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Asset Salability and Debt Maturity: Evidence from 19th Century American Railroads*

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Abstract

I investigate the effect of assets' liquidation values on capital structure by exploiting the diversity of track gauges in 19th century American railroads. The abundance of track gauges limited the redeployability of rolling stock and tracks to potential users with similar track gauge. Moreover, potential demand for both rolling stock and tracks was further diminished when many railroads went under equity receiverships. I find that the potential demand for a railroad's rolling stock and tracks were significant determinants of debt maturity. There is no evidence that salability or industry-demand for assets were correlated with leverage.

Introduction

An extensive literature analyzes financial decisions from an 'incomplete contracting' perspective. In particular, debt is often analyzed in terms of the allocation of residual control rights over its underlying assets. The driving force in this approach is the right to foreclose on the debtor's assets in the case of default. If the debtor fails to make a promised repayment, the creditor can seize his assets and liquidate the assets for their market value. The threat to liquidate induces the debtor to pay up, and a debt contract is a mechanism based on liquidation threat. It is the liquidation value of the assets, therefore that determines the allocation of bargaining power between the creditor and the debtor and the credibility of the liquidation threat. High liquidation value relative to the going concern value of the firm gives the creditor more bargaining power, while low liquidation value shifts power to the hand of the debtor.

Despite the abundant theory, there is relatively little empirical evidence on the relation between liquidation value and debt structure. Testing the theory requires detailed information about the assets, their liquidation values and the capital structure of the firm. Unfortunately, liquidation values are not observed ex-ante when the firm sets its capital structure. In this paper I use physical attributes of assets and proxies of potential demand for the assets to measure their liquidation values.

Liquidation value of an asset is determined along two dimensions. Physical attributes of an asset jointly with the number of its potential users, determine its *redeployability* - the alternative uses an asset has. However, as noted by Shleifer and Vishny (1992), the financial strength of its potential users determine its *liquidity* - the ease with which it can be sold in its next-best use value. I use the term *salability*, to describe how the combination of these two effects determine liquidation values. Using a unique dataset of 19th century American railroads, I find that liquidation values have a large effect on debt maturity. I construct different measures of asset salability, and find more salable assets prolong debt maturity. Surprisingly, I find no relation between leverage and liquidation values in my sample.

The railroad industry in the 19th century is a natural candidate to evaluate the effect of liquidation values on capital structure. Railroads used to own two main types of assets: 1) tracks; and 2) rolling stock, (e.g. locomotives, freight cars, passenger coaches etc.) Railroads relied heavily on external finance, and had diverse capital structures. Almost all the debt of railroads in the United

States during the 19th century was secured by the railroads' property, emphasizing the importance of the liquidation value of tracks and rolling stock for capital structure. Comprehensive data on railroads' assets, as well as cross-sectional dispersion in their capital structures, enable the study of the relation between the two sides of the balance sheet.

The nature of railroads' assets is unique. It combines fixed and site specific tracks with mobile and more flexible equipment. Both tracks and rolling stock are industry specific, and were put together to their highest use. However, while the iron rails connecting two cities were immobile and specialized to their original location, rolling stock was redeployable elsewhere in the country. Furthermore, for most of the second half of the 19th century, lack of standardization in railroad equipment frustrated the interchange of mobile capital. The abundance of track gauges limited the redeployability of the rolling stock and tracks to potential users with exactly the same gauge. Moreover, potential demand for both rolling stock and tracks was further diminished when many railroads went under equity receiverships and were prevented from participating in the market for used capital. The reorganization of the Denver and Rio Grande Railroad in 1886 exemplifies how gauge dispersion and market illiquidity affected the salability of rolling stock. Street (1959) used the Denver and Rio Grande case to demonstrate the importance of asset salability for secured creditors. He wrote

> *The Denver, a narrow gauge railroad built in the seventies to capitalize the civic pride of Denver...failed in the depression of 1884. It had outstanding, in addition to a small issue of first mortgage bonds and a large issue of junior bonds and stock, some $3,500,000 6 percent and 7 percent equipment trust certificates. The equipment, besides being narrow gauge - which both eliminated most potential purchasers and increased the expense of any delivery - was worn, dilapidated, and out of repair. Experts advised buying other equipment at currently depressed prices, if the equipment creditors should refuse to compromise their claim.*[1]

Operating 1,317 miles mostly in Colorado, the Denver and Rio Grande was the largest narrow gauge railroad in the United States. The potential buyers of the rolling stock; railroads that operated the same track gauge were all very small, with an average size of 58 miles. The next largest narrow gauge railroad was the Texas and St. Louis with 735 miles of operation; however, the depression

[1] Street (1959) p. 70.

of 1884 hit the Texas and St. Louis as well. In 1884 the two largest narrow gauge railroads, the Denver and Rio Grande, and the Texas and St. Louis, were insolvent and other small narrow gauge railroads were struggling to survive. The interaction between less redeployable assets (narrow gauge rolling stock), and market illiquidity led to low liquidation values.

I use physical attributes of assets such as track gauge, the composition of rolling stock, the mileage of rails made of steel, and proxies for industry demand to analyze asset salability of railroads and their corresponding capital structures. My results suggest a strong link between asset salability and debt maturity. My findings show that firms which owned more redeployable cars and conformed to the 'standard gauge' had significantly longer maturities of debt. However, the data does not reveal any correlation between salability and leverage. While the results seem to contrast with the theory on debt capacity and liquidation value [i.e. Williamson (1988), Shleifer and Vishny (1992)], I later explain why the lack of evidence about leverage might be specific to American railroads in the second half of the 19th century.

This study provides the first evidence of a relation between asset salability and debt maturity. Previous research typically used balance-sheet proxies such as tangibility (e.g. Rajan and Zingales (1995)), or market-to-book and R&D-to-sales ratios (e.g. Gilson 1997) as proxies for collateral value and liquidation costs; however, oil rigs, satellites, and railways are all very tangible yet their liquidation values are fairly low. Alderson and Betker (1995) define liquidation costs as the firm's going concern value minus its liquidation proceeds, divided by its going concern value. They obtain liquidation and going concern values from estimates of managers of firms in bankruptcy court. However, as argued by LoPucky and Whitford (1990), and Gilson (1997), managers of bankrupt firms may understate liquidation values of their firms to put pressure on creditors to agree to a reorganization. This paper takes a different approach by using data on the physical attributes of the assets in addition to their book values. Furthermore, the diversity of track gauges provides an environment in which demand for assets can be identified. In a related paper, Benmelech, Garmaise and Moskowitz (2005) analyze the effect of liquidation values on commercial property non-recourse loan contracts. They find that liquidation values affect financial contracts, and that higher liquidation values lead to longer maturities of loans. By focusing on zoning regulation that determines the potential buyers of real-estate properties, Benmelech, Garmaise and Moskowitz (2005) take a similar approach to this study, in which liquidation values are determined by the number of potential buyers.

This paper is organized as follows. In the next section I outline the theoretical predictions on the relation between liquidation values and debt maturity. Section II overviews the shift to a standard gauge and the characteristics of rolling stock during the period between the end of the civil war and the late 1880's. Data sources and gauge characteristics are described in Section III. Summary statistics and univariate analysis are presented in Section IV. Section V introduces the proxies for asset salability. Section VI discusses the plausibility of reverse causality endogeneity concerns. Section VII discusses the empirical analysis. Section VIII examines the methodology and the generality of the results. Section IX concludes.

I. Asset Salability and Capital Structure

The salability of an asset affects the willingness of a creditor to provide financing and the terms on which a debt contract may be extended. A vast theoretical literature analyzes the role of collateral and liquidation values in debt financing and capital structure. The concept of *liquidation value* used the theoretical literature is fairly general: an asset's liquidation value is the amount that creditors can expect to receive if they seize the asset. The existing empirical evidence consists mainly of regressions of leverage against the ratio of tangible assets to total assets. However, assets can be very tangible and still have low liquidation values. Williamson (1988) and Shleifer and Vishny (1992) analyze two different components of liquidation value. Williamson focuses on an asset's *redeployability* while Shleifer and Vishny use an industry-equilibrium model and show that assets with few potential buyers, or with potential buyers who are likely to be financially constrained, will be poor candidates for debt finance, since liquidation is likely to yield a low price.

Following Shleifer and Vishny (1992), I use the notion of salability to describe an asset that retains its value in liquidation. A salable asset has two characteristics. First, its attributes make the use of the asset less sensitive to its user and second, its potential buyers have the financial resources to afford paying for its services. The *willingness* of highest valuation potential users to buy is determined by the asset's attributes, while their *ability* to participate in the market depends on the buyer's financial strength. Therefore, it is the interaction between asset redeployability and market liquidity that determines asset salability.

In this paper I focus on the relation between debt maturity and asset salability, the first prediction emrges from the incomplete contracting approach to capital structure:

Prediction 1. Debt maturity increases in asset salability.

Prediction 1 follows from Benmelech (2005), Hart and Moore (1994), Berglöf and von Thadden (1994) and from Shleifer and Vishny (1992). Hart and Moore (1994) argue that a higher profile of liquidation values over time increases the asset's durability and makes longer maturity debt feasible. Berglöf and von Thadden (1994), analyze the optimal structure of debt along the trade-off between discouraging strategic default and limiting inefficient liquidation. Similar to Hart and Moore (1994), they conclude that firms with fungible assets should be financed with long-term debt. Shleifer and Vishny (1992) analyze the trade-off between the benefit of debt overhang in constraining management and liquidation costs. Since, as Benmelech (2005) shows, higher liquidation values make overhang (long-term) debt more attractive, Shleifer and Vishny (1992) thus predict an increase in debt maturity with liquidation value. Benmelech (2005) also develops a model that endogenizes debt maturity choice given the liquidation value of the project, and finds that high liquidation values might lead self-interested managers to finance with long-term debt.

I also test the more general implication of asset salability for leverage as predicted by Shleifer and Vishny (1992) and Williamson (1988):

Prediction 2. Debt levels increase in asset salability.

This prediction follows from Harris and Raviv [1990], Shleifer and Vishny [1992], and Williamson [1988]. The right to foreclose on the debtor's assets in the event of default is more valuable when the asset is more salable.

A. Application to the 19th Century American Railroad Industry

Gauge diversity made the interchange of equipment between different-gauge tracks almost impossible. Moreover, the flow of through traffic was limited to the length of track mileage with the same gauge. Both rolling stock and railways had lower values in alternative uses outside the railroad industry. Yet, rolling stock was in general more redeployable - had more potential buyers - than railways. The iron (or steel) rails and the wooden ties connecting them are site specific according to Williamson's (1983) classification; once put in place, they are highly immobile. In contrast, locomotives, freight cars, and passenger coaches are mobile by nature.

Gauge and specificity of rolling stock determine redeployability but they should be adjusted for market liquidity as well. While it is hard to tell which railroads were potential buyers or sellers of used capital, I use the notion of equity receiverships to address Shleifer and Vishny's (1992) point about financially constrained buyers. Railroads that were at the hands of the receiver were under reorganization and typically had less access to capital markets and investments. I use the mileage and number of railroads that were in equity receiverships as proxies measure for market illiquidity. According to prediction 1 more long-term debt will be used in railroads with highly salable assets and commonly used gauges. According to prediction 2, railroads should finance highly salable assets with debt.

II. Track Gauge, Standardization and Asset Specificity in the American Railroad Industry during the 19th Century

Early American railroads operated lines with a variety of track gauges - the horizontal distance between the two rails.[2] Many of the first roads were built to the English so-called standard gauge of 4'8.5", since they used English-built engines. However, only in the late 1880's was the American rail network really an integrated system. The standard gauge was the most common in New England and in the North, although much variation was to be found in Ohio and Pennsylvania. In most of the southern states a wider gauge of 5'0" dominated the lines, while a narrow gauge of 3'0" was introduced in the western mountain states during the 1870's.

A. The Origins of Gauge Diversity

The standard gauge of 4'8.5" was first adopted by the railroads in the north of England.[3] It was assumed to be wide enough to accommodate the most efficient locomotives, narrow enough to permit train operation around sharp curves, and at the same time able to support substantial freight tonnage. In 1870, the Scottish engineer Robert F. Fairlie argued in favor of a narrow gauge of 3'6" in his address before the annual meeting of the British Railway Association. Fairlie argued that such a gauge was cheaper to build, equip and maintain, and that with sharper curves and lighter equipment, the narrow gauge was better suited for mountainous regions. New roads with narrow gauges ranging from 3'0" to 3'6" were built in the United States during the 1870's. Much of the narrow-gauge trackage was built in eastern states; however, the standard gauge remained dominant in the east and narrow gauge was roughly a sixth of the total western mileage in 1880. Technology and cost reduction were not the only reasons for gauge diversity. In New York, for

[2] This section draws heavily from Klein (1993), Stover (1961), Taylor and Neu (2003), and Wilner (1997).

[3] Wilner (1997) suggests that the term "standard gauge" is related to the width of the ruts made in dirt roads by Roman chariots.

example, the Erie Railroad deliberately operated a broad gauge of 6'0". Not only did the broad gauge enhance the hauling of larger loads for a given freight car, but it also was designed specifically to carve a niche in this market and prevent loss of traffic to other lines. Erie's behavior was no exception. Klein (1993), for example, notes that in many cases railroad promoters deliberately chose a different gauge than the one used in neighboring lines. This strategy was assumed to bring trade and commerce to their town, forcing traffic to stop there rather than just pass through.

On the eve of the civil war, American railroads used gauges from as narrow as 2 feet to as wide as 6 feet. The abundance of track gauges was not the only impediment to integration. Strategic behavior, parochial views of cities and towns who owned railroads, and myopic planning were all obstacles to efficient integration of the rail network. Yet, different gauges frustrated physical interchange of freight cars and passenger coaches even for those railroads willing to integrate operation. Stover (1961), for example, noted that: "Gauge diversity was one of the most serious handicaps to through service. In 1861, because of different gauges, eight changes of cars were necessary for a trip from Charleston to Philadelphia." Further evidence is given by Klein (1993): "Differences in gauge forced railroads to 'break bulk' at the terminal town; it encouraged the flow of local traffic and hampered the flow of through traffic."

