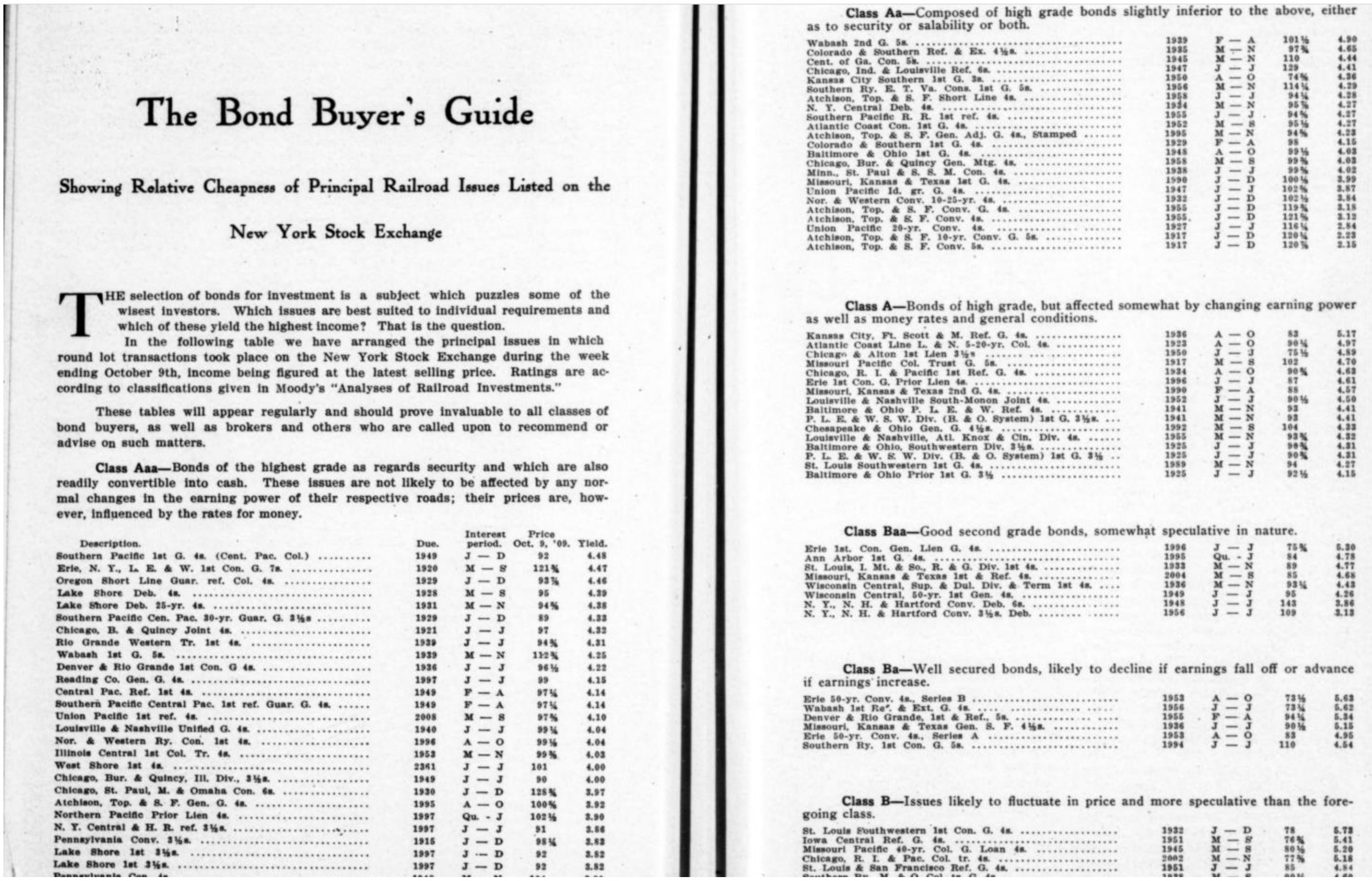
Note: The table presents estimates of the reduced-form relationship between the instrument used in estimating Equation (2), the yield on the other bonds of the same railroads, and bid-ask spreads. The regressions are estimated using 12 weeks of data before and after the introduction of ratings, for a total of 24 weeks of data. The pre-rating yield and the pre-rating spread are calculated as the mean yield and spread for each issue using all the observations 12 weeks before treatment. Column (1) is a regression of bid ask spreads on the instrument, interacted with a post-ratings indicator and with a time trend. It also includes bond, week, week × pre-rating yield, and week × pre-rating spread fixed effects. Column (2) is the same as column (1), but restricts the analysis to only those issues with a mean bid-ask spread at or above the 60th percentile in the period prior to ratings being released. Column (3) is the same as column (2) but for those above the 80th percentile instead of the 60th. In column (4), we present the results of a falsification test in which we restrict the sample to the most *liquid* bonds—those in the 20th percentile of pre-rating spreads or below. In column (5), we present another falsification test, withe the sample restricted to bonds in the 40th percentile of spreads or below. Robust standard errors, clustered by bond, are in parentheses. ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

Table 9:
IV Results: Effect of Ratings on Block Size

	2SLS (1) Any Trans	2SLS (2) # 1 Lot Trades	2SLS (3) $\mathbb{1}_{1LotTrade}$	2SLS (4) #≥10 Lot Trades
Post 23rd April 1909 × Rated Issue	-0.0083	0.568**	0.391**	0.132
	(0.1153)	(0.274)	(0.194)	(0.743)
Trend × Rated Issue	0.0031	-0.035	-0.024	0.010
	(0.0085)	(0.025)	(0.017)	(0.091)
Weak IV Robust Confidence Set, Post × Rated	–	[0.120, 1.238]	[0.081, 0.859]	–
Bond FE	Y	Y	Y	Y
Week FE	Y	Y	Y	Y
Week FE × Pre-Rating Yield	Y	Y	Y	Y
Week FE × Pre-Rating Spread	Y	Y	Y	Y
Kleibergen-Paap F-Stat	18.7	11.6	11.6	11.6
Dep Var Mean	0.259	0.403	0.333	0.741
Observations	9,675	2,429	2,429	2,429

Note: The table presents estimates of the effect of ratings on trade size, and in particular the number of lots (of $1,000 par-value bonds) per transaction. All regressions are versions of Equation (2) estimated via 2SLS, with different second-stage outcomes as shown in the column headings. We use the yields of other bonds that are part of that same firm in the same period as an instrumental variable for being rated (because of Moody's propensity to rate all bonds of a given firm). All regressions include bond, week, week × pre-rating yield, and week × pre-rating spread fixed effects. The pre-rating yield and the pre-rating spread are calculated as the mean yield and spread for each issue using all the observations 12 weeks before treatment. Similarly, the instrument, the same-issuer pre-rating yield, is calculated using observations over the 12 weeks before the introduction of ratings. The regressions are estimated using 12 weeks of data before and after the introduction of ratings, for a total of 24 weeks of data. The weak instrument robust confidence sets are two-step identification robust 95% confidence sets proposed by Andrews (2018) based on linear combination tests, as implemented in the "twostepweakiv" package in Stata using 1,000 grid points. See also Andrews, Stock and Sun (2019). Column (1) is a 2SLS regression of the probability of any transaction occurring that day for that bond on an instrumented endogenous dummy variable equal to 1 if an issue (bond) is rated interacted with a dummy variable equal to 1 after ratings are released. Column (2) is the same column (1), but the dependent variable is number of standard (single) lot trades in a day, conditional on at least one transaction occurring that day for that bond. Column (3) is the same column (1), but the dependent variable is a dummy variable equal to one if at least one standard (single) lot trade occurs in a day, conditional on at least one transaction occurring that day for that bond. Column (4) is the same column (1), but the dependent variable is number of ten or larger lot trades in a day, conditional on at least one transaction occurring that day for that bond. Robust standard errors, clustered by bond, are in parentheses. ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

APPENDIX



The Bond Buyer's Guide

Showing Relative Cheapness of Principal Railroad Issues Listed on the New York Stock Exchange

THE selection of bonds for investment is a subject which puzzles some of the wisest investors. Which issues are best suited to individual requirements and which of these yield the highest income? That is the question.

