

# Asset Salability and Debt Maturity: Evidence from 19<sup>th</sup> Century American Railroads

Efraim Benmelech<sup>†</sup>

First Draft September 2003

Revised October 2003

## Abstract

In this paper I study the relation between asset salability and capital structure. Using a unique dataset of more than 200 19th century American railroads, I find that salability and debt maturity are strongly correlated. Railroads that had more redeployable cars, and that conformed to the standard track gauge had longer debt maturities. Moreover, I find that the potential demand for the railroads' rolling stock and track mileage were significant determinants of debt maturity. Interestingly, there is no evidence that salability or industry-demand for assets were correlated with leverage. Similar results were found in a study of COMPUSTAT firms in the period 1980-2001, suggesting that the results in this paper are not sample specific, and can be consistently interpreted using the Shleifer and Vishny's (1992) model.

**JEL classification:** G32 G33 L92 N21 N71.

**Keywords:** Capital structure, Debt maturity, Liquidation, Salability, Gauge, Railroads.

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<sup>†</sup> Graduate School of Business, University of Chicago, I have greatly benefited from the support and guidance of Douglas Diamond and Raghu Rajan. I am also grateful to Douglas Baird, Zahi Ben-David, David Greenberg, Eugene Kandel, Toby Moskowitz, Wendy Rothschild, Per Stromberg, and Luigi Zingales. Last but not least, I thank my colleagues at the doctoral program for insightful discussions and constructive feedbacks on an earlier version. All errors are my own.

E-Mail: ebenmele@gsb.uchicago.edu

## 1. Introduction

There is an extensive literature that analyzes financial decisions from an "incomplete contracting" perspective. In particular, papers in this literature often analyze debt in terms of the allocation of residual control rights over assets. The driving force in these models is the right to foreclose on the debtor's assets in a default state. If the debtor fails to make a promised repayment, the creditor can seize his assets and liquidate them for their market price.<sup>1</sup> The liquidation threat induces the debtor to pay up, and a debt contract is a mechanism based on this threat. It is the liquidation value of the assets 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 emphasis in the theory, there is relatively little empirical evidence on the relation between liquidation values of a firm's assets and its capital structure. 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 in 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.

In this paper I provide additional evidence on the association between asset salability and capital structure. The railroad industry in the 19th century is a natural candidate for this task. Railroads used to own two main types of assets: 1) tracks; and 2) rolling stock, (e.g. locomotives, freight cars, passengers coaches etc.) Detailed data

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<sup>1</sup>These models often assume that the investor cannot use the assets himself because he does not have the specialized skills, or alternatively he will need to hire a new manager and again will face an agency problem.

on rolling-stock's composition, length of mileage tracks owned by the railroads, and their location, were provided in the railroads' original financial reports and in the *Poor's Manuals of Railroads*. This enables the interested researcher to fully identify the real assets that the railroads used to control. Moreover, railroads relied heavily on external finance, and as such had diverse capital structures. 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. Unfortunately, lack of standardization in railroad equipment created a wedge between buyers and 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. I use physical attributes of assets 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, correlation between salability and leverage per se is not supported by the data. Benmelech (2003) documents a positive association between debt maturity and asset liquidity as well. Moreover, consistent with the results reported here, there is no relation between asset liquidity and leverage.

These results seem to contrast with the theoretical models that link debt capacity and the liquidation value of assets [i.e. Williamson

(1988), Shleifer and Vishny (1992)]. However, I later suggest that salability is related to the debt's term, and I show that Shleifer and Vishny's (1992) predictions relate closely to debt maturity rather than to leverage.

This study provides some of the first evidence of a relation between asset salability and debt maturity. Previous research typically used balance-sheet proxies such as tangibility (ratio of fixed assets to total assets) to test the collateral value of assets, or asset maturity (fixed assets divided by depreciation expenses) to test the assets-liabilities matching hypothesis. One contribution of this paper is that it uses data on the core physical attributes of the assets in addition to their book values. Furthermore, the diversity of track gauges provides an opportunity to identify the potential demand for the assets, and thus proxies for their salability.

This paper is organized as follows. The next section overviews the shift to a standard gauge in the railroad industry during the period between the end of the civil war and the late 1880's. In Section 3, I discuss the predictions of Shleifer and Vishny (1992) regarding debt maturity, and its implications for the railroad industry. Data sources and gauge characteristics are described in Section 4. Summary statistics and univariate analysis are presented in Section 5, while Section 6 discusses the empirical analysis. Section 7 discusses the generality of the results and their implications for modern corporations. Section 8 concludes.

## **2. The Diversity of Track Gauges in the American Railroad Industry during the 19th Century**

### *2.1. Background*

Early American railroads operated lines with a variety of track gauges - the horizontal distance between the two rails.<sup>2</sup> Many of the

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<sup>2</sup>This section draws heavily from Klein (1993), Stover (1961), and Wilner (1997).

first roads were built to the English so-called standard gauge of 4 feet  $8\frac{1}{2}$  inches since they used English-built engines. However, only in the late 1880's was the American rail network really an integrated system. According to Stover (1961), 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-feet dominated the lines, while a narrow gauge of 3 feet was introduced in the western mountain states during the 1870's.

## *2.2. The Origins of Gauge Diversity*

The standard gauge of 4 feet  $8\frac{1}{2}$  inches was first adopted by the railroads in the north of England.<sup>3</sup> 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 feet 6 inches 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 feet to 3 feet 6 inches 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, while the 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 example, the Erie Railroad deliberately operated a broad gauge of 6 feet. 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),

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

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.

### *2.3. Gauge Diversity and the Railway Network*

On the eve of the civil war American railroads used different 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 passengers' 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."<sup>4</sup> 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."<sup>5</sup>

### *2.4. 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. These cars could be used on either standard-gauge track or track as wide as 4 feet 10 inches. 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

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<sup>4</sup>See Stover (1961), p. 45.

<sup>5</sup>See Klein (1993), p. 24.

the railways themselves. 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 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."<sup>6</sup>

### *2.5. The Adoption of the Standard Gauge and Asset Salability*

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 (1983) classification, once sited they are highly immobile. In contrast, locomotives, freight cars, and passenger coaches are very mobile. 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.

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 local nature of the railroads in the 19th century, potential buyers of mileage tracks were local competitors. To benefit from unification, potential buyers had to connect to the acquired

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<sup>6</sup>See Wilner (1997), p. 6.

(or leased) line, which required them to both operate in the same region and have the same gauge. The gauge, thus, was an important determinant of both rolling-stock and track's salability.

### 3. Asset Salability and Capital Structure

Shleifer and Vishny (1992) were the first to address the general equilibrium aspect of asset sales within an industry. As they point out, their model has two important implications. First, cash auctions are likely to be inefficient when the same adverse shock that led one firm to sell off assets prevents industry insiders from bidding the next best-use value. Second, asset liquidity can explain cross-section and time-series financing patterns.

While there is a growing empirical and theoretical literature that tests the first implication, [e.g., Pulvino (1998, 1999) for U.S. airlines and Stromberg (2000) for a model of cash auction and evidence from the Swedish cash auction code], there is relatively little research on the second prediction. In this section I discuss the model's prediction about leverage and show that their model can also lead to the following prediction: asset liquidity increases long-term debt capacity.

#### 3.1. *The Role of Long-Term Debt*

Hart (1993) was the first to argue that a firm's capital structure must also include long-term debt to create a debt overhang that limits management's ability to issue new securities, and therefore to avoid the disciplinary role of short-term debt.<sup>7</sup> Thus, by itself, short-term debt does not put effective pressure on management.<sup>8</sup> Shleifer and Vishny (1992) use this idea in their model. They assume that when

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<sup>7</sup>The reader might wonder how Hart (1993) was the first to address this view, if it was already pointed by Shleifer and Vishny in 1992. Hart's paper was published in 1993, however its working paper version was available already in 1991, and his contribution is acknowledged by Shleifer and Vishny (1992).