B. Gauge Diversity and Asset Specificity

Creative engineers used several expedients to enable the interchange of rolling stock between lines of different gauges. The 'compromise car' had wheels with five inch wide tread. The compromise cars could be used on either standard-gauge track or track as wide as 4'10". However, the compromise cars were not considered safe, and their use resulted in several serious accidents. Car hoists with the car lifted to a set of trucks of different gauge, were considered safer and were used more extensively. A second approach was to adjust the rails. In the 'double gauge' system, a third rail was added to the line, permitting the use of rolling stock of different gauges. Despite the innovation in multi-gauge equipment, many railroads adapted the standard gauge: by 1890 roughly 95% of the nation's track mileage conformed to the standard gauge. The railroads incurred substantial expenses to change the track gauge. According to Wilner (1997): "The willingness of railroad owners to pay ...[the expenses]...often necessitating acquisition of new locomotives, freight cars, and coaches to fit the horizontal distance between rails - was testimony to the strength of market forces demanding greater efficiency." For example, the collapse of the Ohio & Mississippi Railroad which owned more than 600 miles of road and 2,600 cars was declared by the receiver to be due to new construction together with the expenses changing the gauge from 6'0" to 4'9".[4]

C. The Adoption of the Standard Gauge and Asset Salability

Rolling stock was mobile despite the diversity in gauge track and breaks in through traffic. Before the linkage between western states to eastern lines was established, rolling stock used to be shipped by lake vessels, or on ocean ships to New Orleans and from there by riverboats. A cheaper and faster solution was to transport cars and locomotives using heavy duty flatcars. Express shipping firms such as the Kasson Locomotive Express Company, specialized in handling oversize shipments over roads with different tracks gauge. As a result, potential buyers of the rolling stock were those railroads that could easily adopt and acquire these assets in the used-capital markets. Their geographic location was less relevant. What really mattered was the fitness of the equipment to their own tracks.

In addition to differences of gauges, other factors determined the redeployability of rolling stock. Locomotives were in general less redeployable than freight cars. Hinkley's locomotives, for example, were made of 6,270 parts and pieces (excluding wood work and nails), while less than 60 parts were needed to assemble a general purpose boxcar. Passenger coaches were based on a similar technology as freight cars, yet interior design, decor and amenities made them more railroad or service specific, and less redeployable compared to general purpose freight cars. For example, the Pullman 'Pioneer' passenger car finished with hand-carved woodwork, plush carpets and fine mirrors, was built for railroads with first-class service. Appendix A describes the role of technology in determining redeployability for the cases of locomotives and freight cars.

Despite their site specificity, tracks had potential buyers as well. Economies of scale made long lines more efficient, and therefore railroads willing to integrate were potential buyers of existing railways. However, given the network nature of a railway system, potential buyers of roads were local railroads. To benefit from unification, potential buyers had to connect to the acquired (or leased) line, which required them to both operate in the same region and have the same gauge. Thus, track gauge was an important determinant of both rolling-stock's and track's salability.

[4]See Swain (1898) p. 84.

III. Data Sources and Gauge Characteristics

Standardizing and changing the gauge of the lines and the rolling stock took time. As a result, although the importance of standardization was widely recognized during the civil war, the shift to the standard gauge lasted more than 20 years. Since it takes time for a firm to change its leverage and debt maturity structure as well, it is interesting to analyze the relation between the railroads' assets and their capital structure over this time period.

A. Data Sources

To capture both the time-series dynamics of these changes and the cross-sectional variation across firms, I have collected data at the firm (railroad) level for the years 1868, 1873, 1877, and 1882. To obtain firm level data I used the *Poor's Manual of Railroads* [5] for the relevant years. I included in the sample railroads that had at least 100 miles of operation (owned or leased),[6] and sufficient data to construct the necessary variables. The panel data constructed in this process consists of 390 firm-year observations, representing 221 different railroads.

For each railroad I obtained the total value of its assets, the value of its equipment and constructions, leverage, debt maturity and profitability from *Poor's Manuals of Railroads*, as well as data on the firm assets such as length and location of lines operated, (owned or leased), whether the rails were made of iron or steel, the numbers of locomotives, passenger coaches, freight cars and other specialized cars.

B. Sample Characteristics

Table 1 lists the distribution of the railroads across gauge tracks and over the years 1868, 1873, 1877, and 1882. Panel A of Table 1 reports the gauge distribution of the firms in the pooled data. The most common gauges in the sample are the standard gauge of 4'8.5" (56.5 inches), and 5'0" (60 inches), representing 64.6% and 16.4%, of the number of firms in the sample, respectively. To capture the evolution of the different gauges over time, Panel B of Table 1 reports the distribution of the railroads across track gauge and time. As can be seen, the proportion of the firms conforming to the standard gauge increased during that period, ranging from 52.2% in 1868, to 76.8% in

[5] The first volume of the Poor's Manuals of Railroads was published in 1868.

[6] Early American railroads operated short lines. However standardization accelerated their agglomeration. For example, only one line had more than 1000 miles in 1867, while there were 28 such railroads in 1887. To make the data collection tractable, I have concentrated on medium and large railroads.

1882. Yet, the convergence to the standard gauge was not uniform across the country. While new railroads were built to fit the standard gauge in the East and the Midwest, the southern railroads continued to expand their existing wide-gauge lines, frustrating the standardization of rolling stock and tracks.

Table 2 breaks down the data according to the geographical groups, as they are defined by *Poor's Manuals of Railroads*. The table demonstrates that in New England and in the West between 89.9% and 96.4% of the firms conformed to the standard gauge, while in the East railroads used different gauges, such as 4'9" and 4'10" gauges. The South, on the other hand, was the dominion of the wide gauge. More than 64% of the southern railroads used the 5'0" gauge representing 81.1% of the total wide gauge firms in the country.

C. Selection Biases and Representativeness of the Sample

Because the sample only includes railroads that operated more than 100 miles, the sample is potentially subject to a selection bias. If larger firms are more likely to operate lines with a specific gauge, then the size threshold could potentially bias the sample and its gauge distribution.

Figure 1 compares my sample with the distribution of the actual population of track mileage in the United States for selected gauges. To obtain the population's distribution, I use the *Poor's Railroads of the United States*, which reports the distribution of the nation's track mileage over the different gauges for each of the relevant years. There are no significant differences between my sample and the entire population. The wide gauge of 5 foot (60 inches), seems to be slightly over-weighted in my sample during the years 1873, 1877 and 1882, and the 4'9" (57 inches) gauge, is slightly over-weighted in the sample as well, but, as a whole the sample is quite representative. I conclude that the sample seems largely free of a bias in its gauge distribution.

IV. Summary Statistics and Univariate Analysis

This section outlines summary statistics and univariate analysis of the relation between debt maturity, leverage, and railroad characteristics.

A. Descriptive Statistics

In order to better understand the economic significance of the 19th century American railroads, Table 3 displays the book value of railroads' assets. Panel A of Table 3 presents descriptive statistics for the nominal dollar values of assets in the pooled data. Panel B of Table 3 illustrates the increase in the railroads' value over the sample period. The mean book value increased by more than 96% between 1868 and 1882, while the median book value increased by more than 98% during the same period. To get a better sense of the railroads' book value during that period, Panel C of Table 3 presents real values, which are calculated using the Consumer Price Index. The median real 1868 value (in 2000 dollars) is $88.0 million, compared to the median real 1882 value of $214.1 million. The largest railroad's real value in the 1868 sub-sample is $691.9 million, while in 1882 the largest railroad's value exceeded $2.84 billion. While Panel C emphasizes real values it does not demonstrate the relative importance of the railroads in the 19th century American economy. Panel D addresses this point by reporting summary statistics of railroads values as percentages of nominal GDP for each of the years.[7] The mean (median) railroad size scaled by GDP ranges from 0.138% (0.077%) to 0.217% (0.121%), compared to a mean (median) of 0.100% (0.059%) in the railroad industry in the year 2002. The average 19th century American railroad was, in relative terms, four times larger than the average American airline in 2002 and tenfold the size of the average American public industrial firm in the year 2002.

B. Railroad Characteristics

Table 4 displays descriptive statistics for a selected set of variables. I examine the following variables: tangibility (defined as the ratio of the book value of road and equipment to total assets), leverage (defined as the ratio of funded debt to total assets), and profitability (defined as net earnings scaled by total assets). In order to describe the nature of the railroads' rolling stock, I report descriptive statistics for the size of the cars-fleet, (defined as the total number of locomotives, passenger coaches, freight cars, baggage mail and express cars, and service cars), the ratio of freight cars to total cars, and the ratios of passenger coaches and locomotives to the total number of cars.

Railroads' assets were almost entirely comprised of fixed assets during the period being examined. Across the 390 firm-year observations, the median tangibility value is 0.86, representing a high level of fixed assets. Additional evidence for the nature of the railroads' assets is given by their inventory and cash management (not reported in the table.) Not all the railroads in the sample report these figures, however based on 201 observations the mean (median) cash holdings, defined

[7] I start with Balke and Gordon (1989) and Berry (1988) estimates of GNP and add the net factor income (NFI) calculated by Simon (1960) to get historical GDP estimates.

as the ratio of cash and liquid financial assets to total assets, was 1.8% (1.1%), and the standard deviation was 2.3%. Moreover, based on 144 observations, the mean (median) of inventories (defined as the ratio of inventories to total assets), was 1.7% (1.1%) and the standard deviation was 2.6%. Guthmann and Dougall (1962) suggested that given the fixed nature of the railroads investment, long-term debt and proprietorship obligations were the main source of funds and current assets were insignificant. Moreover, given the cash basis of the railroads, receivables were negligible, and since railroads sell a service, they had no inventories in the ordinary sense. The average leverage of 0.46 reported in Table 4 is based on funded debt, and does not include current liabilities. As explained by Guthmann and Dougal (1962), however, this type of financing played a minor role. The time period spanned by the sample reflects the shift from equity financing to funded debt financing. The earliest railroads in the United States were financed almost entirely by equity. However the proportion of bonds to stock gradually increased, for example the sample mean (median) in 1868 is 0.36 (0.32) compared to 0.44 (0.46) in 1882.

Most of the railroads in the sample appear to be profitable: only 9 firms, representing 2.3% of the sample, experienced losses. Yet, while positive, the modest profitability rate seems low relative to the required initial investment and sunk costs. The average (median) return on assets, defined as net earning divided by the book value of construction, was 6.6% (5.2%), and is similar in magnitude to the profitability rate. This evidence confirms Baird and Ramussen's (2002) observation that "...many railroads turned an operating profit, but could not hope to recoup their construction costs." Finally, freight cars dominated the railroads rolling stock, accounting for 87% on average of the total cars' fleet, with a median of 805 freight cars.

C. A Measure of Debt Maturity

Following Stohs and Mauer (1996), I construct a measure of the weighted average maturity of the firm's debt structure. I calculate the weighted average maturity of a firm's debt as:

$$Maturity = \sum_{j}^{J} D_j M_j \Big/ \sum_{j}^{J} D_j \quad (1)$$

where J is the number of debt instruments outstanding, D_j is the dollar book value of debt instrument j, and M_j is the term to maturity of debt instrument j.

Titman and Wessels (1988) used the proportion of short-term debt as a measure of debt maturity, while Barclay and Smith (1995) and Johnson (2003) used the proportion of short-term debt with maturities exceeding three years. However, as argued by Stohs and Mauer (1996), these measures provide only crude approximations of the maturity structure. An alternative approach is to study individual debt issues. Guedes and Opler (1996), for example study the determinants of individual public bond issues. While this approach uses an accurate measure of maturity it has several limitations. First, as argued by Stohs and Mauer (1996), the method of Guedes and Opler (1996) provides information only about incremental financing decisions, and can be very different from the average maturity of the firm's existing debt. While this method seems appropriate to test signaling models - where maturity choice signals the firm's type from an incremental perspective - it fails to represent the overall relation between characteristics of assets and debt which is the focus of this paper. The weighted average maturity method, on the other hand, captures the entire maturity structure of the firm's liabilities. Second, focusing on samples of debt issues ignore the role of debt buy-backs and exchange offers. Firms often decide to amortize their debt service by buying back debt, swapping short- for long-term debt, or by exchanging debt for equity - these "negative issuance activities" are omitted in a study of individual bond issues.

Debt maturity magnitudes are striking; as Table 4 demonstrates the average and median debt maturity in the sample are 20.1 and 20.0 years, respectively. Only 25% of the railroads in the sample had a weighted maturity shorter than 14.0 years, and 25% of the railroads in the sample had weighted maturity longer than 27 years. This seems to be consistent with the conventional wisdom, [as well as the predictions by Myers 1977, and Hart and Moore (1994)] that assets should be matched with liabilities and that long-lived assets support long-term debt.

D. Univariate Analysis of Railroad Characteristics and Capital Structure

In this subsection I use a univariate analysis to elucidate candidate factors which are correlated with leverage and debt maturity. While this subsection is self contained, it constitutes a benchmark for the model specification I use later in the regression analysis.

D.1 Leverage

I partition the full sample into 6 subsamples based on the 10th, 25th, 50th, 75th and 90th percentiles of leverage, and report means and medians of railroads' characteristics for each of the groups in Table 5. Although this procedure is far from being exhaustive, it does help to identify how railroads' characteristics vary with leverage, and serves a non-parametric benchmark for the multivariate analysis. The last column reports p-values from a Kruskal-Wallis test of the hypothesis that the characteristic's median is distributed uniformly over the six leverage groups. The Kruskal-Wallis test indicates that size, profitability, and tangibility are not randomly distributed over the leverage bins.

While smaller firms dominate the leverage distribution tails (first and last deciles), larger firms are scattered in the middle of the leverage distribution. Previous research on capital structure [e.g. Harris and Raviv (1991), and Rajan and Zingales (1995)], has found strong positive correlation between firm size and leverage. However, despite its non-randomness (as indicated by the Kruskal-Wallis test), it does not appear as if there is persistent association between railroad's size and its leverage. Furthermore, alternative measures of size, such as the number of miles owned by the railroad or its number of cars, seem to be randomly distributed over leverage. Why does size appear less relevant for leverage ratios of 19th century American railroads? Rajan and Zingales (1995) explain that size may be an inverse proxy for the probability of bankruptcy, since larger firms tend to be more diversified, and as such has a positive impact in equilibrium on the supply of debt. However, large railroads were not diversified, they had a single business and were as likely to fail as small railroads.[8]

Profitable firms will demand less debt according to Myers and Majluf (1984), because firms will prefer to finance with internal funds rather than debt. However they will demand more debt according to Jensen (1986), if the market for corporate control is effective, and will demand less debt if it is ineffective.[9]

Although there is no direct empirical evidence on the effectiveness of the market for corporate control, there are many anecdotes that describe an aggressive takeover activity by figures like Jay Gould, Thomas A. Scott, and especially Cornelius Vanderbilt. Table 5, however, displays negative correlation between profitability and leverage, and thus supports the pecking order prediction.

