

# **Investment, Taxes, and Capital Structure: A Study of U.S. Firms in the Early 1900s**

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## **Abstract**

The period surrounding the U.S. entry into World War I is characterized by (i) a large, but transitory increase in investment outlays related to the war effort; and (ii) the imposition of a large excess profits tax that created an unambiguous tax bias towards equity financing. Our analysis of capital structure decisions of U.S. firms between 1905 and 1924 yields little evidence that shocks to corporate and individual taxes have a meaningful influence on leverage ratios. By contrast, we find strong evidence that changes in leverage are positively related to investment outlays and negatively related to operating cash flows. Moreover, the transitory investments made by firms during World War I are associated with transitory increases in debt, especially by firms with relatively low earnings. Our findings do not support models that emphasize taxes as a first-order determinant of leverage choices, but support models that link the dynamics of leverage with the dynamics of investment opportunities.

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## 1. Introduction

The period surrounding World War I is characterized by shocks to two factors often identified as primary determinants of observed capital structures: investment opportunities and taxes. The outbreak of war in 1914, followed by the U.S. declaration of war in 1917, led firms in various industries to increase productive capacity to accommodate a dramatic increase in demand from the U.S. and European governments. This shock thus presents an opportunity to examine how firms finance an exogenous, but transitory, change in investment opportunities. Because dynamic capital structure models emphasize the importance of investment outlays as a first-order determinant of leverage dynamics, the onset of World War I provides a unique setting for examining whether the financing decisions of firms conform to the predictions of these models.<sup>1</sup> At the same time, the War years are accompanied by tax law changes that are among the largest in U.S. history; most notably, the imposition of an “excess profits tax” associated with the U.S. entry into World War I in 1917. Because taxes play a central role in standard tradeoff models of capital structure, this shock provides a particularly useful experimental setting for examining the role that taxes play in financing decisions.

To provide evidence on the impact (if any) of these shocks on financing decisions, we hand-collect financial information for 57 publicly-traded U.S. industrial firms over the period of 1905 through 1924. We supplement this financial data with qualitative data obtained from a reading of the management discussion section of annual reports released by firms during this period.

Our findings yield no evidence that taxes play a central role in capital structure decisions, despite statutory tax rates that range between 0% and 80% over the sample period. Prior to the

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<sup>1</sup> See, for example, studies by Hennessy and Whited (2005), Tserlukevich (2008), Dudley (2010), and DeAngelo, DeAngelo, and Whited (2011).

inception of the corporate income tax, debt financing is common -- sample firms have a mean (median) debt to asset ratio of approximately 14.8% (11.4%) during 1905-1908. After the inception of corporate and individual income taxes in 1909, mean (median) leverage ratios do not change significantly. Most importantly, although the adoption of the excess profits tax in 1917 creates an unambiguous tax bias towards equity financing, we find that debt ratios actually *increase* significantly, after controlling for other variables, during the period in which this tax is in place. Our inferences are robust to the inclusion of direct measures of tax incentives, alternative assumptions about the tax rate of the marginal investor, and possible confounding effects from variation in state taxes.

Despite finding little evidence of a link between leverage changes and tax changes, we nonetheless observe substantial *within-firm* variation in leverage ratios during the sample period. The difference between the maximum and minimum debt-to-asset ratios for individual firms over the entire sample period averages 16.9 percentage points. The wide variation in leverage ratios within our sample fits well with the variation documented by DeAngelo and Roll (2013) for a broad set of U.S. firms between 1950 and 2008 and suggests that the capital structures of firms were changing considerably over the sample period, apparently for reasons other than taxes.

Our analysis of the World War I period yields important insights into these leverage dynamics. We first document that corporate investments in fixed assets and net working capital increase substantially during the World War I period and subside afterwards. Moreover, for a majority of firms, management teams explicitly link these investments to war-related investment requirements. Second, we report evidence that leverage ratios are linked to unexpected changes in investment outlays and cash flows. Most notably, during the World War I period, the ratio of investment outlays to assets is significantly higher for firm years in the top quartile of leverage

changes (0.134) than for firm years in the corresponding bottom quartile (0.032), whereas the ratio of earnings to assets is significantly lower in the top (0.069) than the bottom (0.117) quartile. Further, we find that when firms exhibit investment spikes during the War period and the spikes exceed internal resources, the sample firms predominantly finance these spikes using incremental debt financing despite a strong tax bias towards equity financing during this period. By contrast, when the firm's internal resources are sufficient to finance the spike, firms do not exhibit any abnormal change in leverage. This evidence is consistent with the hypothesis that firms increase debt to finance transitory increases in investments, especially when their operating earnings and cash flows are low relative to their investment requirements.

Additionally, we find that the change in debt ratios during 1917-1920 is significantly and inversely related to the corresponding change in debt ratios during 1921-1924 (i.e., the post-War period), suggesting that the increase in debt during World War I was, like the increase in investments, transitory. Further, we find the inverse relation between the change in debt ratios across periods is driven by firms with high investment during the 1917-1920 period. In fact, we show that reductions in leverage in the post-War period are confined almost exclusively to those firms that had a debt-funded expansion of investment during the war. Thus, our findings do not appear to be driven by an across-the-board incentive to de-lever in the face of the post-World War I recession.

Although shocks to investment outlays and operating cash flows are largest and, more plausibly, exogenous during the WWI period, we find similar evidence of a positive association between leverage and investment outlays, and a negative association between leverage and operating cash flows in other periods as well. Perhaps most notably, we find that year-to-year changes in leverage over the entire sample period are positively related to investment and

negatively related to earnings. Both relations are economically and statistically significant. Although the level of investments and earnings is substantially higher during the World War I period versus other periods, we do not find that the association between the change in leverage and these two variables is significantly different during the war period as compared with other periods.

Collectively, these findings provide strong support for capital structure models that emphasize the dynamics of investment opportunities and operating cash flows as factors influencing the dynamics of capital structure decisions. By contrast, our findings do not support capital structure models that emphasize taxes as a first-order determinant of leverage choices. We discuss the implications of our findings for capital structure models in greater detail in Section 5.

The remainder of the paper is structured as follows. Section 2 describes the two shocks of primary interest during the sample period, i.e., the inception of a federal income tax system and a transitory increase in corporate investments caused by World War I. Section 3 describes the sample and data. Section 4 provides the empirical results. Section 5 includes a discussion of the results and concluding comments.

## **2. Sample and data**

### *2.1. Sample*

We begin by identifying all U.S. industrial companies that were publicly traded in 1905. Specifically, we include all U.S. industrial firms with stock price data listed in the *Wall Street Journal* on either September 30, 1905 or December 30, 1905. We exclude utilities, railroads, and mining companies, which reduces the initial sample of 212 firms to 92 firms. Because our

primary source of financial data are annual issues of *Moody's*, our final sample consists of the 57 publicly traded companies for which we are able to obtain sufficient financial data from the *Moody's* manuals.<sup>2</sup> A list of the sample is included in Appendix A.

The sample includes a diverse group of companies in terms of both size and industry. U.S. Steel is by far the largest firm in the sample, with average assets of \$2.03 billion during the period. Other large companies in the sample include Swift (\$238 million), General Electric (\$199 million), American Smelting & Refining (\$174 million), and Pullman (\$147 million). At the other end of the spectrum are very small firms, including American Cement (\$4.6 million), American Grass Twine (\$5.7 million), and Pacific Mail Steamship (\$16.4 million). The sample includes firms from various industries, including steel, coal, paper, food, textiles, tobacco, chemicals, rubber, and real estate.

## 2.2 Data

We are not aware of existing databases that contain financial information for U.S. firms during the early part of the 20<sup>th</sup> century. As a result, we hand-collect financial data from annual issues of *Moody's* during the sample period. Specifically, we record various data from income statements and balance sheets that are published in *Moody's*, including information about earnings, interest expense, taxes, cash holdings, working capital, property plant and equipment, and debt. Although there is variation in how companies report these items we attempt to maintain consistency within firms across time. We are not aware of any systematic biases this may cause. We collect data on stock prices from the *Commercial and Financial Chronicle*.