In the following table we have arranged the principal issues in which round lot transactions took place on the New York Stock Exchange during the week ending October 9th, income being figured at the latest selling price. Ratings are according to classifications given in Moody's "Analyses of Railroad Investments."

These tables will appear regularly and should prove invaluable to all classes of bond buyers, as well as brokers and others who are called upon to recommend or advise on such matters.

Class Aaa—Bonds of the highest grade as regards security and which are also readily convertible into cash. These issues are not likely to be affected by any normal changes in the earning power of their respective roads; their prices are, however, influenced by the rates for money.

Description.	Due.	Interest period.	Price Oct. 9, '09.	Yield.
Southern Pacific 1st G. 4s. (Cent. Pac. Col.)	1949	J — D	92	4.48
Erie, N. Y., L. E. & W. 1st Con. G. 7s.	1920	M — S	121¾	4.47
Oregon Short Line Guar. ref. Col. 4s.	1929	J — D	93⅞	4.46
Lake Shore Deb. 4s.	1928	M — S	95	4.39
Lake Shore Deb. 25-yr. 4s.	1931	M — N	94⅝	4.38
Southern Pacific Cen. Pac. 30-yr. Guar. G. 3½s	1929	J — D	89	4.33
Chicago, B. & Quincy Joint 4s.	1921	J — J	97	4.32
Rio Grande Western Tr. 1st 4s.	1939	J — J	94⅝	4.31
Wabash 1st G. 5s.	1939	M — N	112¾	4.25
Denver & Rio Grande 1st Con. G 4s.	1936	J — J	96½	4.22
Reading Co. Gen. G. 4s.	1997	J — J	99	4.15
Central Pac. Ref. 1st 4s.	1949	F — A	97¼	4.14
Southern Pacific Central Pac. 1st ref. Guar. G. 4s.	1949	F — A	97¼	4.14
Union Pacific 1st ref. 4s.	2008	M — S	97⅝	4.10
Louisville & Nashville Unified G. 4s.	1940	J — J	99¼	4.04
Nor. & Western Ry. Con. 1st 4s.	1996	A — O	99⅛	4.04
Illinois Central 1st Col. Tr. 4s.	1953	M — N	99⅝	4.03
West Shore 1st 4s.	2361	J — J	101	4.00
Chicago, Bur. & Quincy, Ill. Div., 3½s.	1949	J — J	90	4.00
Chicago, St. Paul, M. & Omaha Con. 6s.	1930	J — D	128¾	3.97
Atchison, Top. & S. F. Gen. G. 4s.	1995	A — O	100⅝	3.92
Northern Pacific Prior Lien 4s.	1997	Qu. - J	102⅛	3.90
N. Y. Central & H. R. ref. 3½s.	1997	J — J	91	3.86
Pennsylvania Conv. 3½s.	1915	J — D	98¼	3.83
Lake Shore 1st 3½s.	1997	J — D	92	3.82
Lake Shore 1st 3½s.	1997	J — D	92	3.82

Class Aa—Composed of high grade bonds slightly inferior to the above, either as to security or salability or both.

Wabash 2nd G. 5s.	1939	F — A	101½	4.90
Colorado & Southern Ref. & Ex. 4½s.	1935	M — N	97¾	4.65
Cent. of Ga. Con. 5s.	1945	M — N	110	4.44
Chicago, Ind. & Louisville Ref. 6s.	1947	J — J	129	4.41
Kansas City Southern 1st G. 3s.	1950	A — O	74⅝	4.36
Southern Ry. E. T. Va. Cons. 1st G. 5s.	1956	M — N	114¼	4.29
Atchison, Top. & S. F. Short Line 4s.	1958	J — J	94¼	4.28
N. Y. Central Deb. 4s.	1934	M — N	95⅞	4.27
Southern Pacific R. R. 1st ref. 4s.	1955	J — J	94⅝	4.27
Atlantic Coast Con. 1st G. 4s.	1952	M — S	95½	4.27
Atchison, Top. & S. F. Gen. Adj. G. 4s., Stamped	1995	M — N	94⅝	4.23
Colorado & Southern 1st G. 4s.	1929	F — A	98	4.15
Baltimore & Ohio 1st G. 4s.	1948	A — O	99½	4.03
Chicago, Bur. & Quincy Gen. Mtg. 4s.	1958	M — S	99⅝	4.03
Minn., St. Paul & S. S. M. Con. 4s.	1938	J — J	99⅝	4.02
Missouri, Kansas & Texas 1st G. 4s.	1990	J — D	100⅛	3.99
Union Pacific Id. gr. G. 4s.	1947	J — J	102⅝	3.87
Nor. & Western Conv. 10-25-yr. 4s.	1932	J — D	102½	3.84
Atchison, Top. & S. F. Conv. G. 4s.	1955	J — D	119⅝	3.18
Atchison, Top. & S. F. Conv. 4s.	1955.	J — D	121⅝	3.12
Union Pacific 20-yr. Conv. 4s.	1927	J — J	116¼	2.84
Atchison, Top. & S. F. 10-yr. Conv. G. 5s.	1917	J — D	120¼	2.23
Atchison, Top. & S. F. Conv. 5s.	1917	J — D	120⅞	2.15

Class A—Bonds of high grade, but affected somewhat by changing earning power as well as money rates and general conditions.

Kansas City, Ft. Scott & M. Ref. G. 4s.	1936	A — O	83	5.17
Atlantic Coast Line L. & N. 5-20-yr. Col. 4s.	1923	A — O	90¼	4.97
Chicago & Alton 1st Lien 3½s	1950	J — J	75½	4.89
Missouri Pacific Col. Trust G. 5s.	1917	M — S	102	4.70
Chicago, R. I. & Pacific 1st Ref. G. 4s.	1934	A — O	90⅝	4.63
Erie 1st Con. G. Prior Lien 4s.	1996	J — J	87	4.61
Missouri, Kansas & Texas 2nd G. 4s.	1990	F — A	88	4.57
Louisville & Nashville South-Monon Joint 4s.	1952	J — J	90½	4.50
Baltimore & Ohio P. L. E. & W. Ref. 4s.	1941	M — N	93	4.41
P. L. E. & W. S. W. Div. (B. & O. System) 1st G. 3½s.	1941	M — N	93	4.41
Chesapeake & Ohio Gen. G. 4½s.	1992	M — S	104	4.33
Louisville & Nashville, Atl. Knox & Cin. Div. 4s.	1955	M — N	93¾	4.32
Baltimore & Ohio, Southwestern Div. 3½s.	1925	J — J	90¾	4.31
P. L. E. & W. S. W. Div. (B. & O. System) 1st G. 3½	1925	J — J	90¾	4.31
St. Louis Southwestern 1st G. 4s.	1989	M — N	94	4.27
Baltimore & Ohio Prior 1st G. 3½	1925	J — J	92½	4.15

Class Baa—Good second grade bonds, somewhat speculative in nature.

Erie 1st. Con. Gen. Lien G. 4s.	1996	J — J	75¾	5.30
Ann Arbor 1st G. 4s.	1995	Qu. - J	84	4.78
St. Louis, I. Mt. & So., R. & G. Div. 1st 4s.	1933	M — N	89	4.77
Missouri, Kansas & Texas 1st & Ref. 4s.	2004	M — S	85	4.68
Wisconsin Central, Sup. & Dul. Div. & Term 1st 4s.	1936	M — N	93¼	4.43
Wisconsin Central, 50-yr. 1st Gen. 4s.	1949	J — J	95	4.26
N. Y., N. H. & Hartford Conv. Deb. 6s.	1948	J — J	143	3.86
N. Y., N. H. & Hartford Conv. 3½s. Deb.	1956	J — J	109	3.13

Class Ba—Well secured bonds, likely to decline if earnings fall off or advance if earnings increase.