<sup>8</sup>This point is essential for Hart and Moore (1995) as well.

state-contingent contracts cannot be written, and managers are self-interested, the ex-ante optimal capital structure must include both short-term debt and senior long-term debt. The function of the short-term debt is to bring the firm to the capital market in the first period, rather than let it invest its internal funds. The long-term debt is designed to create debt overhang, so that a firm cannot borrow against its future earnings to finance negative NPV projects. They also assume that creditors liquidate the firm when it defaults on its short-term debt; that is, they rule out negotiation or reorganization. To summarize, debt overhang keeps the firm from making bad investments and from raising enough money to delay liquidation when hit by an adverse shock. Thus, long-term debt helps to mitigate the agency problem.

### *3.2. Industry Equilibrium*

In the model, the cost of long-term debt is that a firm cannot raise funds in the capital markets because of the debt overhang, and thus cannot avoid liquidation in bad states of the world. That is, the gains from avoiding negative NPV investments must outweigh potential losses from liquidation. Shleifer and Vishny (1992) assume that there are two firms in the industry; one of the firms is hit harder during a depression, and has to be liquidated. The second firm is the potential buyer for the first-firm's assets, however this firm does not have enough internal funds to buy the assets. The buyer has to appeal to the capital markets, yet at the same time its debt overhang may limit the amount it can borrow. There are two possible equilibria. In the first, the potential buyer has a lot of debt overhang. Investors in the firms that will be hit harder anticipate that, and understand that in the event of liquidation their firm will be sold to an outsider for a low price, since the industry insider will not be able to receive external financing. If this suggests that the cost of debt overhang outweighs its benefits in constraining management, then investors may choose to have no long-term debt.

The second possible equilibrium suggests that investors in the firm

that is hit harder decide to have debt overhang since the benefits of debt overhang exceed the cost of liquidation for a low price. Faced with these prospects, the investors in the buying firm choose to have no debt overhang. This enables them to have access to the capital markets in the next period, and allows them to exploit the opportunity of buying the second firm's assets.

While the commonly perceived notion of this model is that debt capacity increases with liquidation value, the actual prediction concerns *debt overhang*. If we believe that debt overhang limits management's ability to circumvent short-term debt constraints [i.e. Hart (1993)], then *long-term debt* capacity increases with the liquidation value of assets.

### 3.3. *Implications for the Railroad industry*

The implications of this model for the railroad industry are as follows. If assets are liquid enough, and long-term debt limits management discretion, then more long-term debt will be used in railroads with highly salable assets, since the cost of liquidation is smaller in this case. On the other hand, when assets are less salable, then the cost of liquidation will induce short-term debt.

In the following I discuss how technology and specificity affected liquidation values in the railroad industry during the 19th century.

While Shleifer and Vishny (1992) focus on liquidity, redeployability - the alternative uses of the asset: matters for its liquidation value as well. In this paper, I use the notion of salability to describe an asset that retains its value in liquidation. An asset that is more salable than another has two characteristics. First, its core attributes are durable and usable in a manner that makes the use of the asset less sensitive to its user, and second, its potential buyers have deep enough pockets to afford paying for its services. In short, the *willingness* of highest valuation potential users to buy is determined by the assets attributes, while their *ability* to participate in the market is dictated by their financial strength. Therefore, it is the interaction between asset

redeployability and market liquidity that determines asset salability.

The Pullman "Pioneer" passenger car finished with hand-carved woodwork, plush carpets and fine mirrors, was redeployable only to railroads with first-class service. Likewise, early steam locomotives were specialized to operating conditions such as high speed, hill climbing, heavy loads, sharp corners, as well as types of coal for fuel, and thus were redeployable only to lines with similar geographical and topographical conditions. In contrast, platform and box freight cars were less specialized and thus more redeployable within the industry. Moreover, before the standardization of the gauge, narrow-gauge cars were redeployable mostly in Colorado and California, while potential buyers for wide-gauge cars were railroads in the South. Even the tracks were subject to different levels of redeployability within the industry.<sup>9</sup>

While it is hard to tell which railroads were potential buyers or sellers, 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 market and investments. I use the market share (in terms of mileage) of railroads that were in equity receiverships as a crude measure for market illiquidity.

#### 4. 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,<sup>10</sup> it

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<sup>9</sup>The location of the line in the nation's network determined the salability of its tracks. In 1897, for example, annual passenger earnings per mile of road were \$5,190 in New England compared to \$1,111 in the South, while annual freight earnings per mile of road were \$9,647 in Pennsylvania compared to \$5,859 in New England.

<sup>10</sup>Long-term bonds skew the maturity distribution, and unless the firm calls its debt, (which was uncommon during this period), the maturity remains right-

is interesting to analyze the relation between the railroads' assets and their capital structure over this time period.

#### 4.1. 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*<sup>11</sup> for the relevant years. I included railroads in the sample that had at least 100 miles of operation (owned or leased),<sup>12</sup> and sufficient data to construct the necessary variables. The panel data constructed in this process consists of 340 firm-year observations, representing 202 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*. *Poor's Manuals of Railroads*, in turn, obtained the figures they report from the annual reports published by each of the railroads, as well as data on the firm assets such as length and location of lines operated, (owned or leased), the numbers of locomotives, passenger coaches, freight cars and other specialized cars. Throughout the paper, debt maturity is defined at the railroad level as the book-weighted average of term-to-maturity of all the debt instruments issued by the firm which are still outstanding.<sup>13</sup> Given the richness of both the assets and the debt data, it is

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skewed over time.

<sup>11</sup>The first volume of the *Poor's Manuals of Railroads* was published in 1868.

<sup>12</sup>Early American railroads were very small. 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.

<sup>13</sup>The actual prediction of the model is about long-term debt capacity. However since my measure of debt maturity is a weighted average one, it proxies for long-term debt capacity as well. Some railroads carry overdue debt, either if they have failed to make scheduled payments, or when the bondholder did not arrive yet at the railroad's or the trustee's office to receive his payment. In any of these cases,

possible to empirically test the relation between capital structure and the nature of the firm's assets.

#### 4.2. *Sample Characteristics*

Table I lists the distribution of the railroads across gauge tracks and over the years 1868, 1873, 1877, and 1882. Panel A of Table I reports the gauge distribution of the firms in the pooled data. The most common gauges in the sample are the standard gauge of 4 feet  $8\frac{1}{2}$  inches (56.5 inches), and 5 foot (60 inches), representing 66.4% 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 I 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 53.1% in 1868, to 77.4% in 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 II 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, more than 94% of the firms conformed to the standard gauge, while in the East railroads used different gauges, such as 4 feet 9 inches and 4 feet 10 inches gauges. The South, on the other hand, was the dominion of the wide gauge. More than 65% of the southern railroads used the 5-foot gauge representing 84.4% of the total wide gauge firms in the country.

#### 4.3. *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.

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I include the overdue debt in the leverage calculation and set the maturity equal to zero.

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.

Table III 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. Fortunately, 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 feet 9 inches (57 inches) gauge, is slightly over-weighted in the sample during 1868, 1877 and 1882, but, as a whole the sample is quite representative. I conclude that the sample seems largely free of a bias in its gauge distribution.