Finally, the physical attributes of the capital, (such as the internal allocation between locomotives, passenger coaches and freight cars), and tangibility, have no association with leverage. This last result is important. It is reasonable that specificity and redeployability of rolling stock varied a lot with the rolling stock's type. As noted before, freight cars were less specific than locomotives

[8] This hypothesis deserves more attention, Swain (1898) documents anecdotes of failures of large railroads, yet his examples are far from being conclusive.

[9] Zingales and Rajan (1995) also suggest that on the supply side, suppliers should be more willing to lend to profitable firms.

and passenger coaches. Moreover, Klein, Crawford and Alchian (1978) use the American steam locomotives as an example for a specialized (hence less redeployable) asset. However, the results in Table 5 suggest that Williamson's (1988) prediction that redeployability and leverage are positively correlated is not supported by the sample of railroads used in this paper.

D.2 Debt Maturity

Table 6 stratifies the same variables used previously, by the 10th, 25th, 50th, 75th and 90th percentiles of debt maturity, and reports the relevant means and medians for each of the subsamples.

Previous empirical evidence on the impact of size on maturity is mixed. Barclay and Smith (1995) found a positive relation between size and debt maturity. This result is consistent with high fixed flotation costs of issuing long-term debt. Smaller firms may find issuing public debt costly, and would opt for arm's length debt which is typically shorter-termed. Larger firms can take advantage of scale economies in issuing public debt, and are more likely to use more long-term debt. In addition, size may be an inverse proxy for the probability of bankruptcy and earning volatility, and in equilibrium it can prolong debt maturity. Guedes and Opler (1996) and Johnson (2003) found a U-shape pattern in the relation between size and debt maturity. I find that size (proxied by either logarithm of total assets, number of miles operated, or the total number of cars) displays an increasing pattern over most of the maturity spectrum. This result is consistent with the flotation costs, earnings volatility, and default likelihood explanations.

Surprisingly, there is no observed pattern in the relation between tangibility and debt maturity. On the other hand, redeployability seems to matter a lot. The proportion of freight cars displays an increasing pattern. If freight cars are more redeployable, then redeployability and debt maturity are positively correlated. The proportions of passenger cars and locomotives are, of course, the mirror image of the freight proportion and thus it is not surprising that they display a negative pattern. However, passenger cars and locomotives were also less redeployable assets, which suggests that this result is not merely mechanical.

Interestingly, the increasing pattern of the proportion of freight cars (and the corresponding decrease in the proportion of locomotives and passenger cars), is less steep at the right tail of the maturity spectrum (i.e. more than 20 years). This might suggest that the redeployability of rolling stock matters more at the early stages of its economic life.

V. Measures of Asset Salability

The main idea behind my empirical proxies for asset salability is motivated by Shleifer and Vishny's (1992) argument that the number of potential buyers and their financial strength affect liquidation values. A broader set of potential buyers can raise the liquidation value of an asset. The analysis so far has focused more on the physical attributes and less on the demand for assets. Gauge diversity made the use of rolling stock of different gauges either impossible or expensive. This prevented potential buyers within the industry to bid the full value of the asset to its current user. Potential buyers of rolling stock were all the railroads in the country that used the same gauge, since freight cars were mobile and not unique to one location. In contrast, given the immobility and site specificity of the roads and the local nature of American railroads in the 19th century, it is plausible that the highest valuation potential users of tracks were railroads that operated in the same region and had similar gauge. Tracks gauge and geographical location were potential determinants of asset salability. Gauge affected the redeployability of rolling stock, while both gauge and geographical location determined the redeployability of the road.

A. Methodology

Economies of scale and the network nature of railroads, both suggest that an existing road or line and a potential buyer had to *connect* in order to take advantage of cost reduction and scale economies. I assume that potential buyers of lines and roads were railroads that were located in the same area of the road and operated the same gauge. In order to test this hypothesis, I have collected data on mergers, consolidations and lease contracts between 1866 and 1872. In a sample of 60 such cases, I find that in **all** the cases the buyer (or lessee) and seller (or lessor) operated in a common state - confirming that location was crucial for the salability of roads. Furthermore, in 53 cases representing 88.3% of the sample, both the buyer (or lessee) and seller (or lessor) had exactly the same gauge, in 4 leases (6.7%) the lessee operated two types of gauge (56.5 and 72 inches) where one was also the gauge of the lessor, and only in 3 cases (5.0%) did the buyer have a different gauge from the seller - suggesting that common gauge was an important determinant of salability. I conclude that matching potential buyers along gauge and operation in a common state is a reasonable proxy for the actual set of potential buyers.

Given its mobility, I assume that potential buyers of rolling stock were railroads with same gauges regardless of their location. As discussed earlier, rolling stock used to be shipped by lake vessels and riverboats, or by transporting it using heavy duty flatcars over roads with different tracks gauge. Unfortunately, rolling stock sales transactions are not reported in the *Poor's Manuals of Railroads*, but anecdotal evidence confirms that common gauge was crucial for rolling stock salability while proximity was not. For example, according to the *Locomotives of the Rio Grande* following the conversion of the Denver & Rio Grande from narrow to standard gauge, it sold narrow-gauge rolling stock to neighboring lines as well as to roads through Texas and the south, "...with some going to such faraway places as Pennsylvania, Florida and Mexico".

The idea that liquidation values are lower when there are fewer potential buyers was noted by researchers of the railroad industry. According to Hilton (1990): "conversion of most of the large narrow gauges [railroads] outside of Colorado in the late 1880s and early 1890s released a large amount of relatively new narrow gauge equipment at bargain prices." He provides additional evidence that the conversion of narrow gauge railroads to the standard gauge dampened prices of narrow gauge rolling stock by 30 to 40 percent.

A.1 Proxies for Road Salability

I start by computing 1) total track mileage for each gauge in every state,[10] and 2) the number of railroads operating in every state for each of the different gauges.

To address the liquidity notion of Shleifer and Vishny (1992), I use data on equity receiverships. Equity receivership was a legal device designed originally to oversee property of a firm during the pendency of a suit or upon order of court. Lawyers and interested investment bankers extended the equity receivership to a procedure similar in its principal features (automatic stay, infusion of operating funds, and negotiations among creditors) to the current chapter 11. I use railroads in receiverships as a proxy for potential buyers that cannot participate in the market for used capital since their access to external finance was limited. I assume that more equity receiverships imply a less liquid market. I obtain the equity receiverships data from Swain (1898), and from the *Poor's Manuals of Railroads.*

I use the total number of mileage in addition to the number of railroads in equity receiverships,

[10] I use a broad definition of state that includes territories, such as the, Washington Territory that was formed from part of Oregon and joined the U.S as a separate state in 1889, and the Wyoming Territory that was established in 1868, and joined the U.S. in 1890. In addition, Arizona, Idaho and Montana enter the sample in 1882, although they were not members of the Union at that time. I include a "state" in the sample whenever it is classified as such by the Poor's Manuals of Railroads.

as proxies for the market share and number of railroads in financial distress in each of the state-gauge cohorts. To obtain the adjusted potential demand, I subtract the mileage and railroads number figures from their corresponding mileage and railroads number in each of the state-gauge cohorts. [11] This process yields two sets of numbers for each of the sample years: 1) state-wide track-mileage for each gauge; and 2) state-wide number of railroads for each gauge. Equations 2 and 3 summarize this procedure for tracks mileage and number of railroads, respectively.

$$mileage^{road}_{s,g,t} = \sum_{b \in B^{s,g,t}} length_b \tag{2}$$

$$number^{road}_{s,g,t} = \sum_{b \in B^{s,g,t}} I_b \tag{3}$$

where B is the set of all railroads that are not in receiverships and operates *length* miles in state s and sample year t for a given gauge g, and I is an indicator variable that equals one for railroads that belong to the set B, and zero otherwise.

To construct the proxies at the railroad level I define the salability of the road to be the mileage-weighted average of the state salability index corresponding to the states of the railroad's line. I calculate two measures of road salability using 1) tracks mileage and 2) number of railroads. Equations 4 and 5 present the two proxies for the salability of the railroad's road.

$$mileage^{road}_{i,t} = \sum_{s}^{S} \sum_{g}^{G} \omega_{i,s,g,t}(mileage^{road}_{s,g,t} - length_{i,s,g,t}) \tag{4}$$

$$number^{road}_{i,t} = \sum_{s}^{S} \sum_{g}^{G} \omega_{i,s,g,t}(number^{road}_{s,g,t} - 1) \tag{5}$$

where t represents sample year, s a state, g denotes the gauge, $length_{i,t,s,g}$ is railroad's i own mileage in state s gauge g and sample year t, and $\omega_{i,t,s,g}$ is defined as

$$\omega_{i,s,g,t} = length_{i,s,g,t} \Big/ \sum_{s}^{S} \sum_{g}^{G} length_{i,s,g,t} \tag{6}$$

I subtract the railroad's own mileage in each of the operation states in order to account for the *residual demand* for its road.

[11] For every railroad I check whether this particular railroad was in equity receivership to avoid subtracting it twice.

A.2 Proxies for Rolling Stock Salability

I follow the same algorithm as in the previous proxies. Given that rolling stock was salable across the country as long as the potential buyer had the same gauge, the proxies are calculated at the country level.

$$mileage_{g,t}^{rolling} = \sum_{c \in C^{g,t}} length_c \tag{7}$$

$$number_{g,t}^{rolling} = \sum_{c \in C^{g,t}} I_c \tag{8}$$

where C is the set of all railroads that are not in receiverships and operates $length$ miles in sample year t for a given gauge g, and I is an indicator variable that equals one for railroads that belong to the set C, and zero otherwise. To construct the proxies at the railroad level I define the salability of the rolling stock to be the mileage-weighted average of the gauge salability index corresponding to the railroad's gauge.

$$mileage_{i,t}^{rolling} = \sum_{g}^{G} \pi_{i,g,t}(mileage_{g,t}^{rolling} - length_{i,g,t}) \tag{9}$$

$$number_{i,t}^{rolling} = \sum_{g}^{G} \pi_{i,g,t}(number_{g,t}^{rolling} - 1) \tag{10}$$

where t represents sample year, g denotes the gauge, $length_{i,g,t}$ is railroad's i own mileage in gauge g, and $\pi_{i,g,t}$ is defined as

$$\pi_{i,g,t} = length_{i,g,t} \Big/ \sum_{g}^{G} length_{i,g,t}\,. \tag{11}$$

Panel A of Table 7 presents descriptive statistics for the salability proxies. Panel B of Table 7 uses the same procedure as in Table 6 to demonstrate the relation between debt maturity and asset salability. Panel B of Table 7 stratifies the salability proxies, by the 10th, 25th, 50th, 75th and 90th percentiles of debt maturity, and reports the relevant means and medians for each of the subsamples. As before I use the Kruskal-Wallis test to identify the randomness of the subsamples' medians. Panel B reveals a positive correlation between asset salability and debt maturity. While the pattern is not monotone in some ranges - it is increasing over most of the distribution of debt maturity in all the measures of salability. As in table 5, I have also partitioned the salability proxies into 6 subsamples based on the same percentiles of leverage (not reported). Leverage results, however, show no correlation with measures of asset salability.

VI. Reverse Causality and Endogeneity

One concern about using gauge-related proxies in the analysis is the direction of causality. A reverse causality argument suggests that instead of track gauge explaining capital structure – it was finance that drove the gauge choice. According to this explanation, railroads with better access to finance would choose commonly used gauges and more redeployable cars. If better access to finance also facilitated longer maturities then the direction of causality might be reversed. However, other factors (not related to finance) determined the initial distribution of gauge tracks. According to Puffert (2001) railroads in the U.S. were initially viewed as inferior substitutes for waterways, used for routes where canal construction was impractical, and served strictly local purposes. As a result, local considerations determined the gauge choice. For example, some gauge choices were designed to divert traffic from competing lines, (e.g. the wide gauges of 5'6" in Maine, and 6'0") and others were based on local topography (e.g. the narrow gauges of 3'0", and 3'6"). Few states regulated the choice of the gauge; the Ohio legislature passed a law in 1848 requiring that all roads built within the state should have a 4'10" gauge, and North Carolina prohibited by law the use of 5'0" gauge. The 5'0" gauge in the south resulted from the desire of the Charleston and Hamburg, the earliest important railroad in the south, to divert trade from Savannah to Charleston. According to Taylor and Neu (2003):

> *Although a width of 4 feet 6 inches had been originally advised for the Charleston and Hamburg railroad, Horatio Allen, who became chief engineer of the road in September 1829, recommended a 5-foot gauge on the basis of engineering consideration...the decision to adopt this gauge greatly influenced railroad construction throughout most of the South. Georgia, South Carolina, and Tennessee railroads adopted it exclusively, and it was the predominant gauge in Kentucky, Mississippi, and Alabama. So far as gauge was concerned, rolling stock could be moved all the way from such Atlantic ports as Norfolk, Charleston, and Savannah to Louisville, Memphis, and New Orleans.*

Furthermore, engineering mistakes (as opposed to engineering consideration) also played a role in determining gauge choices. Some gauge choices are attributed to engineering mistakes (for example the 4'10" inches), as the following quote from an article in *The American Railway Times* illustrates:[12]

[12] *The American Railway Times*, May 11, 1861

> *In the early history of railways in America they were laid with timbers running lengthwise with strips of iron, 3.5 inches wide, nailed or spiked on the top, for the wheels to run upon; they were of 5 feet gauge, measuring from centre to centre of the iron or strap rail, as it was called; hence the origin of the 4 feet 8.5 inch gauge. At a later date, when the solid iron rail was introduced, it was with a two inch face also, the five foot gauge measuring from centre to centre of rails; hence the origin of the 4 feet 10 inch gauge; hence the conclusion that if our system of measuring from inside to inside of the rails had been adopted at first, the uniform gauge of this country would have been five feet.*

Moreover, the evolution of gauge tracks in the postbellum years seem to have been determined by network coordination considerations. Puffert (2001) uses a path-dependent process to explain the evolution of gauge tracks, while it was also suggested that as the demand for interregional transport grew, standardization became more important.

The benefits from a connection to a unified network were the key determinants of the conversion to the standard gauge. Railroads that deliberately chose different gauges in later years seem to have done so because of local network externalities (in the south), and topographical conditions (narrow gauge in the 1870's). The initial distribution of gauges, which seems exogenous to finance, had a major impact on the evolution of the railroad network in the second half of the 19th century. Since the origins of gauge choice were not determined by finance, a reverse causality explanation is not consistent with the historical evolution of the American railroad network.