We supplement this financial data with more qualitative data obtained from a review of annual reports for fiscal years 1917 through 1920. For each sample firm, we identify from the

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<sup>2</sup> Nine of the firms exit the sample before 1924. Five were acquired, three exited due to bankruptcy, and one firm in the alcoholic beverage industry, American Malting Co., liquidated assets in 1918 apparently because of the prohibition movement. The results are robust to excluding these nine firms from the sample.

Purdue University Library website the availability and location of annual reports for the 1917-1920 period. Annual reports for at least part of this sub-period are available for 52 of the 57 firms in the sample.<sup>3</sup> A complete set of annual reports for the period of 1917-1920 is available for 46 companies. One company, American Malting Co., liquidated in 1919, and another, General Chemical Co., was acquired in 1920, which means only two and three annual reports are available for American Malting Co. and General Chemical Co., respectively, over this period. Annual reports were available for only part of the 1917-1920 period for Cambria Steel Company, United States Realty & Improvement Company, and The Westinghouse Brake Company.

Ultimately, we are able to obtain 199 annual reports for the sample firms over the four-year period of 1917-1920, which represents 95% of the 209 annual reports that potentially could have been released during these years.<sup>4</sup> A list of the available annual reports for each firm in the sample, along with the source of the annual reports, is contained in Appendix B.<sup>5</sup>

### *2.3 Summary statistics*

Table 1 reports summary statistics for the variables used in the subsequent analysis over the entire sample period of 1905-1924. The data indicates wide variation in leverage and several of its traditional determinants. Whereas the median ratio of the book value of debt to the book

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<sup>3</sup> We were unable to locate annual reports for American Cement Company, National Carbon Co (which was acquired by Union Carbide in 1916), Rubber Goods Manufacturing Company (acquired by US Rubber in 1914), Streets Western Stable Car Line Company (sold in 1915), and United States Reduction & Refining Co. (foreclosure in 1916).

<sup>4</sup> Of the 199 annual reports we obtain, 156 (78%) are collected from the Columbia University Business School library, 22 (11%) are collected from Harvard University's Baker Library, eight (4%) are collected from the University of Alabama library, six (3%) are collected from the New York Public Library, four (2%) are provided directly by the U.S. Steel Corporation, and three (2%) are collected from MIT's library

<sup>5</sup> The amount of information disclosed in the annual reports varies greatly across the sample firms. For example, the annual reports of some firms, such as Crex Carpet and Electric Storage Battery Co., are quite short (two and three pages, respectively), containing cryptic narrative and little financial information. Other firms, such as U.S. Steel Corporation and Swift & Co. issued annual reports of more than 50 pages, containing extensive narrative and fairly detailed financial information.

value of assets is 0.115, this variable ranges from 0 to 0.554. Similarly, the ratio of the book value of debt to the market value of assets ranges from 0 to 0.915, with a median value of 0.204.<sup>6</sup>

The median value of assets is \$51.3 million.<sup>7</sup> As described above, there is considerable variation in the size of firms in the sample, with book asset values ranging from \$3.4 million to \$2,572 million. The table also presents data on inflation-adjusted assets, using constant 1905 dollars. This inflation-adjusted number also reveals wide variation in the size of firms in the sample.

Other variables known to be associated with leverage also vary widely across firms during the sample period. The market to book value of assets, generally found to be inversely related to leverage, ranges from 0.041 to 2.342, with a median value of 0.675. The ratio of earnings before interest and taxes to the book value of assets, also generally found to be inversely related to leverage, ranges from -0.141 to 0.472, with a median value of 0.056. The ratio of tangible to total assets, often found to be directly related to leverage has a median value of 0.652 and ranges from 0 to 0.973. Finally, the ratio of investment, defined to be the sum of investment in working capital and fixed assets, to total assets varies widely, from -0.627 to 1.114, with a median value of 0.016.

### **3. Investment and tax shocks during 1905-1924**

In this section, we present descriptive evidence on shocks to two factors that plausibly are related to observed capital structures during our sample period. We first describe how the onset of World War I caused a large, transitory increase in investment expenditures by firms in our

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<sup>6</sup> Graham, Leary, and Roberts (2013) report similar levels of leverage for U.S. firms between 1920 and 1945, but then report that leverage increases steadily and significantly between 1946 and 1970, so that average leverage levels in 1970 are more than three times those in 1945.

<sup>7</sup> Appendix C lists a description of each of the variables used in the paper.



sample. We then describe the inception of federal income taxes and the variation in corporate and individual tax rates over time, with particular emphasis on the sizeable shock to tax rates during the World War I period.

### *3.1. World War I and corporate investment*

The onset of World War I in August, 1914 followed by the U.S. entry into the war in April 1917 resulted in a large increase in investment expenditures by U.S. firms. Rockoff (2004, pp. 4-6) describes how World War I and the associated increase in federal spending after the U.S. entry into the war generally affected the U.S. economy:

“When the war began the United States was in a recession. European purchases of goods for the war, mainly food and munitions, soon turned things around and created a long economic boom ... Real plant and equipment were added, and because they were added in response to demands from countries already at war, they were added in precisely those sectors where they would be needed once the U.S. entered the war. Bethlehem Steel, for example, was expanded by adding facilities and through acquisitions into a major integrated steel maker during this period of neutrality in response to demands for steel coming mainly from Europe. ... America’s entry into the war in April 1917 unleashed a torrent of Federal spending. Spending rose from month to month, reaching a peak of \$2,087 million in January of 1919, about 32.43 percent of GDP.”

Figure 1 reports median annual ratios of inflation adjusted investment (defined as the sum of investments in working capital and fixed assets adjusted to 1905 dollars) to beginning of period assets during the sample years. The data indicate that, during the period encompassing the U.S. entry into and subsequent exit from World War I, median investment increased sharply, and then fell dramatically. Specifically, investment increases from less than one percent of assets in 1914 and 1915 to 3.3% of assets in 1916, 4.8% of assets in 1917, and a striking 6.5% of assets in 1920. Investment rates in these three years are greater than in any other years during

our sample timeframe. Median investment rates shrink dramatically in 1921 (median = -0.8%) and never rise above 1.3% over the subsequent four years.

To more clearly establish the link between the U.S. entry into World War I and increased investment, we conduct a clinical analysis of annual reports issued by the sample firms during the 1917 to 1920 sub-period. The full results of this analysis are presented in the Internet Appendix in the form of brief case histories of financing and investment for each sample firm for which we are able to obtain annual reports. Whenever available, we read the full management discussion section of the annual report and record any relevant commentary about the firm's investment, financing, and operating profits.

In Table 2, we summarize the frequency of investment spikes, their timing, the connection (if any) to World War I, and the nature of the investment. We arbitrarily define a firm-year as having an investment spike if the firm's ratio of investment-to-total assets in that year is at least 50% greater than the median investment-to-assets ratio for that firm during the pre-war period of 1905 to 1916 and the firm's investment-to-total assets ratio is greater than one percent. As shown in the first row of Table 2, we identify 114 different firm-years exhibiting such an investment spike. If we conduct a similar analysis at the firm level, we find that 52 of the 53 firms with available data have at least one year during the 1917-1920 period in which its investment rate is at least 50% greater than its pre-war median.<sup>8</sup> Moreover, though our definition of investment spike is arbitrary, it is notable that the typical spike is economically large; the median investment spike during the war period represents an investment rate that is

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<sup>8</sup> If we require the firm's investment-to-total assets ratio to be at least 100% greater than the pre-war median, we identify 103 investment spikes and 48 out of 53 firms have at least one spike. We also note that spikes of this magnitude are much more common during the 1917-1920 period. In untabulated results, we find that investment spikes at least 50% greater than pre-war median occur in 56.7% of the firm-years during the 1917 to 1920 period, but only 33.4% of the firm-years during the baseline 1905 to 1916 period and 26.2% of the firm-years in the 1921 to 1924 period.

344% greater than the firm's pre-war median investment rate (this result is not reported in the table).

Among firms with investment spikes, qualitative discussions in the annual report often directly link the investment spikes to World War I. This is true for 34 of the 52 firms with investment spikes.<sup>9</sup> As summarized in Table 2, the most common war-related investment is for the construction of new manufacturing facilities or expansion of existing facilities to meet war-related product demand (22 cases). For example, in its 1917 annual report, General Electric states that “a substantial portion of the large increase [in orders] for the past year consisted of orders for ship propulsions and other apparatus placed by and for the US Government.” Further, in its 1918 annual report, General Electric stated that “in order to expedite the completion of Government and other contracts essential to the prosecution of the war, your Company was forced to make heavy expenditures for additional manufacturing facilities ...”

