RAILROAD ACCOUNTING HISTORY AND

THE MODIGLIANI AND MILLER THEOREMS: 1891-1922

By Betul ACIKGOZ

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Written under the direction of

Professor Paul J. Miranti, Jr

and approved by

Dr. Paul J. Miranti, Jr.

Dr. Dan Palmon

Dr. Bharat Sarath

Dr. Deirdre M. Collier

Newark, New Jersey

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ABSTRACT OF THE DISSERTATION

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By Betul Acikgoz

Thesis Director: Professor Paul J. Miranti, Jr.

Accounting history has been approached in two ways from the standpoint of methodology. The mainstream in this field has focused on the relationship between accounting measurement and institution building. This literature includes studies of such questions as how accounting measurement helped business and government to make significant decisions. Other scholars in this tradition have focused on the social origins of the practitioner community and how this contributed to the development of professional organizations. Still other researchers have focused on the connections between accounting and the emergence capitalistic institutions.

The second approach, which I pursue in this dissertation, involves the application of empirical methodologies that provide new insights about the significance of historical events germane to the evolution of accountancy. While empirical methodologies figured prominently in economics history they have not been utilized extensively in the study of accounting's past. I have selected as my research focus, the US railroad history which was America's first big business and which also had an excellent body of statistical research and accounting reports prepared by the Interstate Commerce Commission (ICC) beginning in 1887.

My research is informed by the methodologies used by Modigliani and Miller (MM) in their 1958 and 1963 studies. They provide a useful analog that I employ evaluating railroad cost of capital and capital structure at three important historical turning points. Like Modigliani and Miller I evaluate how a change in an important parameter affects railroad financing. Unlike MM my comparison is between conditions in imperfect markets. Specifically I measure the impact on rail finance of stock market crash in 1893, the introduction of mandatory depreciation after Hepburn Act (1906), and federal income taxation after 1913.

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Chapter 1: Railroad Accounting History

1. Introduction

In the late-19th century John Neville Keynes noted in his work *The Scope and Method of Political Economy* (1890) that scholars in economics and allied fields such as accounting have pursued two broad lines of inquiry in their research. One such line emphasized statistical methodologies for business, accounting and economic analysis. The second emphasized the influence of qualitative factors including the role of governing institutions, laws controlling property rights and other institutional arrangements that shaped how accounting knowledge could be best applied in ordering society. Both systems continue to influence studies in these fields through the contemporary era. (Blaug 1997; Hopwood 1987; Watts and Zimmerman 1978; and Keynes 1904).

My dissertation emphasizes empirical research methodologies to assess the transformation of railroad accounting at different times between 1891 and 1922. My research tests the MM theory about the relative benefit of debt equity in structuring corporate finance. Modigliani and Miller initially argued that in perfect markets there was no difference between financing business enterprise using either debt or equity. In a later consideration of this question in which they allowed for the deductibility of interest expense and found that debt finance was cheaper than equity (Modigliani and Miller 1958 and 1963).

My analogous comparisons focus on three transitions in railroad financial evolution. The first focuses on the impact of the stock market crash in 1893 on railroad

cost of capital and capital structure. This period was similar to the MM first condition where there was no deductibility on income tax expense (Modigliani and Miller 1958). Although there was several state taxes dealing with real estate capitalization and excises for items like ticket sales, there was no federal income tax. The 1893 stock market crash was significant because it induced leading underwriters to substitute preferred and common stock for debt in planning the financial reorganization of bankrupt firms. I will test this proposition by comparing cost of capital and capital structure for the largest railroads (by mileage) by comparing their position before and after the 1893 stock crash. This should cast a new light on the many non-empirical studies of the 1893 crash claim that there was a significant change in railroads capitalization through bankruptcy reorganization.

My research methodology is analogous to the approaches employed by Modigliani and Miller in 1958 and 1963. In these studies, Modigliani and Miller first evaluated the question of capital structure in perfect market; later in 1963 they relaxed the perfect market condition to allow for the effects of the deductibility of interest. In this before and after comparison Modigliani and Miller isolated the impact of one specific operating parameter on capital structure and impliedly on the cost of capital.

In my analogous methodology I compare the effects of a change in a single critical business parameter between two different years on capital structure and cost of capital. Unlike MM, my work is real rather than perfect markets. Like MM my research design focuses on the influence that changes in a single but vital factor exercises over corporate finance in railroad industry.

My second analogous test focuses on the effects of depreciation mandated in the Hepburn Act in 1906. While MM theory did not consider this parameter, it did have a major effect on a railroad accounting. This chapter will supplement the cost of capital calculations by assessing whether there was any significant change in dividend payments for the same years.

The third analogous test approximates the conditions described in MM second rendition of the theory that allowed for the deductibility of interest expense (Modigliani and Miller, 1963). The federal income tax allowed deductibility of interest beginning in 1913. Although this effect initially was weak because of the low tax rates, it became more significant as rates went up due to higher federal expenditure.

In the following sections I provide a summary of the background of railroad evolution and scholarly literature related to industry governance and accounting. With one notable exception these studies did not involve any empirical testing. Nevertheless it is a body of research that is presented to better contextualize my empirical findings. In addition I discuss my specific methodologies and state my hypothesis in the section after the review of literature.

1.1. Background to Railroad Accounting Evolution

Although the ICC exercised weak power over railroads since its inception in 1887 this would change radically during the period of the study 1908-1916. Beginning with the Hepburn Act (1906), the ICC's power to standardize accounting steadily increased beginning with mandatory practices for depreciation. This power was important to government, consumers and investors because it provided a platform for public debate

over how the powerful and monopolistic railroads could be controlled with the aide of accounting information to better serve the public interest. The railroads had radically transformed the American society. Virtually every socioeconomic element in the US was affected by changes brought about by the transportation revolution that exploited coal and steam. It made possible the concentration of population in rising cities and the establishment of factories to serve markets continental in scope. Moreover, management techniques including the development of accounting practices became vital in controlling the activities of these giant enterprises.

Although substantial progress had been achieved in the six decades before the formation of the ICC by railroad enterprises, the development was uneven and did not satisfy the information wants of all stakeholder groups. Financial statements and statistical reports had from the earliest years had been filed with state governments such as Maryland and Pennsylvania who often were investors in the new enterprises (Previts and Samson 2000; Burgess and Kennedy 1949). Balance sheets and other operating information were often included in the prospectuses prepared by underwriters for the sale of securities particularly in European financial markets (Carosso et. al. 1970). Engineers like Albert Fink prior to the Civil War had created a ton-mile measure to assess costs and efficiency (Chandler 1977). This highly flexible ratio enabled managements to determine the revenues or expenses associated with the movement of one ton of freight one mile for virtually every business segment or service. The Eastern Trunk Line Association, which represented the larger interregional carriers in the East, pursued the design of more uniform accounting and routing documents to better control the transfer of freight between connecting railroad lines (Saunders 2001). While 1869 many states began to

mandate uniform accounting rules to control railroad activities within their jurisdiction. In 1869 Massachusetts passed Sunshine law to provide investors with information about railroad finances (McCraw 1984). During the next decade the states in West and South introduced Grainger law, which called for accounting information to assess in the process of rate regulation (Hoogenboom and Hoogenboom, 1903).

I argue that government sought to socially construct accounting to achieve four broad purposes: 1) the assurance of rate equity; 2) the reduction of informational asymmetry for investors; and 3) to constrain the political power of monopolistic enterprises in order to preserve traditional democratic institutions; 4) to reduce the degree of disruptive competition that resulted from the exploitive activities of speculative railroad managers and their bankers. To achieve these outcomes the ICC leadership had to develop an approach for standardization that satisfied the competing wants of major stakeholder groups. Although guidance for accounting rules came from the American Association of Railway Accounting Officers, a professional body made up of industry executives that the ICC sponsored, the recommendations had to be satisfying to shippers, investors and the general public. Many railroad leaders were also eager to support such policies to counter the ability of aggressive rivals to compete for scarce capital by providing misleadingly favorable information about their firms' profitability and returns on investment. The ICC also perceived standardized accounting as a device for possibly signaling illegal rebating through unusual fluctuations in freight volumes and revenues.

Accounting became a medium for negotiating a reconciliation of the differences that had separated shippers, investors, and railroads. Regulatory institutions, first at the state level beginning in the 1860s, and then later at the federal level beginning in 1887

with the formation of the Interstate Commerce Commission (ICC), became major agencies for constructing new ways to use accounting knowledge to reconcile the interest of service providers and users. Government was compelled to extend the focus of accounting models initiated by the railroads to satisfy the requirements of important social groups who had been disadvantaged by the asymmetric distribution of information about the railroad enterprise.

Accounting science is the basic structure of the knowledge in the field beyond any specific social context. Thus, it is concerned primarily with basic concepts and broad interrelationships, which may exist for virtually any type of enterprise. Accounting technology, on the other hand, relates to the way in which scientific concepts of accounting are applied to solve specific socio-economic problems. Consequently the process of accounting innovation is to a high degree conditioned by the way that affected groups respond to the contingency, risk and uncertainty brought by accounting change. Because of accounting's basic tractability it may be successfully applied to a wide variety of different social and economic problems. Human actions shape technology and its application. The notion of accounting technology implies that basic conceptual knowledge may be applied in different ways depending on the requirements of a particular social situation (Miller 1990).

2. Literature Review

What distinguishes my research from earlier studies of accounting standardization is the emphasis placed on connections between changes in accounting methodology and the imperatives contemporary public policy debate. Although much of the literature deals

with the developments since the formation of SEC, my study focuses on an earlier era at the beginning of 20th century when the ICC sought to achieve several goals affecting the interest of many interdependent groups including shippers, investors and the industry through the accounting standardization. Although my analysis compliments the findings of several present-day scholars, it takes into consideration of the influence of a much wider range of factors in shaping accounting rule definitions.

My research design draws on two streams of scholarship. The first, which is qualitative and sociological in its orientation, is discussed in the following section. This is followed by a review of the much sparser body of literature dealing with quantitative research relating to railroad evolution.

2. 1. Patterns of Qualitative Research

Foremost among the early commentators at the beginning of the 20th century were Progressive historians such as Charles Beard and Mary Ritter Beard viewed the federal regulation of large-scale industries with monopoly powers like the railroads as a positive development. Although they welcomed the material improvements and higher living standards brought about by the modern industry including the railroads, they worried about the threat that powerful corporate entities potentially were to the preservation of traditional democratic values that had added long characterized American society (Beard and Beard 1927). The Progressives saw commission regulation as one means to protect the US polity from being subverted by powerful private economic forces that had grown up rapidly after Civil War. In the view of William Z. Ripley the progressive economist on faculty of Harvard University, the public interest could be best

served through government oversight of railroad affairs. He also thought that accounting provided greater transparency of railroad affairs thus facilitating the ICC's efforts to assure rate equity, reduced risk perceptions with regard to the railroad investment securities and curtail the destructive speculation of exploitive railroad managements.

More recent commentators like Robert Chatov (1975) on the other hand who followed in the tradition of political scientist Marver Bernstein (1972) and historian Gabriel Kolko (1965), believed that commission regulation was ineffective in protecting the public interest. Chatov (1975) rejected the progressive claim about the effectiveness of regulation, arguing instead in favor of what has become termed "capture theory." Chatov asserted that the groups that were supposed to be subject to regulatory constraints were able to use their considerable political power to co-opt reform. In his view, the commission structure simply implemented policies that ultimately reinforced the power of giant enterprise (Chatov 1975).

Other scholars, however, have viewed accounting standardization as a process involving both competition and corporation between government and professional groups. Paul Miranti (1989) for example has argued that how government and professional bodies competed to control accounting standardization. In his view the determinant of the boundary separating the scope of authority of these groups was set by public opinion expressed through actions of Congress. During times of crises government would authorize federal agencies to play a more active role in corporate oversight. In times of market stability the public was much more willing to defer to professional groups in maintaining market order (Miranti 1989).

In the positive accounting theory propounded by Watts and Zimmerman (1986), the process of standardization is viewed primarily as a function interest group lobbying. In this view, individual corporations became highly active in trying to influence in content and application of proposed new accounting rules through modalities such as writing comment letters to the FASB about draft standards. What is also unique about the school is the methodological approach to evaluating this dynamic, which involves reliance primarily on statistical, empirical analysis. This latter circumstance is quite different from the more qualitative narratives often employed by political scientists and historians in their study of interest group activism. The same dynamic has been explored by Palmon, Peytcheva and, Yezegel (2009). They note that the semi-autonomous FASB exercises substantial authority in standard setting. Unlike Miranti, however, these authors find that the SEC plays a constant but subtle role in pressuring the FASB to undertake particular disclosure projects.

Other scholars such as Alfred D. Chandler (1965, 1977), Richard Brief (1965), Gary Previts and Barbara Merino (1997) and Joshua Ronen have considered how measurement practices affected industry management and protected property rights. In Chandler's view, measures such as the ton/mile introduced by Albert Fink in the 1800s were essential in supporting in the rise of industry-management techniques. Brief has noted how inconsistencies in capital cost measurement undermined efficient resource allocation. In their broad survey of the evolution of the US accounting, Previts and Merino have emphasized the role of accounting as a critical mechanism for protecting property rights. Joshua Ronen in like vein emphasizes the role of accounting for

managers in satisfying the requirements of the stewardship function that involves prudent corporate governance aimed at securing the property rights of stakeholder groups.

Although Jan Heier parallels my study by addressing railroad depreciation in the early 20th century, his focus is narrower and his overall conclusions are not encompassing (Heier 2006). Unlike my work, he sees the process of standardization as involving a narrow conflict between industry and government. His study however does not consider the influence of shippers and investors on the social construction of accounting. Nor does his work seek to test his main propositions through any statistical evaluation.

Another school drawing on the insights of Frankfurt sociological school, scholars that promote critical perspectives of accounting or deeply concerned about how questions of social justice had been confronted historically. Their historiography generally focused on two broad questions: (1) They were deeply concerned about the continuance of any legacy of social injustice that might be embedded in contemporary institutions; and (2) They were deeply concerned about contingency in history, that is, how the present might have been different if other choices or outcomes had occurred in the past. The accounting historians who have looked to critical perspectives largely focused on the first of these issues. Many became highly sensitive to the historical problems such as slavery, racial exploitation and colonialism, witness, for example, the role of accounting in the recent work of Richard Fleischman and Thomas N. Tyson (2004), and Marcia Annisette (2003, 2011).

Other accounting historians embracing historical perspectives have incorporated in their research agendas the analytical techniques associated with social and cultural deconstruction as practiced by Jacques Derrida (1996, 1997) and Michel Foucault (1982).

They believed that the cultural artifacts including accounting practices provide the clues for understanding how particular societies are ordered. The analyst evaluates various social "discourses" which include narratives, themes, images and other devices of communication that rationalize social ordering. The deconstruction of cultural forms provides insight into the rationalizations justifying the socioeconomic *status quo*. The work of Cheryl Lehman (2005) who focuses on biases and shortcoming of current financial reporting, similarly Marilyn Neimark and Tony Tinker (1987) applies the same form of analysis in understanding the insensitivity of financial reports of leading industrial enterprises to issues relating to gender and class.

Peter Miller has expanded our horizons of understanding through his two components model of the historical relationship between the state and accounting. In his view "political rationalities" deal with various types of statements and claims that define the objective of government activity. In addition there are "technologies" that include the procedures and tools that helped to conceptualize and explain various governmental activities and processes. Thus governmental activity can be comprehended in terms of the conjunction of these complimentary domains. Miller believes that technologies like accounting enables government to pursue its various programs of political rationality. His research has focused narrowly in the 17th century in France during the regime of Louis XIV's when the French crown under the leadership of Jean-Baptist Colbert, the finance minister, arrogated private enterprise accounting practices to support key fiscal activities particularly the collection of taxes. A similar pattern of thought to Miller may also be found in New Institutionalism school in political science reflected the work of Stephen Skowronek (1981), Louis Galambos (1983, 1989) and Thomas McCraw (1984) who were

concerned about how the American government developed its administrative capabilities beginning in the 19th century. Like Miller for the new institutionalism, my study is deeply concerned with the connections that developed between politics and accounting knowledge. The structure that I analyze also proved to be effective in reconciling the economic competition that separated important social groups at the beginning of the 20th century. I demonstrate how accounting technologies enhance the power of state and its political constituencies over the railroad enterprise. Thus accounting had both an administrative and political role that was helpful in moderating.

2.2. Patterns of Quantitative Research

The only empirical and statistical study of railroad accounting is for the time period of my dissertation is the article by Kumar Sivakumar and Gregory Waymire (2003). They assessed the effect of Hepburn Act and the mandating of depreciation by the ICC on income smoothing. Their research supported the view that net income patterns were more volatile prior to Hepburn Act because of the effect of replacement cost accounting on railroad equipment investment. After Hepburn Act this capital cost were regularized through the establishment of standard depreciation rates. Overall their research provided persuasive evidence of the income smoothing effect of depreciation mandates introduces in 1906.

The railroad statistical yearbook differs because of a relatively high degree summarization and compression of sub-accounts into major account categories in the balance sheet. In 1891, for example permanent capital is reported under the heading “capital stock” without differentiating between common or preferred stock. Additional

liability accounts funded debt category included all classes of long-term debt. Instead of retained earnings the surplus earned from operations was denoted under the heading on the balance sheet as “profit and loss”. The miscellaneous account on the liability side of the balance sheet included various reserves, which were not reported in detail. The magnitude of this reserve however did not usually exceed 10% of the combination of capital stock and funded debt through 1910. After 1910 the statistical series provide much more detail about the composition what earlier had been aggregated under the miscellaneous heading.

Another question that is not clear is exactly how contemporary viewed significant results. Baskin and Miranti (1997), the point is made that turn of the century investors viewed common stock in the same way they valuated bonds, that is, they focused on the par value of the bond and the dividend of the par value, analogous to the way that bond valuations were depicted.

The par value of the common stock also had another purpose that was important to creditors. Par value represented the amount of cash that the original purposes of equity were committed to pay. This was important because frequently the original purchases paid less than par value and the issuing company would have on their books a receivable for the unpaid balance. Creditors could go to court and sue for payment to recover these amounts only from the original purchases, but not from purchases that subsequently acquired the shares.

3. Thesis Statement

This section states the basic hypotheses testing in my research of relating to railroad accounting change. It also includes a description of the basic methodologies applied to test the hypotheses.

Chapter 2: Capital Structure, Cost of Capital and the Stock Market Crash of 1893

1. Cost of capital

Modigliani and Miller in their first rendition of thesis argue that there should be no benefit for financing business using either debt or equity. In this part of the dissertation, I focus on cost of capital and capital structure in pre-tax era.

My first test evaluates whether there was any statistically significant shift in cost of capital and capital structure as a result of the major decline in stock market in 1893. I select two years one before and the other after 1893. The scholarly literature, particularly the work of business historian Vincent Carosso claims that there was a shift after 1893 to a more conservative financing mix. This was supposedly because leading underwriters like JP Morgan and Kuhn Loeb endeavored to reduce the risk of corporate finance for entities undergoing reorganization by substituting preferred and common stock for debt particularly junior debentures (Carosso 1970).

My study will test the impact of these claims by comparing cost of capital and capital structure for a sample of leading railroad firms before and after 1893. I will apply chi-squared test to determine whether there is a significant variation in the composition of the financial attributes before and after 1893.

Based on the work of authorities such as Carosso, after the panic of 1893, the overall risk of the firm would be expected to go down because of a lower dependency on debt. Lower risk perception presumably would contribute if the perception of risk goes down. It is logical to assume that the risk premium demanded by investors would also decline resulting in lower cost of capital to overall cost of capital in 1895 as compared to 1891.

My expectation is that the amount of debt relative to equity will decline during the period 1891 to 1895. Risk averse managers would be expected to place an increasing reliance on equity over debt after the stock market crash and the onset of economic recession. Under these circumstances one would also expect that the dividends would represent a higher proportion of the cost of capital in 1895 as compared to 1891.

Our basic formula to determine WACC is as followed:

$$WACC = \frac{SE}{SE + LTD} R_{SE} + \frac{LTD}{SE + LTD} R_{LTD}(1 - TR)$$

SE = Stockholders' equity

LTD= Long Term Debt

$R_{SE} = \frac{Dividends}{SE}$

$R_{LTD} = \frac{Interest\ Accrued\ on\ Long\ term\ debt}{Long\ Term\ Debt}$

TR = tax rate

For the first test a median WACC will be determined for 38 companies whose mileage were more 1000 miles in my sample in both 1891 and 1895. Second two cells will be constructed with data for 1891 and 1895. I will then determine the WACC median

value for the 1891 sample. The 1891 median will then be introduced to the cell for the 1895 firm sample. I will then determine the proportion of 1895 sample firms that lie above or below the 1891 median. If more than half of the 1895 sample were below the 1891 median this would indicate a declining trend in the cost of capital in the latter year. If there were a net increase in firms above the 1895 median, this would indicate a trend of increasing cost of capital. To determine whether the results have statistical significance, I will apply the chi-squared test. The chi-squared formula that I will use is as follows:

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

χ^2 = Pearson's cumulative test statistic,

O_i = an observed frequency;

E_i = an expected (theoretical) frequency, asserted by the null hypothesis;

n = the number of cells in the table.

The data in this chapter can be used to test both MM I and, MM II theorems. MM I is relevant because the shifts in finance occurred prior to the imposition in federal income tax in 1913. My hypotheses for the MM I test are,

H_0: The cost of capital will exhibit statistically significant change between 1891 and 1895.

H_1: The cost of capital will not exhibit any statistically significant change between 1891 and 1895.

For MM II the effects of the finance market shock in the panic of 1893 is analogous to the imposition of another condition imposed on the perfect market model that MM used in their second essay. In effect I am relaxing the perfect market feature of MM I by introducing the effects of stock market price dislocations, although in my test I am dealing with imperfect markets. The magnitude of the circumstances was so great as to treat this as an event that shifted the financial environment in a significant way.

Based on Carosso the expectation would be for a reduction in cost of capital as firm shift to a greater reliance on stock rather than bonds because stock dividends were not mandatory in the period of financial stress likely 1893 crisis. I expect any increase in common stock finance will not be accompanied by a proportional increase in stock cost of capital. I also expect that total bonds will either level off or decline, a condition that would not be expected to lead to an increase in the cost of debt finance.

H_0: The cost of capital in 1895 will be equal or higher than 1891.

H_1: The cost of capital in 1895 will be lower than 1891.

2. Capital structure

A second test will focus on capital structure 1891 vs. 1895. I will also develop a combined sample for these two years listing each in terms of relative debt to stockholders' equity. This measure of financial leverage will be determined using by the following formula.

$$Capital\ Structure\ Ratio = \frac{Total\ Funded\ Debt}{Total\ Assets}$$

As in the previous test I will combine listing of capital structure ratios from highest to lowest for sample firms in both 1891 and 1895. From the combined list I will determine a median capital structure ratio. Next I will reallocate the individual capital structure ratios for each sample company to two cells for separating 1891 and 1895 reading. These two arrays reflecting the numbers of companies above and below the 1891 median should give us an indication of whether railroad companies were shifting significantly to equity finance to avoid the risks that had contributed to the 1893 stock market crash. I will also test the statistical reliability of my findings by applying chi-squared tests whose formula presented above.