Erie 50-yr. Conv. 4s., Series B	1953	A — O	73½	5.63
Wabash 1st Ref. & Ext. G. 4s.	1956	J — J	73¼	5.62
Denver & Rio Grande, 1st & Ref., 5s.	1955	F — A	94¼	5.34
Missouri, Kansas & Texas Gen. S. F. 4½s.	1936	J — J	90½	5.15
Erie 50-yr. Conv. 4s., Series A	1953	A — O	83	4.95
Southern Ry. 1st Con. G. 5s.	1994	J — J	110	4.54

Class B—Issues likely to fluctuate in price and more speculative than the foregoing class.

St. Louis Southwestern 1st Con. G. 4s.	1932	J — D	78	5.73
Iowa Central Ref. G. 4s.	1951	M — S	76¾	5.41
Missouri Pacific 40-yr. Col. G. Loan 4s.	1945	M — S	80½	5.20
Chicago, R. I. & Pac. Col. tr. 4s.	2002	M — N	77⅝	5.18
St. Louis & San Francisco Ref. G. 4s.	1951	J — J	85	4.84

Figure A.1:
***The Ticker's* Bond Buyer's Guide**

Note: This figure provides an example (from November, 1909) of the tables printed in the popular finance magazine *The Ticker* beginning in November 1909. Bonds that had recently traded were grouped by the rating assigned by Moody, and then within each ratings class, were sorted by the yield to maturity implied by their price. The magazine frames the table as a guide to the "relative cheapness" of bonds, implying that bonds with high yields within their ratings class were cheap, and bonds with low yields compared to other bonds of the same rating were expensive. The magazine thus encouraged investors to trade on the basis of the surprises contained in Moody's ratings relative to market yields.

Complete Bond Transactions.

Total Week End. Mar. 13, $17,013,000	First.	High.	Low.	Last.	Sales.
Adams Express 4s	92⅞	93½	92⅞	93½	9
Albany & Susquehanna 3½s	97	97	97	97	16
Allis-Chalmers 5s	81¾	82	81½	82	75
American Agricult. Chem. conv. 5s, rcts.	99⅝	100	99⅝	99⅞	25
American Ice Securities 6s	71½	73	71½	73	36
American Cotton Oil 4½s	97⅛	97⅛	97⅛	97⅛	3
American Hide & Leather 6s	99	99	98	98	9
American Tel. & Tel. conv. 4s	94⅞	95½	94⅞	95½	924
American Tel. & Tel. col. tr. 4s	94	94½	94	94½	15
American Tobacco 4s	75⅝	78	75⅝	78	258
American Tobacco 6s	106⅝	107¾	106⅝	107¾	123
American Tobaco 6s, reg.	106¾	106¾	106¾	106¾	4
Ann Arbor 4s	86⅝	87¾	86⅝	87¾	12
Atch., Top. & Santa Fé gen. 4s	101	101	100¾	101	167
Atch., Top. & Santa Fé adj. 4s	94¼	94½	94¼	94½	9½
Atch., Top. & Santa Fé adj. 4s, stamped	94¾	94¾	94¾	94¾	16
Atch., Top. & Santa Fé conv. 5s	107½	107⅝	107	107¼	297
Atch., Top. & Santa Fé, East Okla. 4s	97⅞	97⅞	97⅞	97⅞	2
Atch., Top. & Santa Fé, Trans. Sh. 4s	95½	95½	95½	95½	44
Atch., Top. & Santa Fé conv. 4s	105⅞	105⅞	105⅛	105⅛	677
Atlantic Coast Line 4s	97½	97½	97	97¼	54
Atlantic Coast Line, L. & N. col. 4s	90	90¼	90	90	25
Baltimore & Ohio prior lien 3½s	93¾	93¾	93½	93¾	27
Baltimore & Ohio prior lien 3½s, reg.	92	92	92	92	8
Baltimore & Ohio gold 4s	100⅞	101	100¾	100¾	75
Balt. & Ohio, P., L. E. & W. Va. 4s	94⅝	94⅝	94⅛	94⅛	21
Bethlehem Steel 5s	80	80	79½	79½	68
Brooklyn Rapid Transit gold 5s	104¼	104¼	104¼	104¼	2
Brooklyn Rapid Transit ref. 4s	84	84	83½	83½	91
Brooklyn Union Elevated 1st 5s	102⅜	102½	102	102½	12
Brooklyn Union Gas 1st 5s	106½	106⅝	106½	106⅝	2
Canada Southern 1st ext. 6s	106¼	106¾	106¼	106¾	25
Canada Southern 2d 5s	102½	102½	102¼	102¼	5
Central of Georgia consol. 5s	110	110	110	110	1
Central of Georgia 2d inc. 5s, stamped	62	62	62	62	5
Central of Georgia 2d inc. 5s, Cent. Tr. cfs	63	63	63	63	27
Central of New Jersey gen. 5s, reg.	127⅜	127⅜	127⅜	127⅜	1
Central Leather 5s	97	97½	97	97½	46
Central Pacific gtd. 4s	98	98	97¾	98	191
Central Pacific 3½s	90½	90½	90½	90½	12
Central Pacific, Through Short Line 4s	94	94	94	94	5
Central Vermont 4s	83	83	83	83	3
Chesapeake & Ohio gen. 4½s	105⅜	105½	105	105	26
Chesapeake & Ohio con. 5s	115⅞	116	115⅞	116	256
Ches. & Ohio, Big Sandy 4s	90½	90½	90½	90½	1
Ches. & Ohio, tr. rcts. for gen. f. & i. 5s	102⅛	102⅝	101⅞	101⅞	200
Chicago & Alton 3s	75½	78½	75½	78½	25
Chicago & Alton 3½s	74⅞	74⅞	74	74	4
Chi., Bur. & Q., N. P.-Gt. N. jt. 4s	98⅝	98⅝	98⅛	98⅝	508
Chi., Bur. & Q., N. P.-Gt. N. jt. 4s, reg.	98	98⅝	98	98⅝	7
Chi., Bur. & Q., Illinois Div. 3½s	92½	92½	91⅞	91⅞	3
Chi., Bur. & Q., Illinois Div. 4s	102¼	102¼	101⅞	101⅞	28
Chi., Bur. & Q., gen. 4s	100¼	100¼	100¼	100¼	185
Chi., Bur. & Q., Nebraska Ext. 4s	102	102	102	102	6
Chi., Bur. & Q., Southwest Div. 4s	99½	99½	99½	99½	1
Chicago & Eastern Illinois gen. 5s	115⅜	115⅜	115¼	115¼	13
Chicago & Eastern Illinois ref. & imp. 4s	88⅞	88⅞	88	88	86
Chicago & Erie 1st 5s	116¾	116¾	116½	116½	7
Chi., Mil. & St. P. gen. 3½s, Series B	91⅞	91⅞	91⅞	91⅞	11
Chi., Mil. & St. P. gen. 4s, Series A	102⅞	103½	102⅞	103½	11
Chi., Mil. & St. P., Hast. & Dak. 7s	102⅝	102⅝	102⅝	102⅝	17
Chi., Mil. & St. P., Mineral Point Div. 5s	101⅞	101⅞	101⅞	101⅞	1
Chi., Mil. & St. P., Dak. & Gt. So. 5s	105⅞	105⅞	105⅞	105⅞	1
Chi., Mil. & St. P., Chi. & Mo. River 5s	112⅜	112⅜	112⅜	112⅜	2
Chi., Mil. & St. P., So. Minn. Div. 5s	101⅞	101⅞	101⅞	101⅞	10
Chi., Mil. & St. P., Chi., Pac. & West. 5s	110¼	110¼	110⅛	110⅛	4
Chicago & Northwestern ext. 4s reg.	100⅞	100⅞	100⅞	100¾	5
Chicago & Northwestern gen. 3½s	92⅞	93	92⅝	93	36
Chicago, Rock Island & Pacific ref. 4s	93	93	92⅞	92½	314
Chicago, Rock Island & Pacific col. 4s	79	79	78⅜	78⅜	211
Chicago, Rock Island & Pacific col. 5s	90⅞	90⅞	89⅞	89¼	43
Chicago, Rock Island & Pacific gen. 4s	100⅞	100⅞	100½	100⅞	83