## 5. Summary Statistics and Univariate Analysis

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

### 5.1. Descriptive Statistics

In order to better understand the economic significance of the 19th century American railroads, Table IV displays the book value of railroads' assets. Panel A of Table IV presents descriptive statistics for the nominal dollar values of assets in the pooled data. Panel B of Table IV illustrates the increase in the railroads value over the sample period. The mean book value increased by more than 85% between 1868 and 1882, while the median book value more than doubled during the same period. To get a current sense of the railroads book value during that period, Panel C of Table IV presents real values, which are calculated using the Consumer Price Index. The median real 1868 value (in 2000 dollars) is \$108.3 million, compared to the median real

1882 value of \$402.7 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 \$2.82 billion.

Table V displays the descriptive statistics for a selected set of variables. The variables that I examine are: firm's size, (defined as the logarithm of the book value of total assets), 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), debt maturity (defined as the weighted average of the term-to-maturity of the firm's outstanding debt instruments), 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 size, (defined as the total number of locomotives, passenger coaches, freight cars, baggage mail and express cars, and service cars), and the ratio of freight cars to total cars.

Railroads' assets were almost entirely fixed during the period being examined. Across the 340 firm-year observations, the median tangibility value is 0.86, representing a high level of tangibility. 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 as the ratio of cash and liquid financial assets to total asset, 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 V, is based on funded debt, and does not include current liabilities. As explained by

Guthmann and Dougal (1962), however, this type of financing played but a minor role. The time period spanned by the sample reflects the shift from capital stock 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.

Debt maturity magnitudes are striking; 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.

Most of the railroads in the sample appear to be profitable: only 6 firms, representing 1.8% 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 943 freight cars.

## 5.2. *Variation in Capital Structure*

This subsection presents the dynamics of both leverage and debt maturity over the sample years and across regions.

The standardization of the gauge enhanced the efficiency of the railway network, saved the exhausting costs of breaking bulk, increased

the speed of through traffic, and boosted productivity. As demonstrated in Tables I and II, the gauge distribution changed over time and states, suggesting variation in both the cross-section and time-series. The next issue I address is whether leverage and debt maturity varied across these dimensions as well.

### 5.2.1. *Time-Series*

Panel A of Table VI displays summary statistics for the distribution of leverage during the sample period. The mean (median) column indicates an increase of 6.0% (9%) in leverage between 1868 and 1873. In order to analyze its significance, Panel B of Table VI shows Z-values for a Mann-Whitney test of difference in leverage medians between paired years.<sup>14</sup> The analysis confirms that leverage was significantly lower in 1868 compared to each of the other years in the sample, however the difference in the medians from 1873 and afterwards is not statistically different from zero.

Panel A of Table VII displays summary statistics for the distribution of debt maturity during the sample period. The mean (median) column indicates an increase of 5.5 (8.0) years in debt maturity between 1868 and 1873, and an additional increase of 4.8 (4.5) years from 1877 to 1882. The Mann-Whitney test reported in Panel B of Table VI, points that the increase in the median debt maturity was significant at the 1 percent significance level.

### 5.2.2. *Regional Effects*

Panel A of Table VIII displays summary statistics for the distribution of leverage over five geographical regions in the U.S. The Mann-Whitney test reported in Panel B of Table VIII points that the West, South and the Midwest all had similar levels of leverage, and that

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<sup>14</sup>I use the nonparametric Mann-Whitney test of medians since it is less sensitive to outliers. I compare medians rather than means, as the selection process truncate the sample distribution.

railroads in the Midwest had significant higher levels of leverage compared to the East. In addition, leverage was higher in the Midwest compared to New England, the Z-value, however is significant only at the 10 percent significance level. In short, variations across geographical regions do not seem to explain leverage as much as time-variation does.

Table IX, however, demonstrates that debt maturity varies a lot across different regions. Panel A of Table IX suggests that the medians of debt maturity in the Midwest and the West were higher by 5.5 and 9.0 years, respectively, than the debt maturity medians in New England, the East and the South. The Z-values in Panel B confirm these observations, and further suggest that debt maturity was higher in the East than in New England.

Thus far, two key stylized facts have emerged from the data: 1) leverage varies over time but not with geographical location; and 2) debt maturity varies both in the time-series and with the location of the railroad.

### *5.3. Univariate Analysis of Railroad Characteristics and Capital Structure*

In the following 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 specification I use later in the regression analysis.

#### *5.3.1. 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 X. Although this procedure is far from being exhaustive, it does help to identify how railroads characteristics vary with leverage, and is aimed to serve as 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.<sup>15</sup> 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. This begs the question: what makes railroads different? Why does size appear less relevant for leverage choice? 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.<sup>16</sup>

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

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<sup>15</sup>The Kruskal-Wallis test is a nonparametric test that compares three or more unpaired groups. The  $p$ -value of the test answers the question whether random sampling would result in medians as far apart as observed in the subsamples. A significant  $p$ -value rejects the hypothesis that the differences between the medians are all coincidence, yet the  $p$ -value does not apply to each comparison, but rather to all the comparisons together.

<sup>16</sup>This hypothesis deserves more attention. Moreover, Swain (1898) documents anecdotes of failures of large railroads, yet his examples are far from being inclusive.

will demand less debt if it is ineffective.<sup>17</sup> Although there is no direct empirical evidence on the effectiveness of the market for corporate control, there are many anecdotes that describe aggressive takeovers by figures like Jay Gould, Thomas A. Scott, and especially Cornelius Vanderbilt. Table X, 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, passengers 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 their type. For example, as noted before, freight cars were less specific than locomotives and passengers 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 the table 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.

### 5.3.2. *Debt Maturity*

Table XI 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. Again I use the Kruskal-Wallis test, to identify the randomness of the subsamples' medians.

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, however their specification does not allow to test a non-monotonic effect. Guedes and Opler (1996), and Johnson (2003), allowed for non-monotonic size specification, and found a U-

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<sup>17</sup>Zingales and Rajan (1995) also suggest that on the supply side, suppliers should be more willing to lend to profitable firms.

shape pattern. This results might be consistent with the prediction of Diamond (1991), assuming that size is correlated with credit quality or liquidity risk. 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 the entire maturity spectrum. Larger 19th century railroads had longer-term maturities. However, if borrower quality is determined by its profitability as well, then the negative pattern displayed by the profitability distribution suggests that higher-quality railroads used more short-term debt.

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 passengers coaches 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, passengers coaches 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 26 years). This might suggest that the redeployability of rolling stock matters more at the early stages of its economic life, and thus an asset is salable insofar it retains its economic value.

## 6. Empirical Analysis

This section first defines the variables that are used to proxy for the salability of rolling stock and tracks. Subsequently, it presents empirical results from estimating the relations between leverage, debt maturity and asset salability.

The analysis so far has focused more on the physical attributes of

the assets and less on the demand for its services. As discussed earlier, the demand for rolling stock or tracks was not uniformly distributed over geographical location and time. 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. Given 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. Potential buyers of rolling stock, on the other hand, were all the railroads in the country that used the same gauge, since rolling stock was mobile and not unique to one location. In short, gauges affected the redeployability of rolling stock, (over and above the distinction between freight, passengers or locomotives), while both gauges and geographical location determined the redeployability of the tracks.

### 6.1. *Proxies for Salability*

I start by calculating track mileage for each gauge in every state.<sup>18</sup> I use *Poor's Railroads of the United States* for the years that the distribution of mileage over gauge and states is reported (1873 and 1877). To calculate the track-mileage distribution over gauge and states for the years 1868 and 1882, I use *Poor's Manuals of Railroads*, and sum these figures over the entire universe of U.S. railroads reported in the manuals.<sup>19</sup> This process yields two sets of numbers: 1) *nation – wide*

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<sup>18</sup>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*.