Hypotheses for the second test will be;

H_0: *The capital structure ratio in 1895 will show statistically significant change as compared to 1891.*

H_1: *The capital structure ratio in 1895 will show no statistically significant change as compared to 1891.*

In testing MM II our expectation is that the shock of the 1893 panic will motivate sample companies to reduce risk by shifting their long-term finance from funded debt to stock. This is consistent with the non-empirical analysis of finance structures for this period advanced by Vincent Carosso who contended that the railroads reduced debt expense and increased reliance on common and preferred stock finance. Thus the hypotheses that I will test is:

H_0: The capital structure ratio in 1895 will be equal or higher than 1891.

H_1: The capital structure ratio in 1895 will be lower than 1891.

Chapter 3: Cost of Capital, Capital Structure and Depreciation

1. Cost of Capital

The second hypothesis focusing on railroad finance examines the effect of mandatory depreciation on capital structure and cost of capital brought about by the passage of Hepburn Act (1906). Under Hepburn railroads were compelled to report depreciation expense for equipment but not for roadbed or structures using mandatory rules for measurement. The depreciation requirement replaced the previous practice of using replacement accounting for measuring the consumption of fixed capital. Depreciation was thought to be more effective in reflecting the firm's true cost of capital consumption than replacement, which was more subject to manipulation through relatively simple expedients of deferring the timing of new equipment purchases. Compliance, however, initially was slow most railroads not following the rules completely until about 1909.

Our basic formula to determine WACC is as followed:

$$WACC = \frac{SE}{SE + LTD} R_{SE} + \frac{LTD}{SE + LTD} R_{LTD}(1 - TR)$$

SE = Stockholders' equity

LTD= Long Term Debt

$$R_{SE} = \frac{Dividends}{SE}$$

R_{LTD} = *Interest rate on long-term debt*

TR = tax rate

In my test I will focus on an important ICC income statement expenses category known as "cost of equipment." Because of the way the data was arranged my test must be indirect. This aggregate includes not only the estimated using up of the cost of fixed capital but also charges for maintenance and repair. Prior to 1907 the cost of retirements and betterments would have been embedded in this total but not reported separately. After Hepburn depreciation expense would be included in this subtotal. The pre and post 1907 are comparable to the extent that they both include a measure of capital cost consumption but measured in different ways. My test will compare cost of equipment as a percentage of railroad revenue for 1905 versus this same measure for 1911 as a proxy for changes in the cost of capital. My expectation is that the greater regularity of the depreciation calculation as compared to replacement accounting will have the effect of raising the overall cost of capital and thus be reflected in a higher percentage of the cost of equipment as a percentage of revenue for 1911 as compared to 1905.

In testing the hypotheses in Chapter 3, I have selected the Wilcoxon signed rank test to evaluate whether the observed changes in the sample are statistically significant. For i = 1,2, …, N. The Wilcoxon signed rank test is beginning with a set of paired values from samples of 1905 and 1911. I take the absolute difference $|X_{1905}-X_{1911}|$ for each pair and $\mathrm{sgn}(X_{1905,i} - X_{1911,i})$, where sgn is the sign function and then omit from consideration those cases where $| X_{1905,i} - X_{1911,i} | = 0$. I rank the remaining absolute differences, from smallest to largest, employing tied ranks where appropriate; and assign to each such rank

a "+" sign when $X_{1905,i} - X_{1911,i} > 0$ and a "−" sign when $X_{1905,i} - X_{1911,i} < 0$. I use R_i denote the rank and then calculate the value of **W** for the Wilcoxon test by this formula,

$$W = \left|\sum_{i=1}^{N_r}\left[sgn\left(X_{1905,i} - X_{1911,i}\right).\ R_i\right]\right| \qquad \text{(assume sgn(0) = 0)}$$

W in the present version of the procedure is equal to the sum of the signed ranks. To calculate the sampling probabilities I used this formula,

$$\pi^+ = P\left(X_{1905,i} > X_{1911,i}\right), \pi^- = P\left(X_{1905,i} < X_{1911,i}\right),\ \pi^0 = P\left(X_{1905,i} = X_{1911,i}\right)$$

Since N≥ 10 I use the normal approximation,

$$Z = \frac{4W - N(N+1)}{\sqrt{\frac{2N(N+1)(2N+1)}{3}(\pi^+ + \pi^- - (\pi^+ + \pi^-)^2)}}$$

As in the case of chapter 2, I test the effects of mandatory depreciation using both MM I and, MM II. Under MM I, the cost of capital in this pre-tax era should exhibit no statistically significant change. Thus,

H_0: The cost of capital will exhibit statistically significant change between 1905 and 1911.

H_1: The cost of capital will not exhibit any statistically significant change between 1905 and 1911.

I also tested the data in terms of the expected results under MM II. In this case the added depreciation expense from Hepburn would be expected to increase the overall cost of capital. The hypotheses follow:

H_0: Cost of capital in 1911 should not show a statistically significant change over 1905.

H_1: Cost of capital in 1911 should show a statistically significant increase over 1905.

2. Capital Structure

Consistent with the previous approach in evaluating cost of capital, I first tested the patterns of change in capital structure using MM I by using the formula below:

$$Capital\ Structure\ Ratio = \frac{Total\ Funded\ Debt}{Funded\ Debt + Common\ Stock}$$

Hypotheses for the test will be;

H_0: The capital structure ratio in 1911 will show statistically significant change as compared to 1905.

H_1: The capital structure ratio in 1911 will show no statistically significant change as compared to 1905.

The second test of the effects of depreciation was conducted in a way that is broadly consistent with the approaches followed by MM II. The marketability of equity would have declined as the market began to anticipate the effects of the new accounting rules. In periods of capital stringency the railroads would have been compelled to borrow rather than issuing a stock. Debt financing would have been easier because the lending contracts better protects the property rights of creditors. I expect that:

H_0: The 1911 capital structure ratio will not exhibited a statistically significant increase over 1905.

H_1: The 1911 capital structure ratio will exhibit a statistically significant increase over 1905.

Chapter 4: Cost of Capital and Capital Structure with a Material Increase in Taxes

1. Cost of Capital with Taxes

The test in this section directly replicates the circumstances contemplated under MM II. Thus, I do not as in previous chapters evaluate this data in the context of MM I. In my third test I look at the impact that the federal income tax of 1913 had on cost of capital, and capital structure. MM second version of the theory predicts debt finance would reduce the cost of capital because of the deductibility of interest expense. Moreover if debt were inherently cheaper than equity, I would expect to see an increase in debt finance after 1913. I test this proposition by comparing firm results in 1912 when there was no federal income tax on net income to 1922 when there was a tax on net income. Although federal income tax was first initiated in 1913 tax rates initially were low. In selecting a post 1913 year to test I rejected 1917-1918 because of effects of WWI. I also sought to avoid the effects of sharp recession in 1921. Consequently the comparison will be made against in 1922 a year in which tax rates were substantial and the economic data was not distorted by the effects of war or the recession.

$$WACC = \frac{SE}{SE + LTD} R_{SE} + \frac{LTD}{SE + LTD} R_{LTD}(1 - TR)$$

The hypotheses applied to the second test as follows. For the cost of capital,

H_0: The cost of capital in 1922 will be equal or higher than 1912.

H_1: The cost of capital in 1922 will be lower than 1912.

2. Capital Structure with Taxes

The hypothesis with respect to the capital structure ratio will be as follows:

$$Capital\ Structure\ Ratio = \frac{Total\ Funded\ Debt}{Funded\ Debt + Capital\ Stock + Reserves}$$

H_0: The capital structure ratio in 1922 will be equal or lower than 1911.

H_1: The capital structure ratio in 1922 will be higher than 1911.

Chapter 2: Capital Structure, Cost of Capital and the Stock Market Crash of 1893

1. Introduction

As noted in the introductory chapter, I use the methodologies incorporated in Modigliani and Miller's (MM) 1958 and 1963 articles relating to corporate capital structure to evaluate the effects of a major stock market disturbance, namely Crash of 1893. The design of the chapter differs from MM model because it looks at events in imperfect markets. In addition the MM model assumes market equilibrium and did not factor in the impacts of a major financial market disturbance. The third difference is that in MM model, there was no consideration of the influence of differences in firm size or in market areas. And lastly, the MM model does not incorporate any notion of business enterprise financial reorganization because of bankruptcy.

My study will contrast using the MM I and, MM II models the cost of capital and capital structure in the railroad industry before and after stock market crash and the onset of five-year recession. My study will also cast a new light on the historical literature, which has contended that during the 1890's there was a strong trend to reduce corporate risk by shifting away from debt finance in favor of greater equity especially in the form of preferred stock. Commentators like the late Vincent Carosso (1970) has asserted that in the bankruptcies of 1890's how investment bankers sought to determine the maximum amount of fixed charges that bankrupt railroads could be expected to sustain after reorganization. The latter proceedings generally required cancellation of some portion of pre-existing debt, giving investors preferred stock as a substitute. The wisdom of this policy was that in severe economic times, the railroads could be expected to survive by avoiding the heavy

fixed charges from too much debt leverage. In these circumstances the allocation of cash flows could be reduced by skipping payment of preferred stock dividend, an event that would not force the railroad into bankruptcy.

The Carosso thesis would be expected to lead to a general lowering of the cost of capital and a reduction of debt as a percentage of long-term capital. Under Carosso, cost of capital on average should be higher before the crisis in 1893. The refinancing after the onset of the 1893 crash should motivate the firms in the industry to initiate two policies under Carosso's scenario. First there should be a reduction of debt as a proportion of total capital as a means to reduce the financial risk of the firm. Second, it would be expected also that industry firms would modify their financing commitments to reduce their overall cost of capital. In addition, during the recession the expectation would be that the cost of capital would be reduced throughout the economy. Interest rates would be expected to drop because of a lower need to borrow to finance business operations. Lower profits would tend to limit the amounts payable for dividends.

It is interesting to note that the Carosso thesis is consistent with the predictions of the pecking order hypothesis. The pecking order hypothesis had served as the theoretical explanation of the capital structure choice before MM's 1958 article. This holds that corporate managers will generally prefer to finance using debt rather than equity. This is because equity finance implies change in ownership and control. Thus managers are reluctant to issue new stock for fear of undermining the security of their positions in the firm. Preferred stock however generally does not have voting rights. Therefore, the issuance of preferred stock that Carosso describes as a palliative for bankruptcy is consistent with the pecking order hypothesis. It represents a compromise. It allows the

issuance of equity with strong preferences for dividends but without giving up voting rights.

In this chapter I will use the MM's methodology to test the validity of Carosso-pecking order explanation. I will rank order all the largest railroads with mileage more than 1000 miles. There will be two analyses. The first will be for 1891, before the crash that in effect serves as a base year in our analysis. From the rank ordering I will determine the median cost of capital and the median of capital structure ratio for all of the firms in the sample. I will repeat this analysis for 1895 by determining what the medians were for cost of capital and the capital structure ratio. My expectation is that the Carosso pecking order hypothesis will be evident but it is not clear whether this trend will be statistically significant as evidenced by chi-square analysis.

2. Background to the Railroad Industry in the 1890's

2.1. Railroad Industry in the 1890's

As end of 1890, the length of railroad miles and related statistics all over the world exceeded 385,000 miles is presented below. Most of the mileages concentrated in Europe and the North America.

Table 2-1: Railway mileage of the World for the year ending December 31, 1890

Grand Division	Length of line (miles)
Europe	139,110
North America[1]	190,680
USA	168,402
South America	16,876
Asia	20,956
Africa	5,832
Australia	11,737
Total	385,191

Source: Annual Report of the Statistics of Railways in the United States, 1891.

In Table 2-2 below the railroad mileage reported by geographic groups indicates wide disparity (see map in Appendix for group areas). Groups 1 through 6 that represent heavily populated northeast and northwest. They account for most of the mileage in the national railroad system. These areas also on average have lower miles of line per 10,000 inhabitants. This means that a greater concentration of population is served on average by fewer tracks than the more sparsely populated areas accounted for under group 7 through group 10. This concentration in groups 1 through 6 is also reflected in a higher average number of miles of line per 100 square miles of territory than in the case of the Western roads making up groups 7 through 10.

[1] Includes West Indies.

Table 2-2: Classification of mileage according to organization for operation.

Territory covered[·]	Line Owned			Number of miles of line per 100 square miles of territory[2]			Number of miles of line per 10,000 inhabitants		
	1891	**1895**	**1896**	**1891**	**1895**	**1896**	**1891**[3]	**1895**[4]	**1896**[5]
Group I	6,930	7,296	7,388	11.18	11.77	11.92	14.47	14.11	14.04
Group II	19,017	20,607	20,802	17.55	19.01	19.19	13.54	13.61	13.50
Group III	22,021	22,651	22,937	17.47	17.98	18.21	25.71	24.54	27.31
Group IV	9,834	11,117	11,286	7.07	7.99	8.11	19.50	20.44	20.39
Group V	19,503	20,709	21,088	6.51	6.91	7.04	21.11	20.79	20.80
Group VI	37,890	40,446	40,666	10.18	10.86	10.92	36.20	35.84	35.39
Group VII	9,385	10,304	10,351	2.27	2.50	2.51	64.17	65.36	64.52
Group VIII	20,776	22,024	22,449	5.69	6.03	6.15	41.41	40.72	40.76
Group IX	10,173	11,014	11,196	3.14	3.40	3.45	33.51	33.65	33.60
Group X	12,878	14,486	14,607	1.69	19.1	1.92	53.97	56.32	55.79
Total – USA	168,402	180,657	182,776	5.67	6.08	6.15	26.29	26.16	26.00

Source: Annual Report of the Statistics of Railways in the United States, 1891-1896.

ICC classified the railroads using either mileage or gross income. Classification based on mileage is illustrated below. In 1895, 43 railroads accounted for 56% of total railroad mileage in the US. The remaining 1061 companies accounted for the remaining 44%. Yet in 1896, 44 railroads accounted for 57% of total railroad mileage in the US. The remaining 1067 companies accounted for the remaining 43%.

Table 2-3: Classification of Railways on the basis of operated mileage for the years ending June 1891, 1895, and 1896.

Classification of road	Operating Corporations			Aggregate mileage in classes			Proportion to total mileage (per cent)		
	1891	1895	1896	1891	1895	1896	1891	1895	1896
Mileage over 1,000	41	43	44	94,265	100,714	103,345	56.05	55.67	56.89
Mileage from 600 to 1,000	25	24	22	19,080	18,896	17,450	11.35	10.45	9.60
Mileage from 400 to 600	25	22	24	12,829	11,177	12,157	7.63	6.18	6.69
Mileage from 250 to 400	40	45	44	12,933	14,366	14,226	7.69	7.94	7.83
Mileage under 250	860	970	977	29,068	35,770	34,497	17.28	19.76	18.99
Total	991	1,104	1,111	168,176	180,925	181,677	100.	100.	100.

Source: Annual Report of the Statistics of Railways in the United States, 1891-1896.

[·] The group areas are presented in appendices.
[2] On basis of 2,970,000 square miles, which covers "land surface" only, and excludes Alaska.
[3] On basis of 64,051,571 population and excludes Alaska.
[4] On basis of 70,301,571 population and excludes Alaska.
[5] On basis of 70,301,571 population and excludes Alaska.

2.2. The Effect of the Panic of 1893 on Railroad Industry

The stock market crash also affected the railroad employment. In 1890, 749,301 employees were working. This increased to a high 873,602 employee in 1893. Then it fell sharply about 100,000 for both 1894 and 1895. Employment started to recover in 1896, reaching 826,620 employees.

Graph 2-1: Summary of Employees for the years ending June 30, 1890-1896.

Source: Annual Report of the Statistics of Railways in the United States, 1891-1896.

The effects of recession can also be seen in terms of railroad passenger and freight traffic. Passengers carried increased from 429 million in 1890 to a high 593 million in 1893. It then declined to a low of 507 million in 1895 and increased slightly to 511 million in 1896. A similar pattern is evident for freight. Freight haulage increased from 636 million tons in 1890 to a high 745 million tons in 1893. It then fell sharply 638 million tons in 1894 but recovered strongly to 765 million tons in 1896. A different pattern emerges in terms of total freight train mileage recorded. This series shows an increase 435 million miles in 1890 to 508 million miles in 1893. It then declined to 447 million miles in 1895 and 479 million miles in 1896.

Table 2-4: Comparative summary of passenger and freight service for the years ending June 30, 1891-1896.

Item	1890	1891	1892	1893	1894	1895	1896
Passengers carried	492,430,865	531,183,998	560,958,211	593,560,612	540,688,199	507,421,362	511,772,737
Tons carried	636,541,617	675,608,323	706,555,471	745,119,482	638,186,553	696,761,171	765,891,385
Freight train mileage	435,170,812	446,274,508	485,402,369	508,719,506	446,807,223	449,291,238	479,500,170

Source: Annual Report of the Statistics of Railways in the United States, 1891-1896.

Total assets of the railroad industry in 1891 was $10.4 billion and by 1895 that increased to $11.6 billion, a net increase of 11.7%. The capital stock during the same period grew from $4.3 billion to $4.8 billion, a net increase of 11.8%. Funded debt increased from $4.75 billion to $5.39 billion, a net increase of 13.3% (See illustration 2-1 and 2-2).

Illustration 2-1: General Balance Sheet for the Year Ending June 30, 1891

Item.	Amount.	Increase.
ASSETS.		
Cost of road	$8, 293, 883, 822	$280, 892, 798
Cost of equipment	444, 649, 343	30, 297, 914
Stocks owned	566, 395, 273	56, 757, 007
Bonds owned	284, 405, 263	32, 011, 061
Cash and current assets	357, 148, 908	38, 624, 098
Materials and supplies	64, 651, 495	1, 660, 625
Sinking fund and sundries	[1] 108, 252, 577	6, 897, 735
Miscellaneous	285, 480, 117	17, 164, 187
Total	10, 404, 866, 798	464, 305, 425
LIABILITIES.		
Capital stock	4, 307, 633, 199	109, 594, 662
Funded debt	4, 756, 831, 285	215, 076, 804
Current liabilities	526, 801, 274	87, 867, 280
Accrued interest on funded debt not yet payable	23, 878, 490	1, 929, 154
Miscellaneous	556, 032, 930	23, 730, 667
Profit and loss	233, 689, 620	26, 106, 858
Total	10, 404, 866, 798	464, 305, 425

Source: Annual Report of the Statistics of Railways in the United States, 1891.

Illustration 2-2: General Balance Sheet for the Year Ending June 30, 1895

Item.	Amount.	Increase.	Decrease.
ASSETS.			
Cost of road	$8, 631, 919, 673	$27, 387, 992	.....
Cost of equipment	571, 570, 946	10, 460, 667	.....
Stocks owned	578, 473, 957	.....	$33, 227, 772
Bonds owned	355, 511, 091	595, 454	.....
Cash and current assets	330, 181, 627	.....	21, 176, 197
Materials and supplies	60, 123, 916	.....	3, 356, 706
Sinking fund and sundries	[1] 126, 996, 994	.....	1, 581, 130
Miscellaneous	968, 817, 887	53, 187, 906	.....
Total	11, 623, 596, 091	32, 290, 214	.....
LIABILITIES.			
Capital stock	4, 819, 763, 581	11, 208, 657	.....
Funded debt	5, 390, 109, 320	22, 465, 267	.....
Current liabilities	609, 299, 806	40, 112, 397	.....
Accrued interest on funded debt not yet payable	27, 070, 880	407, 484	.....
Miscellaneous	636, 882, 174	11, 669, 356	.....
Profit and loss	140, 470, 330	.....	53, 572, 947
Total	11, 623, 596, 091	32, 290, 214	.....

[1] **Sinking fund, $76,368,668; sundries, $50,628,326.**

Source: Annual Report of the Statistics of Railways in the United States, 1895.

The gross earnings from operations and net income decreased drastically right after 1893 (see Table 2-5). The gross earnings from operations in railroads was leveled at $1.1 billion in both 1891 and 1895.While net income was $111.1 million in 1893, it declined by almost 50% to 55.8 million in 1895. Also the total dividends paid during these periods decreased from $96.5 million to $85.9 million (See illustration 2-3 and 2-4).

Illustration 2-3: Comparative Condensed Income Account for the Years Ending June 30, 1891, 1890, and 1889.

Item.	Amount.			Increase of 1891 over 1890.
	1891.[1]	1890.[2]	1889.[3]	
Gross earnings from operation	$1,096,761,395	$1,051,877,632	$964,816,129	$44,883,763
Less operating expenses	731,887,893	692,093,971	644,706,701	39,793,922
Income from operation	364,873,502	359,783,661	320,109,428	5,089,841
Income from other sources	133,911,126	126,767,064	125,169,702	7,144,062
Total income	498,784,628	486,550,725	445,279,130	12,233,903
Total deductions from income	388,707,712	384,792,138	343,890,394	3,915,574
Net income	110,076,916	101,758,587	101,388,736	8,318,329
Total dividends (including "Other payments from net income.")	[4]96,489,013	[5]89,688,204	82,110,198	6,800,809
Surplus from operations	13,587,903	12,070,383	19,278,538	1,517,520

[1] 161,275.17 miles of line represented. [2] 156,404.06 miles of line represented.
[3] 153,385.37 miles of line represented. [4] Includes $5,371,100 "Other payments from net income."
[5] Includes $2,616,591 "Other payments from net income."

Source: Annual Report of the Statistics of Railways in the United States, 1891.

Illustration 2-4: Comparative Condensed Income Account for the Years Ending June 30, 1895, and 1894.

Item.	Amount.		
	1895.[1]	1894.[2]	Decrease of 1895 under 1894.
Gross earnings from operation	$1,075,371,462	$1,073,361,797	[3] $2,009,665
Less operating expenses	725,720,415	731,414,322	5,693,907
Income from operation	349,651,047	341,947,475	[3] 7,703,572
Income from other sources	132,432,133	142,816,805	10,384,672
Total income	482,083,180	484,764,280	2,681,100
Total deductions from income	425,966,921	429,008,310	3,041,389
Net income	56,116,259	55,755,970	[3] 360,289
Total dividends (including "Other payments from net income").	[4] 85,961,500	[5] 101,607,264	15,645,764
Surplus from operation	[6] 29,845,241	[6] 45,851,294	[6] 16,006,053

Source: Annual Report of the Statistics of Railways in the United States, 1895.

Table 2-5: Comparative condensed income account for the years ending June 30, 1891 and 1896.