	First.	High.	Low.	Last.	Sales.
Norwolk & Western gen. 6s	127½	127½	127½	127½	1
Norfolk & Western conv. 4s	96¼	96½	96	96	104
Norfolk & Western div'l 4s	93¾	93¾	93½	93½	25
Norfolk & Western consol. 4s	98⅝	98⅝	98⅝	98⅝	1
Norfolk & West. Pocahontas C. & C. 4s	92	92	92	92	8
Northern Pacific prior lien 4s	103¼	103⅜	103¼	103⅜	61
Northern Pacific 3s	74¾	74¾	74⅝	74¾	31½
Oregon Railroad & Navigation 4s	99	99	99	99	17
Oregon Short Line gtd. ref. 4s	94¾	95	94¾	95	73
Oregon Short Line consol. 5s	117	117	117	117	3
Pacific of Missouri 1st 4s	99¾	100	99¾	100	7
Pennsylvania con. 4s, 1948	104⅝	104⅝	104¼	104⅝	154
Pennsylvania conv. 3½s, 1912	97⅞	98	97⅞	97⅞	105
Pennsylvania conv. 3½s, 1915	95¾	95¾	95½	95½	448
Pennsylvania gtd. 3½s, tr. rects	96¾	96¾	96¾	96¾	11
Pennsylvania gtd. 3½s, Series B	90¼	90¼	90¼	90¼	5
Pennsylvania gtd. 4s	99	99	99	99	1
Pennsylvania gtd. 4½s	106	106	106	106	1
Peoria & Eastern inc. 4s	41⅛	41¼	41⅛	41¼	6
Peoria & Eastern 1st 4s	94¾	94¾	94¾	94¾	4
People's Gas of Chicago consol. 6s	121	121	120¼	120¼	3
Philippine Railway 4s	94	94	94	94	10
Reading gen. 4s	100	100⅛	99⅞	99⅞	152
Reading, Jersey Central col. 4s	97	97	97	97	1
Republic Iron & Steel 5s	99	99	99	99	10
Rochester & Pittsburg consol. 6s	121½	121½	121½	121½	3
Rio Grande Western coll. 4s	83	83	83	83	2
Rio Grande Western 1st 4s	98	98	98	98	4
St. Joseph & Grand Island 4s	95	95	95	95	2
St. Louis, Iron Mt. & So., R. & G. 4s	91	91	90⅞	91	12
St. Louis, Iron Mt. & So. unif. & ref. 4s	89	90⅜	89	90⅜	82
St. Louis, Iron Mt. & Southern gen. 5s	111½	111½	111¼	111½	12
St. Louis & San Francisco gen. 5s	111	111	111	111	4
St. Louis & San Francisco ref. 4s	86	86¼	85	85	94
St. Louis & San Francisco gen. 5s, tr. r.	89⅜	89⅜	89	89	34
St. Louis Southwestern consol. 4s	78¾	78¾	78¾	78¾	1
St. Louis Southwestern 1st 4s	94	94	94	94	14
St. Paul, Minn. & Man. consol. 6s	132⅝	132⅝	132⅝	132⅝	1
St. Paul, Minn. & Man. consol. 4½s	109¼	109½	109¼	109½	15
St. Paul, Minn. & Man. Montana Ext. 4s	99¼	99¾	99¼	99¾	5
St. Paul, Minn. & Man., Mont. Central 5s.	116½	116½	116½	116½	1
St. Paul & Northern Pacific 6s	121	121	121	121	1
San Antonio & Aransas Pass 4s	90¼	90¼	90	90	16
Seaboard Air Line 4s	65¼	65¼	65⅛	65⅛	18
Scioto Valley & New England 4s	97	97	97	97	1
Southern Railway 1st 5s	111¼	111¼	111	111	34
Southern Railway dev. & gen. 4s	78¾	78⅞	78½	78¾	801
Southern Railway, Mob. & Ohio col. 4s	89½	89½	89	89½	8
Southern Pacific 1st 4s	92	92	91¾	91¾	21
Southern Pacific ref. 4s	95¼	95¼	95⅛	95⅛	138
Terminal Assn. of St. Louis ref. 4s	97¾	97¾	97½	97½	17
Texas Pacific 1st 5s	118	118	118	118	2
Texas & Pacific 2d inc.	70	70	70	70	1
Third Ave. con. 4s, Cent. Tr. ctfs., st'p'd.	67½	68⅛	67	67¼	33
Toledo, Peoria & Western 4s	92½	94	92½	94	10
Ulster & Delaware con. 5s	108¾	108¾	108¾	108¾	2
Underground Rys. of London income 6s	28	28	28	28	3
Underground Rys. of London 4½s	79¼	79¼	79¼	79¼	10
Union Pacific 1st & ref. 4s	98¾	98⅞	98⅝	98⅝	322
Union Pacific 1st 4s	103¼	103½	103	103	38
Union Pacific conv. 4s	103⅛	103¾	102⅞	103¼	816
United Railways of San Francisco 4s	74	74	73	73	31
U. S. Reduction & Refining 6s	91	91	91	91	5
U. S. Rubber s. f. 6s, ctfs.	102½	103	102½	102¾	45
U. S. Leather 6s	106½	106½	106	106	23
U. S. Realty & Improvement 5s	87¾	89¼	87¾	89	63
U. S. Steel Corp. 2d mtge. s. f. 5s	103	103¼	103	103	601
U. S. Steel Corp. 2d mtge. s. f. 5s reg.	103	103	103	103	1½

Figure A.2:
New York Stock Exchange Weekly Bond Prices

Note: This figure provides an example (from March 13th, 1909) of weekly closing prices for all bonds traded on the New York Stock Exchange reported in the Monday edition of the *New York Times*. Data was collected for the two years surrounding the introduction of securities ratings in April of 1909.

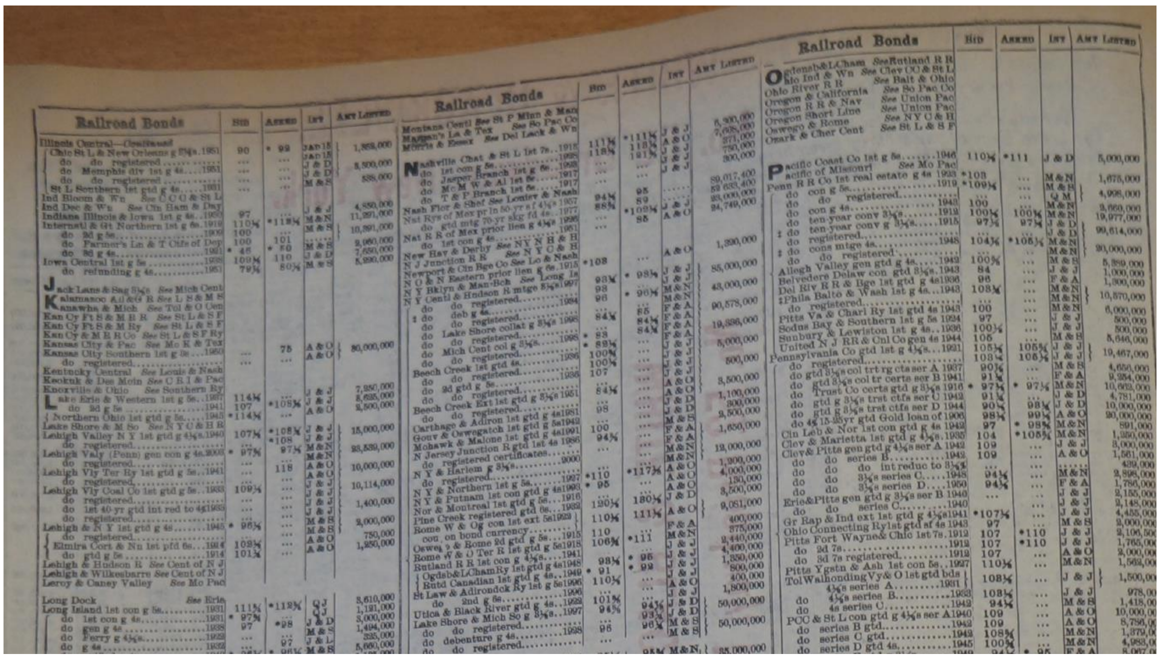


Figure A.3:
New York Stock Exchange Bond Bid and Ask Quotations

Note: The figure provides a partial example (from April 7, 1909) of New York Stock Exchange printed and distributed quotation sheets that include all bid-ask spreads from 11am accessed and digitized from the archives at the New York Stock Exchange. Data were collected at a weekly frequency for the 12 weeks surrounding the introduction of securities ratings in April of 1909.