<sup>19</sup>These manuals are claimed to cover every single railroad in the U.S. The size distribution for example goes from tiny lines of 22 yards to the transcontinental railroads Union Pacific and Central Pacific.

track-mileage for each gauge; and 2) *state – wide* track-mileage for each gauge. For every railroad I subtract its own mileage from its corresponding nation-wide and state-wide mileage, in order to calculate the *residual demand* for its assets, which I term potential demand.

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.<sup>20</sup>

The number of mileage in receiverships is used as a proxy for those railroads (and their market shares), who cannot participate in the market for used capital. The more track mileage in equity receiverships, the less liquid the market. To adjust the potential demand for market illiquidity, I obtain the equity receiverships data from Swain (1898), and from *Poor's Manuals of Railroads*. I use the total number of mileage in equity receiverships as a proxy for the market share of railroads in financial distress in each of the state-gauge and nation-wide bins. To obtain the adjusted potential demand, I subtract these mileage figures from their corresponding potential demand measures.

In order to calculate the proxies for salability, I use interaction terms between the potential demand of rolling stock or tracks (proxied by the logarithm of nation- or state-wide gauge-mileage, adjusted for equity receiverships, respectively) and the corresponding assets (i.e. the proportion of freight cars, and the logarithm of the number of miles owned by the railroad). Since interaction terms behave like cross partial derivatives, the inclusion of an interaction term in the regression measures how the marginal effect of freight, for example, changes with its potential demand.

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<sup>20</sup>See Swain (1898) for classical treatment of equity receiverships, and Skeel (2001), and Baird and Rasmussen (2002), for a detailed and retrospective treatment of equity receiverships, and their influence on the current bankruptcy code.

## 6.2. *Determinants of Leverage*

The five regressions reported in Table XII 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 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.

In order to capture a non-monotonic pattern (such as the one observed in Table X), I include a squared size-term in the second regression. However, size is not significant under this specification either. 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 in the field 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*, so a market-to-book proxy (MV/BV) cannot be used.

Since technology was quite similar across railroads, and given their local nature, it is plausible that expected growth opportunities *within* the industry were determined mainly by the geographical location of the railroads.<sup>21</sup> For example, the shift from waterway traffic to rail-

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<sup>21</sup>To obtain understanding of the distribution of MV/BV within the railroad industry, I use COMPUSTAT data to calculate MV/BV of railroads between 1950 and 2002. The median MV/BV in this sample is 0.96, the 25th and 75th percentiles are 0.80 and 1.15 respectively. This might suggest a dense distribution of growth

roads enhanced the expected earnings and investment of railroads located along rivers and canals.<sup>22</sup> I use state fixed-effects as proxies for growth opportunities, and report the results in the last column of Table XII. As the table demonstrates, much like previous results in this paper, only profitability appears to matter for leverage.

### 6.3. *Debt Maturity and Salability*

Table XIII displays the results from estimating the determinants of debt maturity.<sup>23</sup> Among the control variables, size and profitability are the strongest, while tangibility is significant at the 5% level in 4 regressions out of 7. 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.<sup>24</sup> Model 1 investigates how railroad-specific variables affect debt maturity, using size, tangibility, profitability, time-trend variable, 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.

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opportunities within the industry.

<sup>22</sup>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.

<sup>23</sup>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 thus are not reported in this paper.

<sup>24</sup>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 leverage remain intact.

Model 1 suggests that after controlling for size, tangibility, profitability, and time-effect, the internal composition of the rolling stock mattered for debt maturity. If freight cars were more redeployable than passenger coaches and locomotives, then redeployability prolonged debt maturity. However, redeployability is not determined only by physical attributes, but by potential buyers of freight cars as well. Furthermore, what matters is the salability of the asset: whether or not the asset is both redeployable and liquid. I use the interaction between the nation-wide mileage of unconstrained railroads with the same gauge and the proportion of freight cars to proxy for the salability of the rolling stock.

The positive coefficient of rolling-stock salability in Model 2 potentially demonstrates that redeployability was transmitted through demand of railroads with financial slack. A similar mechanism for the railroad tracks is specified in Model 3 and Model 4. The potential demand for the tracks is assumed to be more local, and thus I use the mileage of unconstrained railroads in the same state and with same gauge interacted with the number of miles operated by the railroad. Since the number of miles owned by the railroad and its size are collinear, the specification in Model 4 does not include the number of miles.

To capture the combined effect of rolling stock's and the tracks' salability, Model 5 includes their proxies, in addition to mileage, freight and a set of control variables. As partial multicollinearity arise when interaction terms are used, I center the data by subtracting from each of the right-hand variables its corresponding time-series mean.<sup>25</sup> This specification reduces the significance of the track salability proxy, probably since some collinearity is still prevalent.

Finally, in an attempt to address the omission of a proxy for growth opportunities,<sup>26</sup> Model 6 and Model 7 use similar specifications to

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<sup>25</sup>I do not subtract the time-series mean from the dependent variable, (which will be asymptotically equivalent to fixed-effects regression), since my purpose is to decrease the multicollinearity of the variablses on the right-hand side only.

<sup>26</sup>Myers (1977) model has an implication for debt maturity as well. Short-term

Models 2 and 3 , respectively, with the addition of state fixed-effects. The results under these specifications display again a positive relation between measures of salability and debt maturity.

#### 6.4. *The Economic Significance of Asset Salability*

So far the results indicate that after controlling for firm characteristics such as size, profitability, and tangibility, salability lengthens the maturity of debt. Moreover, the analysis also demonstrates that leverage is not affected by the same measures of redeployability and salability that influence maturity. The next concern is whether the results are economically significant.

Table XIV reports the impact on debt maturity of: 1) one standard deviation, 2) a move from the 25th percentile to the 75th percentile, and 3) a shift from the 10th percentile to the 90th percentile, of the proportion of freight cars (*Freight*), tangibility, rolling stock salability, and tracks salability. The impact of tangibility and *Freight* is found to be similar: a one standard deviation shift in these variables increases debt maturity by roughly 1.5 years, while a dramatic move from the 10th percentile to the 90th percentile lengthens the maturity by an order between 2.6 and 3.4 years.

The impact of the rolling stock salability proxy is almost twice as much as the impact of *Freight* by it self. The estimated coefficient from Model 2 implies that moving from the 25th percentile to the 75th percentile increases debt maturity by 3.6 years, while a shift from the 10th percentile to the 90th percentile prolongs the maturity by more than six and a half years.

Interestingly, the effect of tracks salability as estimated in Model 3 is similar to the effect of the rolling stock. Theoretical predictions [e.g. Myers (1977), and Hart and Moore (1994)], as well as empirical results [e.g. Guedes and Opler (1996), Johnson (2003), and Benmelech (2003)]

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debt may reduce the potential for underinvestment caused by debt overhang. This prediction is supported by Barclay and Smith (1995), and Johnson (2003), while Stohs and Mauer (1996) find a positive relation.

suggest that assets are matched with liabilities. Since it is plausible that the economic life of tracks are longer than the life of the rolling stock,<sup>27</sup> it is surprising that their marginal effect on debt maturity is of the same order. The results can be reconciled by a trade-off between durability and salability. Even if the tracks are longer-lived, their fixed nature reduces their impact on maturity since they are less redeployable. Mobility, on the other hand, increases the economic significance of the rolling stock.

Finally, when both proxies are included in a regression, the effect of rolling stock salability seems larger than the effect of the tracks. A shift from the 10th percentile to the 90th percentile in the salability of rolling stock boosts debt maturity by more than eight years!