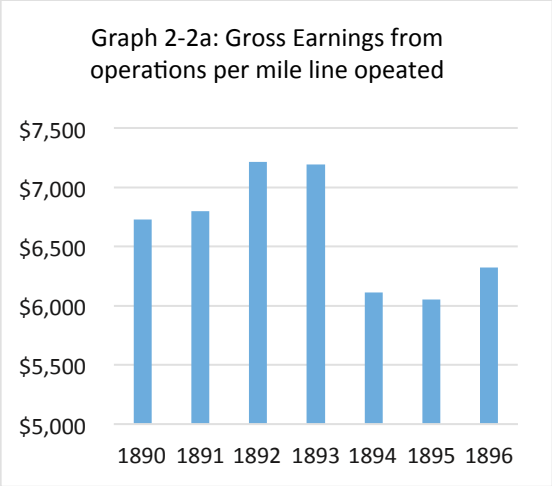
Item	Amount (Millions)						
	1890[6]	1891[7]	1892[8]	1893[9]	1894[10]	1895[11]	1896[12]
Gross Earnings from operations	$1,051,9	$1,096,8	$1,171,5	$1,220,8	$1,073,4	$1,075,4	$1,150,2
Less operating expenses	692,1	731,9	781,0	828,0	731,5	725,8	773,0
Income from operations	359,8	364,9	390,5	392,9	342,0	349,7	377,2
Income from other sources	126,8	134,0	142,0	149,7	142,9	132,5	130,0
Total Income	486,6	498,8	532,4	542,5	484,8	482,1	506,3
Total deductions from income	384,8	388,8	416,5	431,5	429,0	426,1	416,6
Net income	101,8	110,1	116,0	111,1	55,8	56,2	89,7

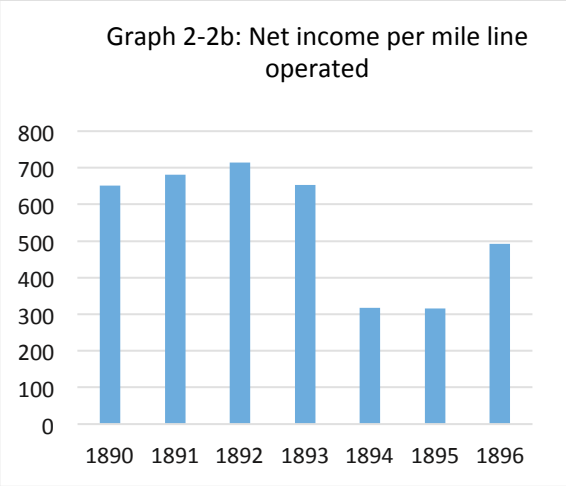
Source: Annual Report of the Statistics of Railways in the United States, 1891

The sharp change in both gross earnings and net income is depicted in Graph 2-2a and, 2-2b. Graph 2-2a indicates a peaking in Gross Earnings at $7,200 per mile line operated in 1892 and 1893. The falls off significantly by 1895 to about $6,100 per mile line operated. A similar pattern is revealed in Graph 2-2b where net income per mile operated peaks slightly above $700 in 1892 it then falls sharply to a low of $300 per mile line operated in 1894. By 1896 there was a recovery to about $500 per mile line.

[6] 156,404.06 miles of line represented.
[7] 161,275.17 miles of line represented.
[8] 162,397.30 miles of line represented.
[9] 169,779.84 miles of line represented.
[10] 175,690.96 miles of line represented.
[11] 177,746.25 miles of line represented.
[12] 181,982.64 miles of line represented.

Graph 2-2a and Graph 2-2b: Comparative condensed income account for the years ending June 30, 1890-1896.





Source: Annual Report of the Statistics of Railways in the United States, 1891

Table 2-6 indicates that the average total revenue per train mile fluctuated between a $1.44 and $1.45 between 1890 and 1893. It then fell off sharply to $1.36 in 1895 and partially recovered to $1.40 in 1896. The average cost of running a train one mile fluctuated between $0.96 and $0.97 from 1890 to 1893. However it reached a low point to $0.92 in 1895, recovering to $0.94 in 1896. The control over cost in railroad operations was reflected in the percentage of operation expenses as compared to operational income. During the entire period 1890-1896, this ratio fluctuated between 66% and 68%. The recession years, cost control was tight with the ratio of operating expenses and income fluctuating between 66 and 68%. Through 1894 to 1896 the ratio remained relatively stable.

Table 2-6: Comparative summary of results, 1890, 1891, 1892, 1893, 1894, 1895, and 1896.

Item	1890	1891	1892	1893	1894	1895	1896
Revenue per train mile, all trains	$1.44	$1.43	$1.44	$1.43	$1.36	$1.35	$1.39
Average cost of running a train 1 mile, all trains	$0.96	$0.95	$0.96	$0.97	$0.93	$0.91	$0.93
Percentage of operating expenses to operating income	65.80	66.73	66.67	67.82	68.14	67.348	67.20

Source: Annual Report of the Statistics of Railways in the United States, 1891-1896.

3. Analysis of Cost of Capital and Capital Structure

I will test both the cost of capital and capital structure hypotheses using MM I and, MM II for 1891 vs. 1895 and, 1896.

3.1. Cost of Capital

In analyzing cost of capital I use the following formula:

$$WACC = \frac{SE}{SE + LTD} R_{SE} + \frac{LTD}{SE + LTD} R_{LTD}(1 - TR)$$

SE = Stockholders' equity

LTD= Long Term Debt

$R_{SE} = \frac{Dividends}{SE}$

$R_{LTD} =$ *Interest rate on long-term debt*

TR = tax rate

For the MM I test my hypotheses are below:

H_0: The cost of capital will exhibit statistically significant change between 1891 and 1895.

H_1: The cost of capital will not exhibit any statistically significant change between 1891 and 1895.

For the test of MM II I will test these hypotheses:

H_0: The cost of capital in 1895 will be equal or higher than 1891.

H_1: The cost of capital in 1895 will be lower than in 1891.

For the first test a median WACC will be determined for 38 individual companies whose mileages were more than 1000 miles in my sample in both 1891 and 1895. Second two cells will be constructed with data for 1891 and 1895. I will then determine the WACC median value for the 1891 sample. The 1891 median will then be introduced to the cell for the 1895 firm sample. I will then determine the proportion of 1895 sample firms that lie above or below the 1891 median. If more than half of the 1895 sample is below the 1891 median this would indicate a declining trend in the cost of capital in the latter year. If there is a net increase in firms above the 1895 median, this would indicate a trend of increasing cost of capital.

Table 2-7: Comparison of Weighted Average Cost of Capital 1891 vs. 1895.

	1891	1895	Total
Below Median	19	24	43
Above Median	19	14	33
Total	38	38	76

$O_{1,1} = 19$ $E_{1,1} = 43\ x\ 38/76 = 21{,}5$

$O_{1,2} = 24$ $E_{1,2} = 43\ x\ 38/76 = 21{,}5$

$O_{2,1} = 19$ $E_{2,1} = 33\ x\ 38/76 = 16{,}5$

$O_{2,2} = 14$ $E_{2,2} = 33\ x\ 38/76 = 16{,}5$

$\chi^2 = ((19 - 21{,}5)^2/21{,}5\ ) + ((24 - 21{,}5)^2\ /21{,}5) + ((19 - 16{,}5)^2\ /\ 16{,}5)\ + ((14 - 16{,}5)^2/\ 16{,}5)$

$\chi^2 = 1.338971$

These results support MM I but they do not support MM II.

I re-perform the test using 1896 data. This necessitated taking a larger sample based on minimum levels of railroad revenue. This level amounted to $3 million. Defining the population, this was enabled to identify total sample of 67 units.

Hypotheses stated above except that my terminal year is 1896 rather than 1895.

Table2-8: Comparison of Weighted Average Cost of Capital 1891 vs. 1896.

	1891	1896	Total
Below Median	33	43	76
Above Median	33	24	57
Total	66	67	133

$O_{1,1} = 33$ $E_{1,1} = 76\ x\ 66/133 = 37{,}7$

$O_{1,2} = 43$ $E_{1,2} = 76\ x\ 67/133 = 38{,}2$

$O_{2,1} = 33$ $E_{2,1} = 57\ x\ 66/133 = 28{,}2$

$O_{2,2} = 24$ $E_{2,2} = 57\ x\ 67/133 = 28{,}7$

$\chi^2 = ((33 - 37{,}7)^2/37{,}7\ ) + ((43 - 38{,}2)^2\ /38{,}2) + ((33 - 28{,}2)^2\ /\ 28{,}2)\ + ((24 - 28{,}7)^2/\ 28{,}7)$

$\chi^2 = 2{,}729478$

The number of companies decreases their cost of capital under the median for 1891 of 33 amounted to 43 a net increase to 10. However like the 1895 results the 1896 test yielded a chi-square value of 2,729478 indicating a lack of statistical significance. The results of tests affirmed the predictions of MM I but not the predictions of MM II.

3.2 Capital Structure

A second test focuses on capital structure 1891 vs. 1895. I will also develop a combined sample for these two years listing each in terms of relative debt to stockholders' equity. This measure of financial leverage will be determined using by the following ratio:

$$Capital\ Structure\ Ratio = \frac{Total\ Funded\ Debt}{Total\ Assets}$$

Table 2-9 gives a general indication of the relative proportion of stocks vs. bonds. In 1889 the value of the bonds and stocks were roughly equivalent. By 1893 stocks were slightly higher than bonds. By 1896 stocks were higher than bonds by $700 million, a substantial increase over previous years. The ratio of bonds to stocks in 1889 was roughly one, by 1896 this ratio had reduces to 86%.

Table 2-9: Comparative summary of ownership of railway stocks and bonds for the years ending June 30, 1889-1896.

Item	Amount Outstanding (millions)							
	1889	1890	1891	1892	1893	1894	1895	1896
Stocks	4,251.2	4,409,7	4,450,7	4,633,2	4,669,0	4,834,1	4,961,3	$5,226,6
Bonds	4,267,6	4,124,0	4,081,7	4,302,6	4,504,4	4,594,0	4,641,8	4,517,9
Total stocks and bonds	8,518,8	8,533,6	8,532,3	8,935,7	9,173,4	9,428,1	9,603,1	9,744,4
Bonds/Stocks	1.003	0.935	0.917	0.928	0.964	0.950	0.935	0.864

Source: Annual Report of the Statistics of Railways in the United States, 1891-1896.

As in the previous section I will test MM I and, MM II using a combined listing of debt/total assets ratios from highest to lowest for sample firms in both 1891 and 1895. From the combined list I will determine a median debt/ total assets ratio. Next I will reallocate the individual debt/ total assets ratios for each sample company to two cells for separating 1891 and 1895 reading. These two arrays reflecting the numbers of companies above and below the 1891 median should give us an indication of whether railroad companies were shifting significantly to equity finance to reduce financial risks that had contributed to the 1893 stock market crash. I will also test the statistical reliability of my findings by applying chi-squared tests whose formula presented above.

The hypotheses for MM I test will be;

H_0: *The capital structure ratio in 1895 will show statistically significant change as compared to 1891.*

H_1: *The capital structure ratio in 1895 will show no statistically significant change as compared to 1891.*

For the test of MM II I will test these hypotheses:

H_0: *The capital structure ratio in 1895 will be equal or higher than 1891.*

H_1: *The capital structure ratio in 1895 will be lower than 1891.*

Table 2-10: Comparison of debt/total assets ratio 1891 vs 1895.

	1891	1895	Total
Below Median	19	18	37
Above Median	19	20	39
Total	38	38	76

$O_{1,1} = 19$ $E_{1,1} = 37\ x\ 38/76 = 18{,}5$

$O_{1,2} = 18$ $E_{1,2} = 37\ x\ 38/76 = 18{,}5$

$O_{2,1} = 19$ $E_{2,1} = 39\ x\ 38/76 = 19{,}5$

$O_{2,2} = 20$ $E_{2,2} = 39\ x\ 38/76 = 19{,}5$

$\chi^2 = ((19 - 18{,}5)^2/18{,}5) + ((18 - 18{,}5)^2/18{,}5) + ((19 - 19{,}5)^2/19{,}5) + ((20 - 19{,}5)^2/19{,}5)$

$\chi^2 = 0.052668$

These results affirmed the predictions of MM I but not the predictions of MM II.

I reperformed the test for capital structure using the expanded sample for 1896 that I applied in the earlier second test for cost of capital. In this second capital structure test the increase in firms increase the debt leverage grew by 33 to 36. However like the other test the chi-square number was low at 0,273292 indicating a lack of statistical significance.

My hypotheses for this test are the same as for that in 1895 except that the terminal year will be 1896.

Table 2-11: Comparison of capital structure ratio 1891 vs 1896.

	1891	1896	Total
Below Median	33	30	63
Above Median	33	36	69
Total	66	66	132

$O_{1,1} = 33$ $E_{1,1} = 63\ x\ 66/132 = 31{,}5$

$O_{1,2} = 30$ $E_{1,2} = 63\ x\ 66/132 = 31{,}5$

$O_{2,1} = 33$ $E_{2,1} = 69\ x\ 66/132 = 34{,}5$

$O_{2,2} = 36$ $E_{2,2} = 66\ x\ 69/132 = 34{,}5$

$\chi^2 = ((33 - 31{,}5)^2/31{,}5\ ) + ((30 - 31{,}5)^2\ /31{,}5) + ((33 - 34{,}5)^2\ /\ 34{,}5)\ + ((36 - 34{,}5)^2/\ 34{,}5)$

$\chi^2 = 0.273292$

These results of these tests affirm the predictions of MM I but do not affirm the predictions of MM II.

4. Conclusion

The findings of this chapter indicate limitations to the application what I refer to as the MM methodology. That is the comparison of the base year distribution of corporate cost of capital and capital structure ratios against a later period result that reflect some significant financial change that affected the entire sample. In this chapter we looked in at the two test variables before and after 1893 financial market panic. Although our test outcomes provide support for both Carosso hypothesis and pecking order hypothesis, the chi-square results were not robust. They indicated only a confidence level about 70% probability for cost of capital. We did the test for the second time for 1895 data with a confidence level about 18% probability for capital structure, also 90% confidence level for cost of capital for 1896 and 39% confidence level for capital structure for 1896.

These results indicate that the effects of the exogenous change namely the stock market crash, was not universally responded to by industry firms in similar manners. The reason for this is because of the wide range of differences in endogenous factors. Some firms had previously operated with low risk capital structures and others were more leveraged. Some firms had lower pre-existing cost of capital based on their unique financing plans than other firms in the industry. Demand patterns for railroad

transportation varied significantly by region: The Eastern US having steadier patterns of rail utilizations than the West. For these and other reasons the impact of financial market shock as not uniform to industry.

The other chapters in this dissertation are different to the extent they had more endogenous impact on cost of capital and capital structure. As we shall see, the test focused on major expense categories that would have affected all firms. The MM methodology as we shall see in the forthcoming chapters was more effective in measuring changes in capital structure and cost of capital when all companies experienced similar impacts from as results from exogenous changes. All sample firms were affected by depreciation and tax expense and were less able to diminish the impacts of these new requirements through financial planning.

The MM I hypotheses were affirmed in all cases tested. This result was very much influenced by the high confidence level of 95% that had to be reached in order to achieve statistical significance. There was a shift in capital structure toward lower funded debt but it did not affect a higher proportion of the sample companies. Moreover, it appears that this shift involved for the most part of railways in the Western states, which financially were most vulnerable because of the long haulage mileage and low density of traffic except for the seasonal grain harvest.

Appendix 2-1: Weighted Average Cost of Capital (1891 vs. 1895)

	WACC-1891	WACC-1895
Boston and Maine RR	0.070801	0.053056
Canadian Pacific Railway	0.030662	0.026459
Baltimore and Ohio Railroad	0.043119	0.041753
Lehigh Valley Railroad	0.053171	0.026718
New York Central and Hudson River Railroad	0.047522	0.048531
New York, Lake Erie and Western Railroad	0.027647	0.029658
Pennsylvania Railroad	0.053146	0.052503
Cleveland, Cincinnati, Chicago and Saint Louis Railway	0.041847	0.040701
Lake Shore and Michigan Southern Railway	0.067739	0.064958
Michigan Central Railroad	0.05399	0.048966
Norfolk and Western Railroad	0.029642	0.025261
Pennsylvania Company	0.024411	0.022257
Pittsburgh, Cincinnati, Chicago and Saint Louis Railway	0.023344	0.026106
Wabash Railroad	0.021658	0.020519
Chesapeake and Ohio Railway	0.015812	0.024827
Southern Railway	0.063417	0.026983
East Tennessee and Western North Carolina Railroad	0.025599	0.019949
Illinois Central Railroad	0.050326	0.044264
Louisville and Nashville Railroad	0.052117	0.032271
Central Railroad and Banking Company of Georgia	0.058076	0.007161
Atchison, Topeka and Santa Fe Railroad	0.022331	0.026198
Burlington, Cedar Rapids and Northern Railway	0.034737	0.042442
Chicago and Northwestern Railway	0.052159	0.051152
Chicago, Burlington and Quincy Railroad	0.048186	0.04808
Chicago, Milwaukee and Saint Paul Railway	0.044285	0.0512
Chicago, Rock Island and Pacific Railway	0.048878	0.042884
Chicago, Saint Paul, Minneapolis and Omaha Railway	0.032242	0.038077
Great Northern Railway	0.0325	0.052857
Northern Pacific Railroad	0.03765	0.035142
Fremont, Elkhorn and Missouri Valley Railroad	0.025365	0.02614
Union Pacific Railway	0.023891	0.037098
Saint Louis and Saint Francisco Railway	0.030448	0.031771
Denver and Rio Grande	0.024264	0.019067
Missouri Pacific Railway	0.047017	0.026843
Saint Louis, Iron Mountain and Southern Railway	0.047696	0.034858
Texas and Pacific Railway	0.013802	0.013727
Oregon Short Line and Utah Northern Railway	0.036467	0.036666
Oregon Railway and Navigation Co	0.055603	0.025359

Appendix 2-2: Capital Structure (1891 vs. 1895)

	FD/TA 1891	FD/TA 1895
Boston and Maine Railroad	0.391877	0.420187
Canadian Pacific Railway	0.321724	0.389049
Baltimore and Ohio Railroad	0.560535	0.536966
Lehigh Valley Railroad	0.359268	0.372892
New York Central and Hudson River Railroad	0.360167	0.364317
New York, Lake Erie and Western Railroad	0.450677	0.433691
Pennsylvania Railroad	0.313477	0.304522
Cleveland, Cincinnati, Chicago and Saint Louis Railway	0.48314	0.55259
Lake Shore and Michigan Southern Railway	0.414558	0.409036
Michigan Central Railroad	0.402199	0.399336
Norfolk and Western Railroad	0.473601	0.477948
Pennsylvania Company	0.476981	0.44982
Pittsburgh, Cincinnati, Chicago and Saint Louis Railway	0.472005	0.48094
Wabash Railroad	0.583827	0.595639
Chesapeake and Ohio Railway	0.330746	0.499263
East Tennessee and Western North Carolina Railroad	0.380686	0.498107
Illinois Central Railroad	0.242756	0.427737
Louisville and Nashville Railroad	0.541119	0.548766
Atchison, Topeka and Santa Fe Railroad	0.431823	0.38241
Burlington, Cedar Rapids and Northern Railway	0.564002	0.558837
Chicago and Northwestern Railway	0.568556	0.55949
Chicago, Burlington and Quincy Railroad	0.510797	0.485334
Chicago, Milwaukee and Saint Paul Railway	0.615092	0.623807
Chicago, Rock Island and Pacific Railway	0.437121	0.490071
Chicago, Saint Paul, Minneapolis and Omaha Railway	0.360937	0.396622
Great Northern Railway	0.35099	0.29108
Northern Pacific Railroad	0.526025	0.541311
Fremont, Elkhorn and Missouri Valley Railroad	0.149247	0.146158
Union Pacific Railway	0.50555	0.365488
Saint Louis and Saint Francisco Railway	0.465517	0.542192
Denver and Rio Grande	0.388142	0.396469
Missouri Pacific Railway	0.461758	0.480362
Saint Louis, Iron Mountain and Southern Railway	0.550478	0.577654
Southern Pacific	0.064694	0.019236
Texas and Pacific Railway	0.575059	0.575665
Oregon Short Line and Utah Northern Railway	0.601198	0.523709
Oregon Railway and Navigation Company	0.416794	0.41921

Appendix 2-3: Weighted Average Cost of Capital (1891 vs. 1896)

	WACC-1891	WACC-1896
Canadian Pacific Railway	0.030662174	0.032301546
Boston and Maine Railroad	0.070800976	0.053055613
New York, New Haven and Hartford RR	0.093961353	0.073597112
Boston and Albany Railroad	0.073332685	0.071971064
Old Colony Railroad	0.061257722	0.056782639
Fitchburg Railroad	0.032321532	0.034237068
New York and New England Railroad	0.031462682	0.008340277
Maine Central Railroad	0.061489574	0.058053576
Pennsylvania Railroad	0.053145746	0.051983777
New York Central and Hudson River Railroad	0.047521622	0.047111666
New York, Lake Erie and Western Railroad	0.027646806	0.010594489
Philadelphia and Reading Railroad	0.023101495	0.021599209
Delaware, Lackawanna and Western Railroad	0.105234308	0.106331551
Baltimore and Ohio Railroad	0.04311944	0.036133966
Lehigh Valley Railroad	0.053170753	0.051054423
Central Railroad of New Jersey	0.053794936	0.051728237
Philadelphia, Wilmington and Baltimore Railroad	0.055126527	0.06168633
Northern Central Railway	0.060898115	0.060750099
Western New York and Pennsylvania Railroad	0.023104698	0.011511545
Lake Shore and Michigan Southern Railway	0.067739469	0.065045442
Pennsylvania Co	0.02441061	0.02182606
Michigan Central Railroad	0.053990003	0.048965889
Pittsburgh, Cincinnati, Chicago and Saint Louis Railway	0.023343976	0.030808597
Cleveland, Cincinnati, Chicago and Saint Louis Railway	0.041846679	0.033683384
New York, Chicago and Saint Louis Railroad	0.019273163	0.021004742
Wabash Railroad	0.021657985	0.019809524
Cincinnati, Hamilton and Dayton Railroad	0.040225393	0.031521701
Chicago and Grand Trunk Railway	0.035482957	0.035483871
Pittsburgh and Lake Erie Railroad	0.059053533	0.0775
Columbus, Hocking Valley and Toledo Railway	0.03495516	0.035166539
Grand Rapids and Indiana Railroad	0.040263271	0.024716995
Terre Haute and Indianapolis Railroad	0.062387689	0.027851119
Norfolk and Western Railroad	0.029641677	0.025411675
Chesapeake and Ohio Railway	0.015812003	0.024916624
Atlantic Coast Line Association	0.056804114	0.054123097
Louisville and Nashville Railroad	0.052116816	0.032352805
East Tennessee and Western North Carolina Railroad	0.025598585	0.019949461
Illinois Central Railroad	0.050325683	0.065523087