Another concern about using gauge-related proxies is endogeneity. Is it possible that an omitted variable explains both capital structure and tracks gauge? Given the nature of railroads, if any omitted variable drives both debt maturity and the choice of the gauge it should be regional, correlated with local network effects, and correlated with regional financial development. To control for such omitted variables I use state fixed-effects in the analysis.[13] State-fixed effects should absorb any regional heterogeneity. It is unlikely that an omitted variable which correlates with tracks gauge but is uncorrelated with regional heterogeneity drives the empirical results.

[13] I also use regional (instead of state-) fixed effects (not reported) which does not affect any of the results.

VII. Empirical Analysis

A. Determinants of Leverage

The five OLS regressions reported in Table 8 use different specifications to predict leverage. Yet, the table has little to say about factors that explain leverage. Among the various variables used in the analysis, only profitability proves to be a significant determinant of leverage for 19th century American railroads. These results are in contrast with the common wisdom [e.g. Harris and Raviv (1991), and Rajan and Zingales (1995)], which suggests that both size and tangibility are positively and strongly correlated with leverage. Consistent with the univariate analysis, the proportion of freight cars and leverage are not correlated. Moreover, the proxies for the salability of both the tracks and the rolling stock do not prove to be determinants of leverage.

The analysis thus far potentially suffers from an omitted variable problem. Myers (1977) suggested that firms that expect high future growth should use less debt to avoid underinvestment. Thus, he predicts a negative correlation between growth opportunities and leverage. Traditionally, researchers have confirmed Myer's hypothesis by using a Tobin's Q proxy (typically the ratio between market value of assets to their book value), to control for growth opportunities. Stock prices and the number of shares, however, are seldom reported by *Poor's Manuals of the Railroads* and many of the railroads were privately held, so a market-to-book proxy cannot be used.

It is possible that profitability is a noisy proxy for growth opportunities as well. Poterba (1988) argues that current cash flow (which drive profitability in my calculation), is correlated with the "true" marginal Q, and that market-to-book is not a sufficient statistic for future cash flows. If current cash flow and growth opportunities are positively correlated, then the negative relation between profitability and leverage is consistent with Myers' (1977) prediction.

Since technology was quite similar across railroads, it is plausible that expected growth opportunities *within* the industry were determined mainly by the geographical location of the railroad. For example, the shift from waterway traffic to railroads enhanced the expected earnings and investment of railroads located along rivers and canals. Another example for the connection between geography and growth is the shift of crop production centers westward between 1860 and 1900. This shift was partly caused by the use of railroads, but it had a feedback effect as well, amplifying investment and expected growth of these lines. I use state fixed-effects as proxies for growth opportunities (and as argued earlier to absorb any regional heterogeneity), and report the results in the last column of Table 8.[14] As the table demonstrates, much like previous results in this paper, only profitability appears to matter for leverage.

B. Asset Salability and Debt Maturity

Table 9 displays the results from estimating the effect of asset salability on debt maturity.[15] In Models 1-4 I use 4 different proxies for asset salability in addition to: size, tangibility, profitability, the proportion of freight cars and year fixed effects. To control for potential heterogeneity at the state level and in an attempt to address the omission of a proxy for growth opportunities, Models 5-8 include state fixed effects as well. Among the control variables, size is significant at the 5% level in all the regressions and profitability is significant at the 5% level in 6 regressions out of 8. The results confirm the univariate findings; larger firms have longer average maturities while more profitable firms have shorter maturities. The size result is consistent with the flotation costs, earnings volatility, and default likelihood explanations discussed earlier. If current profitability is correlated with growth opportunities then the negative relation between profitability and maturity is consistent with Myers' (1977) prediction that firms with higher growth opportunities should shorten their debt maturity. Hard assets (proxied by tangibility) have a positive impact on debt maturity, and similar to Table 6 the composition of the assets is important as well; the proportion of freight cars in the railroad's rolling stock fleet and debt maturity are positively correlated. I do not include leverage as an explanatory variable in the debt maturity regressions since it is likely that leverage and debt maturity are jointly determined.[16]

Models 1,2,5 & 6 investigates how road salability affects debt maturity. The models control for railroad-specific variables using size, tangibility, profitability, and the proportion of freight cars as explanatory variables. The results indicate that larger railroads with more tangible assets had debt of longer maturity, and that profitability is negatively correlated with debt maturity. Interestingly, debt gets longer when the railroad's rolling stock consists of more freight cars. Moreover, consistent

[14] I also use alternative proxies for growth opportunities such as measures of competition and efficiency and find similar results.

[15] I have used an ordered logit model as well, to address a possible non-linear ranking of debt maturity. The marginal effects and their statistical significance are quite similar to those found by the linear model, and are not reported.

[16] There is no theoretical model that allows for a reduced form estimation. To potentially address this issue, I try different specifications of 2SLS estimation procedures, using tangibility or profitability as instruments for leverage, and salability proxies as instruments for debt maturity. In these regressions (not reported) leverage is found to have a positive and statistically significant coefficient. The magnitudes and the significance of the other explanatory variables of debt maturity remain intact.

with the univariate analysis in Panel B of Table 7, I find that the salability of the road (measured by mileage or number of potential buyers) is positively correlated with debt maturity. Similarly, Models 3,4,7 & 8 use the same specification and controls as Models 1,2,5 & 6, but the salability proxies are constructed at the country level to estimate the effect of the rolling stock salability (measured by mileage or number of potential buyers).

After controlling for railroads characteristics, year dummies and state fixed-effects, the salability of road and rolling stock has a positive and statistically significant impact on debt maturity. The effect is also economically sizable. Moving from the 25th percentile of road salability measure (using mileage) to the 75th percentile increases the average maturity by almost 3 years. Moving from the 25th percentile of rolling stock salability measure (using number of buyers) to the 75th percentile prolongs the average maturity by almost 2.3 years. Moreover, when I include state fixed-effects in the regressions, the economic effect of the salability measure increases significantly in 3 out of the 4 regressions suggesting that these estimates are biased downward. This bias is in particular notable in the road salability coefficients that increase in magnitudes of between 45% to more than twofold. The state fixed-effects also dramatically cut the economic significance of size, tangibility and freight by about a half and decreases their statistical power. The changes in the coefficients and statistical significance result from the nature of the within estimator of a fixed-effects regression. Since the within-state estimator uses only time-series variation within a state, estimates of railroads characteristics that are similar across railroads within a state (e.g. size) and do not vary much over time are expected to be lower economically and statistically.

Interestingly, the coefficient of profitability is unaffected by the state-fixed effects and its statistical significance hardly changes, which indicates that profitability was hardly determined at the state level. This is important in light of the omitted variable issue raised before. If future investment opportunities and current profitability are correlated, then an inclusion of state-fixed effects would control for state-level unobservables that are different from investment opportunities. However, if investment opportunities are determined by location - which is more likely in a network economy - then the negative relation between profitability and debt maturity is not driven by Myers' (1977) prediction. Finally, the within-state estimates of asset salability become stronger statistically and economically in 3 out of 4 regressions. There is enough between-groups (Models 1-4) and within-groups (Models 5-8) variation in salability that its positive effect on debt maturity is robust to this specification.

C. Asset Salability or Profitability?

The analysis so far suggests that the number of potential buyers is correlated with debt maturity. The interpretation suggested in the paper is that a larger number of potential buyers leads to higher liquidation values. However, the number of railroads with similar gauge is possibly correlated with competition and profitability. Is it the case that the results are driven by profitability rather than salability? The regressions in Table 9 show that the salability proxies are correlated with debt maturity controlling for profitability[17], yet they don't test the direct relation between profitability and the number (or mileage) of railroads with similar gauge. To address this concern, I regress profitability on the salability measures controlling for size, the proportion of freight cars, the railroad's age and Herfindahl-Hirschman Index (HHI) of railroads concentration as a proxy for competition. The results are reported in Table 10. Interestingly, the railroad age is the only significant determinant of profitability – older railroads and higher profitability rates are correlated. Profitability, however, is not correlated with *any* of the four salability proxies, with t-statistics on these variables ranging from -0.26 to 0.46. The salability proxies thus do not capture a profitability effect.

Another concern is that the salability proxies are correlated with the volatility of earnings. The volatility hypothesis suggests that a larger number of potential buyers leads to more stable cash flows that support long-term debt. To address this concern, I regress profitability on size, the proportion of freight cars, the railroad's age, Herfindahl-Hirschman Index (HHI) and year and state fixed effects. I then regress the squared residual from this regression on each of the salability measures. This procedure tests whether volatility of the earnings' part that is not explained by a set of firm's level controls and year and state fixed effects, is correlated with asset salability. The regressions in Table 11 show that this is not the case - non of the salability measures is statistically significant in explaining earnings' volatility. For robustness, I also stratify profitability by the 20th, 40th, 60th, 80th and 100th percentiles of each of the salability measures, and report the means, medians and standard deviations of profitability for each of the subsamples and for every salability measure. Panel A of Table 12 presents means and medians of profitability stratified by salability, while Panel B reports standard deviations of profitability across the stratified salability measures. As Panel A of Table 12 demonstrates, profitability levels seem to be similar across different levels

[17] I also control later (in Table 14) for competition using Herfindahl-Hirschman Index (HHI) of railroads concentration for every state in each of the years.

of salability. Likewise, according to Panel B of Table 12 there is almost no difference between earnings' volatility across the stratified salability measures. Finally, a Bartlett's χ^2 test cannot reject the hypothesis that the stratified sub-samples have equal variances. I conclude that the salability proxies do not capture a volatility effect.

D. The Size Distribution of Firms and Debt Maturity

While scale economies in issuing public debt and reducing flotation costs induce larger firms to issue longer-maturities on the demand side, large firms are also less salable in periods of market illiquidity. As such, creditors would prefer shorter maturities on the supply side, if larger firms retain lower values from selling assets in illiquid markets. The idea is that larger firms are more likely to suffer from fire-sales if the market capacity to absorb their assets is limited. Shleifer and Vishny (1992) predict that smaller firms are ceteris paribus better candidates for debt finance. However, smaller firms might be too specialized and have a thin market because of asset specificity. According to Shleifer and Vishny (1992) "The way to test this prediction is to look at an industry where firms of different sizes operate together, and to see if smaller ones have more debt". It is important to note that it is not the absolute size that affect the salability of the assets, but rather the firm size relative to the size of its potential buyers. To test this prediction, I construct 3 different measures of relative size.

The first measure is defined as the ratio between the railroad mileage and the mileage of the potential buyers of its road:

$$State\ share_{i,t} = length_{i,s,g,t} \Big/ \sum_{s}^{S} \sum_{g}^{G} \omega_{i,s,g,t}(mileage_{s,g,t}) \tag{12}$$

where t represents sample year, s a state, g denotes the gauge, $length_{i,s,g,t}$ is railroad's i own mileage in state s gauge g and sample year t, and $\omega_{i,s,g,t}$ is defined as in equation 6.

The second measure is defined as the ratio between the railroad mileage and the mileage of the potential buyers of its rolling stock:

$$Country\ share_{i,t} = length_{i,s,g,t} \Big/ \sum_{g}^{G} \pi_{i,g,t}(mileage_{g,t}) \tag{13}$$

where t represents sample year, g denotes the gauge, $length_{i,g,t}$ is railroad's i own mileage in gauge g, and $\pi_{i,g,t}$ is defined in equation 11.

In the third measure, I calculate the number of potential buyers for the road in two categories: 1) railroads with similar gauge that operate in the same states and are not in receiverships with road length smaller than or equal to 300 miles, and 2) the number of railroads with similar gauge that operate in the same states and are not in receiverships with road length larger than 300 miles. While the first two proxies measure the railroad size relative to the *aggregate* size of its potential buyers, the third measure is designed to capture the influence of a relatively large *individual* buyer.

The negative coefficients on the share variables in Models 1-4 reported in Table 13 are consistent with the prediction, since a larger fraction of the industry assets owned by the firm implies lower market liquidity for its own assets. After controlling for size (defined here as the logarithm of the road's length in miles), tangibility, profitability and the proportion of freight cars, I find that being too large relative to the aggregate size of potential buyers decreases debt maturity.[18] Similar to the results in Table 9, the within-states estimator dampens the estimates of size, tangibility and freight. As before, the within-states estimator increases the economic significance of the salability estimates. It is also interesting to note that while firm size has a positive effect on debt maturity (significant at 5% level in all the regressions), being too large relative to the aggregate size of potential buyers decreases debt maturity.

Models 5 & 6 estimate the effect of the number of buyers with 1) road length smaller than 300 miles (Model 5), and 2) road length larger than 300 miles (Model 6). Consistent with Table 9, the number of buyers is correlated with debt maturity. Furthermore, having one large firm as a potential buyer prolongs debt maturity by almost 1.5 years. A one standard deviation shift in the number of smaller potential buyers increases debt maturity by 2.1 years, and moving from the 25th percentile to the 75th percentile increases debt maturity by almost 3 years.

Hence, the relative size of the market for railroads' assets is found to be important for capital structure. Holding a smaller fraction of the industry assets, and having large buyers who are not credit constrained affect the maturity structure of debt.

E. Robustness

The analysis so far demonstrates that proxies for salability are positively associated with debt maturity. In this subsection, I analyze the robustness of the results to alternative explanations.

[18]As before, I estimate the effect of the salability measure (higher fraction imply lower salability) on leverage, but find no relation.

First, I employ different measures of growth opportunities in addition to the state fixed-effects used in the previous analysis. I also discuss the possibility that the salability measures are correlated with growth opportunities, and argue that this interpretation contradicts both theory and empirical evidence.

Later, I analyze a life-cycle explanation for my results about gauge and debt maturity. If railroads were more likely to issue long-term debt when young (e.g. to finance the construction of the road), then young railroads should have longer-term debt. Moreover, if new railroads were built after the civil war to the standard gauge, then the relation between maturity and gauge is mechanical. Using data on the age of the railroad I reject this hypothesis.

E.1 Gauge and growth opportunities

Since the composition of rolling stock is driven by the nature of the railroad's business, there is always the chance that some other omitted variables correlated with freight drive the results. For example, it is possible that the proportion of freight cars is correlated with profitability, efficiency or more general with the investment opportunities set of the railroad.