### 6.5. *Robustness*

The analysis so far demonstrates that proxies for salability are positively associated with debt maturity, however how accurate are these proxies? Does the salability of locomotives, for example, matter as well? In addition, it is possible that the association between maturity and gauge is rather mechanical. If railroads are more likely to issue long-term debt when young (e.g. to finance the construction of the road), then young railroads should have more 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. In the following I attempt to address these concerns.

#### 6.5.1. *Alternative Rolling Stock Salability Measures*

I have assumed that freight cars are more salable than passenger coaches or locomotives, yet it is possible that when there is more potential demand (i.e. more nation-miles with the same gauge) even spe-

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<sup>27</sup>Asset maturity can be estimated using the book value of the asset and its depreciation expenses (assuming the accounting depreciation is informative about economic depreciation). However, depreciation was not reported in the Railroads' financial reports.

cialized types of cars become more salable. Table XI illustrates a negative relations between locomotives and passengers cars.<sup>28</sup> Nonetheless, if *other* railroads are potential buyers of these cars, then an interaction term between the potential demand and the fraction of locomotives or passengers cars should have a positive and significant coefficient.

Model 2 in table XV confirms that locomotives were not salable. The potential demand for rolling stock, when interacted with locomotives, is statistically insignificant, while the coefficient of locomotives alone is negative and statistically significant. Passenger coaches, on the other hand, seem more salable. While the passenger coefficient itself is negative and statistically significant, the interaction term has a positive impact on debt maturity. Furthermore, a one standard deviation shift in passengers coaches proportion shortens debt maturity by 1.6 years, while an equivalent shift in locomotives proportion cuts down maturity by more than 2.2 years. Interestingly, these magnitudes might reflect the purchase price of rolling stock as well. Locomotives were more expensive than passengers cars, and general freight cars were the cheapest. At the same time, locomotives were specialized and more sensitive to technology which reduced their collateral value compared to freight cars, although freight cars were cheaper.

#### 6.5.2. *Does the Railroad's Age Matter?*

One major 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,

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<sup>28</sup>The negative correlation is not surprising since locomotives and passengers cars reflect together the mirror image of *Freight*.

as the results might capture a life cycle pattern of external finance.<sup>29</sup> 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 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 as 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 if the debt was negotiated or converted to equity. I obtained data for 297 firm-year observations which represents more than 87% of the entire sample, and I define a railroad's age as the number of years since its establishment (reorganization).

Table XVI displays the results from estimating the impact of railroads' age on its debt maturity. As the table illustrates, railroad age has no impact on the term of the debt, ( $t$ -statistics range from -0.42 to 0.05 in the four different specifications). Moreover, both statistical and economic significance of the salability proxies slightly increase. I thus reject the life cycle hypothesis, and conclude that the results are not driven by entry of new railroads.

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

At this point, it is prudent to question the generality of the results, and to draw a link to today's corporations. After all, railroads were (and still are) unique. The first question that should come to

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<sup>29</sup>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.

mind is: why don't salability and redeployability 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."<sup>30</sup>

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. At 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."

If the capital structure was indeed a mess, why do my results indicate that the nature of the assets and debt maturity were strongly related? One potential answer is that for each individual bond, the maturity was matched to the idiosyncratic durability and salability of the asset it financed, and the firm's level weighted maturity reflects that. However, Benmelech (2003) finds similar results using a proxy for asset salability in a sample of 40,691 firm-year observations using COMPUSTAT for the period 1981-2000. This suggests that the results are not driven by the "messy" capital structures of railroads.

As argued earlier, the model of Shleifer and Vishny (1992) predicts that long-term debt capacity increases with the liquidation value of the asset; however, if a firm uses only short-term debt, then asset liquidity

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<sup>30</sup>See Baird and Rasmussen (2002) page 759.

does not affect its leverage. In a related model, Kiyotaki and Moore (1997) assume that durable assets play a dual role: they not only serve as production factors, but they also serve as implicit collateral for debt. Alternatively, if firms pledge their future earnings, or borrow in the short-term against working capital and short-term securities, then durable asset salability would not affect leverage ratios.

## 8. Conclusions

In this study I present empirical evidence on the association between asset salability and capital structure. The 19th century American railroads were proven 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 has been floating around since the capital structure literature started to focus on managerial discretion and liquidation threats, but 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 are shown to 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 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. On the empirical front, studies of up-to-date industries should suggest whether this paper's findings are specific to the railroad industry of the 19th century or have wider implications.

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## Table I

### The Distribution of the Track Gauge 1868 - 1882

The sample consists of 340 railroad-year observations in the years: 1868, 1872, 1877 and 1882. The track gauge is the horizontal distance separating the two rails in inches. The “standard gauge” was 4 feet and 8.5 inches (or 56.5 inches.)

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Panel A: Distribution of gauge across the pooled data

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Gauge	36	56.5	57	57.25	57.5	58	60	62	65	66	72	Total
Frequency	2	227	27	1	10	10	56	1	1	2	5	342
Percent	0.6%	66.4%	7.9%	0.3%	2.9%	2.9%	16.4%	0.3%	0.3%	0.6%	1.5%	100%

Panel B: Distribution of gauge across years

1868

Frequency	0	26	1	0	1	3	13	0	1	1	3	49
Percent	0.0%	53.1%	2.0%	0.0%	2.0%	6.1%	26.5%	0.0%	2.0%	2.0%	6.1%	100.0%

1873

Frequency	2	49	5	1	4	2	17	1	0	1	2	84
Percent	2.4%	58.3%	6.0%	1.2%	4.8%	2.4%	20.2%	1.2%	0.0%	1.2%	2.4%	100.0%

1877

Frequency	0	70	6	0	5	5	17	0	0	0	0	103
Percent	0.0%	68.0%	5.8%	0.0%	4.9%	4.9%	16.5%	0.0%	0.0%	0.0%	0.0%	100.0%

1882

Frequency	0	82	15	0	0	0	9	0	0	0	0	106
Percent	0.0%	77.4%	14.2%	0.0%	0.0%	0.0%	8.5%	0.0%	0.0%	0.0%	0.0%	100.0%

---

## Table II

### 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 340 railroad-year observations, since several railroads operate in more than one region.

Gauge	36	56.5	57	57.25	57.5	58	60	62	65	66	72	Total
<u>New England</u>												
Frequency	0	49	0	0	0	0	0	0	0	2	0	51
Percent	0.0%	96.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.9%	0.0%	100%
<u>East</u>												
Frequency	0	71	10	0	2	1	3	0	0	0	5	92
Percent	0.0%	77.2%	10.9%	0.0%	2.2%	1.1%	3.3%	0.0%	0.0%	0.0%	5.4%	100.0%
<u>South</u>												
Frequency	1	19	8	0	0	0	54	1	0	0	0	83
Percent	1.2%	22.9%	9.6%	0.0%	0.0%	0.0%	65.1%	1.2%	0.0%	0.0%	0.0%	100.0%
<u>Midwest</u>												
Frequency	1	102	12	1	9	10	6	0	1	0	1	143
Percent	0.7%	71.3%	8.4%	0.7%	6.3%	7.0%	4.2%	0.0%	0.7%	0.0	0.7%	100.0%
<u>West</u>												
Frequency	0	16	0	0	0	0	1	0	0	0	0	17
Percent	0.0%	94.1%	0.0%	0.0%	0.0%	0.0%	5.9%	0.0%	0.0%	0.0%	0.0%	100.0%

### Table III

#### The Representativeness of The Sample

This Table compares the percentage of mileage gauges between my sample and the entire population of the railroads.