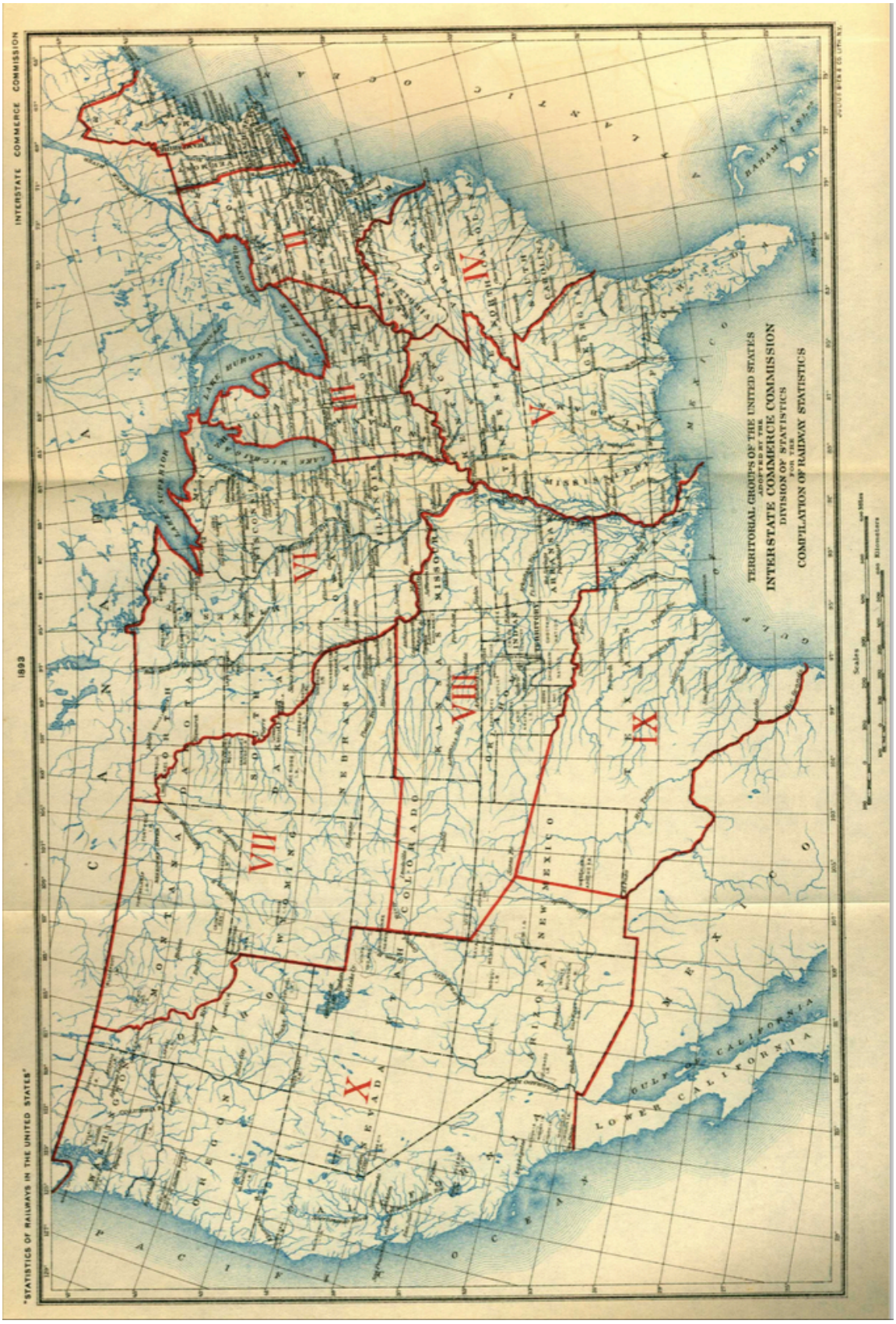
Nashville, Chattanooga and Saint Louis Railway	0.058897808	0.052447526
Cincinnati, New Orleans and Texas Pacific Railway	0.040343144	0.005720868
Mobile and Ohio Railroad	0.033016032	0.032153335
Savannah, Florida and Western Railway	0.041504531	0.041542198
Chicago and Northwestern Railway	0.052159119	0.053392582
Chicago, Milwaukee and Saint Paul Railway	0.044284744	0.051107348
Chicago, Burlington and Quincy Railroad	0.048186182	0.04710857
Chicago, Rock Island and Pacific Railway	0.048878431	0.040712453
Northern Pacific Railroad	0.037650329	0.034995547
Chicago and Alton Railroad	0.073817999	0.075443181
Chicago, Saint Paul, Minneapolis and Omaha Railway	0.032242492	0.037088125
Atchison, Topeka and Santa Fe Railroad	0.022330568	0.009288891
Wisconsin Central Co	0.019520376	0.007157123
Chicago and Eastern Illinois Railroad	0.038157738	0.039420947
Burlington, Cedar Rapids and Northern Railway	0.03473715	0.043743499
Union Pacific Railway	0.023890707	0.033340938
Fremont, Elkhorn and Missouri Valley Railroad	0.025364679	0.052205801
Missouri Pacific Railway	0.047016791	0.028298249
Saint Louis, Iron Mountain and Southern Railway	0.047696333	0.035589239
Denver and Rio Grande	0.024264405	0.023580917
Saint Louis and Saint Francisco Railway	0.030447654	0.031709103
Kansas City, Fort Scott and Memphis Railroad	0.050504787	0.035551378
Union Pacific, Denver and Gulf Railway	0.018475384	0.005955955
Atlantic and Pacific Railroad	0.009349407	0.005551056
Texas and Pacific Railway	0.013802029	0.013744567
International and Great Northern Railroad	0	0.028915928
Houston and Texas Central Railway	0	0.030737632
Oregon Short Line and Utah Northern Railway	0.036467141	0.036666325
Oregon Railway and Navigation Co	0.055603098	0.025334833

Appendix 2-4: Capital Structure (1891 vs. 1896)

	FD/TA 1891	FD/TA 1896
Canadian Pacific Railway	0.321724	0.389633
Boston and Maine Railroad	0.391877	0.403815
New York, New Haven and Hartford Railroad	0.067603	0.051843
Boston and Albany Railroad	0.321792	0.209055
Old Colony Railroad	0.420558	0.426901
Fitchburg Railroad	0.444308	0.456785
New York and New England Railroad	0.411421	0.159954
Maine Central Railroad	0.549309	0.431544
Pennsylvania Railroad	0.313477	0.313193
New York Central and Hudson River Railroad	0.360167	0.363326
New York, Lake Erie and Western Railroad	0.450677	0.465135
Philadelphia and Reading Railroad	0.719608	0.682182
Delaware, Lackawanna and Western Railroad	0.067546	0.055483
Baltimore and Ohio Railroad	0.560535	0.527574
Lehigh Valley Railroad	0.359268	0.390733
Central Railroad of New Jersey	0.604702	0.604844
Philadelphia, Wilmington and Baltimore Railroad	0.268629	0.24814
Northern Central Railway	0.559126	0.542908
Western New York and Pennsylvania Railroad	0.470444	0.567254
Lake Shore and Michigan Southern Railway	0.414558	0.4069
Pennsylvania Co	0.476981	0.417686
Michigan Central Railroad	0.402199	0.397305
Pittsburgh, Cincinnati, Chicago and Saint Louis Railway	0.472005	0.482373
Cleveland, Cincinnati, Chicago and Saint Louis Railway	0.48314	0.5512
New York, Chicago and Saint Louis Railroad	0.384704	0.391463
Wabash Railroad	0.583827	0.595491
Cincinnati, Hamilton and Dayton Railroad	0.449609	0.379768
Chicago and Grand Trunk Railway	0.604233	0.527415
Pittsburgh and Lake Erie Railroad	0.329576	0.350535
Columbus, Hocking Valley and Toledo Railway	0.572424	0.526073
Grand Rapids and Indiana Railroad	0.660623	0.663037
Terre Haute and Indianapolis Railroad	0.391361	0.395629
Norfolk and Western Railroad	0.473601	0.467646
Chesapeake and Ohio Railway	0.330746	0.502131
Atlantic Coast Line Association	0.526203	0.571617
East Tennessee and Western North Carolina RR	0.380686	0.287834
Illinois Central Railroad	0.242756	0.448293
Nashville, Chattanooga and Saint Louis Railway	0.510293	0.523482

Cincinnati, New Orleans and Texas Pacific Railway	0.001408	0.051988
Mobile and Ohio Railroad	0.664544	0.68298
Savannah, Florida and Western Railway	0.475056	0.564028
Chicago and Northwestern Railway	0.568556	0.585117
Chicago, Milwaukee and Saint Paul Railway	0.613348	0.614508
Chicago, Burlington and Quincy Railroad	0.510797	0.489974
Chicago, Rock Island and Pacific Railway	0.437121	0.488303
Northern Pacific Railroad	0.526025	0.528494
Chicago and Alton Railroad	0.33693	0.224851
Chicago, Saint Paul, Minneapolis and Omaha Railway	0.360937	0.405335
Atchison, Topeka and Santa Fe Railroad	0.431823	0.404514
Wisconsin Central Co	0.564878	6.009763
Chicago and Eastern Illinois Railroad	0.502596	0.523803
Burlington, Cedar Rapids and Northern Railway	0.564002	0.545097
Union Pacific Railway	0.50555	0.36218
Fremont, Elkhorn and Missouri Valley Railroad	0.149247	0.145378
Missouri Pacific Railway	0.461758	0.53643
Saint Louis, Iron Mountain and Southern Railway	0.550478	0.629901
Denver and Rio Grande	0.388142	0.395951
Saint Louis and Saint Francisco Railway	0.465517	0.534282
Kansas City, Fort Scott and Memphis Railroad	0.528587	0.537403
Union Pacific, Denver and Gulf Railway	0.385742	16.49281
Atlantic and Pacific Railroad	0.297606	0.240573
Texas and Pacific Railway	0.575059	0.574439
International and Great Northern Railroad	0.50045	0.615204
Houston and Texas Central Railway	0.220525	0.556335
Oregon Short Line and Utah Northern Railway	0.601198	0.552427
Oregon Railway and Navigation Co	0.416794	0.429879

Appendix 2-5: Railroad Map (1893)



Chapter 3: Cost of Capital, Capital Structure and Depreciation

1. Introduction

The late Richard Brief has noted that 19th century railroad industry had a capital costing problem because of its failure to depreciate fixed assets on a regular basis. He explained that the railroads in this era relied primarily on renewal and betterment accounting for long-term assets. The main problem with this approach is the unsystematic recognition of cost expiration. Railroad managers would write off the cost of equipment and fixed assets on an arbitrary basis. The lack of systematic cost management had the potential to enable railroad managements to manipulate earnings. The high managerial discretion with regard to capital costing could contribute to earnings variability, which would increase the perception of firm risk to investors.

The problem of capital costing was addressed by the ICC in 1906 through one of the provisions of Hepburn Act. Such costing affected two operating expense categories used by the ICC in its Annual Report on the Statistics of Railways in the United States. These were: 1. Maintenance of way and 2. Maintenance of equipment. A first category of expense called maintenance of way dealt primarily with cost associated maintaining the rail track, buildings, stations and terminals. Under Hepburn Act, the capital costing method remained renewal and betterment for this category of expense. The ICC deferred applying depreciation to fixed assets under maintenance of way because of high uncertainty about the dollar amounts assigned to fixed assets in this category. This uncertainty is due to the revaluations that had previously occurred because of bankruptcies, reorganizations and mergers since 1820s. These latter adjustments were not standardized at that time. Moreover the original records affecting long-term asset

valuations in the maintenance of way category were often lost and unavailable for contemporary analysis. The ICC later planned to address this problem by taking an inventory of those facilities to determine more reliable values. This was undertaken through the Valuation Act by 1913, an inventory-taking process which would take decades to complete.

The second category, maintenance of equipment was subject to the new rules of depreciation under Hepburn Act. There were five major subcategories of equipment including steam locomotives, electric locomotives, passenger cars, freight cars and miscellaneous equipment. The new rules were supposed to be implemented in 1907. However some firms were slow to make the transition such as Philadelphia and Reading Railroad and New York Central Railroad.

The systematic calculation of this cost was important for two reasons. First it affected the determination of enterprise income and thus affected the calculation of investor equity. Second its impact on corporate operating results also affected the determination of whether freight and passenger rates were fair and equitable. Since 1898 under the Supreme Court dictum from the *Smyth v. Ames,* the railroads were supposed to receive a fair return on the fair value of their assets committed to public service. Thus the depreciation calculations directly affected the rates for transportation services.

Previous accounting historical studies have not focused on valuating the consequences of depreciation standardization under the Hepburn Act. A well-known empirical study by Sivakumar and Waymire (2003) has evaluated the smoothing effects on reported net income that were discernable after the imposition of new law. A second

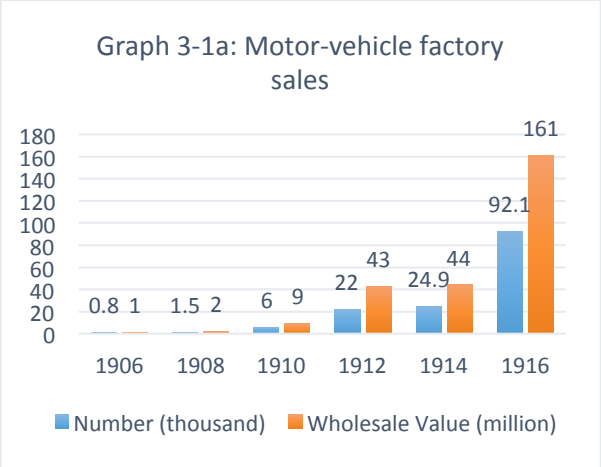
study by Heier (2006), on the other hand as concentrated on analyzing the opposition that erase within some of the railroad industry to the new accounting regulation.

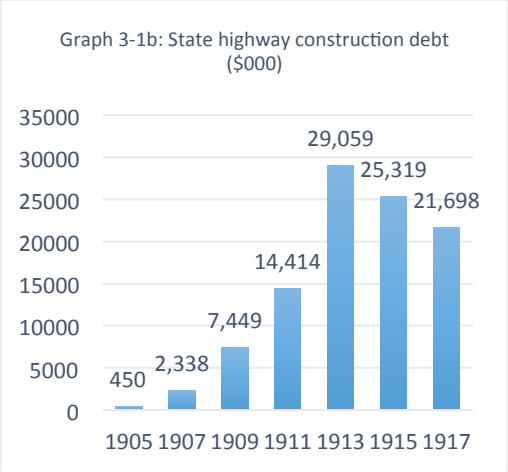
In this chapter, I examine using both MM I and MM II models whether there is an effect of depreciation application on the cost of capital and capital structure after Hepburn Act. I do this by evaluating cost of capital and capital structure before and after the imposition of mandatory depreciation rules for cost of equipment. Specifically I measure these two variables in 1905 two years before the new legislation and in 1911 four years after the legislation.

2. Railroad Industry in the early 20th century

The railroad enterprise in the USA continued to exhibit strong growth during the period 1905 to 1911. It did not experience significant freight competition from trucks until about 1912 when there was a significant increase in vehicle production (see graph 3-1a) and the expansion of the state highway construction debt (see graph 3-1b).

Graph 3-1a and Graph 3-1b: Motor vehicle factory sales and State Highway Construction debt by years





Source: Historical Statistics of the United States: Millennial Edition

In the following exhibits in this section we can see some of the major indices of railroad growth between 1905 and 1911. During this period 1905-1911 railroad mileages increased from 218,101 miles to 244,179 miles, an increase of 12%.

Table 3-12 Railroad mileage 1905-1911 (thousands)

	1905	1906	1907	1908	1909	1910	1911
Mileage	218.1	224.3	229.9	233.4	236.8	240.3	244.1

Source: Annual Report of the Statistics of Railways in the United States, 1905-1911.

Table 3-2: Classification of railways on the basis of operated mileage on June 30, 1905, 1907, and 1911.

Item	Classification of Roads		
	Class I, mileage over 1,000	All other classes	Total
1905			
Number of operating corporations	49	1,331	1,380
Aggregate mileage in class	147,299	77,897	225,196
Proportion to total mileage, percentage	65.41	34.59	100.
1907			
Number of operating corporations	51	1513	1,564
Aggregate mileage in class	155,101	81,847	236,948
Proportion to total mileage, percentage	65.46	34.54	100.
1909			
Number of operating corporations	53	1,263	1,316
Aggregate mileage in class	161,380	82,704	244,084
Proportion to total mileage, percentage	66.12	33.88	100.
1911			
Number of operating corporations	56	1256	1,312
Aggregate mileage in class	171,695	83,036	254,731
Proportion to total mileage, percentage	67.40	32.6	100.

Source: Annual Report of the Statistics of Railways in the United States, 1905-1911.

Class I railroads numbered about 49 companies in 1905 and 56 companies in 1911 and that accounted for two-thirds of the railroad mileage of the nation. Class I railroads continued to expand, growing from 147,299 miles in 1905 to 171,695 miles in 1911. The other four classes of small railroads during the same period experienced shrinkage because of continuing consolidation of the rail network in the hands of the largest enterprises. The total railroad mileage for Class II-V decreased from 1,331 in

1905 to 1256 in 1911. Total number of individual railroad companies also decreased from 1380 in 1905 to 1312 in 1911.

Graph 3-2: Comparative summary of employees, on June 30, 1905 to 1911.

Source: Annual Report of the Statistics of Railways in the United States, 1905-1911.

Graph 3-2 indicates a moderate increase in railroad employment from 1.4 million in 1905 to 1.7 million in 1911, a net increase of 20%.

Table 3-3: Summary of railway long-term capital on June 30, 1905, 1907, and 1911 ($Mns).

	1905	1907	1909	1911
STOCK				
Common	5,180.9	5,932.9	6,218.3	7,074.9
Preferred	1,373.6	1,423.9	1,467.9	1,395.8
Total	6,554.5	7,356.8	7,686.2	8,470.7
Percent of group capital	47.48	45.75	43.96	44.10
FUNDED DEBT				
Mortgage Bonds	6,024.4	6,472.8	6,942.0	7,825.2
Collateral trust bonds	-	-	1,147.3	1,183.7
Plain bonds, debentures, and notes	-	-	803.5	951.3
Income bonds	253.7	306.2	284.5	261,7
Miscellaneous obligations	786.2	1,616.4	316.3	196,4
Equipment trust obligations	186.3	329.7	307.8	319,5
Total	7,250.7	8,725.2	9,801.6	10,738.2
Percent of group capital	52.52	54.25	56.05	55.90
TOTAL RAILWAY CAPITAL	13,805.2	16,082.1	17,487.9	19,208.9

Source: Annual Report of the Statistics of Railways in the United States, 1905-1911.

Table 3-3 provides a summarization of total railroad long-term capital from 1905 to 1911. Total value increased from $13.8 billion in 1905 to $19.2 million in 1911. Slightly more than half long-term capital came from funded debt. Railroad total funded debt increased from 52.5% in 1905 to 55.9% of total railroad capital in 1911. The largest proportion of funded debt was in the form of mortgage funds that was 6,024 billion in 1905 and 7,825 billion in 1911.

Total railroad assets increased from $16.6 billion in 1905 to $18.7 billion in 1911, a net increase of 12.5%. Capital stock for the same period stayed steady at $16.7 billion. Total funded debt, however, increased from $7.56 billion to $9.15 billion, a net increase of 21%. Due to the format change in 1911, the total long-term debt was selected as being equivalent to the funded debt classification in 1905 (See illustration 3-1 and 3-2).

Illustration 3-1: General Balance Sheet for the Year Ending June 30, 1905.

Item.	Amount.	Increase.	Decrease.
ASSETS.			
Cost of road	$11,170,458,581	$389,288,643	.....
Cost of equipment	780,890,368	46,889,612	.....
Stocks owned	1,766,761,049	43,539,611	.....
Bonds owned	572,609,132	14,216,048	.....
Cash and current assets	1,014,288,239	278,076,758	.....
Materials and supplies	149,371,001	.....	$9,251,850
Sinking funds and sundries	[1] 128,588,790	5,033,417	.....
Miscellaneous	1,021,425,195	.....	42,780,071
Total	16,604,392,355	725,012,168	.....
LIABILITIES.			
Capital stock	6,680,473,280	216,967,804	.....
Funded debt	7,568,555,810	317,108,462	.....
Current liabilities	953,319,866	67,834,259	.....
Accrued interest on funded debt not yet payable	47,767,307	1,063,493	.....
Miscellaneous	759,759,031	80,237,261	.....
Profit and loss	594,517,061	41,800,889	.....
Total	16,604,392,355	725,012,168	.....

Source: Annual Report of the Statistics of Railways in the United States, 1905.

Illustration 3-2: Condensed Balance Sheet Statement as of June 30, 1911 – Class I Roads

Item.	Eastern District.	Southern District.	Western District.	Total.
ASSETS.				
Property investment:				
Road and equipment to June 30, 1907	$3,228,288,810	$1,645,790,832	$4,486,300,089	$9,360,379,731
Road and equipment since June 30, 1907	720,210,676	389,626,480	1,408,616,137	2,518,453,293
Reserve for accrued depreciation—Cr.	*59,061,571*	*65,499,970*	*85,904,857*	*210,465,798*
Net road and equipment charge	[1] 3,898,757,330	1,969,917,342	5,809,011,969	[1] 11,677,686,641
Securities of system corporations—pledged	609,455,354	83,090,460	559,230,944	1,251,776,758
Securities issued or assumed—pledged	87,603,468	55,742,000	196,786,684	340,132,152
Securities of system corporations—unpledged	429,757,320	38,413,623	498,579,207	966,750,150
Total book value of investments in system securities	1,126,816,142	177,246,083	1,254,596,835	2,558,659,060
Advances to system corporations for construction, etc	132,807,155	74,352,568	232,320,198	439,479,921
Miscellaneous investments in physical property	56,499,704	7,565,609	66,170,781	130,236,094
Miscellaneous investments in securities	350,226,962	167,594,223	655,041,087	1,172,862,272
Total property investment	5,565,107,293	2,396,675,825	8,017,140,870	15,978,923,988
Working assets:				
Cash	223,811,481	88,514,926	172,162,246	484,488,653
Securities issued or assumed, held in treasury	47,326,580	76,714,055	135,667,063	259,707,698
Marketable securities	286,660,143	18,371,643	217,199,093	522,230,879
Accounts receivable	225,736,921	34,927,004	242,010,269	502,674,194
Materials and supplies	95,549,795	31,689,580	110,912,724	238,152,099
Other working assets	3,031,492	1,054,774	2,913,267	6,999,533
Total working assets	882,116,412	251,271,982	880,864,662	2,014,253,056
Unmatured interest, dividends, and rents receivable	7,730,480	4,980,685	9,928,903	22,640,068
Deferred debit items:				
Temporary advances, working funds, etc	64,793,230	14,370,499	128,070,148	207,233,877
Rents, insurance, and taxes paid in advance	2,280,443	428,561	1,852,725	4,561,729
Unextinguished discount on securities	16,308,559	13,940,080	51,105,321	81,353,960
Cash and securities in sinking and other special funds	68,013,982	5,483,308	51,960,545	125,457,835
Miscellaneous deferred debit items	73,094,144	14,696,826	45,409,614	133,200,584
Total deferred debit items	224,490,358	48,919,274	278,398,353	551,807,985
Profit and loss—debit balance	45,019,645	10,503,887	54,853,620	110,377,152
Total	6,724,464,188	2,712,351,653	9,241,186,408	18,678,002,249

Item.	Eastern District.	Southern District.	Western District.	Total.
LIABILITIES.				
Stock:				
Common stock	$2,148,106,748	$724,098,750	$2,652,442,395	$5,524,647,893
Preferred stock	356,728,785	145,304,050	654,926,918	1,156,959,753
Debenture stock	104,000	11,784,000	3,693,200	15,581,200
Receipts outstanding for installments paid	1,871,635	3,800	3,456,495	5,331,930
Stock liability for conversion, etc	1,382,038	58,550	430,707	1,871,295
Premiums realized on capital stock	45,968,360	2,949,880	182,448	49,100,688
Total stock liability	2,554,161,566	884,199,030	3,315,132,163	6,753,492,759
Mortgage, bonded, and secured debt:				
Mortgage bonds	1,886,757,096	1,197,083,050	3,237,504,651	6,321,344,797
Collateral trust bonds	409,000,143	138,023,200	627,067,475	1,174,090,818
Debentures, etc	614,229,715	46,801,036	190,388,620	851,419,371
Income bonds	26,145,500	79,589,277	126,845,624	232,580,401
Equipment trust obligations	177,983,146	63,074,560	64,719,570	305,777,276
Miscellaneous funded obligations	19,710,213	717,000	166,293,850	186,721,063
Receipts outstanding for funded debt	1,000	.....	442,660	443,660
Receivers' certificates	8,761,531	.....	.....	8,761,531
Obligations for advances for construction, etc	2,991,639	1,653,510	35,263,207	39,908,356
Total long-term debt	3,145,579,983	[1] 1,560,040,633	4,448,525,657	[1] 9,154,146,273
Working liabilities	330,326,789	77,928,260	515,382,168	923,637,217
Accrued liabilities, not due	64,482,210	27,845,841	70,467,621	162,795,672
Deferred credit items:				
Operating reserves	5,146,175	7,940,435	11,151,832	24,238,442
Miscellaneous deferred credit items	62,211,685	6,403,590	33,515,566	102,130,841
Total deferred credit items	67,357,860	14,344,025	44,667,398	126,369,283
Appropriated surplus:				
Additions to property since June 30, 1907, through income	122,824,237	23,707,236	69,196,987	215,728,460
Reserves from income or surplus	85,715,343	5,745,098	68,204,503	159,664,944
Total appropriated surplus	208,539,580	29,452,334	137,401,490	375,393,404
Profit and loss—credit balance	354,016,200	113,541,530	709,609,911	1,182,167,641
Total	6,724,464,188	2,712,351,653	9,241,186,408	18,678,002,249

Source: Annual Report of the Statistics of Railways in the United States, 1911.