Similarly, U.S. Steel's 1917 annual report states that the “large demand for iron and steel products which existed during 1916 continued during the year 1917. This was increased after the entrance of the United States into the European war, especially for certain lines of products required for the war program. These demands largely exceeded the producing capacity of the manufacturers ...” According to the company's 1918 annual report, U.S. Steel's capital expenditures increased from \$100.1 million during August 1, 1914 to April 1, 1917 (the period before the U.S. entered the war), or \$3.2 million per month, to \$202.7 million during April 1, 1917 to December 31, 1918 (the period following the U.S. entry into the war), or \$10.1 million per month.

In other firms, large increases in investment were a byproduct of expanded working capital requirements. Expansions in working capital were brought about by expanded business

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<sup>9</sup> Note that several firms do not provide management discussions in which to identify a link.

opportunities during the war period (14 cases) and war-related increases in the cost of raw materials and supplies (six cases). As an example of the former, American Tobacco dramatically expanded inventory in 1918 due to war-related demands for tobacco as part of the daily rations for soldiers. According to General John J. Pershing, “You ask me what we need to win this war. I answer tobacco as much as bullets. Tobacco is as indispensable as the daily ration; we must have thousands of tons without delay.” [*Advertising and Society: An Introduction*. Chichester, West Sussex: Wiley-Blackwell, 2014.] As an example of the latter, International Paper’s 1919 annual report states “The war has led to revolutionary changes in everything connected with industrial matter. The most notable of these is the enormous increase in the cost of labor and materials, which in turn leads to the necessity of more than twice the working capital required six years ago to carry on the same volume of business.”

Finally, it is notable that, in many cases, war-related spikes in investment take place after the completion of the war. For example, after expanding capacity during fiscal year 1917 to satisfy war-related demands for its product, Diamond Match again substantially expanded investment in 1920 “to cope with peculiar existing post-war conditions in the raw material field, and avail itself of unprecedented opportunities for expansion in profitable branches of its prime business and associated fields of industry” (1919 annual report).

In short, both empirical and qualitative evidence points to the 1917-1920 period as being characterized by a sudden, large, and transitory shock to the investment opportunity set of the sample firms. For most firms, this shock is a direct consequence of the U.S. involvement in World War I and/or market disruptions caused by the war. Moreover, as we later show, there is substantial cross-sectional variation in the extent to which firms require external financing to

fund these war-related investment opportunities. As a result, this time period represents a rich setting for studying the implications of various dynamic capital structure models.

### *3.2. U.S. corporate and individual income taxes, 1905-1924*

Table 3 lists the annual federal tax rates on corporate and individual income, respectively, over the sample period. Between 1905 and 1908, neither corporate nor individual income was taxed in the U.S. at the federal level.<sup>10</sup> Between 1909 and 1916, corporate income taxes and (subsequently) personal income taxes were introduced, but at low marginal rates. The Corporate Tax Act of 1909 called for a one percent tax on corporate income in excess of \$5,000, while the Revenue Tax Act of 1913 established a “normal” individual income tax rate of one percent along with a set of graduated surtax rates as high as six percent. Both Acts treated interest expense as a tax deductible expense, though there were slight variations in the amount of debt to which tax deductibility applied.<sup>11</sup>

World War I, which began on July 28, 1914, was the catalyst for significant increases in U.S. tax rates in 1916 and 1917. Although the U.S. did not enter the war until April 6, 1917,

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<sup>10</sup> Prior to 1905, the U.S. had taxed corporate and/or individual income on two occasions. The Revenue Act of 1861, enacted to generate revenue for the U.S. government during the Civil War, taxed individual, but not corporate, income at a rate of three percent on annual income over \$800. This law was replaced by the Revenue Act of 1862, which also taxed only individual income, this time at graduated rates as high as five percent. In 1870, after the cessation of the Civil War, a law calling for the expiration of the individual income tax in 1873 was enacted. From 1873 through 1893, neither individual nor corporate income was taxed at the federal level in the U.S. In 1894, the Wilson-Gorman Tariff Act, which taxed both corporate and individual income at a rate of two percent on income over \$4,000, was adopted. However, one year later this tax was struck down by the U.S. Supreme Court in *Pollock v. Farmers’ Loan & Trust Co.* 157 U.S. 428 (1895) on grounds that the apportionment requirement of the U.S. Constitution required direct taxes to be levied in proportion to the population of states.

<sup>11</sup> Specifically, the 1909 Act limited tax deductibility to an amount of debt equal to the value of the company’s capital stock. Under the 1913 Act, interest expense was deductible on an amount of debt equal to one-half of the amount of outstanding debt and equity. We thank Steven Bank for pointing out that the Treasury Department later changed its interpretation such that interest expense was deductible up to the paid up capital stock plus one-half of the outstanding debt. Also, whereas dividends were treated as individual income for tax purposes under the 1913 Act, retained earnings were not subject to the individual tax rate unless the tax authorities determined that a company was retaining earnings for the purpose of shielding their stockholders from paying taxes on dividend income.

President Wilson sought large tax increases in 1916 to finance war preparations. Income tax rates more than doubled in 1916 with the enactment of The Revenue Act of 1916, which increased the corporate tax rate from one percent to two percent and the top individual surtax rate seven percent to thirteen percent (on incomes over \$2,000,000). Interest expense remained tax deductible as long as it was less than or equal to the sum of paid up stock and one-half the amount of outstanding interest bearing debt. In addition to the Revenue Act of 1916, the Munitions Manufacturers Tax, which increased the corporate income tax rate to 12.5 % for manufacturers of munitions, was adopted in 1916.

Tax rates increased much more substantially in 1917, with the adoption of two amended war revenue bills on March 3, 1917 and October 3, 1917. The two bills created two new taxes -- a “war profits” tax and an “excess profits” tax. The first bill increased the “normal” tax rates on corporate and individual income to six percent and four percent, respectively. It also created a war profits tax that levied an 80% tax on a corporation’s net income in excess of a war profits credit. The credit was calculated as the sum of (i) \$3,000, (ii) the corporation’s average net income during 1911, 1912, and 1913 (i.e., pre-war years), and (iii) ten percent of the increase in the corporation’s invested capital over its average invested capital during 1911 to 1913. Importantly, under the legislation, invested capital was defined as the sum of (i) actual cash paid in, (ii) the cash value of tangible property, and (iii) paid in or earned surplus and the corporation’s undivided profits. Plehn (1920) notes that “invested capital came to be defined in substance as the amount paid in by stockholders, whether originally or out of profits, in money or in property.”

The war revenue bill adopted on October 3, 1917 replaced the war profits tax with an excess profits tax. The excess profits tax levied a set of graduated tax rates ranging from 20

percent to 60 percent on the difference between a corporation's net income and an excess profits credit, calculated as the sum of (i) \$3,000 and (ii) a measure of "normal" net income, calculated as eight percent of a company's invested capital. In both bills, interest expense was treated as tax deductible as it was in the Revenue Act of 1916. Again, however, the definition of invested capital included equity, but not debt financing.

Tax rates increased yet again in 1918, with the adoption of another war revenue bill. Under the Revenue Act of 1918, both the normal corporate and individual tax rates increased to 12 percent. In addition, this bill adopted both a war profits tax and an excess profits tax, in which corporations would pay whichever tax resulted in a higher tax payment. The 1918 revenue bill also provided for an unlimited interest tax deduction. Finally, the 1918 legislation increased the top individual surtax rate from 63% to 65%.

With the World War I armistice on November 11, 1918, Congress repealed the war profits tax, but not the excess profits tax, in January 1919. The corporate tax rate declined from 12 percent to ten percent in 1919, while the normal individual tax rate declined from 12 percent to eight percent. These rates remained intact until late 1921, when the Revenue Act of 1921 was enacted. This legislation eliminated the excess profits tax but called for an increase in the corporate tax rate from ten percent to 12.5 percent. It also called for a decrease in the normal individual tax rate from eight percent to six percent in 1924 and a gradual reduction in the top individual surtax rate from 65 percent in 1921 to 50 percent in 1922 and 40 percent in 1924.