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Gauge	56.5	57	57.5	58	60	72
<hr/>						
<u>1868</u>						
Percent (Sample)	67.6%	6.4%	0.8%	4.8%	14.8%	4.1%
Percent (Population)	66.5%	2.0%	0.1%	8.4%	15.9%	4.8%
<u>1873</u>						
Percent (Sample)	69.9%	4.8%	4.1%	1.1%	17.0%	1.0%
Percent (Population)	66.7%	5.7%	6.7%	2.9%	14.2%	0.7%
<u>1877</u>						
Percent (Sample)	71.6%	7.1%	4.3%	3.4%	13.6%	0.0%
Percent (Population)	71.9%	5.0%	4.7%	1.3%	11.8%	1.5%
<u>1882</u>						
Percent (Sample)	80.1%	11.8%	0.0%	0.0%	8.1%	0.0%
Percent (Population)	79.1%	7.8%	0.0%	0.0%	6.2%	0.0%

---

## Table IV

### 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.

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Panel A: Nominal Values - Pooled Data (millions of dollars)

Period	Mean	25 <sup>th</sup> Percentile	Median	75 <sup>th</sup> Percentile	Standard Deviation	Min	Max
1868- 1882	19.7	5.5	11.7	22.7	24.8	0.36	171.0

Panel B: Nominal Values – for each of the Sample Years (millions of dollars)

1868	13.1	3.4	8.0	17.5	13.6	1.3	51.1
1873	18.1	4.7	11.4	23.1	19.7	0.36	117.0
1877	19.3	5.6	10.9	22.2	25.0	1.5	159.0
1882	24.3	7.2	13.4	25.2	30.8	2.2	171.0

Panel C: Real Values (2000 dollars) – for each of the Sample Years (millions of dollars)

1868	177.4	46.0	108.3	237.0	184.1	17.6	691.9
1873	236.0	61.3	148.7	301.2	256.9	4.7	1,525.7
1877	297.6	86.4	168.1	342.3	385.5	23.1	2,451.8
1882	402.7	119.3	222.0	417.6	510.4	36.5	2,828.3

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**Table V****Railroads Characteristics**

This table provides descriptive statistics for the characteristics of the railroads a sample of 206 American railroads in the years 1868, 1873, 1877 and 1882 (340 firm-year observations). Size is the log of the book value of total assets. 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.

---

	Mean	25 <sup>th</sup> Percentile	Median	75 <sup>th</sup> Percentile	Standard Deviation	Min	Max	Number of Observations
Size	16.3	15.5	16.3	16.9	1.0	12.8	19.0	341
Tangibility	0.82	0.75	0.86	0.95	0.17	0.0	1.0	335
Leverage	0.43	0.30	0.43	0.55	0.19	0.0	1.0	341
Debt Maturity	20.1	14.0	20.0	27.0	9.4	0.0	60.0	340
Profitability	4.48%	2.12%	4.21%	6.52%	4.37%	-2.77%	50.78%	340
Cars	2520.7	432.0	1051.0	2348.0	4757.4	0.0	32425.0	338
Freight	0.87	0.85	0.90	0.93	0.11	0.0	0.99	336

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## Table VI

### Leverage Dynamics 1868-1882

This table provides descriptive statistics for the leverage of the railroads over time. Leverage is measured as the book value of total funded debt divided by the book value of assets. Panel A reports summary statistics for each of the sample years. Panel B display Z-values for a Mann-Whitney test for difference in distribution between paired-years in the sample. Significance of the Z-values indicates that the null hypothesis of equal population medians is rejected.

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#### Panel A: Summary statistics

Year	Mean	25 <sup>th</sup> Percentile	Median	75 <sup>th</sup> Percentile	Standard Deviation	Min	Max	Observations
1868	0.36	0.19	0.32	0.44	0.23	0.02	1.0	49
1873	0.42	0.28	0.41	0.53	0.19	0.0	1.0	83
1877	0.45	0.33	0.47	0.58	0.17	0.0	0.95	103
1882	0.44	0.31	0.46	0.56	0.18	0.0	0.92	106

#### Panel B: Tests of Medians (Z-values)

1868 vs. 1873	-2.10**	1873 vs. 1877	-1.63
1868 vs. 1877	-3.48 ***	1873 vs. 1882	-1.10
1868 vs. 1882	-2.91 ***	1877 vs. 1882	0.60

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

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## Table VII

### Debt Maturity Dynamics 1868-1882

This table provides descriptive statistics for the debt maturity of the railroads over time. Debt maturity is the weighted average of the term-to-maturity of all the debt instruments outstanding. Panel A reports summary statistics for each of the sample years. Panel B display Z-values for a Mann-Whitney test for difference in distribution between paired-years in the sample. Significance of the Z-values indicates that the null hypothesis of equal population medians is rejected.

---

#### Panel A: Summary statistics

Year	Mean	25 <sup>th</sup> Percentile	Median	75 <sup>th</sup> Percentile	Standard Deviation	Min	Max	Observations
1868	13.9	7.0	11.0	19.0	8.9	1.0	39.0	49
1873	19.4	13.0	19.0	24.0	8.0	0.0	45.0	82
1877	19.4	15.0	20.0	24.0	7.4	0.0	44.0	103
1882	24.2	17.0	24.5	31.0	10.4	0.0	60.0	106

#### Panel B: Tests of Medians (Z-values)

1868 vs. 1873	-3.67 ***	1873 vs. 1877	-0.32
1868 vs. 1877	-3.87 ***	1873 vs. 1882	-3.59 ***
1868 vs. 1882	-5.52 ***	1877 vs. 1882	-3.59 ***

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

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**Table VIII****The Regional Distribution of Leverage**

This table provides descriptive statistics for the leverage of the railroads across geographical regions. Leverage is measured as the book value of total funded debt divided by the book value of assets. Panel A reports summary statistics for each of the geographical regions. Panel B display Z-values for a Mann-Whitney test for difference in distribution between paired-regions in the sample. Significance of the Z-values indicates that the null hypothesis of equal population medians is rejected.

Panel A: Summary statistics

Region	Mean	25 <sup>th</sup> Percentile	Median	75 <sup>th</sup> Percentile	Standard Deviation	Min	Max	Observations
New England	0.36	0.22	0.34	0.50	0.20	0.0	0.86	51
East	0.38	0.20	0.35	0.56	0.22	0.0	0.92	92
South	0.42	0.31	0.44	0.55	0.19	0.0	0.97	83
Midwest	0.46	0.32	0.44	0.57	0.19	0.0	1.0	142
West	0.45	0.34	0.51	0.56	0.18	0.02	0.74	16

Panel B: Tests of Medians (Z-values)

New England vs. East	0.74	East vs. South	-1.39
New England vs. Midwest	-1.79 *	East vs. West	-1.51
New England vs. South	-0.63	Midwest vs. South	1.32
New England vs. West	-1.28	Midwest vs. West	-0.16
East vs. Midwest	-2.85 ***	South vs. West	-0.84

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

**Table IX****The Regional Distribution of Debt Maturity**

This table provides descriptive statistics for the debt maturity of the railroads across geographical regions. Debt maturity is the weighted average of the term-to-maturity of all the debt instruments outstanding. Panel A reports summary statistics for each of the geographical regions. Panel B display Z-values for a Mann-Whitney test for difference in distribution between paired-regions in the sample. Significance of the Z-values indicates that the null hypothesis of equal population medians is rejected.