Railways gross earnings and income amounted to $2.1 billion in 1905 and increased to $2.8 billion in 1911, a net increase of $0.7 billion and 33.9%. The total net earnings and income from rail operations in 1905 amounted to $743 million. This corresponds to total net revenue figure of $875.1 million in 1911, a net increase of $132

million and 17.7%. Differences in the classification titles between 1905 and 1911 result in change in format introduced by the ICC in 1910 (See illustration 3-3 and 3-4).

Illustration 3-3: Comparative Income Account of the Railways in the United States, Considered as a System, for the Years Ending June 30, 1905 and 1904.

Item.	Amount.				
	1905.		1904.		Increase.
Gross earnings from operation.	$2,082,482,406	.....	$1,975,174,091	.....	$107,308,315
Clear income from investments.	51,725,750	.....	49,380,970	.....	2,344,780
Gross earnings and income.	.....	$2,134,208,156	.....	$2,024,555,061	109,653,095
Operating expenses	1,390,602,152	.....	1,338,896,253	.....	51,705,899
Salaries and maintenance of leased lines.	612,518	.....	453,341	.....	159,177
Total	.....	1,391,214,670	.....	1,339,349,594	51,865,076
Net earnings and income.	.....	742,993,486	.....	685,205,467	57,788,019
Net interest on funded debt.	294,803,884	.....	282,118,438	.....	12,685,446
Interest on current liabilities.	11,451,400	.....	13,945,009	.....	[1] 2,493,609
Taxes	63,474,679	.....	61,696,354	.....	1,778,325
Total	.....	369,729,963	.....	357,759,801	11,970,162
Available for dividends, adjustments, and improvements.	.....	373,263,523	.....	327,445,666	45,817,857
Net dividends	.....	188,175,151	.....	183,754,236	4,420,915
Available for adjustments and improvements.	.....	[2] 185,088,372	.....	[2] 143,691,430	41,396,942

Source: Annual Report of the Statistics of Railways in the United States, 1905.

Illustration 3-4: Comparative Income Account and Profit and Loss Account of the Railways in the United States, Considered as a System, for the Years Ended June 30, 1911 and 1910.

Item.	Amount.				Increase (or decrease).
	1911		1910		
Operating revenues—rail operations	$2,789,761,669		$2,750,667,435		$39,094,234
Operating expenses—rail operations	1,915,054,005		1,822,630,433		92,423,572
Salaries and maintenance of organization—nonoperating companies	418,987		332,242		86,745
Net revenue from rail operations		$874,288,677		$927,704,760	53,416,083
Outside operations—revenues	63,093,052		61,474,140		1,618,912
Outside operations—expenses	61,277,859		59,248,685		2,029,174
Net revenue from outside operations		1,815,193		2,225,455	410,262
Total net revenue		876,103,870		929,930,215	53,826,345
Taxes accrued		108,309,512		103,795,701	4,513,811
Operating income		767,794,358		826,134,514	58,340,156
Other income:					
Miscellaneous rent credits	8,169,165		6,515,218		1,653,947
Separately operated property—net profits			2,278,720		2,278,720
Net dividends receivable on stocks owned or controlled [1]	24,718,089		28,069,039		3,350,950
Net interest receivable on funded debt owned or controlled [1]	7,737,796		5,964,331		1,773,465
Interest receivable on other securities, loans, and accounts	32,099,538		30,650,925		1,448,613
Unextinguished premiums on outstanding funded debt	25,404				25,404
Miscellaneous income	5,065,353		9,253,557		4,188,204
Total other income		77,815,345		82,731,790	4,916,445
Gross income		845,609,703		908,866,304	63,256,601
Deductions from gross income:					
Net rents accrued for lease of other roads [1]	5,086,947		2,834,991		2,251,956
Hire of equipment—net debit balance [1]	17,728,770		15,841,144		1,887,626
Joint facilities—net debit balance [1]	11,467,828		11,289,579		178,249
Miscellaneous rent debits	5,699,268		4,499,260		1,200,008
Separately operated property—net loss	318,690				318,690
Net interest accrued on funded debt [1]	380,411,667		370,092,222		10,319,445
Other interest	26,197,537		16,520,342		9,677,195
Extinguishment of discount on securities	1,888,241		565,337		1,322,904
Sinking and redemption funds chargeable to income	5,969,057		5,886,977		82,080
Other deductions	12,153,303		9,973,828		2,179,475
Total deductions from gross income		466,921,308		437,503,680	29,417,628
Net corporate income for year		378,688,395		471,362,624	92,674,229
Balance in profit and loss on June 30 of preceding year		1,036,128,621		858,514,871	177,613,750
Gross surplus		1,414,817,016		1,329,877,495	84,939,521
Adjustments, etc., through profit and loss:					
Credits	170,717,500		204,676,780		33,959,280
Debits	96,082,991		125,445,339		29,362,348
Net adjustment		74,634,509		79,231,441	4,596,932
Surplus available for appropriation		1,489,451,525		1,409,108,936	80,342,589
Appropriations for year:					
Net dividends declared [1]	291,497,164		293,836,863		2,339,699
Appropriations for additions and betterments	58,740,315		58,687,516		52,799
Appropriations for new lines or extensions	3,518,628		219,436		3,299,192
Appropriations for other reserves	7,897,134		3,581,342		4,315,792
Total appropriations for year		361,653,241		356,325,157	5,328,084
Balance on June 30 carried to general balance sheet		1,127,798,284		1,052,783,779	75,014,505

Source: Annual Report of the Statistics of Railways in the United States, 1911.

The following tables provide an overview of selected operating balances for the railroad industry during the period 1905-1911.

Table 3-4: Summary showing passenger and freight service of railways for the years ending June 30, 1905, 1907, 1909, and 1911.

	Number of passengers carried earning revenue ($Mns)	Number of tons carried of freight earning revenue ($Mns)
1905	738.8	1,427.7
1907	873.9	1,796.3
1909	891.4	1,556.5
1911	997.4	1,781.6

Source: Annual Report of the Statistics of Railways in the United States, 1905-1911.

Table 3-4 indicates that railroad industry experienced moderate growth both in terms of passenger and freight revenue during the period 1905 to 1911. Total passengers carried earning revenue grew from $738.8 million in 1905 to $997.4 million in 1911 and an increase of 35%, total number of tons carried of freight earning revenue increased from $1.4 billion in 1905 to $1.7 billion in 1911 and increased of 24%. During this period the highest tonnage of freight transported was registered in 1907 as $1.7 billion. The subsequent decline in tonnage data probably reflects the beginning competition of trucks for short term and medium range of haulage.

Table 3-5: Comparative Summary of Earnings and Income for the Years Ending June 30, 1905-1911 ($Mns)

Source of Income	**1905**	**1907**	**1909**	**1911**
Passenger Revenue	483.7	564.6	563.6	657.6
Mail	45.4	50.3	49.3	50.7
Express	45.1	57.3	59.6	70.7
Freight Revenue	1,455.8	1,823.6	1,677.6	1,925.9
Other earnings from operation	52.4	93.3	68.5	84.8
Total earnings from operation	2,082.4	2,589.1	2,418.6	2,789.7

Source: Annual Report of the Statistics of Railways in the United States, 1905-1911.

The major source of railroad revenue derives from freight transportation, which increases from $1.45 billion in 1905 to $1.92 billion in 1911, and net increase of %32.

Table 3-13: Comparative Summary of Expenditures and Analysis of Operating Expenses for the Years Ending June 30, 1905-1911 ($Mns).

Source of Expenditure	**1905**	**1907**	**1909**	**1911**
Maintenance of way and structures	275.0	343.5	308.5	366.0
Maintenance of equipment	288.4	368.0	363.9	428.3
Conducting transportation	771.2	970.9	863.4	987.3
Traffic Expenses	-	-	-	59.1
General Expenses	55.3	65.4	63,6	73.6
Unclassified	0.5	0.5	0.02	-
Total Operating Expenses	1,390.6	1,748.5	1,599.4	1,914.6

Source: Annual Report of the Statistics of Railways in the United States, 1905-1911.

Total operating expenses increase from $1.4 billion in 1905 to $1.9 billion in 1911. Maintenance of equipment however increased from $288 million to $428 million, a 48% increase that partially reflected the impact of the new depreciation rules.

Table 3-7: Classification of Maintenance of Equipment for the Year Ending June 30, 1905.

Maintenance of Equipment	**Amount**	**Proportion to total operating expenses**
Superintendence	7,831,963	.565
Repairs and renewals of locomotives	114,988,428	8.290
Repairs and renewals of passenger cars	27,342,129	1.971
Repairs and renewals of freight cars	113,723,239	8.199
Repairs and renewals of work cars	3,360,390	.242
Repairs and renewals of marine equipment	2,650,543	.191
Repairs and renewals of shop machinery and tools	9,186,101	.663
Stationery and printing	595,571	.043
Other expenses	8,334,240	.601
TOTAL	288,012,604	20.765

Source: Annual Report of the Statistics of Railways in the United States, 1905-1911.

In 1905 the total maintenance of equipment was $288 million. The two most important categories were repairs and renewals of locomotives and freight cars which together amounted 16.4% of total operating expenses.

Table 3-8: Classification of Maintenance of Equipment for the Year Ending June 30, 1911.

Maintenance of Equipment	Amount	Proportion to total operating expenses
Superintendence	12,190,546	.661
Steam locomotives-repairs	148,307,229	8.042
Steam locomotives-renewals	2,689,558	.146
Steam locomotives-depreciation	12,856,596	.697
Electric locomotives-repairs	293,256	.016
Electric locomotives-renewals	1,776	0
Electric locomotives-depreciation	22,116	0.001
Passenger-train cars repairs	31,298,768	1.697
Passenger-train cars renewals	1,136,478	.062
Passenger-train cars depreciation	5,313,650	.288
Freight-train cars repairs	137,765,844	7.471
Freight-train cars renewals	11,017,699	.597
Freight-train cars depreciation	30,211,254	1.638
Electric equipment of cars repairs	176,253	.010
Electric equipment of cars renewals	-	-
Electric equipment of cars depreciation	46,389	.003
Floating Equipment repairs	917,058	.050
Floating Equipment renewals	106,536	.006
Floating Equipment depreciation	380,475	.021
Work Equipment repairs	4,118,536	.223
Work Equipment renewals	887,575	.048
Work Equipment depreciation	989,215	.054
Shop machinery and tools	10,061,423	.546
Power plant equipment	136,485	.008
Injuries to persons	1,603,524	.087
Stationery and printing	1,052,749	.057
Other expenses	1,372,320	.074
Maintaining joint equipment at terminals-Dr	1,519,217	.082
Maintaining joint equipment at terminals-Cr	*882,125*	*.048*
Total Maintenance of equipment	415,590,400	22.537

Source: Annual Report of the Statistics of Railways in the United States, 1905-1911.

Total maintenance of equipment in 1911 increased to $415 million. This included the five depreciation accounts, which that year amounted to $49,819,695 and represented 2.7% of total operating expenses. This percentage is large in comparison to the Net Income percentage of all Class I roads which in 1911 was $874.2 million.

3. Cost of capital and capital structure

3.1. Cost of capital

In my test I will evaluate the impact of the onset of depreciation expense by using MM I and, MM II under Hepburn Act on railroad cost of capital (see formula below). Under the Hepburn Act the depreciation during this period was limited to the maintenance of equipment expense category, which included freight and passenger cars and, steam and engines. My sample of 41 companies includes enterprises with trackage in excess of 1000 miles. The 1905 data does not reflect the effects of depreciation, the main capital cost being renewals and betterments. The 1911 data by contrast reflects the effects of depreciation.

In this analysis I have a paired sample of 41 companies of 1905 and 1911. These enterprises were classified as Class I by the ICC, which meant they operated rail systems more than 1000 miles of track. The sample was first taken from 1911 data that met this category. The 1905 information included those firms that appeared in 1911 sample.

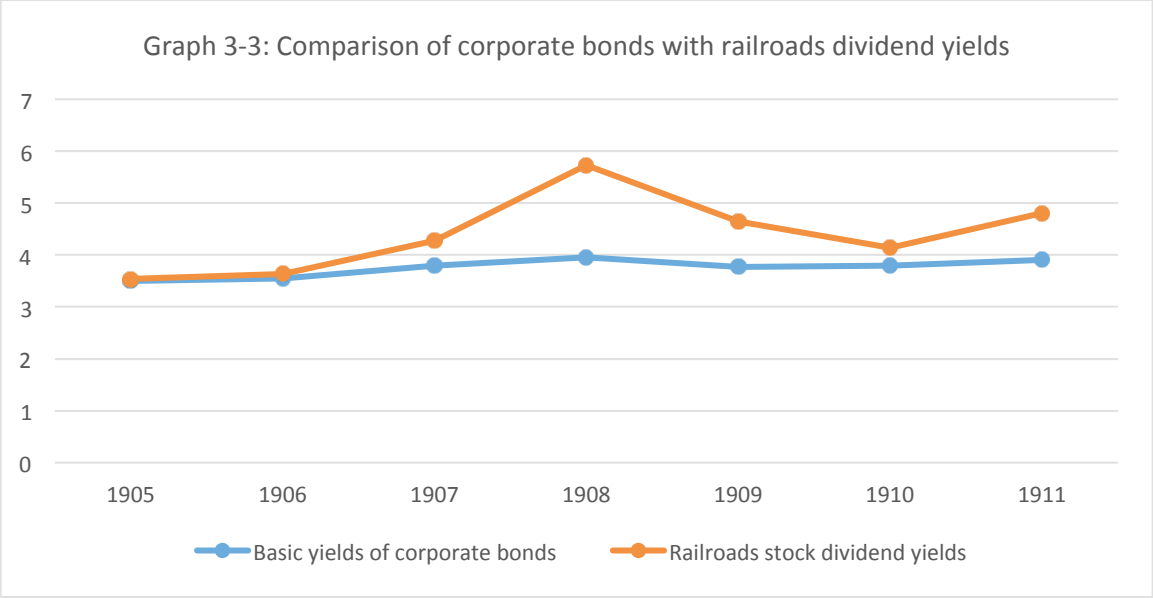
The design of this test is analogous to the research of MM involving comparisons of cost of capital before and after the imposition of income taxes (Modigliani and Miller, 1958, 1963). The original MM comparison in 1958 indicated that the cost of capital would be the same for enterprises operating in perfect markets. The second study in 1963, however, factored the effects of income taxes, a change which demonstrated that the cost of capital would go down with the deductibility of interest expense. In this latter case borrowing helped to reduce the cost of capital. My study is analogous to MM 1963 studies to the extent that I isolate the effects of depreciation expense on cost of capital. I

do this by comparing cost of capital for samples of firms in 1905, prior to imposition of mandatory depreciation and 1911, the comparative year during which the ICC required railroads to depreciate their equipment.

Increased depreciation expense should increase the cost of capital associated with common stock investment. Higher expense should translate to lower net income on average. Since dividends must be paid from either earned surplus or current net income, the increase in expense will reduce the amount available to fund dividend payments. This intuition was supported by the trend in railroad dividend yields for the period in 1905 the average dividend yield was 3.54%, the yield increased to 4.80% in 1911, net growth of 35%. This suggests that investors' expectations for future profit growth had deteriorated. This is consistent with increasing operating cost due to depreciation expense mandates. During the same time period the average interest on corporate bonds increased from 3.50% to 3.90%, an increase of net 11%. While corporate bond yields and dividend yields were almost identical in 1905, the cost of equity capital significantly increased by 1911. However as we shall see in our test, railroad investors responded this change by shifting their portfolio preferences very significantly from stocks to bonds. This shift helped to keep the overall cost of capital lower than it might have been if investors continued to hold the same level of stocks as in 1905. This change was also reflected in the declining percentage of common and preferred stock as part of long-term capitalization.

On bond side there was a substantial increase in debentures and notes and collected trust bonds especially beginning of 1909.

Graph 3-3: Comparative basic yields of corporate bonds vs. railroad stock dividend yields or the years 1905-1911.



Source: Historical Statistics of the United States: Millennial Edition

Depreciation could also have an adverse impact on bond value. Higher depreciation expense would reduce the amount of earnings available to cover current interest charges. The expected deterioration in interest coverage would increase investor's risk perceptions. The increase in risk perceptions in turn would translate to a demand for a higher risk premium on bond.

However this did not happen to a great degree at this time period. Even though the funded debt grew substantially from $7.2 billion in 1905 to $10.7 billion in 1911. The interest rate increase for all corporate bond yields were modest, growing from 3.50% in 1905 to 3.90% in 1911, a net increase of 11%.

The differences in rate changes between bonds and common stock suggests that contemporary investors were more sensitive to the impact of depreciation on Net Income.

Although the systematic recognition of depreciation would decrease future earnings, investors would see the more clearly the magnitude and rate of change applicable to this category of expense over time. Total depreciation expense is material when compared to total railroad operating income. For example, the total depreciation expense in 1911 for entire railroad industry amounted to $49,819,695. This represented 2.70% of the operating expense incurred by Class I railroads that year. It was also an amount that represented 6.4% of the Class I net operating income for that same year.

The increasing trend in cost of equity over cost of debt during the period 1905-1911 suggests that investors were concerned about stock valuations and operating income. The changes in relative cost are consistent with a growing perception of increased stock investment risk and a general desire to populate portfolios with low risk bonds. This tendency brought about by risk aversion would have shifted the relative demand curves for bonds and stocks. The demand for stocks would go down and which would have the effect of increasing yields, the demand for bonds would have gone up and have had the effect of lowering yields.

In my test the main impact of depreciation will be on both factors of the formula for weighted average cost of capital. This reflects the potentially adverse effect on investor perceptions about the ability of sample companies to fund future dividends and interest payments.

Our basic formula to determine WACC is as followed:

$$WACC = \frac{SE}{SE + LTD} R_{SE} + \frac{LTD}{SE + LTD} R_{LTD} (1 - TR)$$

SE = Stockholders' equity

LTD= Long-term Debt

$R_{SE} = \frac{Dividends}{SE}$

$R_{LTD} =$ *Interest rate on long-term debt*

TR = tax rate

Under MM I, the expectation is that there will be no change in cost of capital. Thus,

H_0: The cost of capital will exhibit statistically significant change between 1905 and 1911.

H_1: The cost of capital will not exhibit any statistically significant change between 1905 and 1911.

My expectation is that cost of capital will rise because of the imposition of systematic depreciation expense recognition. The hypotheses for this test are as follows:

H_0: Cost of capital in 1911 should not show a statistically significant change over 1905.

H_1: Cost of capital in 1911 should show a statistically significant increase over 1905.

3.2. Capital structure

My second test involves the effect of new depreciation rules under Hepburn on capital structure consistent with the trends noted in the relative costs of capital for equity and debt, the expectation would be for a relative increase in debt over equity as a source of long-term capital.

In fact debt as a percentage of total capitalization did increase from 1905 to 1911. The total amount of railroad capital from funded debt increased from 52.52% in 1905 to 55.9% in 1911. The total percentage of railway capital from common and preferred stock decreased from 47.5% in 1905 to 44.1% in 1911. During this period also the depreciation was not associated with any offsetting tax benefit due to deductibility. The federal corporate net income tax was not introduced by 1913.

Although the depreciation expense could reduce the earnings coverage over interest expense the charge was minimum. I have used the following formulas to calculate the change the Times Interest Earned (TIE) ratio for Class I roads for 1911. The two formulas are;

$$Times\ Interest\ Earned = \frac{Operating\ Revenue\ -\ Operating\ Expense}{Interest\ on\ funded\ debt}$$

$$Times\ Interest\ Earned = \frac{\$2418.6 - \$1599.4}{\$343.8} = \$2.38$$

In 1911 however the equation changed, reducing the amount of income to service interest charges. This calculation is concentrated with a second variation that eliminates the effect of depreciation in 1911. That equation is;

$$Adjusted\ Times\ Interest\ Earned = \frac{Operating\ Revenue\ -\ Operating\ Expense + Depreciation\ Expense}{Interest\ on\ funded\ debt}$$

$$Adjusted\ Times\ Interest\ Earned = \frac{\$2418.6\ - \$1599.4 + \$49.8}{\$343.8} = \$2.52$$

The calculation of TIE ratio indicates $2.38 a-net-revenue for every dollar of interest on funded debt. The adjusted TIE is calculated by eliminating the depreciation effect indicates coverage of $2.52 or each dollar of interest expense on funded debt.

The difference between these two calculations is 5.88% that probably did not seem to be much of an increase in risk to investors in 1911.

The consequent lower interest coverage because of depreciation contributes to a higher risk perception about bond investment.

The simultaneous increase in risk perceptions of both bonds and stocks brought about by the depreciation expense I argue contributed to a shift toward increased debt finance. The main reason is that investors confronting greater overall market risk would gravitate to the class of investment security with stronger property rights. Bonds with mandatory interest requirements and preferences in bankruptcy and reorganization were perceived as less risky than bonds. The advent of depreciation expense changed public perceptions about the basic profitability of the railroad industry. The finance burden was increased because of the need to recognize substantial charges that previously had been ignored prior to Hepburn Act depreciation rules.

I measure capital structure for both MM I and, MM II models by contrasting total funded debt over total assets. For 1905 total assets were not affected by accumulated depreciation but 1911 total asset number is net of accumulated depreciation.

$$Capital\ Structure\ Ratio = \frac{Total\ Funded\ Debt}{Funded\ Debt + Common\ Stock}$$

My hypotheses for testing MM I are:

H_0: The capital structure ratio in 1911 will show statistically significant change as compared to 1905.

H_1: The capital structure ratio in 1911 will show no statistically significant change as compared to 1905.

Because of the expectation that bonds would be preferred over common stock during the period of increasing depreciation expense. I posit the following hypothesis for MM II.

H_0 : 1911 capital structure shift to increased bonds over equity will not be statistically significant.

H_1: 1911 capital structure shift to increased bonds over equity will be statistically significant.

4. Data, Methodology, and Results

4.1. Cost of Capital

In evaluating the cost of capital, I used the Wilcoxon sign rank test. This involved the pairing the sample companies from 1905 and 1911 and determining the overall cost of capital increased or decreased. The sample consisting 41 firms showed decrease in 25 cases and increase in 16 cases. This translates to a sum ranks value of 527 for positive and 334 for negative. Using STATA program we calculated a z score of 1.25, which equates a confidence probability of greater than 21%. The threshold for statistical

significance should be no greater than 5%. These results affirm the predictions of MM I but do not affirm the predictions of MM II (see table 3-10).