In Table 14 I use alternative proxies for growth opportunities, all the regressions control for size, tangibility and profitability which are not reported for brevity. The proxies that I examine are; efficiency (the ratio of operating profit to expenses), freight earning (the ratio of earning from freight to total earning), area-to-population (the ratio of the state's area in squared miles to the population size), Herfindahl-Hirschman Index (HHI) of railroads concentration for every state in each of the years and state-level competition with waterways (defined as the number of navigable streams and rivers, and canals).[19]

According to Myers (1977) short-term debt reduces the potential for underinvestment caused by debt overhang, and firms with more growth opportunities should have shorter-term debt. This prediction is also supported by the general evidence that value firms issue longer-term debt than growth firms. In Model 1, growth opportunities are assumed to be determined by the railroad's efficiency. If more efficient railroads have more growth opportunities, then Myers's (1977) prediction is supported by the data. Moving from the 25th percentile to the 75th percentile of the efficiency measure cut debt maturity by almost 2 years.

Furthermore, it is possible that the number of freight cars is correlated with earning from freight

[19] I use the list of navigable waterways compiled by Fogel (1964).

and not with the redeployability of the freight cars. However, including earnings from freight in the regression in addition to the proportion of freight cars should separate salability from profitability. According to Model 2 of Table 14, earnings from freight have a negative impact on debt maturity which is consistent with a growth opportunities explanation. This result suggests that current cash flows from operating the cars cannot explain the relation between freight cars and debt maturity.

Out of the 3 state-level proxies used in Models 3,4 & 5 none are found to be statistically significant. If area-to-population is positively correlated with growth opportunities, then its negative coefficient (though it is not statistically significant) may indicate that higher growth opportunities imply shorter-term debt. Moreover, concentration within the railroad industry (proxied by HHI), and competition with the waterways are not found to be statistically significant. Finally, after controlling for size, tangibility, profitability, proxies for growth opportunities, and state fixed-effects, higher salability is positively correlated with debt maturity in all the regressions.

E.2 Does the Railroad's Age Matter?

Another concern is the impact of new entrants in the unbalanced panel-data used in this paper. It is plausible that new railroads needed to make large up-front investments in the course of their construction. If these capital requirements were financed by long-term debt, then it is likely that young railroads had debt of longer maturity. Furthermore, if new railroads were more likely to use the standard gauge after the civil war then the conclusions drawn thus far may be challenged, as the results might capture a life cycle pattern of external finance.[20] To rule out the life-cycle effect, I have collected data on the railroads' age, using *Poor's Manuals of Railroads.* The manuals report (when applicable) the year in which: 1) the firm was chartered, 2) the road was completed, and 3) the firm was reorganized. Whenever the firm was not reorganized or consolidated I chose the date of charter for the railroads' age, and not the completion date, since it reflects the period in which the railroad was in need of external finance. If the firm was reorganized, I checked whether the existing debt was negotiated, and used the reorganization year to calculate the railroad's age. I obtained data for 326 firm-year observations which represents about 86% of the entire sample, and

[20]There is not much empirical work on the life cycle pattern of external finance over the long-run economic life of firms. Rajan and Zingales (1998), for example find support for the common wisdom that firms rely more on external finance in their early years. It is not clear, however, if they begin with short-term or long-term debt. If young firms are subject to more asymmetric information then according to Myers and Majluf (1984), they will issue short-term debt assuming that it is less sensitive to information asymmetries than long-term debt. In addition, Fluck (1999) develops a model in which firms issue short-term debt first.

I define a railroad's age as the number of years since its establishment (reorganization). Models 1-4 in Table 15 displays the results from estimating the impact of railroads' age on its debt maturity. Since the age of the firm is the focus of my interest, and given that age is a time-dependent variable I estimate its effect without year fixed-effects. As the table illustrates, railroad age does not have a statistically significant impact on the term of the debt. I thus conclude that the life cycle hypothesis is not supported by the empirical results in Table 15.

A potential omitted variable from the analysis is the age of the assets. Myers (1977) and Hart and Moore (1994), predict that firms should match assets with liabilities, and that durable assets should be financed with long-term debt. Estimating the age of the assets is tricky since fixed assets accounting rules and depreciation reporting were promulgated by the Interstate Commerce Commission (ICC) only by 1907. I use the fraction of the tracks mileage that were made of steel as a proxy for the assets age. This proxy plays two roles. First, steel rails came into use during the 1870's and as such is a better proxy for the timing of the investment than age. Second, steel rails were also considered more durable than iron rails or iron-capped wooden rails. According to a road engineer quoted in *The Railroad Gazette* from Sep, 21, 1872:

> *A steel rail will carry one-fifth more dead load than the iron rail before taking permanent set. Therefore in using steel and iron rails on the same road, a reduction of the weight of steel rails should not exceed 20 per cent. I estimate the life of steel rails on equal conditions to be six times as great as iron.*

Models 5-6 in Table 15 report the results from estimating the impact of the fraction of steel tracks on debt maturity. Having tracks made of steel has a positive effect on debt maturity, after controlling for the regular variables. It is difficult, however, to separate the two explanations of durability and investment timing. Finally, after controlling for size, tangibility, profitability, proxies for growth opportunities, age, durability or investment timing and state fixed-effects, higher salability is positively correlated with debt maturity.

VIII. What Can We Learn from the 19th Century Railroads?

A. Current vs. Future Liquidation Values

Why should current liquidation values be important for long-term debt? Salable assets enabled financially constrained railroads to sell roads, segments of railways or rolling stock to potential buyers and to use the proceeds to repay or buyback debt. In many cases of acquisitions and asset sales, the acquiring railroad assumed some of the target's debt. In these cases, salable assets enabled the transfer of long-term debt obligations to railroads with better creditworthiness. Furthermore, current and future liquidation values may be correlated as well. According to Shleifer and Vishny (1992), since industry buyer participation and cash flow are persistent, liquidity would be persistent as well. When an asset is liquid today, it is expected to remain for few years.

Kiyotaki and Moore (1997) extend Shleifer and Vishny's (1992) framework into a dynamic setting. They show that current liquidation values are correlated with future liquidation values, since assets play a dual role; they are used as factors of production, but they also serve as collateral for loans. A shock to cash flows translates into a drop in the collateral value of the assets that reduces the firm's ability to invest and to further reduction in the liquidation value of the asset. They show that small, temporary shocks to technology or credit, can generate large persistent fluctuations in output and liquidation values, resulting in credit cycles. The railroads industry in the 19th century fits well the intuition behind Kiyotaki and Moore (1997). Railroads relied extensively on external finance and used the road and its rolling stock as a collateral for its debt. Furthermore, the conversion of the gauge in the U.S. network was a slow moving process and it took a few years to reorganize railroads in equity receiverships, suggesting that liquidation values were correlated over time.

B. The Relevance of Railroads

Why are salability and redeployability not proven to be important for leverage? A possible answer stems from the nature of capital structures of 19th century railroads. According to Baird and Rasmussen (2002) railroads lacked a coherent capital structure. They suggest that,"In the course of their construction, railroads issued dozens of different types of investment instruments, putting up different stretches of track and other assets as collateral for each bond."

Railroads issued very different types of fixed-income instruments: mortgage bonds, equipment certificates, income bonds, secured bonds, and convertibles were all extensively used in the 19th century. In addition, acquirers took responsibility for paying the indebtedness of their targets, by issuing assumed (i.e. guaranteed) bonds. For example, by 1882 the Philadelphia and Reading railroads had 846 miles of tracks, and 26 different types of bonds payable in British pounds, U.S. dollars, and gold. In the same year, the Michigan Central Railroad operated 1,008 miles, and assumed responsibility for 14 different bonds of leased companies, in addition to 6 mortgage bonds and equipment certificates. It is plausible that 19th century railroads were not able to optimize their leverage, or as Baird and Rasmussen (2002) more assertively state: "...the capital structure of the great railroads were a mess." In addition, if railroads that received federal land grants didn't need to take on as much leverage, then land grants should be included in the leverage regressions. However, I find no evidence that federal land grants affected either leverage or debt maturity.[21]

Railroads hardly used seasoned equity offers (SEOs), or other methods of equity financing; instead bonds and loans dominated the external financing of American railroads in the 19th century. Since Railroads were not able to finance new investments with their retained earnings, debt was the default form of external financing. Myers (2003) addresses a similar point. He argues that in countries with limited public capital markets, debt ratio would not be a strategic choice if firms may be forced to rely on bank debt. It is possible that railroads had to use debt regardless of the characteristics of the assets since supply of funds from equity markets was limited, and self financing was not feasible. As a result it is not surprising that leverage does not seem to correlate with the characteristics of the assets.

IX. Conclusion

In this study I present empirical evidence on the association between asset salability and capital structure. The 19th century American railroads prove to be an excellent candidate for this task given their relatively simple structure of assets and the cross-sectional variation in their capital structures.

Is the nature of the firm's assets an important determinant of capital structure? This question is of major importance to the theory of the firm and to theories of capital structure, yet no direct empirical evidence has been established. Theoretical predictions have focused on the relation between liquidation values and debt capacity [i.e. Williamson (1988), and Shleifer and Vishny (1992)], or on the security design of a debt contract given the redeployability of the asset [e.g. Habib and Johnsen (1999)]. The evidence in this paper suggests that more salable assets support longer maturities of debt. However, there seems to be no association between asset salability and leverage. Is it possible that the results are railroad specific? If this is the case, then out of sample

[21] I have collected the land grants data from the Poor's manual. Since I do not find any correlation between federal land grants and capital structure the results are not reported.

evidence is needed.

This question calls for future research. On the theory side, a model that endogenizes asset salability, and at the same time analyzes debt maturity explicitly can shed more light on how liquidation values affect maturity and leverage. In a recent study of commercial property loans, Benmelech, Garmaise and Moskowitz (2005) use commercial property zoning laws as a proxy for liquidation values. They find that higher liquidation values are associated with longer-term loans, smaller number of creditors, higher loan-to-value ratios and lower interest rates. However, they study project-specific financing and not capital structure choices of firms. More studies of up-to-date industries where liquidation values can be identified should suggest whether this paper's findings are specific to the railroad industry of the 19th century or have wider implications.

Appendix A: The Redeployability of Rolling Stock

Locomotives

According to Klein, Crawford and Alchian (1978), steam locomotives were specialized to operating conditions such as "high speed, hill climbing, short hauls, heavy loads, sharp corners, as well as types of coal for fuel." Locomotives were built to meet the design requirements of the railroads. According to Brown (2002),"railroads increasingly sought locomotives with particular characteristics to suit the *terrain* of their routes and the types of service they ran, such as heavy freights or fast passenger trains." For example, in 1886 Baldwin Locomotives Works built the 2-10-0 locomotive which was designed for the Northern Pacific railroad's heavy freight service lines in mountainous territories. The potential buyers of this $13,225 value locomotive were railroads that operated similar lines. Yet less than a handful of railroads managed this kind of services in 1886. Some locomotives were designed for special tasks and used distinctive types of coal. For example, the St. Louis Bridge Company hauled trains across the Eads Bridge over the Mississippi at St. Louis, then through a downtown tunnel into St. Louis Union Station. For this task it used special locomotives with slant-back tender to improve backward visibility in frequent switching moves. Moreover, the special nature of tunnel operation "required that it burn smokeless coke fuel."

Locomotives were often not redeployable even within different segments of their own railroad. Unlike freight cars, they seldom traveled beyond the tracks of their own roads. According to Brown (2001) "...locomotives were generally assigned to separate operating divisions - sections of the line ranging from 75 to 100 miles in length. Conditions varied greatly between divisions in such matters as balance and intensity of freight versus passenger traffic, hilly or level terrain, curved versus straight track, right-of-way clearance, and weight of tracks."

Gauge differences further frustrated locomotives' redeployability. The narrow-gauge Ptarmigan looked like a standard locomotive, but the engine ran on 3-foot gauge track rather than the standard gauge, "Consequently the entire design was scaled down from normal mainline practice." While the standard-gauge American locomotive in 1880 had 18- by 24-inch cylinders, weighed 74,000 pounds with hauling capacity up to 1,400 long tons, "[The Ptarmigan] had 12- by 18-inch cylinders, weighed 42,000 pounds, and could haul 750 long tons on level track."[22] Changing the gauge of locomotives was often impossible or very expensive, as exemplified by the case of the Chicago, St. Louis, and

[22] See Brown (2001) p. 42

New Orleans RR which was part of the Illinois Central system. On November 29th, 1880, W. H. Pundy, who worked for the department of machinery of the Illinois Central, sent a memo to J. C. Clarke, the vice president and general manager of the Illinois Central, regarding the expenses associated with changing the gauge of the Chicago, St. Louis, and New Orleans RR from 5'0" to 4'8.5". He wrote

> *I would gratefully [suggest] the following: Engines 1,2,3,4,5,6 & 7 are all very light, none of their cylinders being over 13 inches diameter and none of them can be narrowed up without bringing the frame closer together and in some cases narrowing the fire box. The changing of these engines will be expensive and will take considerable time. If the change of the gauge is not made until the summer of 1882 I would recommend that during the coming years we build new engines to take the place of these, and that the old engines be taken to pieces, or sold as may be deemed the best.*[23]

Freight Cars

There were different types of freight cars. Boxcars, flatcars, cabooses and gondola cars were all designed for general purpose freight. More specialized cars included grain hoppers, coal cars, refrigerator, milk, heater and ventilated cars. However, the abundance of freight car models did not impede standardization. The increase in traffic volume after 1870 and larger car fleets led to the adoption of relatively standardized cars. Freight cars were according to Klein, Crawford and Alchian (1978): "...generally easily movable and not very specific." Mass production of freight cars boosted standardization, "Cars were being purchased in groups of hundreds and occasionally thousands, and each lot normally followed a single design."[24]

The interchange of freight cars became more popular after the civil war, but gauge differentials hampered its efficiency. According to White (1993): "Even when railroads were ready to exchange cars and local governments did not block the way, the American railroad industry was crippled by the self-inflicted obstacle of gauge differences." Getting around gauge differentials with engineering expedients was either hazardous or expensive. Laying a third rail to permit dual-gauge operations was costly - the additional rail, extra long-ties and special switches were all expensive items. Operation of mixed-gauge freight cars was"surely awkward since nothing really matched or

[23] Chicago St. Louis and New Orleans RR Co. (Papers accompanying Board meetings 1877-1950), The Illinois Central Archive, Newberry Library Chicago.

[24] White (1993)

coupled easily."[25] Exchanging the trucks of different gauge-cars using car hoists, commonly used in the South, was an expensive remedy for gauge differentials. The hoists cost $3,000 in 1870 dollars while a flatcar cost only $500. Switching cars from one set of trucks to another was a lengthy process and the orphan trucks had to be stored for weeks awaiting the return of the loaner body. There was no alternative to using cars with the correct gauge. While individual freight cars were cheap, ranging from $500 for wood-frame flatcar up to $1,000 for a steel-frame hopper, assembling an average fleet of more than 2,200 freight cars was a major investment. Even if the cost of changing the gauge of a single freight car was relatively low, the fleet scale made this process expensive and long.