The net tax incentive of debt financing depends on five different tax rates – the corporate tax rate, the personal tax rate on debt income, the personal tax rate on dividends, the personal tax rate on capital gains, and the excess profits tax – all of which vary over the sample period. Moreover, although direct measures of the net capital structure incentives of four of these rates

can be constructed by using assumptions about the corporate tax rate, the tax rate of the marginal investor, and the company's payout policy, the fifth rate, the excess profits tax rate, has a complex dependence on past and present net income and invested capital. Therefore, to construct a measure of the net tax advantage of debt financing that incorporates all five tax rates, we estimate the net tax incentive for each firm-year observation by calculating the change in total dollar return to debt and equity holders if the firm used \$1,000 more in debt and \$1,000 less in equity for that year. To make this calculation, we use the implied corporate and excess profits taxes for the firm-year and the highest marginal individual income, dividend, and capital gains tax rates for the year. In this manner, we incorporate both the time-series changes in statutory tax rates and any cross-sectional variation in firms' exposure to taxes.

Figure 2 plots the median net tax advantage of debt financing over the sample period along with the 25<sup>th</sup> percentile. Not surprisingly, the net tax advantage of debt financing is essentially zero prior to 1917. There is no excess profits tax and marginal rates on corporate and personal income are trivially low during these years. Beginning in 1917, however, the increase in marginal rates, combined with the imposition of the excess profits tax, produces a net tax preference for equity financing. In isolation, the interest tax deduction of debt has substantial value during this period. However, the tax deductibility feature is dwarfed by the equity incentive created by the excess profits tax. Specifically, the definition of invested capital, which includes equity but not debt financing, unambiguously creates a bias towards equity financing.<sup>12</sup>

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<sup>12</sup> Appendix D details the relative advantage of debt throughout the sample period if the excess profits tax is excluded. It then presents an example of how the excess profits tax dominated the other taxes and conferred a significant advantage to equity over debt financing. Thus, even though the excess profits tax was clearly temporary, it seems plausible that firms would have attempted to exploit the tax advantage of equity, all else equal. Moreover, as shown in Figure 2, there are no indications in the data that firms would expect the tax incentive to shift towards debt financing once the excess profits tax was repealed. Prior to 1917, the tax incentives are trivial, while after repeal of the excess profits tax in 1921, there is still a net tax incentive for equity financing due to the sharp decrease in the capital gains tax. Finally, we later show that a large number of firms required incremental financing to



Consistent with this reasoning, Plehn (1920) writes that “it is of course in the interest of the taxpayer to get as high a valuation of invested capital as possible ... the excess profits tax is so heavy that the taxpayers strain themselves to get these items up (p. 293).” Figure 2 also shows that, because of the decrease in the capital gains rate to 12.5%, the tax preference for equity finance continues beyond the repeal of the excess profits tax in 1921.

### *3.3. Implications for capital structure decisions*

The investment and tax shocks during the 1917-1920 period represent a unique opportunity for exploring the empirical importance of commonly hypothesized determinants of capital structure decisions. First, the war years provide evidence on whether leverage is related to an exogenous shock to a firm's investment opportunity set. Although several recent studies explore this issue by analyzing the correlation between leverage and investment spikes, these studies do not attempt to identify cleanly exogenous shifts in the firm's investment opportunity set.<sup>13</sup> By contrast our analysis identifies the war period as a plausibly exogenous shock to the investment opportunity set that is sudden, large, and transitory. Second, because the war years are characterized by an unambiguous tax preference for equity financing, our study can help shed further light on the importance of taxes as a first-order determinant of leverage decisions.

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undertake war-related investment plans. Thus, it is difficult to argue that transactions costs impeded the ability of these firms to take advantage of the tax benefits of equity financing.

<sup>13</sup> See, for example, DeAngelo, DeAngelo and Whited (2011), DeAngelo and Roll (2013), Denis and McKeon (2013), Dudley (2012), Elsas, Flannery, and Garfinkel (2013), Harford, Klasa, and Walcott (2008), Im (2014), and Mayer and Sussman (2004).

#### **4. Dynamics of leverage ratios**

In this section, we explore the dynamics of leverage ratios in our sample firms. Although we report data over the entire sample period, we focus primarily on the 1917-1920 period since that period is characterized by the World War I-related shocks to investment opportunities and taxes detailed in Section 3.

##### *4.1. Univariate tests of changes in variables over time*

Table 4 contains univariate data showing the intertemporal variation in key variables over the sample period. For illustrative purposes, we partition the sample period of 1905-1924 into five four-year sub-periods corresponding to unique tax and/or investment environments. The periods are:

- a. 1905-1908 – a sub-period in which there was no corporate or individual income tax at the federal level.
- b. 1909-1912 – a sub-period in which there was a corporate excise tax on income, but not an individual income tax at the federal level.
- c. 1913-1916 – a sub-period in which there was both a corporate and individual income tax at the federal level.
- d. 1917-1920 – a sub-period in which there was (i) corporate and individual income tax at the federal level, (ii) a high war-related excess profits tax, (iii) a high war-related surtax on individual income, and (iv) investment spikes related to the U.S. entry into World War I.

- e. 1921-1924 – a sub-period in which the war-related excess profits tax was phased out, individual income tax rates decreased, and the capital gains tax dropped sharply.

Based on the previous discussion, we expect taxes levied between 1909 and 1916 to have little impact because of their low marginal rates. Beginning in 1917, however, our analysis in Section 3 demonstrates a clear tax preference for equity financing that carries through the post-War years. At the same time, the sample companies experience an exogenous shock to their investment opportunity set and to their profitability.

It is important to note that the war-related shocks to investment opportunities and taxes are not the only economic shocks to take place during our sample period. Other important shocks include the panics of 1907 and 1910-11, the fallout from which led the U.S. Congress to create the Federal Reserve System in 1913; the recession of 1913-14; and the post-war depression of 1920-21.<sup>14</sup> Because these other shocks also potentially impact corporate financing decisions, our inferences rely on (i) linking the timing of leverage changes with the timing of war-related shocks to investment opportunities and taxes, and (ii) supplementing this evidence with qualitative evidence from annual report discussions. Nonetheless, we later discuss and provide evidence on the extent to which our findings could be due to the effects of the other macro-economic shocks described above.

Several noteworthy facts emerge from the analysis in Table 4. First, the two measures of leverage, one based on the book value of assets and the other based on the market value of assets, are not significantly different during 1905-1908, a period in which there were no federal income taxes at either the corporate or individual level, than they are throughout the rest of the sample period, during which U.S. corporate and individual tax rates varied widely. The mean value of the book-based leverage ratio during 1905-1908 is 0.148, which is higher (albeit not significantly

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<sup>14</sup> See “US Business Cycle Expansions and Contractions” (<http://www.nber.org/cycles/cyclesmain.html>).

higher) than the corresponding mean value for any of the other sub-periods. The median value of this variable during 1905-1908 is 0.114, which is the third highest value among the five sub-periods. Similarly, the mean and median values of the market-based leverage ratios reveal that leverage is used as a source of financing during 1905-1908 on a level comparable to the rest of the sample period.<sup>15</sup>

Second, whereas the mean and median debt ratios do not change significantly over the sample period, the debt ratios of individual firms do exhibit considerable variation over the sample period. Table 5 lists summary statistics for the ratio of debt to the book value of assets for each firm in the sample. The data show substantial variation in the debt ratio of most firms over the sample period. For example, the debt ratios of U.S. Realty & Improvement Co., American Tobacco Co., and Virginia-Carolina Chemical Co. ranged from 0.000 to 0.454, 0.007 to 0.434, and 0.161 to 0.554, respectively. More generally, on average, the debt ratios of firms in the sample range from 0.067 to 0.236. These data indicate that firms vary their use of debt financing throughout the sample period.<sup>16</sup>

Third, several key determinants of leverage change significantly during the sub-period of 1917-1920 when the U.S. entered World War I. The profitability of firms increased substantially during this sub-period. The mean and median ratios of EBIT to assets during this sub-period are 0.090 and 0.083, respectively, which are significantly higher than the corresponding ratios during the rest of the sample period (at the 0.01 level), which generally average around 0.050. This is

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<sup>15</sup> If we use yearly averages of leverage (both book and market-based), we find no evidence of significant differences in average leverage over the sample period.