Table 3-9: Wilcoxon signed-rank test for overall WACC.

```
. signrank A=B

Wilcoxon signed-rank test

        sign |      obs   sum ranks    expected
-------------+---------------------------------
    positive |       25         527       430.5
    negative |       16         334       430.5
        zero |        0           0           0
-------------+---------------------------------
         all |       41         861         861

unadjusted variance     5955.25
adjustment for ties        0.00
adjustment for zeros       0.00
                     ----------
adjusted variance       5955.25

Ho: A = B
             z =   1.250
    Prob > |z| =   0.2111
```

4.2. Capital Structure

The capital structure test also involved the use of Wilcoxon sign rank test. In this case, capital structure was defined as;

Capital Structure = par value of funded debt + par value of stock

$$\text{Capital Structure Ratio} = \frac{Par\ Value\ of\ Funded\ Debt}{Par\ Value\ of\ Funded\ Debt + Par\ Value\ of\ Common\ Stock}$$

My sample included 41 companies, 11 showed positive sign indicated a net increase in funded debt. Using the STATA program we determined a z-value that is -

3.116 and this yields a confidence probability level less than 1%. This result does not affirm MM I but it does affirm MM II (see Table 3-11).

Table 3-10: Wilcoxon signed-rank test for overall capital structure

```
. signrank A=B

Wilcoxon signed-rank test

        sign |      obs   sum ranks    expected
-------------+---------------------------------
    positive |       11         190       430.5
    negative |       30         671       430.5
        zero |        0           0           0
-------------+---------------------------------
         all |       41         861         861

unadjusted variance     5955.25
adjustment for ties        0.00
adjustment for zeros       0.00
                     ----------
adjusted variance       5955.25

Ho: A = B
             z =  -3.116
    Prob > |z| =   0.0018
```

4.3. Cost of Debt

In addition to the calculation of overall cost of capital, I also performed a separate test relating to the changes in the cost of debt between 1905 and 1911. I used the Wilcoxon signed-rank test (See table 3-12). The formula that I used to calculate cost of debt was below,

$$\text{Cost of Debt} = \frac{Interest\ on\ Funded\ Debt}{Funded\ Debt}$$

The result indicates a statistically significant decrease in the cost of debt. This finding shows that although the cost of debt was declining, it was not sufficiently large to

offset the corresponding increase in cost of equity capital. This finding is also consistent with the pattern noted earlier in the paper, which showed an increase in the relative amount of debt in the capital structure of the railroads and a very modest increase in interest rates.

Table 3-11: Wilcoxon signed-rank test for overall cost of debt

```
. signrank A=B

Wilcoxon signed-rank test

        sign |      obs   sum ranks    expected
-------------+---------------------------------
    positive |       28         625       430.5
    negative |       13         236       430.5
        zero |        0           0           0
-------------+---------------------------------
         all |       41         861         861

unadjusted variance     5955.25
adjustment for ties        0.00
adjustment for zeros       0.00
                     ----------
adjusted variance       5955.25

Ho: A = B
             z =   2.520
    Prob > |z| =   0.0117
```

5. Conclusion

My findings tend to affirm the predictions of MM I for cost of capital but not for capital structure. My findings do not affirm MM II with respect to cost of capital but does affirm MM II with respect to capital structure. For MM II, I discover a statistically significant change in capital structure from stock to bond finance but no corresponding statistically significant change in WACC. My results differ from MM II not because taxes reduced the cost of debt capital but instead reflected an apparent belief by

contemporary investors that depreciation expense would have a greater negative impact on equity capital in the long term.

In the case of railroads, the perceptions of lower income due to the unsettled depreciation had a greater impact on investor negative perceptions about common stock rather than bonds. The possibility to the shift between stock and bond contracts had affected on the overall cost of capital. The increase in dividend rates was offset by a relative decrease in the amount of common stock outstanding and also the increase in debt, which experienced only a small increase in interest cost. This had the effect of keeping the change in overall cost of capital at a statistically insignificant level.

Managers accommodated to the imposition of mandatory rules for depreciation by moderating their financial risk. They shifted to greater reliance on bond finance because it had very minor impact on risk as measured by using a ratio such as Times Interest Earned (TIE). The anticipated effect on net income and dividend payment ability was far more negative as reflected in increase in dividend rates and a declining portion of equity as a percentage of total railroad capital. Although the relative amount of debt increased, the relative cost of debt capital declined because of stagnant interest rates. The increased cost of equity capital offset by the increase in bond capital did not have a statistically significant impact on cost of capital.

This result differs from that found in the previous chapter dealing with the effect of financial market crisis in the 1890s. The principal difference is that depreciation seems to have more uniform impact on sample firms than the shock of securities market decline. The stock market decline had a differential effect on railroads because of their ability to

moderate risk by using different mixes of equity and debt. In the case of depreciation the ability to offset the impact of an increase in operating expenses was difficult because of the new depreciation charge pertained to equipment which was a major proportion of assets on all railroad company balance sheets.

Another implication for the interpretation of MM II is that material increases in operating expenses can motivate changes in capital structure as a means for avoiding increases in cost of capital. As seen in this case, managers had a strong incentive to modify capital structure so as to lower the overall cost of capital.

In this period neither the depreciation expense nor the interest expense had any tax implication, because the data reflected conditions that existed before the imposition of a federal corporate income tax in 1913. Had there been an income tax in 1911 the results of the study would have reflected an additional lowering of the cost of bond debt because of the deductibility interest. The tax savings would have been equivalent to,

$$\text{Tax savings} = \text{pre-tax income} \times (1\text{- tax rate})$$

The decrease in the debt cost of capital would have extenuated the decrease in bond cost of capital because of the deductibility of depreciation and interest. The cost of equity capital however would not have been affected from the imposition of ta because the interest tax and depreciation expenses in combination would have reduced the net income available to pay dividends.

Appendix 3-1: Weighted Average Cost of Capital 1905 vs. 1911.

	WACC-1905	WACC-1911
Boston and Maine Railroad	0.054482465	0.038554478
New York, New Haven and Hartford Railroad	0.075044639	0.052498947
Baltimore and Ohio Railroad	0.039759351	0.044022023
Erie Railroad	0.030494111	0.024726641
Lehigh Valley Railroad	0.041639385	0.050679928
Pennsylvania Railroad	0.054105132	0.048469673
Pere Marquette Railroad	0.031198418	0.025511148
Norfolk and Western Railway	0.036109266	0.044705372
Pennsylvania Co	0.04516001	0.050319024
Pittsburgh, Cincinnati, Chicago and Saint Louis Railway	0.038286521	0.006169729
Southern Railway	0.030543314	0.024812801
Wabash Railroad	0.020057938	0.02214843
Atlantic Coast Line Railroad	0.053655337	0.04358321
Louisville and Nashville Railroad	0.050348761	0.046183738
Seaboard Air Line Railway	0.023491038	0.023475489
Chesapeake and Ohio Railway	0.050348761	0.041955496
Nashville, Chattanooga and Saint Louis Railway	0.055783234	0.023125999
Central of Georgia Railway	0.037329441	0.04290682
Illinois Central Railroad	0.06472893	0.042835194
Yazoo and Mississippi Valley Railroad	0.022319209	0.033002004
Atchison, Topeka and Santa Fe Railway	0.040436226	0.045934887
Minneapolis, Saint Paul and Sault Sainte Marie Railway	0.042004927	0.045972348
Chicago and Northwestern Railway	0.055996035	0.051616905
Chicago, Burlington and Quincy Railroad	0.053793856	0.052984443
Chicago, Milwaukee and Saint Paul Railway	0.058494361	0.035443381
Chicago, Rock Island and Pacific Railway	0.026797297	0.044310502
Chicago, Saint Paul, Minneapolis and Omaha Railway	0.057121548	0.057967356
Great Northern Railway. Co	0.037858758	0.049622186
Northern Pacific Railway	0.052273849	0.051656407
Union Pacific Railroad	0.044638316	0.064803021
Colorado and Southern Railway	0.012138649	0.034872651
Denver and Rio Grande Railroad	0.03362342	0.029883659
Missouri, Kansas and Texas Railway	0.022633356	0.020891937
Missouri Pacific Railway	0.045400788	0.022255058
Saint Louis, Iron Mountain and Southern Railway	0.053763973	0.030333604
Saint Louis and San Francisco Railroad	0.034949477	0.027290738
Gulf Colorado and Santa Fe Railway	0.067349795	0.027490602
International and Great Northern Railroad	0.038961741	0.033751839
Texas and Pacific Railway	0.029016511	0.01704109
San Pedro, Los Angeles and Salt Lake Railroad	0	0.02607896
Southern Pacific Co	0.019266622	0.052822263

Appendix 3-2: Capital Structure 1905 vs. 1911

	1905	1911
Boston and Maine Railroad	0.404256956	0.385483657
New York, New Haven and Hartford Railroad	0.074507567	0.432881804
Baltimore and Ohio Railroad	0.523375967	0.548617758
Erie Railroad	0.485268622	0.508403943
Lehigh Valley Railroad	0.509526163	0.476362534
Pennsylvania Railroad	0.230435398	0.307166676
Pere Marquette Railroad	0.624850033	0.73014537
Norfolk and Western Railway	0.429303746	0.476119438
Pennsylvania Co	0.61206391	0.51081705
Pittsburgh, Cincinnati, Chicago and Saint Louis Railway	0.504316711	4.276279586
Southern Railway	0.414387186	0.58333186
Wabash Railroad	0.621143402	0.550418091
Atlantic Coast Line Railroad	0.506710638	0.610036368
Louisville and Nashville Railroad	0.562467028	0.59735552
Seaboard Air Line Railway	0.455727785	0.646914758
Chesapeake and Ohio Railway	0.562467028	0.689452093
Nashville, Chattanooga and Saint Louis Railway	0.51122314	0.445346979
Central of Georgia Railway	0.859211523	0.803049873
Illinois Central Railroad	0.293365473	0.567793253
Yazoo and Mississippi Valley Railroad	0.864111782	0.73533649
Atchison, Topeka and Santa Fe Railway	0.482800372	0.490918793
Minneapolis, Saint Paul and Sault Sainte Marie Railway	0.606913507	0.569969455
Chicago and Northwestern Railway	0.599705295	0.499576801
Chicago, Burlington and Quincy Railroad	0.454289336	0.450713449
Chicago, Milwaukee and Saint Paul Railway	0.449662183	0.439054754
Chicago, Rock Island and Pacific Railway	0.516201439	0.663434334
Chicago, Saint Paul, Minneapolis and Omaha Railway	0.420702251	0.409674466
Great Northern Railway. Co	0.397239372	0.47963292
Northern Pacific Railway	0.387734681	0.459218974
Union Pacific Railroad	0.302906775	0.293065684
Colorado and Southern Railway	0.288946919	0.4663852
Denver and Rio Grande Railroad	0.459689041	0.536724315
Missouri, Kansas and Texas Railway	0.498885941	0.581276207
Missouri Pacific Railway	0.498820592	0.671900842
Saint Louis, Iron Mountain and Southern Railway	0.647290078	0.718044768
Saint Louis and San Francisco Railroad	0.403174492	0.738458634
Gulf Colorado and Santa Fe Railway	0.389902426	0.866879165
International and Great Northern Railroad	0.630660161	0.321386022
Texas and Pacific Railway	0.560703438	0.532774678
San Pedro, Los Angeles and Salt Lake Railroad	0	0.614933564
Southern Pacific Co	0.122442242	0.219872811

Appendix 3-3: Railroad Map (1905)

Chapter 4: Cost of Capital and Capital Structure with a Material Increase in Taxes

1. Introduction

In this chapter I evaluate my findings using only the MM II model as a basis for testing predictive value. This chapter in effect is a direct replication of the research underlying MM II. In this section I test MM II by comparing changes in cost of capital and capital structure for a sample of large railroads between 1912 when there was no federal corporate net income tax and 1922 when the federal corporate net income tax was 12.5%. There was a federal corporate gross income tax from 1909 to 1913. Under MM II, the inclusion of taxes in the calculation of returns to capital showed theoretically a benefit in financing the firm using debt over equity. The federal corporate net income tax was first instituted in 1913. Initially the tax rate was very low. For example in 1913 it was only one per cent on taxable net income over $2.000 (see table 4-1). This affected my choice of years for analysis. Although the rates increased significantly through 1921, these results were affected by a war (1917-1918), federal nationalization (1918), sharp inflation (1919-1921) and, sudden deflation with recession (1921). Thus, the first stable year is 1922, a period of prosperity when interest rates were significant at 12.5%.

Table 4-1: U.S. Corporation Income Tax: Tax Brackets and Rates, 1909-1927

Year	Taxable income brackets	Rates (percent)
1909-1913 (February 28)	First $5000 Over $5000	- 1.00
1913 (March 1) - 1915	All taxable income	1.00
1916	All taxable income	2.00
1917	All taxable income	6.00
1918	First $2000 Over $2000	- 12.00
1919-1921	First $2000 Over $2000	- 10.00
1922-1924	First $2000 Over $2000	- 12.50
1925	First $2000 Over $2000	- 13.00
1926-1927	First $2000 Over $2000	- 13.50

Source: Internal Revenue Service, Data Release, http://www.irs.gov/pub/irs-soi/02corate.pdf

Because of a change in reporting formats introduced in 1916, the data with respect to 1912 and 1922 pertain slightly different time periods. The 1912 data relates to the operations for the fiscal year ended June 30 that is the operating year of the federal government at that time. Beginning in 1916 however the railway data was for calendar year ending December 31.

The railroads in 1912 were subject to a variety of state taxes that totaled $109.1 million. Most of these taxes were for real and personal property (See illustration 4-1). None of these balances have relevance in testing MM II because they have no impact at all on the calculation on effective interest rate, which is calculated by,

$$\text{Effective interest expense} = \text{Gross interest expense} \times (1\text{-tax rate})$$

Illustration 4-1: Taxes and Assessments for the Year 1912-Class I Carriers, Their Non-operating Subsidiaries and All Operating Roads

State or Territory.	Class I roads.							
	Ad valorem tax.		Specific tax.					
	On the value of real and personal property.	On the value of stocks or bonds, or on valuation based on earnings, dividends, or other results of operation.	On stocks, bonds, loans, etc.	On gross or net earnings, revenue, or dividends.	On traffic or some physical quality of property operated, or on privilege.	On property owned, not used in operation, and miscellaneous.	Unclassified.	Total.
Alabama	$1,147,937	$155,940	$17,095		$36,048	$5,787		$1,362,80
Arizona	288,553		15			2,080		290,64
Arkansas	1,438,112		22,840			825		1,461,77
California	119,111		3,220	$914,551	1,150	11,158		1,049,19
Colorado	1,639,677		871			8,060		1,648,60
Connecticut	57,721	1,159,711				9,587		1,227,01
Delaware	42,232		55		106,500	4,042		152,82
Florida	861,687				39,654			901,34
Georgia	1,346,571	149,603	1,068	6,146	413	7,022		1,510,82
Idaho	1,336,304		1,820			2,299		1,340,42
Illinois	4,922,688			1,186,090		49,352		6,158,13
Indiana	4,109,863					42,105		4,151,96
Iowa	2,678,098		232			1,643		2,679,99
Kansas	3,350,315				600	91		3,351,00
Kentucky	1,032,439	245,739				991		1,279,10
Louisiana	1,356,997				10,917	39		1,367,95
Maine	116,927			809,184		2,603		928,71
Maryland	234,949			341,343	38	199,917		776,24
Massachusetts	1,845,176	1,554,089		34,304		156,095		3,589,66
Michigan	3,717,831		25,171			21,308		3,764,31
Minnesota	3,717			3,668,041		114,538		3,784,29
Mississippi	864,561				73,140	907		938,60
Missouri	1,775,962	45,047				3,102		1,824,11
Montana	1,709,251			2,750		2,825		1,714,82
Nebraska	2,299,031		400			232		2,299,66
Nevada	213,502							213,50
New Hampshire	704,421					24,958		729,37
New Jersey	6,664,208	6,388	4,872			166,901		6,842,36
New Mexico	555,493					5		555,49
New York	8,423,016	595,777	84,468	340,788	8,410	173,084		9,625,54
North Carolina	1,203,225				17,586	4,958		1,225,76
North Dakota	1,676,446					3,928		1,680,37
Ohio	5,035,712	904	10,712	1,658,216		120,021		6,825,56
Oklahoma	2,432,012							2,432,01
Oregon	767,867		1,475			17,065		786,40
Pennsylvania	1,075,368	3,426,677	745,750	903,159	77	207,512		6,358,54
Rhode Island	284,951					1,780		286,73
South Carolina	777,047			28,797	11,271	4,573		821,68
South Dakota	852,227					656		852,88
Tennessee	1,257,863		905		62	6,376		1,265,20
Texas	1,875,456	1,129,360	41,437					3,046,25
Utah	675,446		405			600		676,45
Vermont	6,756		680	232,032	135	2,451		242,05
Virginia	1,635,590		745	508,095	9	2,103		2,146,54
Washington	3,262,937		165		76	182,855		3,446,03
West Virginia	1,390,616		10,095		11	13,027		1,413,74
Wisconsin	3,127,017					24,812		3,151,82
Wyoming	570,968					242		571,21
District of Columbia	33,468			167		19,816		53,45
Total, United States	82,797,322	8,469,235	974,516	10,631,663	306,097	1,624,331		104,803,16

State or Territory	All operating roads.							
	Ad valorem tax.		Specific tax.					
	On the value of real and personal property.	On the value of stocks or bonds, or on valuation based on earnings, dividends, or other results of operation.	On stocks, bonds, loans, etc.	On gross or net earnings, revenue, or dividends.	On traffic or some physical quality of property operated, or on privilege.	On property owned, not used in operation, and miscellaneous.	Unclassified.	Total.
Alabama	$1,186,443	$163,813	$18,325		$36,989	$5,961		$1,411,531
Arizona	344,300		15	$5		2,080		346,400
Arkansas	1,580,596		28,378		1,194	1,118		1,611,286
California	122,440		6,199	1,103,474	1,475	12,346		1,245,934
Colorado	1,808,363		1,213			8,124		1,817,700
Connecticut	57,721	1,159,711				9,587		1,227,019
Delaware	43,072		55		106,500	4,042		153,669
Florida	942,283				48,293	447		991,023
Georgia	1,501,324	152,753	1,580	6,146	491	7,033		1,669,327
Idaho	1,390,281		2,635			2,299		1,395,215
Illinois	5,042,923			1,186,090		49,352		6,278,365
Indiana	4,151,368					42,117		4,193,485
Iowa	2,711,939		252			1,643		2,713,834
Kansas	3,384,210				600	91		3,384,901
Kentucky	1,050,497	247,611				1,016		1,299,124
Louisiana	1,433,524				10,917	376		1,444,817
Maine	119,491		75	815,008		2,665		937,239
Maryland	287,931			396,084	353	199,917		884,285
Massachusetts	1,845,242	1,554,789		34,476	101	156,095		3,590,683
Michigan	4,046,438		25,171			25,011		4,096,620
Minnesota	3,723			3,778,408		115,239		3,897,370
Mississippi	902,056				77,101	907		980,064
Missouri	1,882,431	45,047				3,102		1,930,580
Montana	1,717,823			2,835	12	2,825		1,723,495
Nebraska	2,299,031		400			232		2,299,663
Nevada	306,851				120			306,971
New Hampshire	725,976					25,467		751,443
New Jersey	6,854,200	6,540	7,194			167,238		7,035,272
New Mexico	610,970					5		610,975
New York	8,592,254	606,186	85,820	359,589	8,628	176,750	$5,208	9,834,435
North Carolina	1,257,808				20,089	4,958	3,783	1,286,638
North Dakota	1,686,526					3,928		1,690,454
Ohio	5,137,569	904	10,712	1,728,655	1	123,914		7,001,755
Oklahoma	2,629,673							2,629,673
Oregon	864,275		2,732			17,065		884,072
Pennsylvania	1,094,878	3,535,755	774,502	961,967	157	241,378		6,608,637
Rhode Island	285,514					1,780		287,294
South Carolina	824,945			32,299	13,476	4,959		875,679
South Dakota	924,279					656		924,935
Tennessee	1,277,805		1,320		62	6,376		1,285,563
Texas	2,159,451	1,183,479	52,067	212				3,395,209
Utah	691,948		605			600		693,153
Vermont	7,961		1,100	281,862	135	2,815		293,873
Virginia	1,670,888		1,090	517,822	9	2,103	896	2,192,808
Washington	3,432,023		285		76	182,855		3,615,239
West Virginia	1,458,971		13,842		32	13,101		1,485,946
Wisconsin	3,191,906					25,277		3,217,183
Wyoming	614,055					246		614,301
District of Columbia	34,309			167		19,816		54,292
Total, United States	86,190,485	8,656,668	1,035,567	11,195,099	326,811	1,674,912	9,887	109,089,429

Source: Annual Report of the Statistics of Railways in the United States, 1912

Total federal and state taxes combine in 1922 amounted to $301.3 million. The federal tax portion that year was $52.6 million or 17.45% of the total (See illustration 4-2).

Illustration 4-2: Taxes and Assessments for the Year Ended Dec. 31, 1922-Class I Carriers and Their Non-operating Subsidiaries

STATEMENT No. 39.—TAXES AND ASSESSMENTS FOR THE YEAR ENDED DEC. 31, 1922—CLASS I CARRIERS AND THEIR NONOPERATING SUBSIDIARIES.

State.	Total.		Class I carriers.	Nonoperating subsidiaries of Class I carriers.	State.	Total.		Class I carriers.	Nonoperating subsidiaries of Class I carriers.
	Amount.	Per mile of line.				Amount.	Per mile of line.		
Total, United States	[1] $301,413,784	$1,349	$300,253,282	$1,160,502	Nebraska	$4,876,840	$792	$4,876,840	
					Nevada	1,643,038	1,002	1,643,038	
Alabama	2,425,474	534	2,425,474		New Hampshire	963,984	801	963,984	
Arizona	2,553,917	1,240	2,553,917		New Jersey	14,783,751	6,991	14,760,580	$23,171
Arkansas	2,721,916	654	2,721,916		New Mexico	2,242,363	810	2,242,363	
California	12,125,124	1,789	12,121,648	3,476	New York	20,447,067	2,596	20,392,655	54,412
Colorado	3,579,497	785	3,579,297	200	North Carolina	3,427,368	957	3,427,273	95
Connecticut	1,926,870	1,933	1,926,870		North Dakota	4,817,124	936	4,817,124	
Delaware	170,418	508	170,418		Ohio	18,262,683	2,158	18,261,671	1,012
Florida	3,273,527	816	3,273,527		Oklahoma	5,087,528	810	5,087,004	524
Georgia	2,755,381	508	2,755,381		Oregon	2,612,086	1,018	2,612,036	50
Idaho	2,989,691	1,166	2,989,691		Pennsylvania	10,573,210	1,078	10,529,702	43,508
Illinois	17,978,948	1,578	17,778,991	199,957	Rhode Island	558,134	2,859	558,134	
Indiana	10,697,314	1,583	10,696,363	951	South Carolina	1,808,352	580	1,808,352	
Iowa	7,389,413	761	7,389,413		South Dakota	2,770,454	654	2,770,454	
Kansas	6,748,713	782	6,739,343	9,370	Tennessee	2,551,462	700	2,547,950	3,512
Kentucky	2,387,864	677	2,374,821	13,043	Texas	5,937,236	425	5,937,236	
Louisiana	3,976,305	1,022	3,976,305		Utah	1,988,612	979	1,987,425	1,187
Maine	2,081,738	1,026	2,081,738		Vermont	418,860	566	418,860	
Maryland	1,999,374	1,565	1,999,374		Virginia	4,840,394	1,163	4,840,394	
Massachusetts	3,502,045	1,696	3,499,652	2,393	Washington	6,884,832	1,347	6,884,832	
Michigan	7,085,620	1,016	7,085,620		West Virginia	4,567,808	1,333	4,552,440	15,368
Minnesota	7,612,645	917	7,612,645		Wisconsin	7,158,712	1,019	7,157,125	1,587
Mississippi	3,926,173	1,055	3,926,173		Wyoming	1,392,237	775	1,392,237	
Missouri	3,121,763	427	3,121,763		District of Columbia	105,740	3,061	105,740	
Montana	5,015,483	1,024	5,015,483		United States Government	52,648,696	236	51,862,010	786,686

[1] Excludes $779,749 Canadian taxes, $641 Cuban taxes, and $1,251 not localized by States.
These amounts were charged to income and are included in Statements Nos. 33 and 33A, pages XLIV and XLVI.