[25] White (1993)

References

Alderson, Michael, and Brian Betker, "Liquidation Costs and Capital Structure," *Journal of Financial Economics* 39 (1995) 45-69.

Baird, D. G., and R. K., Rasmussen, "The End of Bankruptcy," *Stanford Law Review* 55 (2002) , 751-789.

Balke, Nathan S., and Robert J. Gordon, "The Estimation of Prewar Gross National Product: Methodology and New Evidence," *Journal of Political Economy* 97 (1989), 38-92.

Barclay M. J., Marx L. M., and C. W. Smith Jr., "The Joint Determination of Leverage and Maturity," Working paper, University of Rochester (2001).

Barclay, M. J., and C. W. Smith Jr., "The Maturity Structure of Corporate Debt," *Journal of Finance* 50 (1995) 609-631.

Benmelech, Efraim, Essays On Debt Maturity, Unpublished Ph.D. thesis, University of Chicago, 2005.

Benmelech, Efraim, Mark J., Garmaise, and Tobias J., Moskowitz, "Do Liquidation Values Affect Financial Contracts? Evidence from Commercial Loan Contracts and Zoning Regulation" *Working paper, Graduate School of Business, University of Chicago* (2005).

Berglöf, Eric, and Ernst-Ludwig von Thadden, "Short-Term versus Long-Term Interests: Capital Structure with Multiple Investors," *Quarterly Journal of Economics* 109 (1994), 1055-1084.

Berry, Thomas S. "Production and Population Since 1789: Revised GNP Series in Constant Dollar," *Bostwick Paper. 6* Richmond: The Bostwick Press (1988).

Brown, John K., The Baldwin Locomotive Works 1831-1915, (The Johns Hopkins University Press), 2001.

Diamond, Douglas, "Debt Maturity Structure and Liquidity Risk," *Quarterly Journal of Economics*, 106 (1991), 709-737.

Fluck, Zsuzsanna, "Capital Structure Decisions in Small and Large Firms: A Life-cycle Theory of Financing", Working paper, Stern School of Business, New York University (1999).

Fogel, Robert W., Railroads and American Economic Growth: Essays in Econometric History, 1964 (The Johns Hopkins Press, Baltimore, Maryland).

Gilson, Stuart C., "Transactions Costs and Capital Structure Choice: Evidence from Financially Distressed Firm," *Journal of Finance*, 52 (1997) 161-196.

Guedes, J., and T. Opler, "The Determinants of The Maturity of Corporate Debt Issues," *Journal of Finance*, 51 (1996) 1809-1833.

Guthman H. G., and H. E., Dougall, Corporate Financial Policy ,4th Edition, 1962 (Prentice-Hall, Inc., Englewood Cliffs, New Jersey).

Habib, M. A., and D. B., Johnsen, "The Financing and Redeployment of Specific Assets," *Journal of Finance* 54 (1999) 693-719.

Harris, Milton and Artur Raviv, "Capital Structure and the Informational Role of Debt," *Journal of Finance*, 45 (1990), 321-349.

Harris, Milton and Artur Raviv, "The Theory of capital Structure," *Journal of Finance* 46 (1991), 297-355.

Hart, O., "Theories of optimal capital Structure: A Managerial Discretion Perspective," In: Blair, M. (Ed.), The Deal Decade: What Takeovers and Leveraged Buyouts Mean for Corporate Governance, Brookings Institution, Washington: D.C, pp. 19-53 (1993).

Hart, Oliver and John Moore, "A Theory of Debt Based on the Inalienability of Human capital," *Quarterly Journal of Economics* 109 (1994), 841-79.

Hart, O. and J., Moore, "Debt and Seniority: An Analysis of the Role of Hard Claims in Constraining Management," *American Economic Review* 85 (1995) 567-585.

Hilton, W., George, American Narrow Gauge Railroads, (Stanford University Press) 1990.

Jensen, Michael C., "Agency Costs of Free cash Flow, Corporate Finance and Takeovers," *American Economic Review* 76 (1986) 323-339.

Johnson, Shane A., "Debt Maturity and the Effects of Growth Opportunities and Liquidity Risk on Leverage," *The Review of Financial Studies* 16 (2003) 203-236.

Kiyotaki, N., and J., Moore, "Credit Cycles," *Journal of Political Economy* 105 (1997) 211-248.

Klein, B., Crawford, R. A., and A. A., Alchian, "Vertical Integration, Appropriable Rents, and the Competitive Contracting Process," *Journal of Law and Economics* 21 (1978) 297-326.

Klein, Maury, Unfinished Business: The Railroad in American Life, (University Press of New England) 1993.

Locomotives of the Rio Grande, (Colorado Railroad Museum) 1980.

LoPucky, Lynn, and William Whitford, "Bargaining over Equity's Share in the Bankruptcy Reorganization of Large, Publicly Held Companies," *University of Pennsylvania Law Review* 139 (1990) , 125-196.

Myers, S. C., "Determinants of Corporate Borrowing," *Journal of Financial Economics* 5 (1977) 147-175.

Myers, S. C., "Financing of Corporations," In *Handbook of the Economics of Finance* edited by George M. Constantinides, Milton Harris. and René M. Stulz (2003) 215-253.

Myers, S. C., and N. S., Majluf, "Corporate Financing and Investment Decisions When Firms Have Information the Investors Do Not Have," *Journal of Financial Economics* 13 (1984) 187-221.

Poor's Railroad Manual Company, 1868, 1869, 1873, 1874, 1877, 1878, 1882, 1883, Poor's Manual of Railroads, (Poor's Railroads Manual Co., New York).

Poterba, James M., "Comment: Financing constraints and corporate investment," *Brookings Papers on Economic Activity* 1 (1988), 200-206.

Puffert, Douglas J., "Path Dependence in Spatial Networks: The Standardization of Railway Track Gauge," Working paper, University of Munich, (2001).

Pulvino, Todd C., "Do Fire-Sales Exist? An Empirical Investigation of Commercial Aircraft Transactions," *Journal of Finance* 53 (1998), 939-78.

Pulvino, Todd C., "Effects of Bankruptcy Court Protection on Asset Sales," *Journal of Financial Economics* 52 (1998), 151-86.

Rajan, Raghuram, and Luigi Zingales, "Financial Dependence and Growth," *American Economic Review* 88 (1998), 559-586.

Rajan, Raghuram G., and Luigi Zingales, "What Do We Know about capital Structure? Some Evidence from International Data," *Journal of Finance* 50 (1995), 1421-60.

Shleifer, Andrei, and Robert W. Vishny, "Liquidation Values and Debt Capacity: A Market Equilibrium Approach" *Journal of Finance* 47(1992), 143-66.

Simon, Mathew, "The United States Balance of Payments, 1861-1900," in *Trends in the American Economy in the Nineteenth Century,* William N, Parker, editor, Princeton University Press (for NBER) (1960), 629-711.

Skeel, David A. Jr., Debt's Dominion, (Princeton University Press) 2001.

Stohs, M. H., and D. C., Mauer, "The Determinants of Corporate Debt Maturity Structure," *Journal of Business* 69 (1996) 279-312.

Stover, John. F., American Railroads, (The University of Chicago Press) 1961.

Street, Donald. M., Railroad Equipment Financing, (Columbia University Press) 1959.

Strömberg, Per, "Conflicts of Interests and Market Illiquidity in Bankruptcy Auctions: Theory and Tests," *Journal of Finance* 55 (2000), 2641-92.

Swain, Henry, H., "Economic Aspects of Railroads Receiverships", *Proceedings of the American Economic Association* 3 (1898) 53-161.

Taylor, George, R., and Neu, Irene D., The American Railroad Network 1861-1890, (University of Illinois Press) 2003.

Titman, S., and Wessels, R., "The Determinants of Capital Structure Choice," *Journal of Finance* 43 (1988), 1-19.

White, John, H. Jr., The American Railroad Freight Car, (Simmons-Boardman Books) 1997.

Williamson, Oliver E., "Corporate finance and Corporate Governance," *Journal of Finance* 43 (1988), 567-91.

Williamson, Oliver E., "Credible Commitment: Using Hostages to Support Exchange," *American Economic Review* 73 (1983) 519-540.

Williamson, Oliver E., The Economic Institutions of Capitalism, (New York: Free Press), 1985.

Wilner, Frank, N., Railroad Mergers: History, Analysis, Insight, (The Johns Hopkins University Press), 1993.

Woodlock, Thomas, F., The Anatomy of a Railroad Report and Ton-Mile Cost, (Doubleday, Page & Co, New York) 1909.

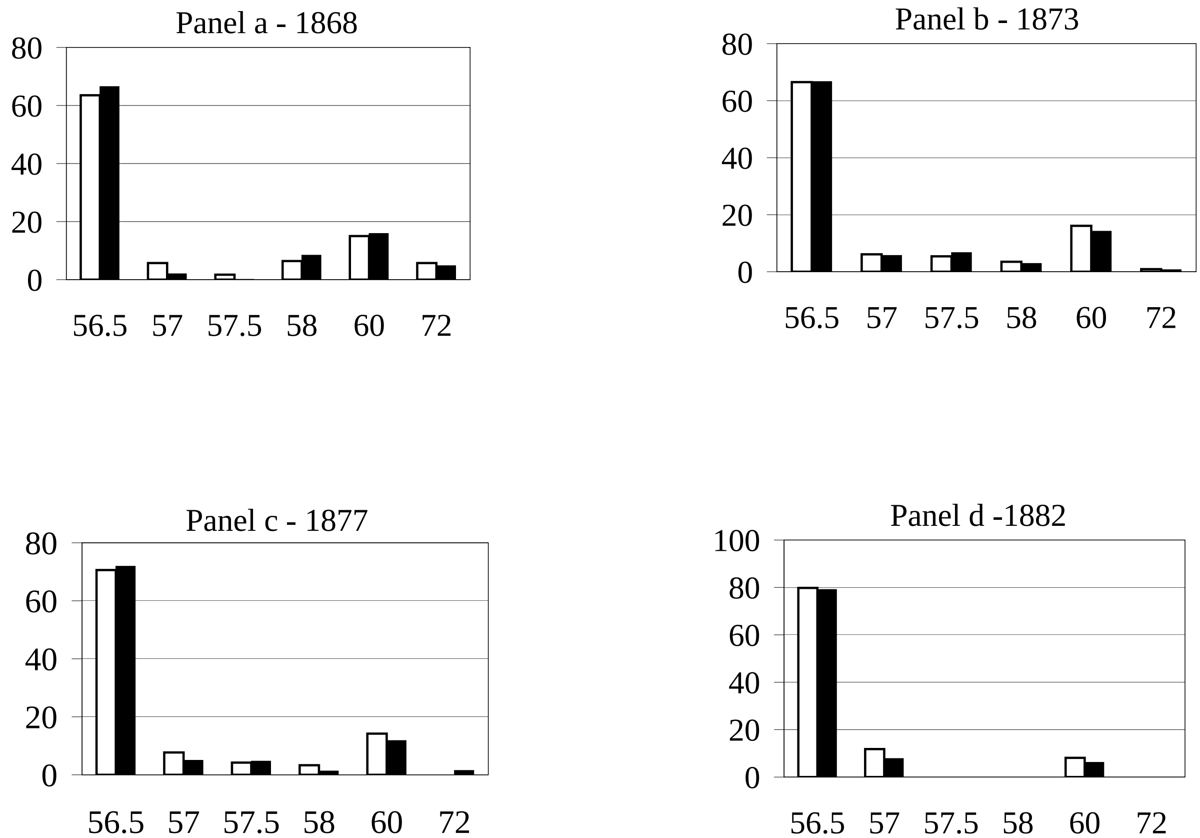

Figure 1
The Representativeness of The Sample

Comparison of percentage of mileage gauges between my sample and the entire population of the railroads for each of the sample's years: *a*, 1868; *b*, 1873; *c*, 1877; and *d*, 1882, and across selected gauges. All panels compare the percentage of mileage in the most common gauges between my sample (gray blocks) and the entire population (black blocks)

Table 1:
The Distribution of Tracks Gauge 1868-1882

The sample consists of 390 railroad-year observations in the years: 1868, 1872, 1877 and 1882. The tracks gauge is the horizontal distance separating the two rails in inches. The ”standard gauge” was 4’8.5” (or 56.5 inches.)

Panel A: Distribution of gauge across the pooled data

	Gauge										
	36	56.5	57	57.25	57.5	58	60	65	66	72	Total
Frequency	3	252	32	1	14	14	64	1	3	6	390
Percent (%)	0.8	64.6	8.2	0.3	3.6	3.6	16.4	0.3	0.8	1.5	100.0

Panel B: Distribution of gauge along years

	36	56.5	57	57.25	57.5	58	60	65	66	72	Total
1868											
Frequency	0	36	2	0	2	4	17	1	2	5	69
Percent (%)	0.0	52.17	2.9	0.0	2.9	5.8	26.6	1.5	2.9	7.3	100.0
1873											
Frequency	2	59	7	1	7	5	19	0	1	1	102
Percent (%)	2.0	57.8	6.9	1.0	6.9	4.9	18.6	0.0	1.0	1.0	100.0
1877											
Frequency	0	69	7	0	5	5	18	0	0	0	104
Percent (%)	0.0	66.4	6.7	0.0	4.8	4.8	17.3	0.0	0.0	0.0	100.0
1882											
Frequency	1	86	16	0	0	0	9	0	0	0	112
Percent (%)	0.9	76.8	14.3	0.0	0.0	0.0	8.0	0.0	0.0	0.0	100.0

Table 2:
The Geographical Distribution of the Track Gauge

This table reports the distribution of the railroads sample across geographical regions and track gauges in the entire (pooled) sample. The geographical categories are in accordance with the railroads geographical groups, as reported in the Poor's Manuals of the Railroads. The Frequencies sum up to more than the 390 railroad-year observations, since several railroads operate in more than one region.