Panel A: Summary statistics

Region	Mean	25 <sup>th</sup> Percentile	Median	75 <sup>th</sup> Percentile	Standard Deviation	Min	Max	Observations
New England	14.9	11.0	14.5	19.0	7.3	0.0	30.0	50
East	19.5	13.0	17.5	27.0	10.9	0.0	60.0	92
South	17.4	10.0	16.0	24.0	9.8	0.0	46.0	83
Midwest	22.9	19.0	23.0	27.0	7.7	0.0	45.0	92
West	23.4	18.5	25.0	27.0	8.8	1.0	39.0	16

Panel B: Tests of Medians (Z-values)

New England vs. East	-2.31 **	East vs. South	1.47
New England vs. Midwest	-5.97 ***	East vs. West	-1.68 *
New England vs. South	-1.03	Midwest vs. South	4.84 ***
New England vs. West	-3.76 ***	Midwest vs. West	-0.27
East vs. Midwest	-3.11 ***	South vs. West	-2.55 **

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

**Table X****Characteristics of railroads Stratified by Leverage**

This table provides means (medians) of railroads characteristics stratified by Leverage. The characteristics are Size, Miles, Profitability, Tangibility, Cars, Freight, Passengers, and Locomotives. 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. 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 maturity bands. Low p-values indicate that the null hypothesis of random sampling is rejected.

*Leverage as a proportion of assets*

<i>Variable</i>	<i>0 - 0.18</i>	<i>0.18 - 0.30</i>	<i>0.30 - 0.43</i>	<i>0.43 - 0.55</i>	<i>0.55 - 0.67</i>	<i>0.67 +</i>	<i>Kruskal-Wallis p-Value</i>
Size	16.00 (16.07)	16.48 (16.48)	16.47 (16.33)	16.14 (16.11)	16.36 (16.45)	15.95 (15.82)	0.0467 **
Miles	311.6 (221)	461.0 (309)	406.6 (281)	306.4 (203)	338.4 (269.5)	277.2 (242)	0.1570
Profitability	6.56% (7.16%)	6.14% (6.41%)	4.96% (3.76%)	4.11% (3.93%)	4.24% (3.07%)	3.47% (3.48%)	0.0001 ***
Tangibility	0.84 (0.84)	0.75 (0.79)	0.82 (0.84)	0.84 (0.88)	0.83 (0.88)	0.87 (0.92)	0.0014 ***
Cars	3558.2 (588)	3072.5 (1666)	2584.4 (1051)	2346.5 (804)	2784.2 (1052)	1114.7 (812)	0.2422
Freight	86.0% (88.8%)	87.4% (89.6%)	86.1% (89.3%)	87.9% (89.9%)	89.6% (91.5%)	87.8% (89.6%)	0.4248
Passengers	4.94% (4.12%)	4.33% (3.01%)	4.81% (3.20%)	4.55% (2.72%)	3.02% (2.52%)	3.65% (3.20%)	0.1134
Locomotives	5.51% (5.50%)	4.69% (4.17%)	5.53% (4.60%)	5.01% (4.44%)	4.80% (4.35%)	4.66% (4.62%)	0.6479

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Leverage as a proportion of assets

<u>Variable</u>	<u>0 - 0.18</u>	<u>0.18 - 0.30</u>	<u>0.30 - 0.43</u>	<u>0.43 - 0.55</u>	<u>0.55 - 0.67</u>	<u>0.67 +</u>	<u>Kruskal- Wallis p-Value</u>
Observations	26	48	87	83	54	36	334

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

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**Table XI****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, 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. 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 maturity bands. Low p-values indicate that the null hypothesis of random sampling is rejected.

---

<i>Variable</i>	<i>Term to Maturity in Years</i>						<i>Kruskal-Wallis p-Value</i>
	<i>1-7</i>	<i>8-13</i>	<i>14-19</i>	<i>20-26</i>	<i>27-30</i>	<i>31+</i>	
Size	15.61 (15.49)	15.80 (15.61)	16.28 (16.27)	16.50 (16.43)	16.44 (16.64)	16.61 (16.42)	0.0001 ***
Miles	216.3 (133.0)	264.0 (168.0)	335.7 (246.0)	434.9 (283.5)	337.0 (331.0)	458.2 (301.0)	0.0001 ***
Profitability	5.51% (5.53%)	4.63% (4.54%)	5.67% (4.54%)	4.15% (3.36%)	3.90% (3.32%)	5.06% (3.91%)	0.0532 **
Tangibility	0.81 (0.84)	0.79 (0.79)	0.80 (0.84)	0.84 (0.88)	0.85 (0.91)	0.83 (0.91)	0.137
Cars	916.8 (372)	2060.2 (633)	2703.0 (1051)	2545.5 (1310)	2112.9 (1024)	4260.0 (1712)	0.0001 ***
Freight	74.51% (83.41%)	85.72% (87.30%)	87.13% (88.40%)	89.21% (90.82%)	89.11% (92.92%)	91.96% (92.66%)	0.0001 ***
Passengers	11.02% (5.13%)	4.50% (4.59%)	4.96% (3.72%)	3.12% (2.60%)	3.32% (2.03%)	2.42% (2.01%)	0.0001 ***

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Term to Maturity in Years

<u>Variable</u>	<u>1-7</u>	<u>8-13</u>	<u>14-19</u>	<u>20-26</u>	<u>27-30</u>	<u>31+</u>	<u>Kruskal- Wallis p-Value</u>
Locomotives	8.60% (6.38%)	5.45% (5.31%)	5.21% (4.88%)	4.91% (4.56%)	4.10% (3.62%)	3.84% (3.71%)	0.0001***
Observations	23	52	84	88	49	38	334

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

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**Table XII**

**Determinants of 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. Rolling Stock Salability is the interaction between the logarithm of nation-miles operated by non-foreclosed firms with the same gauge, and the proportion of freight cars. Freight is the number of freight cars divided by the total number of cars. Track Salability is the interaction between the logarithm of state-miles operated by non-foreclosed firms with the same gauge, and the logarithm of miles owned by the firm. Miles owned is the logarithm of number of miles operated. The table reports estimates from pooled ordinary squares, and fixed effects regressions. T-statistics are calculated using clustered standard-errors and reported in parenthesis.

<i>Variable</i>	Leverage				
	(1)	(2)	(3)	(4)	State Fixed-Effects (5)
Size	-0.000 (-0.00)	0.299 (1.25)	-0.0021 (-0.16)	0.001 (0.03)	-0.025 * (-1.78)
Size squared		-0.010 (-1.27)			
Tangibility	0.080 (1.03)	0.080 (1.03)	0.052 (0.68)	0.053 (0.67)	0.048 (0.59)
Profitability	-0.980 ** (-2.54)	-0.926 ** (-2.32)	-1.059 ** (-2.54)	-1.093 ** (-2.52)	-0.971 ** (-2.50)
Rolling Stock Salability			0.002 (0.19)		
Freight			0.082 (0.72)		
Track Salability				-0.001 (-0.63)	
Miles Owned				0.104 (0.32)	
Year	0.005 ** (2.14)	0.005 ** (2.08)	0.005 ** (2.02)	0.006 ** (2.47)	0.004 * (1.89)
Intercept	0.031 (0.11)	-2.40 (-1.21)	-0.008 (-0.03)	-0.050 (-0.14)	0.526 (1.65)
R-squared	0.08	0.09	0.10	0.10	0.22

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Leverage

<i>Variable</i>	(1)	(2)	(3)	(4)	State Fixed-Effects (5)
Observations	335	335	318	318	335

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

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**Table XIII****Determinants of 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. Rolling Stock Salability is the interaction between the logarithm of nation-miles operated by non-foreclosed firms with the same gauge, and the proportion of freight cars. Freight is the number of freight cars divided by the total number of cars. Track Salability is the interaction between the logarithm of state-miles operated by non-foreclosed firms with the same gauge, and the logarithm of miles owned by the firm. Miles owned is the logarithm of number of miles operated. The table reports estimates from pooled ordinary squares, and fixed effects regressions. T-statistics are calculated using clustered standard-errors and reported in parenthesis.