<sup>16</sup> Although the pattern of substantial variation in individual firm leverage through time is similar to that reported in DeAngelo and Roll (2013), the time-series variation in leverage in our sample is lower than that in DeAngelo and Roll (2013). This is most likely due to the more conservative average levels of leverage exhibited by firms during our sample period (1905-1924) relative to those in the later years studied in DeAngelo and Roll (1950-2008). DeAngelo and Roll (2013) demonstrate a strong association between leverage stability and leverage conservatism.

the only sub-period in which the profitability of firms is significantly higher than it is during the rest of the sample period.

In addition, as depicted earlier in Figure 1 and discussed in Section 3, the investment expenditures of firms increase sharply and significantly during this sub-period due to war-related opportunities. The mean and median ratio of investment to assets are 0.054 and 0.042, respectively, during 1917-1920, and both are significantly higher (at the 0.01 level) than the corresponding ratios during the rest of the period, which generally are in the range of 0 to 0.024. Also consistent with Figure 1, the mean and median values of the ratio decline to 0.000 and 0.004, respectively, in the subsequent sub-period, which further suggests the transitory nature of the investments during 1917-1920. Furthermore, notwithstanding the increase in profitability of firms during the sub-period, the mean and median market-to-book ratios were not significantly different during 1917-1920 as compared with the rest of the period. Insofar as market-to-book ratios are a proxy for growth opportunities, these data suggest that market participants viewed the investments that firms were making during 1917-1920 as transitory and not indicative of a more permanent increase in the growth opportunities of firms.

#### *4.2. Cross-sectional regression results*

To provide more formal evidence on whether the leverage ratios of firms change significantly over time after controlling for the primary determinants of leverage, we estimate several regression models in which the book-based and market-based leverage ratios serve as dependent variables. Included as independent variables are (i) the natural log of assets, (ii) market-to-book ratio, (iii) the ratio of EBIT to assets, and (iv) the ratio of tangible to total assets, which are typically included as independent variables in leverage equations.<sup>17</sup> In addition, we include dummy variables for time periods. In one specification, we include dummy variables for

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<sup>17</sup> See Frank and Goyal (2009) for a study of which variables are reliably associated with observed capital structures.

each year after the first sub-period, and in the other specification, we include dummy variables for all but the first sub-period. The models include firm fixed effects and all variables are winsorized at the 0.01 and 0.99 levels. Standard errors are clustered at the firm level. The results are reported in Table 6.

The first two columns of Table 6 show the results for the regressions in which the book-based leverage ratio is the dependent variable. The results show that firm size, as measured by the natural log of assets is directly related to leverage, a result generally consistent with more recent evidence. Similarly, an inverse relation exists between firm profitability, as measured by the EBIT to asset ratio, and leverage, which also is generally consistent with existing literature. The tangibility of assets enters with a positive but not significant coefficient. Contrary to findings based on more recent data, however, we find a direct relation between market to book ratios and leverage. We note, however, that Graham, Leary, and Roberts (2013) also report a positive relation between book leverage and market to book ratios in the early part of their sample, 1925-1940.

The dummy variables for both the sub-periods and individual years reveal that leverage is significantly higher during the 1917-1920 period than it is in other sub-periods. The coefficient on the period dummy variable is 0.035, which is economically as well as statistically significant (at the 0.05 level). The equation in which dummy variables for individual years are included reveals that leverage is significantly higher in three of the four years during 1917-1920. Here, too, the coefficients on the four dummy variables, ranging from 0.022 to 0.044, reveal economic as well as statistical significance.<sup>18</sup> Moreover, it is notable that the spike in leverage ratios

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<sup>18</sup> When the control variables are replaced by their lagged values, the 1917 - 1920 period dummy is significant in both the BVA and the MVA regressions and the significant year dummies shift to 1918 – 1921.

indicated by the estimated coefficients on the year dummies during the war years closely mirrors the spikes in investment during those same years, as depicted in Figure 1.

The second two columns of Table 6 contain the corresponding results for the equations in which the market-based leverage ratios are the dependent variables. The coefficient estimates for the 1917-1920 period dummy and the year dummies during this period are similar to the book-based leverage ratio estimates, but, due to an increase in the standard errors, the estimates are not statistically significant at conventional levels.<sup>19</sup>

The results in Table 6 warrant additional comments. First, the univariate tests in Table 5 show that the mean and median values of both leverage variables are not significantly different during 1917-1920 than they are during the rest of the period. In light of this result, we interpret the results in Table 6 as follows. As shown, the profitability of firms increased substantially during World War I. Given that leverage is inversely related to profitability, the large increase in profitability during 1917-1920, by itself, would be expected to reduce the leverage ratios of firms. The fact that the leverage ratios of firms remained largely unchanged during this period, despite the large increase in profitability, accounts for the large positive coefficients on the dummy variable for the 1917-1920 sub-period and the dummy variables for each year during this sub-period as shown in Table 6.

Second, the significant increase in leverage during the 1917-1920 sub-period begs the question of what caused the increase in leverage. Recall that this sub-period was characterized by both a large increase in war-related taxes on both corporate and individual income and a large, sudden, and transitory increase in investments by firms. As discussed previously, the net

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<sup>19</sup> In untabulated results, we run yearly regressions of Leverage (BVA) on the same set of continuous independent variables as in Table 6. This methodology allows the coefficients on the independent variables to vary across years. We then test the significance of the constant term across the 20 years in the sample using a Fama-MacBeth methodology. Our findings indicate that the only years in which the coefficient is significant are 1905 (negative) and 1920 (positive).

effect of the tax system during this period created a strong bias in favor of equity financing because of both the net effect of the corporate and individual tax rates and the inclusion of equity financing but not debt financing in the capital base used to determine a firm's excess profits. Hence, if taxes were a primary determinant of financing decisions during this period, we would expect, based on tax considerations alone, that leverage would have declined, not increased, during 1917-1920. Because leverage is actually higher than expected during this period, we conclude that other factors are responsible for this result.

#### *4.3. Linking leverage dynamics with investment shocks and funding needs*

To this point, our evidence suggests that leverage ratios exhibit substantial variation through time, but that these changes do not appear to be primarily a response to tax incentives. Moreover, leverage is abnormally higher during the 1917 to 1920 period that is characterized by an exogenous shock to investment due to the US involvement in World War I. In this section, we attempt to shed further light on the primary determinants of leverage dynamics by focusing on the links among the sample firms' cash flows, investment needs, and financing sources.

##### *4.3.1. Univariate comparisons*

As a starting point, in Table 7 we stratify the sample of firm years into two categories representing the highest and lowest quartiles of year-to-year changes in leverage, where leverage is defined as the ratio of the book value of debt to the book value of assets. We then test whether measures of investment, operating cash flow, and cash holdings differ across the two quartiles. Panel A contains the results over the entire sample period, while panel B focuses on the World War I period 1917-1920.



As shown in Panel A, there are significant differences between the characteristics of firms with the smallest leverage changes and those with the largest changes. The mean level of investment to assets is significantly lower (0.011) for the firm years in the lowest quartile versus firm years in the highest quartile (0.059). Similar results hold for the median value of this variable. Recall also that the average level of investment across all firm-years in the sample is 2.8%. Thus, the difference of 4.8 percentage points between the top and bottom quartile of leverage changes is economically meaningful as well.

Panel A also finds that both (i) the ratio of EBIT to assets and (ii) the ratio of cash to assets are significantly higher for firms in the lowest versus the highest quartile. The mean value of the ratio of EBIT to assets is 0.076 for the lowest quartile, versus 0.048 for the highest quartile, a difference that is significant at the 0.01 level. Similar results hold for the median values of this variable. The ratio of cash to assets is 0.054 for the lowest quartile versus 0.039 for the highest quartile, a result that also is significant at the 0.01 level. The difference in the median value of this variable is less pronounced but nonetheless significant at the 0.05 level. Hence, firms that increase their leverage the most from year to year have larger investment requirements and less cash and operating cash flow than firms that are in the lowest quartile of year to year changes in leverage.

Panel B contains the corresponding results for the 1917-1920 sub-period. The panel shows that during the war period the mean ratio of investment to assets was 0.134 for firms in the highest quartile of change in leverage, versus 0.032 for firms in the lowest quartile, a difference that is significant at the 0.01 level. Similar results hold for the median values of this variable. The difference in this ratio across the two quartiles is 0.112, which is more than twice

the corresponding difference for the entire sample period and indicative of the economic significance of the result.