New England

Gauge	36	56.5	57	57.25	57.5	58	60	62	65	66	72	Total
Frequency	0	53	0	0	0	0	0	0	0	2	0	55
Percent (%)	0.0	96.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	100.0

East

Gauge	36	56.5	57	57.25	57.5	58	60	62	65	66	72	Total
Frequency	0	81	14	0	2	4	3	0	0	0	5	109
Percent (%)	0.0	77.3	12.8	0.0	1.8	3.7	2.8	0.0	0.0	0.0	4.6	100.0

South

Gauge	36	56.5	57	57.25	57.5	58	60	62	65	66	72	Total
Frequency	1	22	9	0	0	0	60	0	0	0	1	93
Percent (%)	1.1	23.7	9.7	0.0	0.0	0.0	64.5	0.0	0.0	0.0	1.1	100.0

Midwest

Gauge	36	56.5	57	57.25	57.5	58	60	62	65	66	72	Total
Frequency	2	112	12	1	13	14	7	0	1	0	2	164
Percent (%)	1.2	68.3	7.3	0.6	7.9	8.5	4.3	0.0	0.6	0.0	1.2	100.0

West

Gauge	36	56.5	57	57.25	57.5	58	60	62	65	66	72	Total
Frequency	0	16	0	0	0	0	1	0	0	1	0	18
Percent (%)	0.0	88.9	0.0	0.0	0.0	0.0	5.6	0.0	0.0	5.6	0.0	100.0

Table 3:
The Railroads Dollar Value

This table provides descriptive statistics for the dollar book value of the railroads lines over time. Panel A reports the distribution of the railroads nominal book value in the pooled data. Panel B reports the distribution of the railroads nominal book value for every year in the sample. Panel C reports the descriptive statistics for the real dollar value of the railroads for each of the sample years. Real book values are in 2000 dollars, and calculated using the Consumer Product Index.

Period	Mean	25th Percentile	Median	75th Percentile	Standard Deviation	Min	Max
Panel A: Nominal Values - Pooled Data (millions of dollars)							
1868-1882	18.5	5.4	10.7	21.9	23.6	0.36	171.0
Panel B: Nominal Values - For Each of the Sample Years (millions of dollars)							
1868	11.7	3.5	6.5	14.3	12.2	1.3	51.1
1873	17.2	5.1	10.3	21.1	18.8	0.36	117.0
1877	19.3	6.1	10.8	22.3	24.9	1.5	159.0
1882	23.0	6.9	12.9	24.8	30.1	1.1	171.0
Panel C: Real Values (2000 dollars) - for each of the Sample Years (millions of dollars)							
1868	158.4	47.4	88.0	193.6	165.2	17.6	691.9
1873	224.1	66.5	134.2	274.9	245.0	4.7	1,524.5
1877	297.2	93.9	166.3	343.4	383.5	23.1	2,448.6
1882	381.8	114.5	214.1	411.7	499.7	18.3	2,838.6
Panel D: Railroads Values as a Percentage of Nominal GDP							
1868	0.138%	0.041%	0.077%	0.168%	0.144%	0.015%	0.602%
1873	0.186%	0.055%	0.111%	0.228%	0.203%	0.004%	1.262%
1877	0.217%	0.068%	0.121%	0.250%	0.279%	0.017%	1.785%
1882	0.185%	0.055%	0.104%	0.199%	0.242%	0.009%	1.373%

Table 4:
Railroads Characteristics

This table provides descriptive statistics for the characteristics of the railroads a sample of 221 American railroads in the years 1868, 1873, 1877 and 1882 (390 firm-year observations). Tangibility is the value of the road and equipment divided by the book value of assets. Leverage is measured as the book value of total funded debt divided by the book value of the assets. Debt Maturity is the weighted average of the term-to-maturity of all the debt instruments outstanding. Profitability is the net earning divided by the book value of total assets. Cars is the total number of locomotives, passenger coaches, freight cars, baggage mail and express cars and service cars. Freight is the number of freight cars divided by the total number of cars. Passengers is the number of passenger coaches divided by the total number of cars. Locomotives is the number of locomotives divided by the total number of cars.

	Mean	25th Percentile	Median	75th Percentile	Standard Deviation	Min	Max
Tangibility	0.83	0.76	0.86	0.95	0.18	0.0	1.0
Leverage	0.43	0.30	0.43	0.56	0.19	0.0	1.0
Debt Maturity	20.1	14.0	20.0	27.0	9.4	0.0	60.0
Profitability	4.85%	2.03%	4.09%	6.53%	4.30%	-2.77%	50.78%
Cars	2317.5	427.0	961.0	2150.0	4460.7	0.0	32425.0
Freight	0.87	0.85	0.89	0.93	0.11	0.0	0.99
Passengers	0.043	0.018	0.031	0.051	0.059	0.000	0.873
Locomotives	0.051	0.033	0.046	0.062	0.037	0.005	0.495

Table 5:
Characteristics of railroads Stratified by Leverage

This table provides means (medians) of railroads characteristics stratified by Leverage. The characteristics are Size, Miles, Profitability, Tangibility, Leverage, Cars, Freight, Passengers, Locomotives, Tracks Salability, Rolling Stock Salability. Size is the log of the book value of assets. Miles is the total number of miles operated by the railroad. Profitability is the net earning divided by the book value of total assets. Tangibility is the value of road and equipment divided by the book value of assets. Leverage is measured as the book value of total funded debt divided by the book value of assets. Cars is the total number of locomotives, passenger coaches, freight cars, baggage mail and express cars and service cars. Freight is the number of freight cars divided by the total number of cars. Passengers is the number of passenger coaches divided by the total number of cars. Locomotives is the number of locomotives divided by the total number of cars. The Kruskal-Wallis p-value gives the significance of a test whether a variable is not distributed identically across debt maturity ranges. Low *p*-values indicate that the null hypothesis of random sampling is rejected.

	Leverage Ranges						
Variable	0-0.18	0.19-0.29	0.30-0.43	0.438-0.55	0.56-0.66	0.67+	Kruskal-Wallis p-Value
Size	15.93	16.41	16.43	16.10	16.26	15.94	0.0144
	(15.63)	(16.44)	(16.32)	(15.97)	(16.31)	(15.84)	
Miles	268.6	435.6	394.4	295.0	305.9	266.1	0.0088
	(206)	(273.5)	(278.5)	(195)	(263)	(239)	
Profitability	6.90%	5.93%	5.07%	3.88%	4.34%	4.01%	0.0001
	(6.53%)	(6.23%)	(3.97%)	(3.44%)	(3.24%)	(3.68%)	
Tangibility	0.84	0.77	0.80	0.85	0.82	0.89	0.0005
	(0.85)	(0.80)	(0.83)	(0.89)	(0.88)	(0.92)	
Cars	2645.1	2843.13	2478.0	2117.9	2594.5	1092.1	0.1474
	(1110)	(1390)	(992)	(789)	(835)	(826)	
Freight	84.76%	87.16%	85.99%	88.39%	89.12%	87.49%	0.1897
	(88.21%)	(89.20%)	(88.23%)	(90.29%)	(89.51%)	(89.50%)	
Passengers	5.55%	4.29%	4.73%	4.15%	3.34%	3.64%	0.0600
	(3.64%)	(3.22%)	(3.51%)	(2.51%)	(2.70%)	(3.19%)	
Locomotives	5.95%	4.83%	5.42%	4.86%	5.11%	4.62%	0.7965
	(5.06%)	(4.23%)	(4.61%)	(4.22%)	(4.74%)	(4.58%)	
Observations	41	52	105	98	53	41	Total=390

Table 6:
Characteristics of railroads Stratified by Debt Maturity

This table provides means (medians) of railroads characteristics stratified by debt maturity. The characteristics are Size, Miles, Profitability, Tangibility, Leverage, Cars, Freight, Passengers, Locomotives, Tracks Salability, Rolling Stock Salability. Size is the log of the book value of assets. Miles is the total number of miles operated by the railroad. Profitability is the net earning divided by the book value of total assets. Tangibility is the value of road and equipment divided by the book value of assets. Leverage is measured as the book value of total funded debt divided by the book value of assets. Cars is the total number of locomotives, passenger coaches, freight cars, baggage mail and express cars and service cars. Freight is the number of freight cars divided by the total number of cars. Passengers is the number of passenger coaches divided by the total number of cars. Locomotives is the number of locomotives divided by the total number of cars. The Kruskal-Wallis p-value gives the significance of a test whether a variable is not distributed identically across debt maturity ranges. Low *p*-values indicate that the null hypothesis of random sampling is rejected.

	Debt Maturity Ranges						
Variable	1-8	9-14	15-20	21-27	28-30	31+	Kruskal-Wallis p-Value
Size	15.60	15.93	16.27	16.46	16.25	16.50	0.0001
	(15.41)	(15.96)	(16.37)	(16.43)	(16.16)	(16.40)	
Miles	201.34	276.3	354.3	401.7	280.6	402.9	0.0001
	(141.5)	(196)	(217)	(283)	(250)	(265)	
Profitability	5.21%	4.63%	5.40%	4.06%	3.42%	5.49%	0.0035
	(4.86%)	(5.16%)	(4.53%)	(3.26%)	(2.21%)	(4.16%)	
Tangibility	0.83	0.80	0.82	0.85	0.83	0.84	0.0372
	(0.85)	(0.80)	(0.86)	(0.89)	(0.92)	(0.91)	
Cars	1032.3	1999.3	2625.7	2237.4	1811.7	4052.2	0.0002
	(449)	(766)	(822)	(1051)	(914)	(1632)	
Freight	78.50%	85.34%	87.89%	88.73%	89.09%	91.68%	0.0001
	(84.73%)	(87.34%)	(89.52%)	(90.61%)	(92.52%)	(92.58%)	
Passengers	8.83%	4.56%	4.50%	3.12%	3.27%	2.47%	0.0001
	(5.12%)	(4.51%)	(3.09%)	(2.47%)	(1.99%)	(2.01%)	
Locomotives	7.76%	5.32%	5.01%	4.92%	4.20%	3.79%	0.0001
	(5.77%)	(5.07%)	(4.78%)	(4.36%)	(3.63%)	(3.68%)	
Observations	41	52	105	98	53	41	Total=390

Table 7:
Characteristics of the Salability Proxies

This table provides descriptive statistics for the characteristics of the salability proxies. Panel A reports summary statistics for the proxies of road salability and rolling stock salability. I use both total mileage and number of railroads to calculate the proxies. Panel B reports means (medians) of the proxies of road salability and rolling stock salability stratified by debt maturity. The Kruskal-Wallis p-value gives the significance of a test whether a variable is not distributed identically across debt maturity ranges. Low *p*-values indicate that the null hypothesis of random sampling is rejected.

Panel A: Summary Statistics

Salability of	Mean	25th Percentile	Median	75th Percentile	Standard Deviation	Min	Max
Road (mileage)	1859.8	440.2	1162.3	3257.0	1857.7	0.0	7649.8
Road (number of buyers)	28.4	5.7	17.7	35.7	34.4	0.0	162
Rolling Stock (mileage)	35605.8	6254.0	37262.9	48483	30137.1	0.0	83603.7
Rolling Stock (number of buyers)	460.3	63	456	649	407.6	0	1100

Panel B: Salability Proxies Stratified by Debt Maturity

	Debt Maturity Ranges						
Salability of	1-8	9-14	15-20	21-27	28-30	31+	Kruskal-Wallis p-Value
Road (mileage)	1265.0 (991.4)	1472.1 (1026.8)	1596.3 (1002.2)	1781.2 (1181.1)	2479.0 (2359.5)	3170.6 (3680.8)	0.0001
Road (number of buyers)	23.93 (12.1)	23.46 (15.83)	27.4 (17.0)	22.7 (15.3)	33.5 (31.8)	50.2 (30.6)	0.0034
Rolling Stock (mileage)	20171.6 (7226)	29723.5 (19535)	34323.1 (37334.9)	33593.8 (37218.9)	48117.8 (48289.1)	55142.4 65310.9	0.0001
Rolling Stock (number of buyers)	265.4 (105)	366.0 (217)	452.0 (456)	437.0 (456)	622.4 (649)	710.8 (874.5)	0.0001

Table 8:
Asset Salability and Leverage

The dependent variable in the regressions is the book value of total funded debt divided by the book value of the assets. Size is the log of the book value of assets. Tangibility is the value of road and equipment divided by the book value of assets. Profitability is the net earning divided by the book value of total assets. Freight is the number of freight cars divided by the total number of cars. Road Salability is defined as the mileage-weighted average of the state salability index corresponding to the states of the railroad's line, where the state salability index is calculated using 1) state-wide track-mileage for each gauge , and 2) the number of railroads in the state for each gauge. Rolling Stock Salability defined as the mileage-weighted average of the gauge salability index corresponding to the railroad's gauge, where as before the state salability index is calculated using 1) state-wide track-mileage for each gauge , and 2) the number of railroads in the state for each gauge. The Salability proxies that are calculated using mileage are in logarithm terms. All regressions include an intercept (not reported). t-statistics are calculated using clustered standard-errors and reported in parenthesis.

Leverage

	Model 1	Model 2	Model 3	Model 4	Model 5
Size	-0.002	0.001	0.001	-0.003	-0.022 *
	(-0.12)	(0.01)	(0.01)	(-0.02)	(-1.72)
Tangibility	0.113	0.110	0.113	0.115	0.010
	(1.36)	(1.31)	(1.42)	(1.44)	(1.03)
Profitability	-0.783 **	-0.769 **	-0.759 **	-0.768 **	-0.743 *
	(-2.54)	(-2.44)	(-2.35)	(-2.38)	(-1.82)
Freight	0.101	0.107	0.103	0.104	0.080
	(0.94)	(0.94)	(1.11)	(1.13)	(0.69)
Road Salability	-0.005				-0.001
(mileage)	(-1.25)				(-0.30)
Road Salability		-0.004			
(number of buyers)		(-0.94)			
Rolling Stock Salability			-0.007		
(mileage)			(-1.08)		
Rolling Stock Salability				-0.000	
(number of buyers)				(-0.41)	
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	No	No	No	No	Yes
Adjusted R^2	0.06	0.06	0.06	0.06	0.13
Observations	382	382	382	382	382

*,**,and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table 9:
Asset Salability and Debt Maturity

The dependent variable in the regressions is the weighted average of the term-to-maturity of all the debt instruments outstanding. Size is the log of the book value of assets. Tangibility is the value of road and equipment divided by the book value of assets. Profitability is the net earning divided by the book value of total assets. Freight is the number of freight cars divided by the total number of cars. Road Salability is defined as the mileage-weighted average of the state salability index corresponding to the states of the railroad's line, where the state salability index is calculated using 1) state-wide track-mileage for each gauge , and 2) the number of railroads in the state for each gauge. Rolling Stock Salability is defined as the mileage-weighted average of the gauge salability index corresponding to the railroad's gauge, where as before the state salability index is calculated using 1) state-wide track-mileage for each gauge , and 2) the number of railroads in the state for each gauge. The Salability proxies that are calculated using mileage are in logarithm terms. All regressions include an intercept (not reported). t-statistics are calculated using clustered standard-errors and reported in parenthesis.