<i>Variable</i>	Debt Maturity						
	Model 1	Model 2	Model 3	Model 4	Centered Model 5	Fixed-Effects Model 6	Fixed-Effects Model 7
Size	2.38 *** (4.46)	2.10 *** (3.83)	1.79 (1.60)	1.59 ** (2.22)	1.70 (1.49)	0.77 (1.00)	1.05 (0.72)
Tangibility	8.42 ** (2.54)	9.00 *** (2.70)	7.22 ** (2.03)	7.16 ** (1.97)	7.67 ** (2.10)	4.37 (1.18)	3.06 (0.76)
Profitability	-24.09 * (-1.90)	-25.13 ** (-2.00)	-21.78 (-1.65)	-22.23 * (-1.70)	-29.34 ** (-2.28)	-25.89 ** (-2.18)	-23.31 ** (-2.02)
Rolling Stock Salability		0.97 *** (2.82)			1.04 ** (2.54)	1.50 *** (3.98)	
Freight	14.13 *** (3.59)	5.65 (1.21)			7.50 (1.52)	-1.78 (-0.38)	
Track Salability			0.25 ** (2.53)	0.24 *** (2.84)	0.19 * (1.72)		0.38 *** (3.29)
Miles Owned			-0.41 (-0.25)		-0.44 (-0.25)		-1.85 (-0.97)
Year	2.13 *** (4.49)	1.54 *** (3.05)	2.16 *** (4.37)	2.18 *** (4.41)			
Intercept	-42.85 *** (-4.46)	-38.08 *** (-3.87)	-27.77 ** (-2.41)	-26.39 ** (-2.30)	20.11 *** (36.11)	N/A	N/A
R-squared	0.24	0.25	0.23	0.23	0.25	0.29	0.27
Observations	330	317	317	317	317	317	317

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Debt Maturity

<i>Variable</i>	Model 1	Model 2	Model 3	Model 4	Centered Model 5	Fixed-Effects Model 6	Fixed-Effects Model 7
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\*, \*\*, and \*\*\*, denote significance at the 10, 5, and 1 percent levels, respectively.

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**Table XIV****Estimation of the Salability Impact on Debt Maturity**

This table demonstrates the economic significance of Freight, Tangibility, Rolling Stock Salability and Tracks Salability, by estimating their impact on debt maturity. For each of these variables, the table calculates the impact of: 1) one standard deviation, 2) moving from the 25<sup>th</sup> percentile to the 75<sup>th</sup> percentile, and 3) moving from the 10<sup>th</sup> percentile to the 90<sup>th</sup> percentile. Freight is the number of freight cars divided by the total number of cars. Tangibility is the value of road and equipment divided by the book value of assets. Rolling Stock Salability is the interaction between the logarithm of nation-miles operated by non-foreclosed firms with the same gauge, and the proportion of freight cars. Track Salability is the interaction between the logarithm of state-miles operated by non-foreclosed firms with the same gauge, and the logarithm of miles owned by the firm. The impacts for Freight and Tangibility are calculated using the estimated coefficients of Model 1 in table XIII. The impacts of Rolling Stock Salability and Tracks Salability are calculated using the estimated coefficients of Models 2 and 3 in table XIII, respectively. The joint impact of Rolling Stock's and Tracks' Salability is estimated under a specification that includes all the controls but excludes Freight and Miles Owned to avoid multicollinearity. All reported figures are in years.

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	Variable Impact					
	Freight	Tangibility	Rolling Stock Salability	Tracks Salability	<u>Joint Effect</u>	
					Rolling Stock Salability	Tracks Salability
One Standard Deviation	1.59	1.44	2.97	2.66	3.61	1.21
25 <sup>th</sup> Percentile -75 <sup>th</sup> Percentile	1.23	1.72	3.63	3.66	4.43	1.67
10 <sup>th</sup> Percentile - 90 <sup>th</sup> Percentile	2.64	3.44	6.59	6.28	8.03	2.86

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**Table XV****Robustness Tests**

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. Locomotives Salability is the interaction between the logarithm of nation-miles operated by non-foreclosed firms with the same gauge, and the proportion of locomotives. Locomotives is the number of locomotives divided by the total number of cars. Passengers Coaches Salability is the interaction between the logarithm of state-miles operated by non-foreclosed firms with the same gauge, and the proportion of passengers' cars. Passengers' coaches is the number of passengers' coaches divided by the total number of cars. The table reports estimates from pooled ordinary squares. T-statistics are calculated using clustered standard-errors and reported in parenthesis.

<i>Variable</i>	Model 1	Model 2	Model 3	Model 4
Size	2.42 *** (4.58)	2.48 *** (4.20)	2.51 *** (4.72)	2.65 *** (4.45)
Tangibility	8.91 ** (2.71)	8.22 ** (2.33)	8.73 *** (2.66)	8.24 ** (2.42)
Profitability	-26.68 ** (-2.03)	-26.91 ** (-1.98)	-22.09 * (-1.75)	-22.18 * (-1.73)
Locomotives Salability		10.46 (1.40)		
Locomotives	-56.98 *** (-5.51)	-124.62 ** (-2.24)		
Passengers Coaches Salability				18.27 ** (2.30)
Passengers Coaches			-25.52 ** (-2.34)	-157.84 *** (-2.75)
Year	0.50 *** (5.12)	0.47 *** (4.37)	0.52 *** (5.29)	0.47 *** (4.61)
Intercept	-27.56 *** (-2.92)	-27.53 *** (-2.59)	-30.69 *** (-3.21)	-32.04 *** (-3.02)
R-squared	0.25	0.26	0.24	0.26
Observations	330	305	330	305

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

**Table XVI****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. 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. Rolling Stock Salability is the interaction between the logarithm of nation-miles operated by non-foreclosed firms with the same gauge, and the proportion of freight cars. Freight is the number of freight cars divided by the total number of cars. Track Salability is the interaction between the logarithm of state-miles operated by non-foreclosed firms with the same gauge, and the logarithm of miles owned by the firm. Miles owned is the logarithm of number of miles operated. Age is the difference between the actual year and the railroad's charter year. The table reports estimates from pooled ordinary squares, and fixed effects regressions. T-statistics are calculated using clustered standard-errors and reported in parenthesis.

<i>Variable</i>	Model 1	Model 2	Model 3	Model 4
Size	2.35 *** (4.01)	2.08 *** (3.46)	2.64 ** (2.37)	1.82 (1.46)
Tangibility	8.34 ** (2.26)	9.50 ** (2.59)	8.84 ** (2.34)	7.01 * (1.80)
Profitability	-31.14 *** (-2.59)	-30.15 ** (-2.54)	-28.60 ** (-2.28)	-28.22 ** (-2.19)
Rolling Stock Salability		1.11 *** (3.27)		
Freight	19.59 *** (3.90)	7.59 (1.19)		
Tracks Salability				0.40 *** (4.48)
Miles Owned			0.38 (0.25)	-1.96 (-1.07)
Age	0.002 (0.05)	-0.01 (-0.28)	0.002 (0.04)	-0.02 (-0.42)
Intercept	-40.75 *** (-3.81)	-36.92 *** (-3.33)	-31.09 ** (-2.43)	-20.05 (-1.39)
R-squared	0.17	0.20	0.12	0.19
Observations	293	281	297	275

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