Source: Annual Report of the Statistics of Railways in the United States, 1922

In testing MM II, I have made some adjustments to their basic formula because of the ways that corporate results were reported in the ICC's *Statistics of Railways in United States* yearbook in 1912 and 1922. Stockholders' equity included capital stock plus Profit and Loss, which is equivalent to what today would be termed Retained Earnings. It also includes reserves that represent appropriations of earned surpluses. The use of surplus accounts seems to have two purposes. First it reduced the amount of Profit and Loss that could fund dividends, which thus insulated these balances against stockholders equity demands for higher payouts. Second it also kept profits low and thus decreased the justification on the part of regulatory authorities to seek rate reductions.

Table 4-2: Comparison of long-term corporate bond rates, railroad stock dividend yields and the effect of federal corporate net income tax for the years 1912-1922.

Year Ended	Amount of stock yielding dividends ($Mns)	Amount of dividends declared	Average rate on dividend-yielding stock	Total Funded Debt	Amount accrued as interest on funded debt	Average Interest Rate	Effective Interest Rate (After Tax)	Difference between Dividend rate and Effective Interest rate
June 30, 1912	5,581.2	400.3	7.17	11,130.1	429.0	3.85	3.85	3.32
June 30, 1913	5,780.9	369.0	6.37	11,185.5	434.7	3.88	3.84	2.53
June 30, 1914	6,667.0	451.6	7.97	11,566.5	442.5	3.82	3.78	4.19
June 30, 1915	5,219.8	328.4	6.29	12,133.0	464.1	3.82	3.78	2.51
June 30, 1916	5,279.4	342.1	6.48	12,033.3	474.5	3.94	3.86	2.62
Dec. 31, 1916	5,430.1	366.5	6.75	12,000.4	481.4	4.01	3.92	2.83
Dec. 31, 1917	5,610.7	381.8	6.81	11,946.8	474.1	3.96	3.72	3.09
Dec. 31, 1918	5,138.8	339.1	6.60	11,729.7	468.2	3.99	3.51	3.09
Dec. 31, 1919	5,298.3	335.2	6.33	11,859.0	476.0	4.01	3.60	2.73
Dec. 31, 1920	5,075.0	331.1	6.52	12,777.7	500.3	3.91	3.51	3.01
Dec. 31, 1921	5,059.8	456.4	9.02	13,215.9	529.3	4.00	3.6	5.42
Dec. 31, 1922	5,321.3	338.8	6.37	13,149.1	538.5	4.09	3.57	2.8

Source: Annual report of the statistics of railways in the United States. 1922

Table 4-2 compares long-term bond rates and railroad stock yields for the period 1912-1922. The average market rate of the bond interest reported in column 6. What is also significant about this table is the fact that stock dividend yields are consistently higher than corporate bond yields. Column 8 reports the average difference between average dividend rates and after tax long-term bond rates. The difference in dividend rates over the effective rates is a low of 2.8% in 1922 to a high of 5.42% in 1921.

Although total railroad assets increased substantially from calendar year 1912 to calendar year 1922 there was not a corresponding increase in either capital stock or funded debt. Total assets for Class I railroads increase from $19.2 billion in 1912 to $24.8 in 1922, a net increase of 29%. The total amount of long-term railway capital increased from $16 billion to $17 billion during the same time period between 1912 and 1922. The total par value of the stock including preferred stock increased from $6.7 billion to $7.2 billion, a net increase of 7.4%. The funded debt increased from $ 9.2 billion to $9.7 billion, a net increase of 5.33%. The relatively high increase in total assets as compared to the modest increase in funded debt and capital stock suggests that a substantial portion

of railroad growth during this period was financed from retained earnings, which was largely reflected in increases in corporate reserves and Profit and Loss.

The growth in stockholders equity would tend to reduce the overall cost of equity capital assuming that dividends did not fluctuate greatly during this period. The average railroad dividend rate was 7.17% in calendar year 1912 and in calendar year 1922 it decreased to 6.37%. During the same period the average effective interest rate decreased from 3.85% to 3.57% in 1922, a net decrease of 7.27%. The amount of corporate surplus plus Profit and Loss in calendar year 1922 was $3.1 billion, as compared to $1.6 billion in 1912, a net increase of 93.75% (See illustration 4-3 and 4-4).

Table 4-3: Class I Railway Capital Actually Outstanding on December 31, 1912-1922 ($Mns)

	1912	1922
	Class I roads	Class I roads
STOCK		
Common	5,568.8	5,614.2
Preferred	1,168.3	1,627.8
Total amount	6,737.2	7,242.1
FUNDED DEBT		
Mortgage Bonds	6,377.2	7,353.6
Collateral trust bonds	1,271.3	776.8
Plain bonds, debentures, and notes	961.9	-
Income bonds	232.3	327.7
Miscellaneous funded obligations	134.5	629.5
Equipment trust obligations	301.4	685.3
Total amount	9,278.8	9,773.2
TOTAL RAILWAY CAPITAL	16,016.1	17,015.3

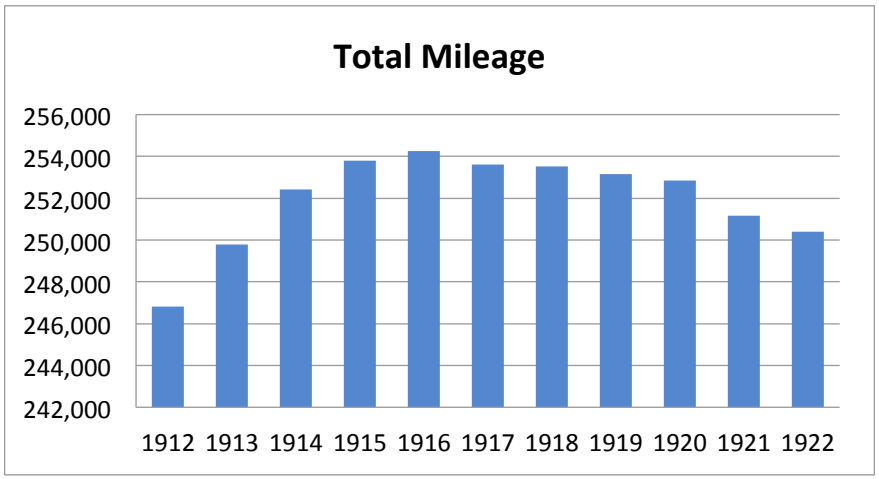
Source: Annual report of the statistics of railways in the United States, 1912-1922

2. Railroad Industry in the early 20th century

As noted in the previous chapter the railroads began to experience a competition from trucks and automobiles in 1912. These inroads curtail the expansion of total railroad mileage, which hit a high point of 254,250 miles in 1916. Total railroad mileage then

continued to decline to 1922 when it reached approximately 250,412 miles. The shrinkage since 1920 was also partially affected by The Transportation Act 1920 which sought to reduce unprofitable and redundant rail mileage.

Graph 4-1: Miles of railway by years, 1912-1922



Source: Annual Report of the Statistics of Railways in the United States, 1912-1922

The major source of rail revenue derives from freight haulage, which hit a peak $4.4 billion in 1920. However overall operating income reached a low of $75.4 million that same year because of a major increase in operating expenses.

Railroad operating income steadily increased from $2.9 billion in 1912 to $6.3 billion in 1920 and then leveled off to about $5.6 billion in 1921 and 1922. Operating income however was much more volatile reaching a peak of $1.1 billion in 1916 to a low of $75 million in 1920. It then recovered to $854 million in 1922. The 1920 low come about because of the steady increase in operating expenses beginning with the war in 1917. The operating expense ratio hit an all-time high of 94% in 1920 before falling off to 79.48% in 1922.

The squeeze in profitability in 1920 reflects the combination of increasing inflationary pressures and the inability of the railroads to receive sufficiently offsetting increases in rates by the ICC. The ability of the industry to recover cost through by increasing volume was reduced because of the previously noted inroads that was made particularly in freight haulage by competing trucking lines. The average ton/mileage carried by industry by the railroads between 1917 and 1920 was about 2.3 billion tons in 1921. This dropped to 1.8 billion tons and recovered to 2.2 billion ton in 1922 (See table 4-4).

Table 4-4: Summary showing passenger and freight service of railways for the years, 1912-1922.

Year ended	Passengers carried	Passenger Revenue (Mns)	Tons carried	Freight Revenue (Mns)	Operating Revenues (Mns)	Operating Expenses (Mns)	Operating Income (Mns)	Net Income (Mns)	Ratio of operating expenses to operating revenues
1912	1,004.0	660,3	1,844.9	1,968.5	2,906.4	2,035.0	757.5	453.1	70.02
1913	1,043.6	695,9	2,058.0	2,198.9	3,193.1	2,235.9	835.1	546.7	70.02
1914	1,063.2	703.4	2,002.0	2,126.7	3,127.7	2,280.4	706.8	395.4	72.91
1915	985.6	646.4	1,828.6	2,037.9	2,956.1	2,088.6	729.0	354.7	70.65
1916	1,048.9	722.3	2,347.3	2,631.0	3,691.0	2,426.2	1,102.1	735.3	65.73
1917	1,109.9	840.9	2,453.4	2,897.4	4,115.4	2,906.2	988.7	658.2	70.62
1918	1,122.9	1,046.1	2,477.0	3,522.0	4,985.2	4,071.5	684.0	442.3	81.67
1919	1,211.0	1,193.4	2,185.2	3,624.8	5,250.4	4,498.8	511.5	496.6	85.68
1920	1,269.9	1,304.8	2,427.6	4,420.8	6,310.1	5,954.3	75.4	481.9	94.36
1921	1,061.1	1,166.2	1,808.8	4,004.1	5,632.6	4,668.9	678.5	350.5	82.89
1922	989.5	1,087.5	1,974.6	4,085.7	5,674.4	4,509.9	854.7	434.4	79.48

Source: Annual Report of the Statistics of Railways in the United States, 1912-1922

Total railroad assets amounted to $19.2 billion in 1912 and increased to $24.8 billion in 1922, a net increase of $5.6 billion and 29.1%. Total capital stock increased from $6.8 billion in 1912 to $7.3 billion in 1922, a net increase of $0.5 billion and 7.35%. Total long-term debt increased from $9.4 billion in 1912 to $10.2 billion in 1922, a net increase of $0.8 billion, and 8.5%. The long-term debt category is equivalent to funded debt category reported in earlier reporting formats used by the ICC.

Corporate surplus defined as Profit and Loss credit balance minus Profit and Loss debit balance plus appropriated surplus amounted to $1.6 billion in 1912 and $3.1 billion in 1922, a net increase of $1.5 billion and 93.75% (See illustration 4-3 and 4-4).

Illustration 4-3: Condensed Balance Sheet Statement as of June 30, 1912 – Class I Roads

STATEMENT NO. 45A.—CONDENSED BALANCE SHEET STATEMENT AS OF JUNE 30, 1912—CLASS I ROADS.*

[172,152.89 miles of line represented.]

Item.	Eastern District.	Southern District.	Western District.	Total.
ASSETS.				
Property investment:				
Road and equipment to June 30, 1907	$3,191,113,575	$1,598,274,610	$4,470,202,353	$9,259,590,538
Road and equipment since June 30, 1907	830,575,876	463,815,056	1,649,259,665	2,948,650,597
Reserve for accrued depreciation—Cr	78,639,496	76,107,546	104,864,300	259,681,342
Net road and equipment charge	[1] 3,945,295,827	1,990,982,120	6,014,597,718	[1] 11,950,875,665
Securities of system corporations—pledged	633,461,857	95,552,454	556,806,371	1,285,820,682
Securities issued or assumed—pledged	102,111,238	85,028,008	173,872,656	361,011,902
Securities of system corporations—unpledged	521,618,457	28,848,858	504,304,052	1,054,771,367
Total book value of investments in system securities	1,257,191,552	209,429,320	1,234,983,079	2,701,603,951
Advances to system corporations for construction, etc	105,152,656	77,124,396	238,186,757	420,463,809
Miscellaneous investments in physical property	60,173,842	8,459,621	59,666,211	128,299,674
Miscellaneous investments in securities	348,351,175	159,837,748	673,314,962	1,181,503,885
Total property investment	5,716,165,052	2,445,833,205	8,220,748,727	16,382,746,984
Working assets:				
Cash	188,451,502	65,182,994	186,936,048	440,570,544
Securities issued or assumed, held in treasury	47,955,731	81,764,933	145,310,223	275,030,887
Marketable securities	277,371,379	36,368,443	243,263,200	557,003,022
Accounts receivable	224,497,954	41,654,304	272,350,163	538,502,421
Materials and supplies	95,075,987	34,184,935	109,917,206	239,178,128
Other working assets	2,858,864	4,899,759	3,789,472	11,548,095
Total working assets	836,211,417	264,055,368	961,566,312	2,061,833,097
Unmatured interest, dividends, and rents receivable	8,654,585	3,721,384	13,450,778	25,826,747
Deferred debit items:				
Temporary advances, working funds, etc	68,884,264	19,739,030	139,356,515	227,979,809
Rents, insurance, and taxes paid in advance	2,327,955	332,846	2,100,395	4,761,196
Unextinguished discount on securities	16,732,685	13,118,897	47,635,348	77,486,930
Cash and securities in sinking and other special funds	71,282,822	5,732,949	48,009,511	125,075,282
Miscellaneous deferred debit items	82,996,608	18,547,061	45,689,533	147,233,202
Total deferred debit items	242,224,334	57,520,783	282,791,302	582,536,419
Profit and loss—debit balance	51,876,153	10,300,639	54,483,682	116,750,474
Total	6,855,131,541	2,781,521,379	9,533,040,801	19,169,693,721

Item.	Eastern District.	Southern District.	Western District.	Total.
LIABILITIES.				
Stock:				
Common stock	$2,151,020,717	$741,782,950	$2,698,109,187	$5,590,912,854
Preferred stock	358,615,031	173,082,850	637,847,908	1,169,545,789
Debenture stock	104,000	9,989,700	3,693,200	13,786,900
Receipts outstanding for installments paid	12,150	1,500	1,705	15,355
Stock liability for conversion, etc	1,511,519	58,550	569,207	2,139,276
Premiums realized on capital stock	46,412,010	3,223,160	182,448	49,817,618
Total stock liability	2,557,675,427	928,138,710	3,340,403,655	6,826,217,792
Mortgage, bonded, and secured debt:				
Mortgage bonds	1,878,962,704	1,215,058,850	3,346,971,728	6,440,993,282
Collateral trust bonds	484,431,144	147,035,200	639,794,925	1,271,261,269
Debentures, etc	581,587,815	36,240,722	331,047,537	948,876,074
Income bonds	26,125,500	79,589,277	130,940,877	236,655,654
Equipment trust obligations	187,945,522	55,054,729	59,655,437	302,655,688
Miscellaneous funded obligations	20,310,158	827,000	113,417,084	134,554,242
Receipts outstanding for funded debt	1,000	13,029,600	4,660	13,035,260
Receivers' certificates	20,148,790	3,250,000	35,000	23,433,790
Obligations for advances for construction, etc	3,397,245	.....	52,249,980	55,647,225
Total long-term debt	3,202,909,878	1,550,085,378	4,674,117,228	9,427,112,484
Working liabilities	360,819,420	96,054,346	541,479,804	998,353,570
Accrued liabilities, not due	70,107,258	27,290,980	72,624,366	170,012,604
Deferred credit items:				
Operating reserves	8,160,856	6,312,332	8,645,577	23,118,765
Miscellaneous deferred credit items	66,832,509	6,970,302	35,289,825	109,092,636
Total deferred credit items	74,993,365	13,282,634	43,935,402	132,211,401
Appropriated surplus:				
Additions to property since June 30, 1907, through income	151,986,316	25,577,210	80,269,964	257,833,490
Reserves from income or surplus	85,272,757	6,853,402	72,510,181	164,636,340
Total appropriated surplus	237,259,073	32,430,612	152,780,145	422,469,830
Profit and loss—credit balance	351,367,120	134,248,719	707,700,201	1,193,316,040
Total	6,855,131,541	2,781,521,379	9,533,040,801	19,169,693,721

* Does not include returns for switching and terminal companies.

[1] Includes $2,295,872, not assigned between "Road and equipment to June 30, 1907," and "Road and equipment since June 30, 1907."

Source: Annual Report of the Statistics of Railways in the United States, 1912

Illustration 4-4: Condensed Balance Sheet Statement as of December 31, 1922 – Class I Carriers

STATEMENT NO. 42.—CONDENSED BALANCE SHEET STATEMENT AS OF DEC. 31, 1922—CLASS I CARRIERS.

Item.	Total United States (178,070.43 miles of line represented).	Eastern District (32,918.15 miles of line represented).	Southern District (35,742.70 miles of line represented).	Western District (109,409.58 miles of line represented).
ASSET SIDE.				
Investments:				
Investment in road and equipment	$15,854,814,868	$5,428,319,777	$2,813,609,592	$7,612,885,499
Improvements on leased railway property	372,739,114	307,930,581	42,130,722	22,677,811
Sinking funds	11,466,229	1,142,977	816,903	9,506,349
Deposits in lieu of mortgaged property sold	7,409,767	2,148,679	2,850,009	2,411,079
Miscellaneous physical property	134,769,182	59,019,572	17,691,037	58,058,573
Investments in affiliated companies	4,152,207,492	1,660,157,194	457,701,147	2,034,349,151
Other investments	910,633,371	415,528,578	75,277,322	419,827,471
Total investments	21,444,040,023	7,874,247,358	3,410,076,732	10,159,716,933
Current assets:				
Cash	483,717,274	166,761,392	99,062,953	217,892,929
Demand loans and deposits	24,499,674	2,692,507	210,000	21,597,167
Time drafts and deposits	43,583,308	3,592,000	18,681,568	21,309,738
Special deposits	177,586,111	83,622,076	37,347,047	56,616,988
Loans and bills receivable	71,980,654	59,348,752	2,939,774	9,692,128
Miscellaneous accounts receivable	296,939,789	135,579,897	46,422,984	114,936,908
Material and supplies	546,284,853	233,692,955	89,856,730	222,735,168
Other current assets	268,521,021	131,187,726	40,518,938	96,814,357
Total current assets	1,913,112,682	816,477,305	335,039,994	761,595,383
Deferred assets	892,702,078	680,231,131	127,813,441	84,657,506
Unadjusted debits:				
Discount on capital stock	24,323,423	2,262,795	3,013,100	19,047,528
Discount on funded debt	73,008,032	21,461,967	10,264,393	41,281,672
Other unadjusted debits	416,005,890	186,822,795	55,196,746	173,986,349
Total unadjusted debits	513,337,345	210,547,557	68,474,239	234,315,549
Grand total	24,763,192,128	9,581,503,351	3,941,404,406	11,240,284,371

Item.	Total United States (178,070.43 miles of line represented).	Eastern District (32,918.15 miles of line represented).	Southern District (35,742.70 miles of line represented).	Western District (109,409.58 miles of line represented).
LIABILITY SIDE.				
Stock:				
Capital stock	$7,242,119,434	$2,591,273,963	$1,054,880,717	$3,595,964,754
Stock liability for conversion	29,143,627	224,658	.....	28,918,969
Premium on capital stock	42,124,367	30,908,441	4,852,040	6,463,886
Total stock	7,313,387,428	2,622,307,062	1,059,732,757	3,631,347,609
Grants in aid of construction	4,049,030	199,149	1,291,413	2,558,468
Long-term debt:				
Funded debt unmatured	9,828,316,188	3,692,143,939	1,707,148,108	4,429,022,141
Receiver's certificates	5,465,469	.....	1,382,500	4,082,969
Nonnegotiable debt to affiliated companies	321,019,815	40,835,749	10,110,902	270,073,164
Total long-term debt	10,154,801,472	3,732,981,688	1,718,641,510	4,703,178,274
Current liabilities:				
Loans and bills payable	131,914,909	74,587,185	20,085,128	37,242,596
Miscellaneous accounts payable	118,026,153	61,118,054	11,033,848	45,869,251
Other current liabilities	1,089,750,043	445,405,146	153,829,149	490,515,748
Total current liabilities	1,339,691,105	581,110,385	184,953,125	573,627,595
Deferred liabilities	1,008,202,385	813,181,261	124,342,918	70,678,206
Unadjusted credits:				
Premium on funded debt	1,614,831	361,951	101,395	1,151,485
Operating reserves	60,361,545	26,420,101	12,465,855	21,475,589
Accrued depreciation	1,192,915,433	485,833,287	229,161,510	477,920,636
Other unadjusted credits	630,824,604	238,821,461	89,720,204	302,282,939
Total unadjusted credits	1,885,716,413	751,436,800	331,448,964	802,830,649
Corporate surplus:				
Additions to property through income and surplus	778,872,944	436,629,104	108,191,432	234,052,408
Funded debt retired through income and surplus	82,029,422	8,204,471	883,800	72,941,151
Sinking fund reserves	42,327,123	23,270,070	4,083,655	14,973,398
Miscellaneous fund reserves	40,957,758	36,972,711	.....	3,985,047
Appropriated surplus not specifically invested	71,965,923	7,732,605	1,030,018	63,203,300
Total appropriated surplus	1,016,153,170	512,808,961	114,188,905	389,155,304
Profit and loss—balance	2,041,191,125	567,478,045	406,804,814	1,066,908,266
Total corporate surplus	3,057,344,295	1,080,287,006	520,993,719	1,456,063,570
Grand total	24,763,192,128	9,581,503,351	3,941,404,406	11,240,284,371

Source: Annual Report of the Statistics of Railways in the United States, 1922.

Net revenue from operations or Class I railroads amounted to $845.7 million in 1912 and increased to $1.14 billion in 1922, a net increase of $255 million and, 35%. Net corporate income in 1912 amounted to $400.6 million, which was equivalent to the net income of $369.6 million in 1922, a net decrease of $31 million and, 7.7%.