BONDS ON STOCK EXCHANGE.

Wednesday.

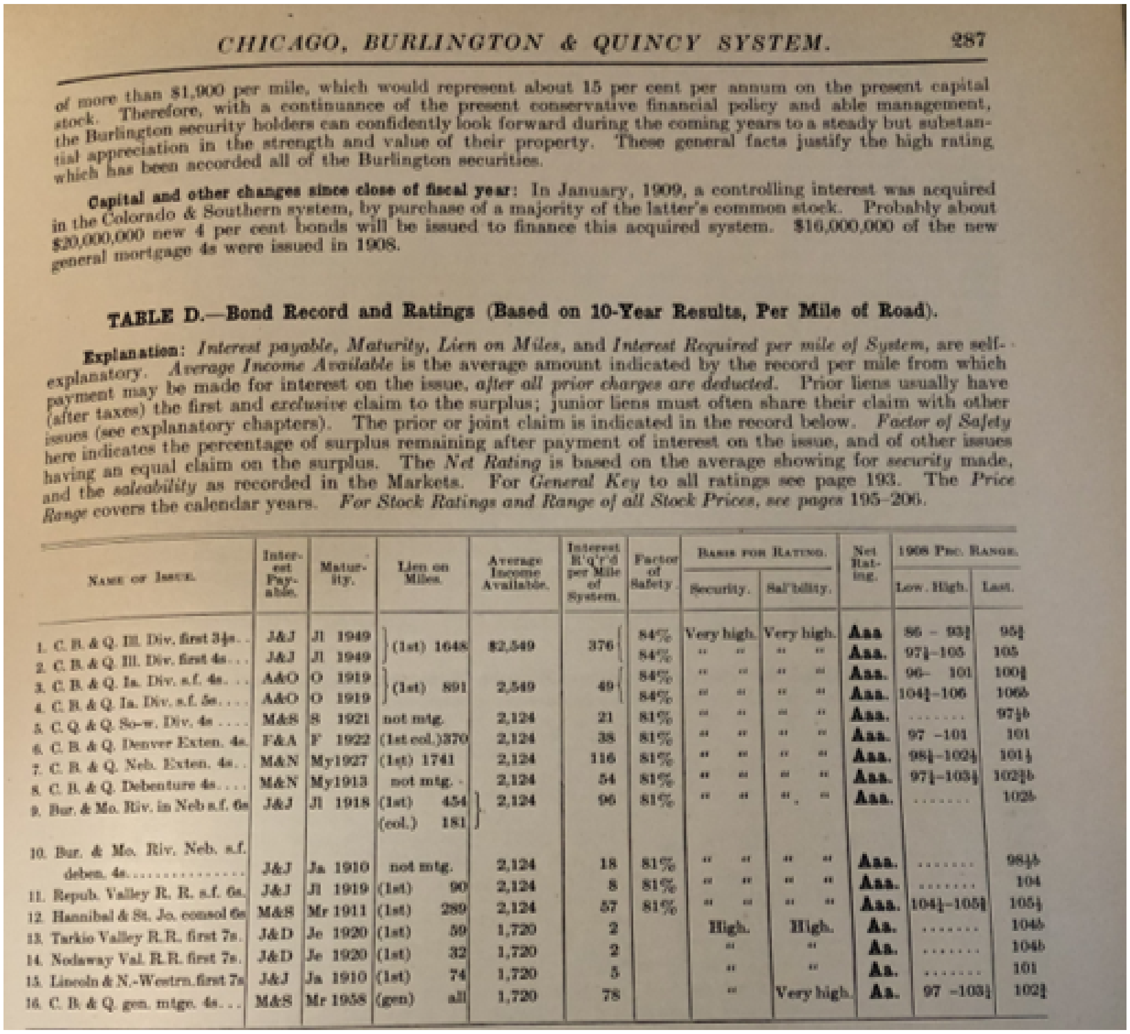
Imprl Jap Gov 4½s
steri loan
1,000 3........ 92⅝
2d series
5,000s6f........ 91¾
San Paulo 5s, trust
recis
12,000.......... 92¾
80,000.......... 93
14,000.......... 93¼
2,000.......... 93⅜
2,000.......... 93⅝
U S of Mexico 4s
1,000.......... 93
U S of Mexico 5s
1,000.......... 98½
N Y City 4½s, 1957
1,000..........111½
new
11,000..........111½
35,000..........111⅝
1917
7,000..........104½
N Y City 4s, 1958,
when issued
10,000..........101¾

Adams Express 4s
2,000.......... 93¾
Allis-Chalmers 5s
7,000.......... 81⅞
Am Ag Ch conv 5s
21,000..........100
Am Ice Secur 6s
1,000.......... 73½
Am Tel & T conv 4s
30,000.......... 95⅜
4,000s10f....... 95¼
134,000.......... 95½
87,000.......... 95⅝
48,000.......... 95¾
10,000.......... 95⅞

Inter-Metro 4½s
10,000.......... 78⅜
3,000.......... 78½
1,000.......... 78⅜
2,000.......... 78¼
11,000.......... 78⅜
46,000.......... 78½
Interb R T conv 6s
30,000..........103¼
14,000..........103⅜
Int & Gt N 2d 5s,
Tr ctfs of dep
10,000.......... 86½
Int Stm Pump 6s
4,000..........102
Iowa Cent ref 4s
4,000.......... 78¾
4,000.......... 79
K C, Ft S & M 4s
3,000.......... 83¾
Kan City So 3s
1,000.......... 75
Kentucky Cent 4s
7,000.......... 98½
Kings Co Elev 4s,
stamped gtd
9,000.......... 87¼
L E & Wn 1st 5s
10,000..........114
L S & Mich So 4s
3,000.......... 95½
L S & M So 4s, 1931
30,000.......... 95½
1,000.......... 95⅞
Leh Val Term 5s
2,000..........118¾
Lex Av & P F 1st
5,000..........101½
Lo & N unified 4s
3,000..........101
Mer Mar col tr 4½s
5,000.......... 71⅞

Figure A.4:
New York Stock Exchange Intraday Bond Transactions

Note: This figure provides an example (from March 17th, 1909) of daily bond intraday transactions for all bonds traded on the New York Stock Exchange as reported in the *New York Times*. Data was collected every Wednesday for 12 weeks surrounding the introduction of securities ratings in April of 1909.



of more than $1,900 per mile, which would represent about 15 per cent per annum on the present capital stock. Therefore, with a continuance of the present conservative financial policy and able management, the Burlington security holders can confidently look forward during the coming years to a steady but substantial appreciation in the strength and value of their property. These general facts justify the high rating which has been accorded all of the Burlington securities.

Capital and other changes since close of fiscal year: In January, 1909, a controlling interest was acquired in the Colorado & Southern system, by purchase of a majority of the latter's common stock. Probably about $20,000,000 new 4 per cent bonds will be issued to finance this acquired system. $16,000,000 of the new general mortgage 4s were issued in 1908.