The panel also finds that the mean ratio of EBIT to assets is significantly higher (at the 0.01 level) for firms in the lowest (0.117) versus the highest (0.069) quartile. The results are similar for the median values of this variable. The mean ratio of cash to assets is higher for firms in the lowest quartile (0.070) versus firms in the highest quartile (0.059), but this difference is not significant. The median value of this variable is slightly higher (0.054) for firms in the highest quartile versus the lowest quartile ((0.053), but this difference also is not significant.

The evidence in Panel B thus shows that firms that increased their leverage the most during World War I had investment requirements (i.e., 13.4% of assets, on average) that outstripped both their EBIT (6.9% of assets) and cash (5.9% of assets). In contrast, the firms in the lowest quartile of year to year changes in leverage during World War I had relatively low investment requirements (3.2% of assets, on average) as compared with both their EBIT (11.7% of assets) and cash (7.0% of assets). Furthermore, the disparity between investment requirements and both EBIT and cash for firms in the highest quartile is more pronounced during the World War I period than it is over the entire sample period. Whereas the difference between mean investment and both EBIT and cash, all expressed as a percentage of assets, is 6.5% and 7.5%, respectively, during the World War I period, the corresponding differences over the entire sample period are 1.1% and 2.0%, respectively.<sup>20</sup> Hence, the evidence in Panel B of Table 7 provides suggestive evidence that the observed increase in leverage during World War I is driven by the need to finance war-related investment expenditures.

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<sup>20</sup> The differences between the highest quartile and lowest quartile groups in the overall sample are not driven completely by the 1917-1920 period. When the 1917-1920 period is excluded from the sample, we also find significant differences between the highest quartile and lowest quartile groups for Investment / Assets, EBIT / Assets, and Cash / Assets.

To provide more direct evidence on this issue, in Table 8 we focus on the 114 investment spikes identified in Table 2 and the subset of 41 of these spikes for which qualitative discussions in the annual report directly link the investment spikes to World War I. We first partition the spikes on the basis of whether or not the spike creates a financing gap for the firm in the year of the spike. We define the financing gap as either the difference between the level of investment in the year of the spike and EBIT (Panel A) or the difference between the level of investment and the sum of EBIT and the firm's cash holdings (Panel B). We then report changes in leverage and the frequency of common stock issues within each subset.

The results indicate that when the investment spikes during the War period exceed internal resources, the sample firms predominantly finance these spikes using incremental debt financing. By contrast, when the firm's internal resources are sufficient to finance the spike, the firms do not exhibit any abnormal change in leverage. Specifically, for the full sample of 114 spikes in Panel A, the change in leverage is equal to 3.9% of assets when the financing gap is positive and -0.5% when the financing gap is negative. The results are somewhat larger in Panel B; the change in leverage is equal to 6.5% of total assets when the financing gap is positive and 0.2% when the financing gap is negative.

We find similar results if we limit the analysis to investment spikes for which there is clear discussion of a World War I link in the firm's annual reports. For these firms, when the financing gap is positive, the gap is larger, on average, and the observed increases in leverage are more substantial (6.7% of total assets in Panel A and 8.8% of total assets in Panel B). Again, when the financing gap is negative, we do not observe meaningful changes in the firm's leverage ratio.

Finally, Table 8 shows that only a small minority of firms issue equity – either preferred or common stock. Among the 114 firm-years exhibiting an investment spike, we observe only six common or preferred stock issues and only two of these six equity issues are associated with investment spikes linked directly to World War I. The equity issues that do take place are limited almost exclusively to those cases in which there is a positive financing gap. However, because they are so infrequent, the net impact on average leverage ratios is minimal despite the tax bias towards equity financing during this period. Changes in leverage during the war period are driven primarily by incremental debt financing.

#### *4.3.2. The World War I sub-period and transitory leverage*

Table 9 provides additional evidence on the evolution of leverage in the years surrounding World War I. In this table, we list the 50 firms with sufficient data in our sample ranked by the change in their leverage ratio during the World War I period, i.e., 1917-1920. We then tabulate the change in leverage during the subsequent four-year period, 1921-24. During the War period Diamond Match Co. exhibits the largest increase (20.3 percentage points), followed by New York Air Brake (18.9 percentage points), American Linseed Co. (17.6 percentage points), and General Electric Co. (15.5 percentage points). All of these firms decrease their leverage over the four year period following World War I and in three cases, by approximately the same amount as the increase in leverage during the World War I period. The reduction in leverage is 20.3, 18.4, 4.6, and 17.9 percentage points for Diamond Match Co., New York Air Brake Co., American Linseed Co., and General Electric Co., respectively. This anecdotal evidence is consistent with the increase in leverage for these firms during the World War I period being a transitory response to the investment shock of WWI.

In contrast, the four firms with the largest decrease in leverage during World War I do not exhibit any reversion after the war. The firms with the largest decreases in leverage during the World War I period are United Fruit Co. (-21.0 percentage points), Virginia Iron, Coal & Coke Co. (-16.8 percentage points), Railway Steel Spring Co. (-15.0 percentage points), and Lehigh Coal & Navigation (-13.8 percentage points). The corresponding changes in leverage in the post war period for the four companies are -0.2, -4.9, 0.0, and -7.9 percentage points, respectively.

More generally, in untabulated results, we find that the correlation between the change in leverage during the World War I period (1917-1920) and the post-war period (1921-1924) is a statistically significant (at the 0.05 level) -0.34. This is more than three times that of the correlation between leverage changes in any other successive four-year periods between 1905 and 1924. Moreover, the significant correlation between changes in leverage across the 1917-1920 and 1921-1924 periods is driven entirely by firms that increased their leverage during the World War I period – the correlation coefficient for these firms is -0.653 and significant at the 0.01 level versus 0.002 and not significant for firms that decreased leverage during the World War I period. This evidence is consistent with the view that the debt issued to finance investment spikes during World War I was transitory.

Finally, to tie the transitory increases in leverage during the 1917-1920 period directly to investment, we separate the sample firms into high and low investment firms during the period. Specifically, we calculate a firm's total investment from 1917 to 1920 divided by its assets at the end of 1916. High (low) investment firms are above (below) the median investment to assets ratio during the period. For each group, we then calculate the correlation coefficient between the change in leverage during the 1917-1921 and 1921-1924 periods. We find the correlation

coefficient for the high investment firms is -0.533 with a  $p$ -value of 0.007, while the correlation coefficient for the low investment firms is -0.055 with a  $p$ -value of 0.803. These results indicate that the transitory leverage increases observed during the 1917-1920 period are specific to firms with high investment during the period.

#### *4.4. Determinants of changes in leverage: regression evidence*

Our evidence for the World War I period implies that increases in leverage are a transitory response to funding needs created by an exogenous shock to the investment opportunity set of firms during the war years. To provide more formal and generalized evidence of the association among leverage changes, investment, and profitability, we estimate regression models in which the annual change in leverage is the dependent variable. The primary independent variables of interest are the firm's contemporaneous investment and operating cash flow (measured as EBIT). In various specifications, we also control for the firm's lagged leverage, cash levels, book value of assets, market-to-book ratio, predicted leverage, and dummy variables denoting our four primary sub-periods. Predicted leverage is estimated from a regression in which the ratio of the book value of debt to the book value of assets is estimated as a function of lagged values of the market-to-book ratio, the book value of assets, the ratio of EBIT to assets, and the ratio of tangible to total assets.

The results, presented in Table 10, indicate that changes in leverage are positively related to investment and negatively related to operating cash flows. These results are robust to inclusion of all of the above control variables as well lagged leverage and predicted leverage. There is evidence that leverage is mean-reverting and that changes in leverage are positively associated with the firm's market-to-book ratio. However, the inclusion of these variables has

virtually no impact on the coefficients of the investment and cash flow variables. Interestingly, when we test the interaction of the investment and cash flow variables with a dummy variable denoting the World War I sub-period (1917-1920), we find that the associations between changes in leverage and investment and changes in leverage and cash flow are no different during the WWI sub-period than during other periods. We interpret this finding as indicating that investment and cash flow are strong, general determinants of leverage changes. We observe more extreme changes in leverage during the 1917-1920 sub-period because of the large shock to investment needs induced by the onset of the U.S. involvement in World War I.