Debt Maturity

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Size	2.37 ***	2.28 ***	2.24 ***	2.22 ***	1.31 ***	1.19 **	1.17 **	1.22 **
	(5.35)	(5.00)	(4.80)	(4.75)	(2.75)	(2.54)	(2.30)	(2.42)
Tangibility	7.75 ***	8.00 ***	7.87 ***	7.97 ***	4.07 *	4.43 *	4.04 *	4.12 *
	(2.61)	(2.73)	(2.61)	(2.65)	(1.72)	(1.91)	(1.72)	(1.82)
Profitability	-26.86 **	-27.60 **	-29.04 **	-28.82 ***	-28.87 *	-26.36 *	-29.46 **	-28.49 **
	(-1.97)	(-2.13)	(-2.20)	(-2.23)	(-1.95)	(-1.89)	(-2.16)	(-2.10)
Freight	13.25 ***	13.31 ***	13.70 ***	13.61 ***	6.96 *	6.67 *	7.24 **	7.42 **
	(4.17)	(4.25)	(4.02)	(4.17)	(1.91)	(1.87)	(2.06)	(2.12)
Road Salability	0.262 **				0.380 **			
(mileage)	(2.20)				(2.37)			
Road Salability		0.023 ***				0.049 ***		
(number of buyers)		(2.66)				(3.20)		
Rolling Stock Salability			0.633 ***				0.749 ***	
(mileage)			(2.61)				(2.62)	
Rolling Stock Salability				0.004 ***				0.003 *
(number of buyers)				(2.62)				(1.92)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Adjusted R^2	0.20	0.20	0.20	0.21	0.29	0.29	0.28	0.28
Observations	379	379	379	379	379	379	379	379

*,**,and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table 10:
Asset Salability or Profitability?

The dependent variable in the regressions is profitability – net earning divided by the book value of total assets. Size is the log of the book value of assets. Freight is the number of freight cars divided by the total number of cars. Age is the difference between the actual year and the railroad's charter year. HHI is the Herfindahl-Hirschman concentration Index of railroads at the state-year level. Road Salability is defined as the mileage-weighted average of the state salability index corresponding to the states of the railroad's line, where the state salability index is calculated using 1) state-wide track-mileage for each gauge , and 2) the number of railroads in the state for each gauge. Rolling Stock Salability is defined as the mileage-weighted average of the gauge salability index corresponding to the railroad's gauge, where as before the state salability index is calculated using 1) state-wide track-mileage for each gauge , and 2) the number of railroads in the state for each gauge. The Salability proxies that are calculated using mileage are in logarithm terms. All regressions include an intercept (not reported). *t*-statistics are calculated using clustered standard-errors and reported in parenthesis.

	Profitability			
	Model 1	Model 2	Model 3	Model 4
Size	0.004	0.004	0.003	0.004
	(0.89)	(0.84)	(0.79)	(0.81)
Freight	0.039	0.039	0.040	0.039
	(1.47)	(1.46)	(1.49)	(1.48)
Age	0.001 ***	0.001 ***	0.001 ***	0.001 ***
	(4.87)	(5.18)	(5.36)	(5.18)
HHI	0.087	0.087	0.086	0.086
	(1.15)	(1.13)	(1.11)	(1.12)
Road Salability	0.001			
(mileage)	(0.06)			
Road Salability		-3.0e-04		
(number of buyers)		(-0.26)		
Rolling Stock Salability			0.010	
(mileage)			(0.46)	
Rolling Stock Salability				3.28e-06
(number of buyers)				(0.37)
Year Fixed Effects	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.18	0.18	0.18	0.18
Observations	335	335	335	335

*,**,and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table 11:
Asset Salability or Cash Flow Volatility?

The dependent variable in the regressions is profitability – net earning divided by the book value of total assets. Size is the log of the book value of assets. Freight is the number of freight cars divided by the total number of cars. Age is the difference between the actual year and the railroad's charter year. HHI is the Herfindahl-Hirschman concentration Index of railroads at the state-year level. Road Salability is defined as the mileage-weighted average of the state salability index corresponding to the states of the railroad's line, where the state salability index is calculated using 1) state-wide track-mileage for each gauge , and 2) the number of railroads in the state for each gauge. Rolling Stock Salability is defined as the mileage-weighted average of the gauge salability index corresponding to the railroad's gauge, where as before the state salability index is calculated using 1) state-wide track-mileage for each gauge , and 2) the number of railroads in the state for each gauge. The Salability proxies that are calculated using mileage are in logarithm terms. All regressions include an intercept (not reported). *t*-statistics are calculated using clustered standard-errors and reported in parenthesis.

Panel A: First-stage Regression

$$Maturity_{i,t} = \alpha_{i,t} + \beta_1 size_{i,t} + \beta_2 age_{i,t} + \beta_3 freight_{i,t} + \beta_4 HHI_{i,t} + \text{year FE} + \text{state FE} + e_{i,t}$$

$$Maturity_{i,t} = -0.067 + 0.0036 size_{i,t} + 0.00085 age_{i,t} + 0.0390 freight_{i,t} + 0.0872 HHI_{i,t} + \text{year FE} + \text{state FE} + e_{i,t}$$

Panel B: Second-stage Regression

$$e^2_{i,t} = Salability\ Measures_{i,t} + \epsilon_{i,t}$$

	Model 1	Model 2	Model 3	Model 4
Road Salability	-0.0002			
(mileage)	(-0.79)			
Road Salability		-4.63e-06		
(number of buyers)		(-0.54)		
Rolling Stock Salability			0.0002	
(mileage)			(1.19)	
Rolling Stock Salability				5.52e-07
(number of buyers)				(0.79)
Adjusted R^2	0.001	0.001	0.001	0.001
Observations	335	335	335	335

*,**,and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table 12:
Profitability Stratified by Salability

This table provides descriptive statistics of profitability stratified by the salability proxies. Panel A reports means (medians) of profitability stratified by different salability measures. I use both total mileage and number of railroads to calculate the proxies. Panel B reports the cross-sectional standard deviation of profitability stratified by proxies of road salability and rolling stock salability. Profitability is the net earning divided by the book value of total assets. The Bartlett's p-value gives the significance of a test whether the sub-samples have equal variances. Low p-values indicate that the null hypothesis of equal variances is rejected.

Panel A: Mean and Median Profitability Stratified by Salability

	Low Salability 1	2	3	4	High Salability 5
Road Salability (Mileage)	4.20%	4.09%	4.42%	5.01%	4.36%
	(3.60%)	(4.05%)	(4.44%)	(4.51)%	(4.02%)
Road Salability (Number)	4.09%	4.34%	3.89%	4.93%	4.76%
	(3.48%)	(4.44%)	(3.42%)	(4.70)%	(4.49%)
Rolling Stock Salability (Mileage)	4.27%	4.18%	4.34%	5.24%	4.12%
	(3.70%)	(3.55%)	(4.02%)	(5.13%)	(4.20%)
Rolling Stock Salability (Number)	4.32%	4.47%	4.62%	4.21%	4.41%
	(3.75%)	(4.14%)	(4.40%)	(4.25%)	(4.31%)

Panel B: Profitability Volatility Stratified by Salability

	Low Salability 1	2	3	4	High Salability 5
Road Salability (Mileage)	2.77%	2.36%	2.31%	2.79%	2.70%
		Bartlett's test for equal variances: $\chi^2(4) = 4.47$ (p-value=0.346)			
Road Salability (Number)	2.76%	2.38%	2.33%	2.87%	2.50%
		Bartlett's test for equal variances: $\chi^2(4) = 4.57$ (p-value=0.334)			
Rolling Stock Salability (Mileage)	2.74%	2.56%	2.54%	2.69%	2.35%
		Bartlett's test for equal variances: $\chi^2(4) = 1.91$ (p-value=0.753)			
Rolling Stock Salability (Number)	2.57%	2.77%	2.61%	2.44%	2.37%
		Bartlett's test for equal variances: $\chi^2(4) = 1.30$ (p-value=0.728)			

Table 13:
The Size Distribution of Railroads and Debt Maturity

The dependent variable in the regressions is the weighted average of the term-to-maturity of all the debt instruments outstanding. Mileage is the log of the total mileage owned by the railroad. Tangibility is the value of road and equipment divided by the book value of assets. Profitability is the net earning divided by the book value of total assets. Freight is the number of freight cars divided by the total number of cars. State-gauge share is the ratio between the railroad's mileage and the corresponding mileage of railroads with similar gauge that operate in the same states and are not in receiverships. Country-gauge Share is the ratio between the railroad's mileage and the corresponding mileage of railroads with similar gauge in the country that are not in receiverships. # of firms $\leq$ 300 is the number of railroads with similar gauge that operate in the same states and are not in receiverships with total length smaller than or equal to 300 miles. # of firms 300 is the number of railroads with similar gauge that operate in the same states and are not in receiverships with total length larger than 300 miles. All regressions include an intercept (not reported). *t*-statistics are calculated using clustered standard-errors and reported in parenthesis.

Debt Maturity

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Mileage	3.08 ***	2.88 ***	1.92 **	1.68 **	1.40 ***	1.34**
	(4.22)	(4.05)	(2.50)	(2.26)	(2.76)	(2.53)
Tangibility	6.15 **	6.20 **	3.53	3.25	4.18 *	3.40
	(2.01)	(1.97)	(1.47)	(1.30)	(1.81)	(1.32)
Profitability	-28.58 *	-29.26 **	-32.44 **	-32.29 **	-30.72 **	-43.78 **
	(-1.93)	(-2.03)	(-2.14)	(-2.22)	(-2.32)	(-2.46)
Freight	14.13 ***	14.54 ***	7.11 *	7.36 **	10.84 ***	11.37 ***
	(3.89)	(3.82)	(1.95)	(2.07)	(3.56)	(3.67)
State-Gauge share	-1.92		-3.19 **			
	(-1.63)		(-2.31)			
Country-Gauge share		-5.06 ***		-7.20 ***		
		(-3.39)		(-2.90)		
# of firms $\leq$ 300					0.245 ***	
					(3.52)	
# of firms $>$ 300						1.49 **
						(2.16)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	No	No	Yes	Yes	Yes	Yes
Adjusted R^2	0.19	0.18	0.29	0.28	0.26	0.25
Observations	379	379	379	379	379	379

*,**,and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table 14:
Debt Maturity and Alternative Measures of Growth Opportunities

The dependent variable in the regressions is the weighted average of the term-to-maturity of all the debt instruments outstanding. Size is the log of the book value of assets. Tangibility is the value of road and equipment divided by the book value of assets. Profitability is the net earning divided by the book value of total assets. Freight is the number of freight cars divided by the total number of cars. Rolling Stock Salability is defined as the mileage-weighted average of the gauge salability index corresponding to the railroad's gauge, where the state salability index is calculated using state-wide track-mileage for each gauge. The Salability proxy is in logarithm terms. Efficiency is the ratio of operating expenses to revenue. Freight Earning is defined as earnings from freight divided by total earnings. Area-to-Population is the ratio of the state's area in squared miles to the population size. HHI is the Herfindahl-Hirschman concentration Index of railroads at the state-year level. Waterways is defined as the number of navigable streams and rivers, and canals within a state. Regressions include intercepts and controls for size tangibility and profitability which are not reported for brevity. All regressions include an intercept (not reported). t-statistics are calculated using clustered standard-errors and reported in parenthesis.

Debt Maturity

	Model 1	Model 2	Model 3	Model 4	Model 5
Freight	5.70 *	9.64 **	11.28	10.37 ***	17.45 ***
	(1.78)	(2.57)	(3.42)	(3.26)	(5.48)
Rolling Stock Salability	0.756 ***	0.409 *	1.29 ***	1.20 ***	1.05 ***
(mileage)	(2.70)	(1.72)	(3.15)	(3.24)	(3.56)
Efficiency	-10.34 ***				
	(-2.58)				
Freight Earnings		-12.26 **			
		(-2.10)			
Area-to-Population			-44.55		
			(-1.42)		
HHI				-7.99	
				(-0.65)	
Waterways					0.097
					(0.88)
State Fixed Effects	Yes	Yes	Yes	Yes	No
Year Fixed Effects	Yes	Yes	No	No	No
Adjusted R^2	0.31	0.28	0.26	0.26	0.20
Observations	371	318	376	376	376

*,**,and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table 15:
The Impact of the Railroad's Age on Debt Maturity

The dependent variable in the regressions is the weighted average of the term-to-maturity of all the debt instruments outstanding. Freight is the number of freight cars divided by the total number of cars. Road Salability is defined as the mileage-weighted average of the state salability index corresponding to the states of the railroad's line, where the state salability index is calculated using 1) state-wide track-mileage for each gauge , and 2) the number of railroads in the state for each gauge. Rolling Stock Salability is defined as the mileage-weighted average of the gauge salability index corresponding to the railroad's gauge, where as before the state salability index is calculated using 1) state-wide track-mileage for each gauge , and 2) the number of railroads in the state for each gauge. The Salability proxies that are calculated using mileage are in logarithm terms. Age is the difference between the actual year and the railroad's charter year. Steel is the ratio of the length of steel tracks to the total mileage of the railroad. Regressions include intercepts, state fixed effects and controls for size tangibility and profitability. For brevity only the coefficient on the freight salability proxies, age and steel are reported. t-statistics are calculated using clustered standard-errors and reported in parenthesis.

	Debt Maturity						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Freight	11.87 ***	11.73 ***	9.76 **	11.23 ***	9.42 **	6.47*	6.12 *
	(2.69)	(2.66)	(2.19)	(2.61)	(2.09)	(1.80)	(1.73)
Road Salability (mileage)		0.266				0.393 **	
		(1.12)				(2.41)	
Road Salability (number of buyers)			0.058 ***				0.050 ***
			(4.34)				(4.93)
Rolling Stock Salability (mileage)				1.166 **			
				(2.16)			
Rolling Stock Salability (number of buyers)					0.005 ***		
					(3.82)		
Age	-0.063	-0.057	-0.064	-0.067	-0.072		
	(-0.83)	(-0.73)	(-0.87)	(-0.89)	(-0.97)		
Steel						5.25 **	5.25 **
						(2.42)	(2.36)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	No	Yes	Yes
Adjusted R^2	0.20	0.21	0.23	0.22	0.24	0.27	0.28
Observations	326	326	326	326	326	379	379

*,**,and *** denote significance at the 10, 5, and 1 percent levels, respectively.