TABLE D.—Bond Record and Ratings (Based on 10-Year Results, Per Mile of Road).

Explanation: *Interest payable, Maturity, Lien on Miles*, and *Interest Required per mile of System*, are self-explanatory. *Average Income Available* is the average amount indicated by the record per mile from which payment may be made for interest on the issue, *after all prior charges are deducted*. Prior liens usually have (after taxes) the first and *exclusive* claim to the surplus; junior liens must often share their claim with other issues (see explanatory chapters). The prior or joint claim is indicated in the record below. *Factor of Safety* here indicates the percentage of surplus remaining after payment of interest on the issue, and of other issues having an equal claim on the surplus. The *Net Rating* is based on the average showing for *security* made, and the *saleability* as recorded in the Markets. For *General Key* to all ratings see page 193. The *Price Range* covers the calendar years. *For Stock Ratings and Range of all Stock Prices, see pages 195–206.*

Name of Issue.	Interest Payable.	Maturity.	Lien on Miles.	Average Income Available.	Interest R'q'r'd per Mile of System.	Factor of Safety.	Basis for Rating.		Net Rating.	1908 Pr. Range.	
							Security.	Sal'bility.		Low. High.	Last.
1. C. B. & Q. Ill. Div. first 3½s. .	J&J	Jl 1949	(1st) 1648	$2,549	376	84%	Very high.	Very high.	Aaa	86 – 93¾	95¾
2. C. B. & Q. Ill. Div. first 4s. . .	J&J	Jl 1949				84%	" "	" "	Aaa.	97½–105	105
3. C. B. & Q. Ia. Div. s.f. 4s. . .	A&O	O 1919	(1st) 891	2,549	49	84%	" "	" "	Aaa.	96– 101	100¾
4. C. B. & Q. Ia. Div. s.f. 5s. . . .	A&O	O 1919				84%	" "	" "	Aaa.	104¼–106	106b
5. C. Q. & Q. So-w. Div. 4s	M&S	S 1921	not mtg.	2,124	21	81%	" "	" "	Aaa.	. . . .	97½b
6. C. B. & Q. Denver Exten. 4s.	F&A	F 1922	(1st col.)370	2,124	38	81%	" "	" "	Aaa.	97 –101	101
7. C. B. & Q. Neb. Exten. 4s. .	M&N	My1927	(1st) 1741	2,124	116	81%	" "	" "	Aaa.	98¼–102¼	101½
8. C. B. & Q. Debenture 4s. . . .	M&N	My1913	not mtg.	2,124	54	81%	" "	" "	Aaa.	97½–103¼	102½b
9. Bur. & Mo. Riv. in Neb s.f. 6s	J&J	Jl 1918	(1st) 454 (col.) 181	2,124	96	81%	" "	" "	Aaa.	. . . .	102b
10. Bur. & Mo. Riv. Neb. s.f. deben. 4s.	J&J	Ja 1910	not mtg.	2,124	18	81%	" "	" "	Aaa.	. . . .	98½b
11. Repub. Valley R. R. s.f. 6s.	J&J	Jl 1919	(1st) 90	2,124	8	81%	" "	" "	Aaa.	. . . .	104
12. Hannibal & St. Jo. consol 6s	M&S	Mr 1911	(1st) 289	2,124	57	81%	" "	" "	Aaa.	104½–105¾	105¼
13. Tarkio Valley R.R. first 7s.	J&D	Je 1920	(1st) 59	1,720	2		High.	High.	Aa.	. . . .	104b
14. Nodaway Val. R.R. first 7s.	J&D	Je 1920	(1st) 32	1,720	2		"	"	Aa.	. . . .	104b
15. Lincoln & N.-Westrn. first 7s	J&J	Ja 1910	(1st) 74	1,720	5		"	"	Aa.	. . . .	101
16. C. B. & Q. gen. mtge. 4s. . .	M&S	Mr 1958	(gen) all	1,720	78		"	Very high.	Aa.	97 –103¼	102¾

Figure A.5:

Note: The figure provides an example of a Ratings Table presented in Moody's Manuals when they are released in 1909.

TABLE B.—Income Factors (Earnings and their Distribution, Per Mile of Road).

Years Ended June 30.	Gross Earnings.	Maintenance. Way.	Maintenance. Equipment.	Total Maintenance.	Cond. Transportation Gen. Exp. etc.	Net Earnings.	Total Net Income.	Fixed Charges.	Margin of Safety.	Surplus over Charges.	Disposal of Surplus. For Dividends.	Disposal of Surplus. For Imp. Etc.	Balance Carried Forward.
1899	$5,942	$872	$659	$1,531	$2,129	$2,282	$2,391	$1,421	**41%**	$970	$722	.....	$248
1900	6,300	1,074	729	1,803	2,149	2,348	2,398	1,348	**44**	1,050	772	.....	278
1901	6,455	1,119	784	1,903	2,280	2,272	2,320	1,272	**45**	1,048	858	.....	190
1902	6,634	960	916	1,876	2,318	2,440	2,481	1,238	**50**	1,243	841	.....	402
1903	7,410	1,084	907	1,991	2,544	2,875	2,916	1,306	**55**	1,610	1,062	.....	548
1904	7,413	1,167	952	2,119	2,729	2,565	2,564	1,107	**57**	1,457	1,004	.....	453
1905	7,437	1,025	1,103	2,128	2,632	2,677	2,711	1,155	**57**	1,556	996	.....	560
1906	8,335	1,272	1,533	2,805	2,980	2,550	2,596	1,163	**55**	1,433	992	.....	441
1907	9,041	1,584	1,604	3,188	3,259	2,594	2,633	1,190	**55**	1,443	968	.....	475
1908	8,740	1,626	1,392	3,018	3,216	2,506	2,477	1,129	**54**	1,348	987*	$359	2
10-Year Average	$7,371	$1,178	$1,058	$2,236	$2,624	$2,511	$2,549	$1,233	**51%**	$1,316	$920	$36	$360

Note.—In 1908, Rents are deducted from net revenue figures, instead of being included in operating costs, etc., as previously done. *See Dividend Record on next page.

Comparison on 10-Year Average with Four Properties of Similar Characteristics.

C., M. & St. Paul	$7,185	$930	$703	$1,633	$2,719	$2,833	$2,892	$1,127	**61%**	$1,765	$1,042	$226	$497
Chic. & N.-W.	8,019	1,019	902	1,921	3,145	2,952	3,205	1,499	**54**	1,706	817	619	270
Rock Island	6,779	1,027	762	1,789	2,693	2,297	2,410	1,621	**33**	789	286	.....	503
Missouri Pacific	6,662	936	955	1,891	3,045	2,123	2,550	1,683	**34**	867	416	.....	451

Definitions: *Gross earnings* include all operating income; *conducting transportation, etc.*, includes traffic expenses, general expenses, etc.; *total net income* includes receipts from investments, and other sources distinct from operation; *fixed charges* include all interest, rentals, taxes, etc.; *margin of safety* signifies percentage of total net income remaining after payment of all fixed charges.

Comment: Like the Northwestern and the St. Paul, the prosperous condition of the Burlington property ... growth of gross business during the entire decade. The

Figure A.6:
Basis of Ratings

Note: The figure provides an example of the kind of information presented in Moody's Manuals when they are released in 1909.