#### *4.5. Robustness*

In this section we address several robustness issues in the paper.

##### *4.5.1. Post-World War I recession and deflation*

The end of World War I was accompanied in 1920 by a severe recession and significant price deflation. It is possible, therefore, that the post-war reductions in leverage that we observe are due more to an across-the-board incentive to de-lever to avoid deflation related increases in the real value of debt obligations than to the reversal of debt-funded expansion during the war.<sup>21</sup>

To address this issue, we first re-estimate our results in Tables 6 and 10 after redefining the World War I period to be 1917 to 1919 and the post-war period to be 1920 to 1924. Our findings are qualitatively similar. We also note that in the regressions in Table 6 using yearly indicator variables, the coefficient on 1920 is positive and significant. Deleveraging did not begin to take place until 1921.

Second, our evidence on the cross-sectional variation in post-war deleveraging is consistent with an unwinding of a debt funded expansion during the war. Specifically, we find

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<sup>21</sup> We thank Harry DeAngelo for bringing this alternative to our attention.

that post-war reductions in leverage are substantially greater for those firms that increased leverage to fund investment during the war than for those firms that had no such debt expansion.

Third, in untabulated results, we match the firms with the ten largest increases in leverage between 1916 and 1919 with firms having similar leverage levels in 1919. In the latter group, leverage changes between 1916 and 1919 are slightly negative. When we compare subsequent changes in leverage over the 1920 to 1924 period, we find a sharp decline in leverage for the first group, but little change in the second group. We conclude, therefore, that there does not appear to be an across-the-board deleveraging of higher leverage firms in the post-war period. Rather, deleveraging appears to be confined primarily to those firms that had a debt-funded expansion of investment during the war.

Finally, in untabulated results, we analyze the maturity of bond issues over the various sub-periods of our sample. Consistent with firms issuing shorter-term debt to finance transitory investment shocks, we find the median maturity of newly issued debt during the WWI period (1917-1920) is only half that of the lowest median maturity of the other sub-periods. Following completion of the war, the median maturity returns to pre-war levels.

#### *4.5.2. Including direct measures of tax incentives in the regressions*

Our regressions in Table 6 identify the net impact of tax law changes through time period dummy variables. We reach identical conclusions if instead we include as an independent variable the direct measure of the relative advantage of debt described earlier and depicted in Figure 2. Recall that this measure estimates the net tax incentive for each firm-year observation by calculating the change in total dollar return to debt and equity holders if the firm had \$1,000 more in debt and \$1,000 less in equity for the year. The calculation is based on the implied corporate and excess profits taxes for the firm-year and the highest marginal individual income,



dividend, and capital gains tax rates for the year. The measure thus incorporates both the time-series changes in statutory tax rates and cross-sectional variation in firms' exposure to taxes. If taxes have a first order effect on capital structure, we would expect a positive relation between leverage and the dollar return to adding more debt. However, regardless of what we assume about the firm's payout policy, we find no evidence of a positive relation between leverage and the relative tax advantage of debt financing.

#### *4.5.3. The marginal investor*

Thus far, we have assumed that the marginal investor faced the highest marginal personal tax rates. We now examine the opposite extreme: the marginal investor faced a marginal personal tax rate of zero. As demonstrated in Table D2, if personal tax rates were zero, equity financing would have an even stronger advantage over debt financing during the period the excess profits tax was in place. Therefore, we would expect even lower levels of leverage during this period. This prediction is inconsistent with the results in Table 6. We find significantly positive coefficients on the year and period variables during the time the excess profits tax is in place.

#### *4.5.4. State taxes*

Variations in state taxes could also affect incentives for equity versus debt financing. In our sample, 40 firms are incorporated in New Jersey, six in New York, four in Illinois, three in Pennsylvania, and one each in Colorado, Connecticut, Delaware, and Virginia. The New Jersey tax structure at the time did not offer a significant advantage to debt or equity financing, charging a rate of only \$50 per year per \$1,000,000 of capital stock in excess of \$5,000,000. The results to the Table 6 regressions are similar if we include only firms incorporated in New Jersey.

#### *4.5.5. Supply of debt, cost of debt, and cost of equity*

Thus far, our analysis focuses on changes to corporate demand for debt; however, World War I also created a shock to the supply of debt. The U.S. government issued hundreds of billions of dollars of Liberty Bonds to fund the war effort and interest rates increased sharply between 1915 and 1920. As suggested by Graham, Leary, and Roberts (2013), corporate debt can be squeezed out by the issuance of government debt. If so, we would expect the constriction of the supply of debt to corporations to have a dampening effect on corporate leverage during the period. However, in Table 6 we observe the opposite, higher than expected leverage. The diminished supply and higher cost of debt both suggest that the supply shifts are not driving the higher than expected leverage levels during the WWI.

Despite a higher cost of debt, a sharp increase in the cost of equity could lead to higher corporate leverage during the WWI period. However, several results suggest that the cost of equity did not increase sharply during the period. First, in untabulated results, we find no evidence of a decrease in equity issuance during the 1917-1920 period which we would expect if the cost of equity increased. Second, in the post-war period of 1921-1924 the shock of World War I dissipates and interest rates revert to pre-war levels, yet we do not observe lower levels of leverage that we would expect based on tax incentives. Third, because a change in the cost of equity affects the market value of equity and not the book value of equity, if the cost of equity increased sharply during the 1917-1920 period, then we would expect the pattern of results across periods in the leverage ratio regressions based on the market value of assets in Table 6 to differ from the pattern of results in the leverage ratio regressions based on the book value of assets. Specifically, an increase in the cost of equity would decrease the market value of assets, thus increasing the leverage ratio based on the market value of assets in the 1917-1920 period. This effect would reverse out when the cost of equity settled back down in the post-WWI 1921-

1924 period, resulting in greater variability in the estimated period coefficients for the MVA regression. However, we do not observe greater changes in the coefficient estimates in the MVA regression than in the BVA regression on the period dummy for the 1917-1920 period or for the 1921-1924 period. In fact, the variability of the estimates is greater in the BVA regression.

#### *4.5.6. Debt changes vs. changes in leverage*

Chang and Dasgupta (2009) argue that tests of capital structure based on leverage changes are potentially misleading and suggest that such tests should also examine incremental changes in debt and equity. We re-estimate our Table 10 regressions using the change in debt scaled by lagged assets as the dependent variable. Our results are qualitatively identical.

## **5. Discussion and conclusion**

Because our sample period encompasses a large shock to the corporate and personal tax code as well as the investment shock of World War I, it provides a rich institutional environment for analyzing factors that drive capital structure decisions. Despite tax rate changes during the sample period that are among the largest rate changes in U.S. history and the imposition of an excess profits tax during the war years that produced an unambiguous tax preference for equity financing, we find little evidence that taxes are a first-order consideration for firms during this period.

At first glance, our lack of evidence in support of taxes as a first-order determinant of capital structure appears to contradict recent studies that provide support for the role of tax incentives in capital structure decisions. For example, Faccio and Xu (2012), Heider and Ljungqvist (2012), Longstaff and Strebulaev (2014), and Panier, Perez-Gonzalez, and Villanueva (2013) all conclude that firms alter their capital structures in response to changes in the tax code.

It is important to note, however, that our experimental setting is designed to address the role of taxes in a different way from that of the papers cited above. Specifically, because these recent studies are primarily interested in whether tax law changes have a causal impact on capital structure decisions, their tests are designed to isolate this causal impact by attempting to hold constant other potential influences on capital structure. By contrast, our experimental design deliberately allows other period-specific factors to influence capital structure, then asks whether observed leverage dynamics are consistent with taxes being of first-order importance. The fact that we find (i) no association between tax rates and average leverage ratios despite an enormous range in statutory tax rates over the sample period, and (ii) substantial variation in leverage ratios within individual firms implies that factors other than taxes are the primary determinants of financing decisions during this period.