Illustration 4-5: Income Statement of Class I Carriers for the Year Ended June 30, 1912

Item.	Class I roads.			
	Eastern District.	Southern District.	Western District.	Total.
INCOME ACCOUNT.				
Income from railway operation:				
Operating revenues—rail operations	$1,217,854,734	$422,431,946	$1,104,055,597	$2,744,342,277
Operating expenses—rail operations	855,820,498	300,159,498	742,682,469	1,898,662,465
Net revenue from rail operations	362,034,236	122,272,448	361,373,128	845,679,812
Outside operations—revenues	34,492,269	3,413,433	22,758,565	60,664,267
Outside operations—expenses	34,155,629	3,433,382	22,843,335	60,432,346
Net revenue from outside operations	336,640	*19,949*	*84,770*	231,921
Total net revenue	362,370,876	122,252,499	361,288,358	845,911,733
Taxes accrued	49,160,772	15,407,938	44,876,697	109,445,407
Operating income	313,210,104	106,844,561	316,411,661	736,466,326
Other income:				
Rents accrued from lease of road	500,094	354,157	1,814,999	2,669,250
Hire of equipment—credit balance	4,824,430	3,152,361	4,268,785	12,245,576
Joint facilities rent credits	8,864,864	2,814,473	8,102,560	19,781,897
Miscellaneous rent credits	4,106,792	422,364	1,445,052	5,974,208
Other properties—net income	3,829,720	521,570	2,115,075	6,466,365
Separately operated properties—net profit	1,455,685	71,619	669,125	2,196,429
Dividends on stocks owned or controlled	60,253,419	6,872,887	59,344,191	126,470,497
Interest on funded debt owned or controlled	8,128,845	4,037,236	28,237,357	40,403,438
Interest on other securities, loans, and accounts	12,252,338	4,324,426	15,500,596	32,077,360
Unextinguished premiums on outstanding funded debt	13,166	.....	14,426	27,592
Miscellaneous income	1,492,105	449,146	1,082,582	3,023,833
Total other income	105,721,458	23,020,239	122,594,748	251,336,445
Gross income	418,931,562	129,864,800	439,006,409	987,802,771
Deductions from gross income:				
Rents accrued for lease of other roads	69,200,023	10,933,639	48,912,486	129,046,148
Hire of equipment—debit balance	14,675,454	1,754,584	11,587,876	28,017,914
Joint facilities rent debits	15,874,867	4,489,873	11,626,762	31,991,502
Miscellaneous rent debits	3,342,985	326,236	565,034	4,234,255
Other properties—net loss	283,256	4,903	47,203	335,362
Separately operated properties—net loss	2,189,408	547,703	1,118,573	3,855,684
Interest accrued on funded debt	123,339,548	59,828,047	176,713,866	359,881,461
Other interest	7,119,810	950,138	8,665,994	16,735,942
Extinguishment of discount on securities	183,744	367,331	1,450,795	2,001,870
Sinking and redemption funds chargeable to income	3,489,408	248,759	1,422,149	5,160,316
Other deductions	4,032,692	227,673	1,657,759	5,918,124
Total deductions from gross income	243,731,195	79,678,886	263,768,497	587,178,578
Net corporate income	175,200,367	50,185,914	175,237,912	400,624,193

Source: Annual Report of the Statistics of Railways in the United States, 1912

Illustration 4-6: Income Statement of Class I Carriers for the Year Ended December 31, 1922.

Item.	Total (234,825.47 miles of line*).			Eastern District (58,792.08 miles of line*).			Southern District (43,773.35 miles of line*).			Western District (132,260.04 miles of line*).		
	Amount.	Average per mile of line.	Ratio to total operating revenues.	Amount.	Average per mile of line.	Ratio to total operating revenues.	Amount.	Average per mile of line.	Ratio to total operating revenues.	Amount.	Average per mile of line.	Ratio to total operating revenues.
INCOME ACCOUNT.												
Operating income.			*Per cent.*			*Per cent.*			*Per cent.*			*Per cent.*
Railway operating revenues	$5,559,092,708	$23,673	100.00	$2,516,678,522	$42,806	100.00	$915,300,678	$20,910	100.00	$2,127,113,508	$16,083	100.00
Railway operating expenses	4,414,522,334	18,799	79.41	2,059,858,442	35,036	81.85	708,694,116	16,190	77.43	1,645,969,776	12,445	77.38
Net revenue from railway operations	1,144,570,374	4,874	20.59	456,820,080	7,770	18.15	206,606,562	4,720	22.57	481,143,732	3,638	22.62
Railway tax accruals	301,034,923	1,282	5.41	115,661,871	1,967	4.60	49,098,725	1,122	5.36	136,274,327	1,030	6.40
Uncollectible railway revenue	1,462,523	6	.03	549,417	9	.02	329,875	8	.04	583,231	5	.03
Railway operating income	842,072,928	3,586	15.15	340,608,792	5,794	13.53	157,177,962	3,590	17.17	344,286,174	2,603	16.19
Revenues from miscellaneous operations	4,176,655	18	.08	2,373,081	40	.09	1,542,867	35	.16	260,707	2	.01
Expenses of miscellaneous operations	2,537,444	11	.05	828,908	14	.03	1,584,135	36	.17	124,401	1	(2)
Net revenue from miscellaneous operations	1,639,211	7	.03	1,544,173	26	.06	*41,268*	*1*	*.01*	136,306	1	.01
Taxes on miscellaneous operating property	1,336,608	6	.02	1,169,130	20	.04	20,777	(1)	(2)	146,701	1	.01
Miscellaneous operating income	302,603	1	.01	375,043	6	.02	*62,045*	*1*	*.01*	*10,395*	(1)	(2)
Total operating income	842,375,531	3,587	15.16	340,983,835	5,800	13.55	157,115,917	3,589	17.16	344,275,779	2,603	16.19
Nonoperating income.												
Hire of freight cars—credit balance	21,995,686	94	.40	7,925,811	135	.32	6,846,742	156	.75	7,223,133	55	.34
Rent from locomotives	9,933,946	42	.18	4,460,028	76	.18	1,163,900	26	.13	4,310,018	33	.20
Rent from passenger-train cars	16,196,147	69	.29	6,998,652	119	.28	2,736,938	62	.30	6,460,557	49	.30
Rent from floating equipment	362,221	2	.01	301,114	5	.01	6,662	(1)	(2)	54,445	(1)	(2)
Rent from work equipment	2,024,030	9	.04	623,229	11	.02	397,735	9	.04	1,003,066	8	.05
Joint facility rent income	32,386,390	138	.58	14,698,364	250	.58	4,883,328	112	.53	12,804,698	97	.60
Income from lease of road	6,010,528	26	.11	3,450,550	59	.14	415,848	10	.05	2,144,130	16	.10
Miscellaneous rent income	15,763,857	67	.28	10,820,490	184	.43	1,780,853	41	.19	3,162,514	24	.15
Miscellaneous nonoperating physical property	4,880,328	21	.09	2,023,146	34	.08	1,008,203	23	.11	1,848,979	14	.09
Separately operated properties—profit	1,431,933	6	.02	1,145,569	19	.05	.....	.....	.....	286,364	2	.01
Dividend income	133,559,828	569	2.40	68,006,424	1,157	2.70	9,558,471	218	1.04	55,994,933	423	2.63
Income from funded securities	64,185,435	273	1.15	16,533,168	281	.66	5,767,981	132	.63	41,884,286	317	1.97
Income from unfunded securities and accounts	28,426,196	121	.51	13,277,136	226	.53	4,230,899	97	.46	10,918,161	83	.52
Income from sinking and other reserve funds	3,961,540	17	.07	3,328,264	57	.13	88,773	2	.01	544,503	4	.03
Release of premiums on funded debt	110,440	(1)	(2)	48,168	(1)	(2)	55	(1)	(2)	62,217	(1)	(2)
Contributions from other companies	5,864,312	25	.11	5,319,883	90	.21	544,429	12	.06	.....	.....	.....
Miscellaneous income	535,855	2	.01	*1,241,474*	*21*	*.05*	*1,454,966*	*33*	*.16*	3,232,295	24	.15
Total nonoperating income	347,628,662	1,481	6.25	157,718,522	2,682	6.27	37,975,851	867	4.15	151,934,289	1,149	7.14
Gross income	1,190,004,193	5,068	21.41	498,702,357	8,482	19.82	195,091,768	4,456	21.31	496,210,068	3,752	23.33
Deductions from gross income.												
Hire of freight cars—debit balance	77,785,533	331	1.40	41,958,988	714	1.67	11,322,045	259	1.24	24,504,500	185	1.15
Rent for locomotives	11,121,031	48	.20	5,917,459	101	.24	1,107,771	25	.12	4,095,801	31	.19
Rent for passenger-train cars	17,587,971	75	.32	8,216,233	140	.33	2,873,791	66	.32	6,497,947	49	.31
Rent for floating equipment	2,140,661	9	.04	2,059,164	35	.08	12,618	(1)	(2)	68,879	1	(2)
Rent for work equipment	1,420,149	6	.03	814,328	14	.03	187,614	4	.02	418,207	3	.02
Joint facility rents	54,728,674	233	.98	24,797,133	422	.99	7,086,982	162	.78	22,844,559	173	1.07
Rent for leased roads	144,640,039	616	2.60	84,558,125	1,438	3.36	8,993,325	205	.98	51,088,589	386	2.40
Miscellaneous rents	7,052,368	30	.13	5,168,167	88	.21	575,835	13	.06	1,308,366	10	.06
Miscellaneous tax accruals	3,737,273	16	.07	2,051,133	35	.08	84,413	2	.01	1,601,727	12	.08
Separately operated properties—loss	6,517,243	28	.12	5,022,722	85	.19	1,127,635	26	.12	366,886	3	.02
Interest on funded debt	457,893,803	1,950	8.24	174,329,639	2,965	6.93	76,451,814	1,746	8.35	207,112,350	1,566	9.74
Interest on unfunded debt	24,424,277	104	.44	14,792,673	251	.59	1,821,829	42	.20	7,809,775	59	.37
Amortization of discount on funded debt	3,173,811	14	.05	1,113,179	19	.04	385,676	9	.04	1,674,956	13	.08
Maintenance of investment organization	44,593	(1)	(2)	41,236	(1)	(2)	1,531	(1)	(2)	2,126	(1)	(2)
Income transferred to other companies	768,968	3	.01	768,968	13	.03	.....	.....	.....	.....	.....	.....
Miscellaneous income charges	7,394,067	31	.13	3,631,763	62	.14	567,354	13	.06	3,194,950	24	.15
Total deductions from gross income	820,430,761	3,494	14.76	375,240,910	6,382	14.91	112,680,233	2,572	12.80	332,589,618	2,513	15.64
Net income	369,573,432	1,574	6.65	123,461,447	2,100	4.91	82,491,535	1,884	9.01	163,620,450	1,237	7.69

*Represents average mileage operated during the year. [1] Less than $1. [2] Less than 0.01 per cent.

Source: Annual Report of the Statistics of Railways in the United States, 1922

3. Analysis of Cost of Capital and Capital Structure

3.1. Cost of Capital

Our basic formula to determine WACC is as followed:

$$WACC = \frac{SE}{SE + LTD} R_{SE} + \frac{LTD}{SE + LTD} R_{LTD}(1 - TR)$$

SE = Capital Stock + Reserves + Profit and Loss

LTD= Long-term Debt

$R_{SE} = \frac{Dividends}{SE}$

$R_{LTD} =$ *Interest rate on long-term debt*

TR = tax rate

The hypotheses for this test are as follows:

H_0: *The cost of capital in 1922 will be equal or higher than 1912.*

H_1: *The cost of capital in 1922 will be lower than 1912.*

3.2. Capital Structure

$$Capital\ Structure\ Ratio = \frac{Total\ Long\ Term\ Debt}{Total\ Long\ Term\ Debt + Capital\ Stock + Reserves}$$

In 1912 ICC data, the reserves were equivalent to the appropriated surplus plus Profit and Loss. The company reported from the whence the data was selected net debit and credit balances or Profit and Loss.

H_0: The capital structure ratio in 1922 will be equal or lower than 1912.

H_1: The capital structure ratio in 1922 will be higher than 1912.

4. Results

4.1. Cost of Capital

In evaluating the cost of capital, I used the Wilcoxon signed rank test. This involved the pairing the sample companies from 1912 and 1922 and determining the overall cost of capital decreased. The sample consisting 61 firms showed decrease in 46 cases and increase in 15 cases.

Table 4-5: Wilcoxon signed-rank test for overall cost of capital.

```
Wilcoxon signed-rank test

        sign |      obs   sum ranks    expected
-------------+---------------------------------
    positive |       46        1510       945.5
    negative |       15         381       945.5
        zero |        0           0           0
-------------+---------------------------------
         all |       61        1891        1891

unadjusted variance    19382.75
adjustment for ties        0.00
adjustment for zeros       0.00
                     ----------
adjusted variance      19382.75

Ho: A = B
             z =   4.055
    Prob > |z| =   0.0001
```

4.2. Capital Structure

My sample included 61 companies, 11 showed positive sign indicated a net increase in funded debt. Using the STATA program we determined a z-value which is -

3.116 and this yields a confidence probability level less than 1% which indicates that the findings with respect to increasing funded debt statistically significant (see Table 3-6).

Table 4-6: Wilcoxon signed-rank test for overall capital structure

```
Wilcoxon signed-rank test

        sign |      obs   sum ranks    expected
-------------+---------------------------------
    positive |       36        1227       945.5
    negative |       25         664       945.5
        zero |        0           0           0
-------------+---------------------------------
         all |       61        1891        1891

unadjusted variance    19382.75
adjustment for ties        0.00
adjustment for zeros       0.00
                     ----------
adjusted variance      19382.75

Ho: A = B
             z =   2.022
    Prob > |z| =   0.0432
```

5. Conclusion

The findings of the test with respect to cost of capital are consistent with MM II. The addition of tax has had the effect of reducing the effective interest rate. This outcome was conditioned by two factors. First increase in the tax rate from the zero level that prevailed in 1912 to 12.5% that was enforced in 1922. In addition, total interest also increased from $429 million to $539 million in 1922.

Contrary to the predictions of MM, the expected change in capital structure, which would have an increase in debt, did not occur. Increase in funded was not statistically significant. The reason for this has to do with the fact that the railway industry had reached to mature stage that has no longer growing. Railroad mileage for

example was actually beginning to decline slightly by 1922. Consequently the need for increases in new stock or bonds was not great. The industry was increasingly financing its activities through Retained Earnings. This was evidenced by significant growth in Profit and Loss (ie. Retained Earnings) and, appropriated surplus.

The second finding of this test is that the increase in Stockholders Equity defined as capital stock plus Profit and Loss and appropriated surplus increased more rapidly than funded debt and then this increase was statistically significant. As noted the cause of this difference was due to the rapid growth in appropriated surplus and Profit and Loss. The difference between my results and MM II could be conditioned by several factors. First MM II does not seem to reflect the effects of a flattening growth curve. The MM II model use this as an example the electrical utility industry, which was growing steadily during their period o analysis. The railroad industry on the other hand had flattened out because of the competition from the growing automobile sector. Second, MM selection of electrical utilities also reflects a debt leverage bias. The industry finances its activities traditionally by using a high proportion of debt. Thirdly, my results were based on the analysis of accounting book values while the MM II results drew on market values.

Future research in the railroad industry could utilize the MM II market data approach but at this time the data resources are not well developed for the period of this test. For example the Cowles commission data series on security market only dates to 1920s.

Appendix 4-1: Weighted Average Cost of Capital 1912 vs. 1922.

	WACC 1912	WACC 1922
Pennsylvania Railroad	0.04503305	0.036296331
New York Central & Hudson River Railroad	0.039629072	0.038301766
Cleveland, Cincinnati, Chicago & Saint Louis Railway	0.029537851	0.039051632
Michigan Central Railroad	0.036875603	0.042028365
New York, New Haven & Hartford Railroad	0.05447993	0.029081345
Boston & Maine Railroad	0.018473268	0.009746044
Maine Central Railroad	0.051698549	0.021014161
New York, Ontario & Western Railway	0.012812804	0.010807653
Baltimore & Ohio Railroad	0.040851951	0.029060749
Central Railroad Co of New Jersey	0.053142058	0.005854798
Philadelphia & Reading Railway	0.017990572	0.010881181
Erie Railroad	0.020493856	0.019761968
Delaware, Lackawanna & Western Railroad	0.085885286	0.01969074
Lehigh Valley Railroad	0.018572146	0.010079321
Wabash Railroad	0.018637606	0.002253194
Delaware & Hudson Co	0.021395307	0.009532794
Pere Marquette Railroad	0.028284683	0.011867984
Chicago & Eastern Illinois Railway	0.04118142	0.022102404
Buffalo, Rochester & Pittsburgh Railway	0.044014639	0.024598144
Elgin, Joliet & Eastern Railway	0.038260699	0.018361148
Atlantic Coast Line Railroad	0.024123373	0.021512402
Louisville & Nashville Railroad	0.023604222	0.023050377
Nashville, Chattanooga & Saint Louis Railway	0.062630366	0.016023812
Illinois Central Railroad	0.020460886	0.022209138
Central of Georgia Railway	0.029944265	0.028732989
Yazoo & Mississippi Valley Railroad	0.019686817	0.013543612
Southern Railway	0.026754946	0.024725972
Mobile & Ohio Railroad	0.032962258	0.033218711
Norfolk & Western Railway	0.022358711	0.01597637
Chesapeake & Ohio Railway	0.038008273	0.026437246
Seaboard Air Line Railway	0.023208716	0.023289317
Northern Pacific Railway	0.044668485	0.042597041
Chicago, Burlington & Quincy Railroad	0.038046894	0.042774737
Colorado & Southern Railway	0.033187204	0.024737204
Minneapolis, Saint Paul & Sault Sainte Marie Railway	0.022536432	0.025706101
Southern Pacific Co	0.04519721	0.01071844
Galveston, Harrisburg & San Antonio Railway	0.027033063	0.031913722
Houston & Texas Central Railroad	0.015880816	0.008709891

Atchison, Topeka & Santa Fe Railway	0.043746561	0.034741226
Gulf, Colorado & Santa Fe Railway	0.036814682	0.107828637
Union Pacific Railroad	0.050275492	0.048963255
Oregon Short Line Railroad	0.056286864	0.028963958
Oregon-Washington Railroad & Navigation Co	0.021614567	0.020260925
Chicago, Saint Paul, Minneapolis & Omaha Railway	0.050492113	0.046496356
Chicago, Rock Island & Pacific Railway	0.040996462	0.030941746
Chicago, Milwaukee & Saint Paul Railway	0.015505007	0.023766593
Great Northern Railway	0.04482218	0.040913906
Missouri Pacific Railway	0.023393334	0.023230126
Saint Louis & San Francisco Railroad	0.02855337	0.032879455
Missouri, Kansas & Texas Railway	0.019877361	0.016611782
Missouri, Kansas & Texas Railway Co of Texas	0.034864967	0.032121204
Denver & Rio Grande Western Railroad	0.023144232	0.015840196
Western Pacific Railway	0.025547276	0.012363703
Texas & Pacific Railway	0.015736482	0.012284103
Chicago & Alton Railroad	0.020012829	0.022820442
Chicago Great Western Railroad	0.008289993	0.008605624
Saint Louis Southwestern Railway	0.019093277	0.014580349
Kansas City Southern Railway	0.023562011	0.022568471
International & Great Northern Railroad	0.008239025	0.00196556
International & Great Northern Railroad	0.023567365	0.069784265
Minneapolis, Saint Louis Railroad	0.022741046	0.025386986

Appendix 4-2: Capital Structure 1912 vs. 1922.

	1912	1922
Pennsylvania Railroad	0.315036	0.381765145
New York Central & Hudson River Railroad	0.58133	0.673717862
Cleveland, Cincinnati, Chicago & Saint Louis Railway	0.598769	0.614922103
Michigan Central Railroad	0.560439	0.522107265
New York, New Haven & Hartford Railroad	0.476396	0.668558589
Boston & Maine Railroad	0.456249	0.561082675
Maine Central Railroad	0.366683	0.528071258
New York, Ontario & Western Railway	0.310972	0.307590027
Baltimore & Ohio Railroad	0.573607	0.67214149
Central Railroad Co of New Jersey	0.460492	0.340728942
Philadelphia & Reading Railway	0.442831	0.29936814
Erie Railroad	0.522782	0.473620385
Delaware, Lackawanna & Western Railroad	0.004554	0.000919138
Lehigh Valley Railroad	0.507191	0.4676192
Wabash Railroad	0.617409	0.333383678
Delaware & Hudson Co	0.489136	0.499534356
Pere Marquette Railroad	0.78081	0.34243348
Chicago & Eastern Illinois Railway	0.702948	0.484579122
Buffalo, Rochester & Pittsburgh Railway	0.555815	0.578521447
Elgin, Joliet & Eastern Railway	0.425119	0.407947901
Atlantic Coast Line Railroad	0.623814	0.547067832
Louisville & Nashville Railroad	0.608887	0.574530455
Nashville, Chattanooga & Saint Louis Railway	0.630542	0.388770242
Illinois Central Railroad	0.59895	0.611044059
Central of Georgia Railway	0.834058	0.632817373
Yazoo & Mississippi Valley Railroad	0.762797	0.56500713
Southern Railway	0.573954	0.513833636
Mobile & Ohio Railroad	0.68305	0.66079043
Norfolk & Western Railway	0.455854	0.308506037
Chesapeake & Ohio Railway	0.726397	0.630447329
Seaboard Air Line Railway	0.665544	0.686927258
Northern Pacific Railway	0.472483	0.532967509
Chicago, Burlington & Quincy Railroad	0.458485	0.35934365
Colorado & Southern Railway	0.510235	0.490803903
Minneapolis, Saint Paul & Sault Sainte Marie Railway	0.578404	0.658743635
Southern Pacific Co	0.291757	0.305278919
Galveston, Harrisburg & San Antonio Railway	0.592557	0.654673696
Houston & Texas Central Railroad	0.316058	0.180070487

Atchison, Topeka & Santa Fe Railway	0.508765	0.330969383
Gulf, Colorado & Santa Fe Railway	1.11736	0.978489415
Union Pacific Railroad	0.302763	0.329309872
Oregon Short Line Railroad	0.531413	0.44282283
Oregon-Washington Railroad & Navigation Co	0.540235	0.724211438
Chicago, Saint Paul, Minneapolis & Omaha Railway	0.474475	0.55769962
Chicago, Rock Island & Pacific Railway	0.721079	0.591285695
Chicago, Milwaukee & Saint Paul Railway	0.489847	0.613990727
Great Northern Railway	0.496891	0.436707025
Missouri Pacific Railway	0.715862	0.575798087
Saint Louis & San Francisco Railroad	0.756011	0.778810098
Missouri, Kansas & Texas Railway	0.609083	0.439894977
Missouri, Kansas & Texas Railway Co of Texas	1.031173	1.323729492
Denver & Rio Grande Western Railroad	0.559785	0.677830931
Western Pacific Railway	0.511185	0.251562602
Texas & Pacific Railway	0.560776	0.480254735
Chicago & Alton Railroad	0.651545	0.685034309
Chicago Great Western Railroad	0.207815	0.242026647
Saint Louis Southwestern Railway	0.59525	0.484193853
Kansas City Southern Railway	0.451971	0.448600945
International & Great Northern Railroad	0.795184	0.831458882
International & Great Northern Railroad	0.863606	0.499048356
Minneapolis, Saint Louis Railroad	0.656163	0.649438246

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