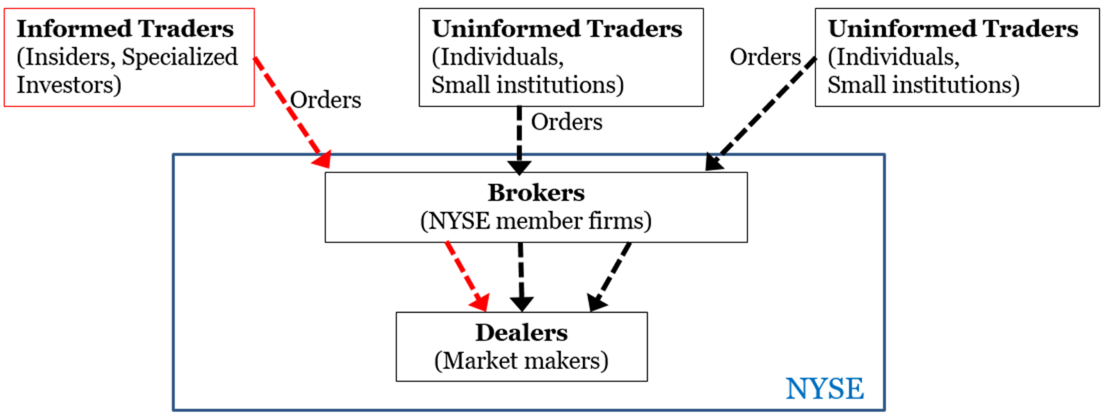


Figure A.7:
Structure of Bond Trading on the NYSE

Note: The figure provides a visual demonstration of the structure of bond trading on the New York Stock Exchange in the early 20th century.

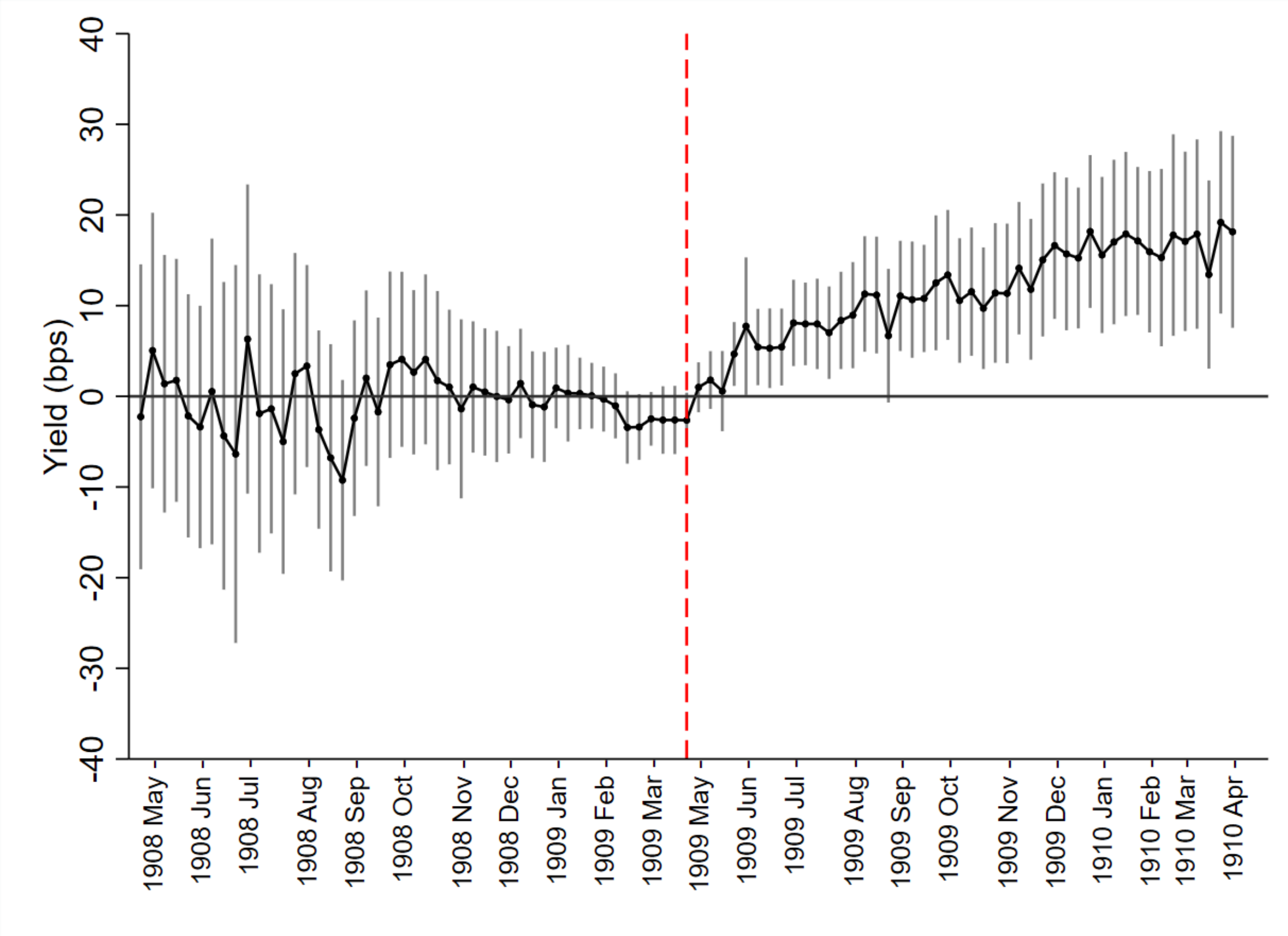


Figure A.8:
Ratings Surprises and Bond Yields (Robustness to yield measure)

Note: The figure presents the differences in yields between bonds whose ratings constituted a negative surprise and other rated bonds—those that either received a positive surprise, or no surprise. The differences plotted in the figure are estimated from regressions of "perpetuity yield" (PY = coupon/price) on indicators for a negative surprise interacted with indicators for each week, with the week prior to the introduction of ratings excluded. The regressions also include bond fixed effects, as well as rating level fixed effects interacted with time trends (see text). The figure also includes lines representing 95 percent confidence intervals.

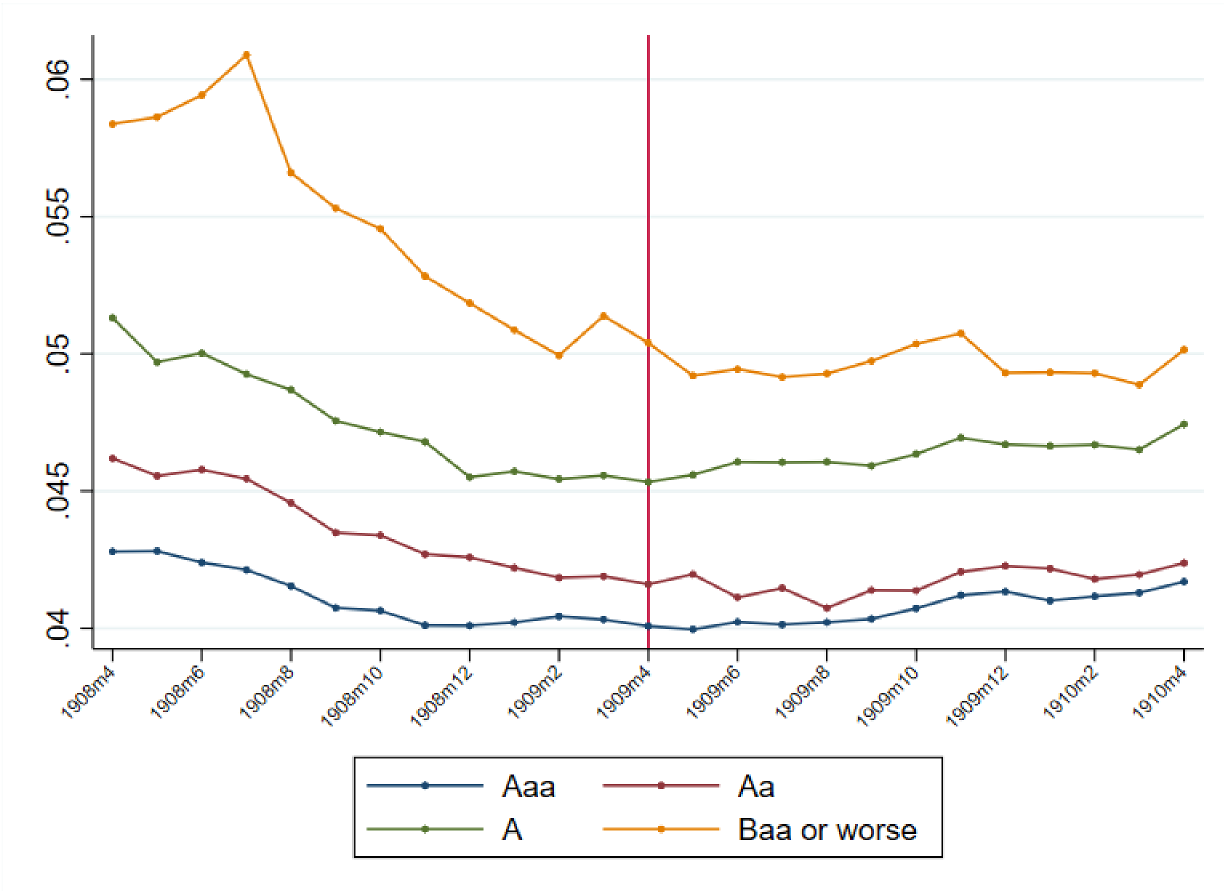


Figure A.9:
Railroad Bond Yields, by Rating Level

Note: The figure presents the mean yield-to-maturity for railroad bonds both before and after the introduction of ratings, by the level of their ratings, from April 1908 to April 1910, as computed from closing prices reported in the *New York Times*.

Table A.1:
Summary Statistics: Transactions Data, Railroad Bonds

Statistic	*N*	Mean	St. Dev.	25th pct	50th pct	75th pct
Coupon	17,720	4.37	0.756	4	4	5
Yield	17,720	0.050	0.275	0.041	0.043	0.048
Last Price	17,720	94.76	17.30	87.88	97.25	103.9
Maturity (year)	17,720	1953	51	1931	1945	1955
Rated Issue	17,720	0.902				

Note: This table presents summary statistics for all railroad issues in the transactions data collected from the *New York Times* for our analysis of the effect of ratings on bond yields. The data were collected weekly from 11th of April 1908 to the 23rd of April 1910. The observations for issues that do not have at least one observed last price before and after the 23rd of April 1909 are dropped. The yield is the yield to maturity using the last price and is winsorized at the top and bottom 1%. Rated issue is an indicator that is equal to 1 if the issue was rated by Moody.

Table A.2:
Effect of Ratings Surprises on Yields: Robustness Checks

Yield (Basis Points)	(1)	(2)	(3)	(4)	(5)
Neg Surprise × Weeks Since	0.39***	0.31**	0.24**		0.43***
	(0.11)	(0.13)	(0.11)		(0.10)
Neg Surprise × Trend (Wks) × Post				0.48***	
				(0.18)	
Neg Surprise × Trend (Wks)				-0.11	
				(0.14)	
All interactions	Y	Y	Y	Y	Y
Bond FE	Y	Y	Y	Y	Y
Rating FE × Trend	Y	-	-	-	Y
Week FE	Y	Y	Y	Y	Y
PreYieldFEs x Trend	-	Y	Y	Y	-
# Yield Groups	-	4	10	4	-
Yield	YTM	YTM	YTM	YTM	PY
R^2	0.886	0.888	0.882	0.887	0.936
Obs	15,478	15,478	15,478	15,478	15,525

Note: This table depicts the effects of "surprises" (i.e. deviations in ratings from the median for those in the same yield quartile based on their mean yield among all traded bonds prior to the introduction of ratings) on secondary market bond yields trading on the New York Stock Exchange, using alternative specifications. Column (1) replicates our preferred specification (column (3) from Table 4), in which we regress the yield to maturity in basis points on a dummy variable equal to one for a negative surprise (*Neg Surprise*) interacted with a variable recording weeks since the release of the ratings (*Weeks Since*). This specification also includes bond and week fixed effects and rating fixed effects interacted with weeks since ratings were released. The pre-period includes the year prior to the release of ratings, while the post-period includes the period 6 months to 12 months following their disclosure. In column (2) we modify the specification by replacing the rating fixed effects interacted with trends with yield level fixed effects interacted with trends. Column (3) is the same as column (2), but the original four yield level groups are replaced with 10 yield level groups. In column (4) we interact our negative surprise variable with a trend, and then also with a post ratings indicator. In column (5), we revert to our baseline specification, but replace our yield to maturity variable, which is measured imprecisely, with perpetuity yield (coupon rate/price). Standard errors clustered at the bond level are in parentheses.***, **, and * denote significance at 1%, 5%, and 10%, respectively.

Table A.3:
Summary Statistics: Bid-Ask Data, Railroad Bonds

Statistic	N	Mean	St. Dev.	25th pct	50th pct	75th pct
Coupon	5,085	4.55	0.87	4.00	4.00	5.00
Bid Price	5,085	100.32	13.62	93.25	100.38	110.00
Ask Price	5,085	101.22	14.33	94.00	101.00	111.00
Bid-Ask Spread	5,085	0.0116	0.0157	0.0033	0.0061	0.0123
Yield	5,085	0.044	0.009	0.040	0.042	0.046
Maturity (year)	5,085	1946	36	1927	1939	1952
Rated Issue	5,085	0.944				

Note: The table presents summary statistics for all the railroad issues in the bid-ask data for the 12 weeks surrounding the introduction of ratings and for the sample used in the primary regression analysis on bid-ask spreads. Observations for issues that do not have at least one observed bid price before and after the 23rd of April 1909 are dropped. Additionally, observations for issuers that do not have at least two issues with at least one observed bid price before and after the 23rd of April 1909 are also excluded. When there are multiple coupons listed for a single issue, we use the maximum. The yield is the yield to maturity using the bid price and is winsorized at the top and bottom 1%. The bid-ask spread is presented as a percentage and is calculated as $\frac{(ask-bid)\times 2}{(ask+bid)}$. The bid-ask spread is also winsorized at the top and bottom 1%.

Table A.4:
IV Results: Effect of Ratings on Bid-Ask Spreads (First Stage)

	OLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)
		Post × Rated Issue (First Stage)		
Post 23rd April 1909 × OtherBondsYields	NA	-11.35***	-13.73***	-14.83***
		(2.05)	(2.22)	(1.57)
Trend × OtherBondsYields	NA	-0.048	-0.094	-0.045
		(0.080)	(0.086)	(0.082)
		Trend × Rated Issue (First Stage)		
Post 23rd April 1909 × OtherBondsYields	NA	-4.88	1.62	-5.01
		(7.25)	(8.28)	(7.21)
Trend × OtherBondsYields	NA	-12.56***	-15.49***	-15.22***
		(1.96)	(2.00)	(1.57)
Bond FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Time FE × Pre-Rating Yield	Y	Y	Y	Y
Time FE × Pre-Rating Spread	Y	Y	Y	Y
Pre-Rating Spread >th-tile	-	-	60	80
Kleibergen-Paap F-Stat	-	17.5	20.7	50.1
Observations	5,085	5,085	2,076	1,042

Note: These are the corresponding first stages from the regressions in columns (1)-(4) of Table 7, plus one additional set of first stages (column 5) for comparison purposes which lack power (and therefore corresponding IV estimates are not produced in Table 7 since they would be invalid). See Table 7 description for more details. Robust standard errors, clustered by bond, are in parentheses. ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

Table A.5:
Summary Statistics: Intraday Trading Data

	Mean	SD	1st	5th	10th	25th	50th	75th	90th	95th	99th
Block size per trade	9.71	12.13	1	1	1	2	5.5	12	22.5	31.5	59
Log block size per trade	1.53	1.01	0	0	0	0.69	1.61	2.30	2.82	3.22	3.91
# of trades/day (cond. on trading)	2.58	3.50	1	1	1	1	1	3	5	9	18
# of trades of block size = 1 (cond. on trading)	0.41	0.64	0	0	0	0	0	1	1	2	3
% of trades in a day block size = 1	0.22										
% trades in a day block size≤5	0.59										
% Trades in a day block size ≥15	0.18										