Our findings on the role of taxes in leverage decisions is consistent with the findings in Graham, Leary, and Roberts' (2013) study of the capital structure of US firms over the past century and with Li and Whited's (2013) dynamic contracting model of financing decisions. Interestingly, our finding that the initiation of federal income taxes had no discernible impact on corporate capital structures contrasts with the impact of such initiation on ex dividend day price effects. Barclay (1987) finds significant changes in ex dividend day price effects following the initiation of federal and personal income taxes. The fact that Barclay (1987) finds such significant effects implies that the tax changes are large enough to make tests of potential tax effects sufficiently powerful over this period of time. Yet we find no traces of a tax effect on financing decisions.

Why don't such large changes in taxes affect capital structure decisions? One possibility is that financial flexibility considerations of debt capacity dominate incremental tax

considerations. DeAngelo and DeAngelo (2007) emphasize that if there is a reasonable probability that unexpected changes in investment or earnings will create a desire for external financing, the marginal value of preserving debt capacity might well exceed the tax-related opportunity cost. Indeed, they note that Modigliani and Miller (1963) themselves recognize such flexibility benefits of debt capacity and argue that such benefits most likely exceed any of the tax advantages associated with debt in their model.

Broadly consistent with this view, we find evidence of considerable within-firm variation in leverage over time that is strongly associated with investment needs and operating cash flows. Such findings are consistent with capital structure models that emphasize the dynamics of leverage ratios being connected with the dynamics of investment opportunities and operating cash flows. One such model is the pecking order model of Myers (1984). Consistent with the existence of a pecking order in financing choices, we find that firms were less likely to issue external debt or equity to finance investment outlays during the World War I period if their cash flows were large in relation to their investment expenditures. Furthermore, among firms that raised external capital during the war period and, more generally, over the sample period, the number of debt issues was approximately three times the number of equity issues. Nonetheless, inconsistent with the pecking order model, we do observe equity issues during the sample period and, in many cases, these equity issues are completed by firms that appear to have substantial debt capacity.

Another broad class of capital structure models emphasizes the role of adjustment costs in affecting the dynamics of capital structure.<sup>22</sup> These models predict that firms will have target leverage ratios, but that adjustments towards those targets will be infrequent and ‘lumpy’ due to adjustment costs. As a result, firms will tend to adjust leverage ratios towards targets only when

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<sup>22</sup> Examples include Leary and Roberts (2005), Strebulaev (2007), and Dudley (2010).

required financing events take place. Many of our findings are broadly consistent with predictions of these dynamic models in that there appears to be a strong association between leverage changes and financing required for investment outlays. Nonetheless, the frequency with which firms make relatively large adjustments to leverage ratios appears to undermine the view that adjustment costs are substantial.

A third class of dynamic models directly emphasizes the role of financial flexibility in capital structure policy. In perhaps the most prominent example of these models, DeAngelo, DeAngelo and Whited (2011) predict that firms increase their debt from target levels to finance transitory increases in investments that are prompted by external shocks. Subsequently, debt is paid down as the firm generates cash flows in excess of required investment outlays. Our findings fit well with these predictions. As previously mentioned, our regression results document significantly higher than expected debt-to-asset ratios during 1917-1920, years in which firms generally were expanding productive capacity for reasons related to World War I. This increase in debt is transitory; the sample firms quickly reverse the leverage increase when required investment outlays decrease following the end of the War.

## Appendix A: List of firms

The sample includes firm-years from the 1905 to 1924 for all U.S. industrial firms that were publically traded in 1905 with financial statement information available in *Moody's Manuals*. Utilities, railroads, and mining companies are excluded from the sample. The table lists the name of each firm and the number of years in the sample.

<b>Name</b>	<b>Years in sample</b>	<b>Name</b>	<b>Years in sample</b>
Allis-Chalmers Co.	18	Lehigh Coal & Navigation Co.	20
American Agricultural Chemical Co.	20	National Biscuit Co.	20
American Can Co.	20	National Carbon Co.	12
American Car & Foundry Co.	20	National Lead Co.	20
American Cement Co.	17	New York Air Brake Co	17
American Cotton Oil Co.	18	New York Dock Co.	20
American Grass Twine Co.	19	Pacific Coast Co.	20
American Hide & Leather Co.	20	Pacific Mail Steamship	20
American Linseed Co.	16	Pittsburgh Coal Co	20
American Locomotive Co.	20	Pressed Steel Car Co.	20
American Malting Co.	14	Pullman Co.	20
American Smelting & Refining Co.	20	Quaker Oates	20
American Snuff Co.	20	Railway Steel Spring Co.	20
American Steel Foundries Co.	19	Republic Iron & Steel	20
American Sugar Refining Co.	18	Rubber Goods Mfg. Co.	9
American Tobacco Co.	20	Sloss-Sheffield Steel & Iron Co.	20
American Woolen Co.	20	Streets Western Stable Car Line	9
Cambria Steel Co.	17	Swift & Co.	20
Central Leather Co.	20	Union Bag and Paper Co.	20
Colorado Fuel & Iron Co.	20	United Fruit Co.	20
Corn Products Co.	19	United States Cast Iron Pipe & Foundry Co.	19
Diamond Match Co.	20	United States Realty & Improvement Co.	20
Distillers Securities Corporation	16	United States Reduction & Refining Co.	10
Electric Storage Battery Co.	20	United States Rubber Co.	19
General Asphalt Co.	20	United States Steel Co.	20
General Chemical Co.	15	Virginia Iron, Coal & Coke Co.	20
General Electric Co.	20	Virginia-Carolina Chemical Co	20
International Paper	20	Westinghouse Air Brake Co.	20
Lake Superior Corporation	20		

## Appendix B: List of annual reports

The table lists the source of each firm's annual reports and the years for which reports are available.

Name	Source	Annual reports	Name	Source	Annual reports
Allis-Chalmers Co.	MIT	1918-1920	Lehigh Coal & Navigation Co.	Columbia	1917-1920
American Agricultural Chemical Co.	Harvard	1917-1920	National Biscuit Co.	Columbia	1917-1920
American Can Co.	Columbia	1917-1920	National Carbon Co.		Acquired
American Car & Foundry Co.	Columbia	1917-1920	National Lead Co.	Columbia	1917-1920
American Cement Co.		Not available	New York Air Brake Co.	Columbia	1917-1920
American Cotton Oil Co.	Columbia	1917-1920	New York Dock Co.	Columbia	1917-1920
American Grass Twine Co.	Columbia	1917-1920	Pacific Coast Co.	Columbia	1917-1920
American Hide & Leather Co.	Columbia	1917-1920	Pacific Mail Steamship	Columbia	1917-1920
American Linseed Co.	Col/Harv	1917-1920	Pittsburgh Coal Co.	NYPL	1917-1920
American Locomotive Co.	Columbia	1917-1920	Pressed Steel Car Co.	Columbia	1917-1920
American Malting Co.	Columbia	1917-1918	Pullman Co.	Harvard	1917-1920
American Smelting & Refining Co.	Columbia	1917-1920	Quaker Oats	Columbia	1917-1920
American Snuff Co.	Columbia	1917-1920	Railway Steel Spring Co.	Columbia	1917-1920
American Steel Foundries Co.	Columbia	1917-1920	Republic Iron & Steel Co.	Columbia	1917-1920
American Sugar Refining Co.	Columbia	1917-1920	Rubber Goods Mfg. Co.		Acquired
American Tobacco Co.	Harvard	1917-1920	Sloss-Sheffield Steel & Iron Co.	Columbia	1917-1920
American Woolen Co.	Columbia	1917-1920	Streets Western Stable Car Line		Sold
Cambria Steel Co.	Columbia	1917, 1919, 1920	Swift & Co.	Columbia	1917-1920
Central Leather Co.	Columbia	1917-1920	Union Bag & Paper Co.	Columbia	1917-1920
Colorado Fuel & Iron Co.	Columbia	1917-1920	United Fruit Co.	Columbia	1917-1920
Corn Products Co.	Alabama	1917-1920	United States Cast Iron Pipe & Foundry Co.	Alabama	1917-1920
Diamond Match Co.	Columbia	1917-1920	United States Realty & Improvement Co.	NYPL	1919-1920
Distillers Securities Corporation	Columbia	1917-1918	United States Reduction & Refining Co.		Foreclosure
Electric Storage Battery Co.	Columbia	1917-1920	United States Rubber Co.	Columbia	1917-1920
General Asphalt Co.	Columbia	1917-1920	United States Steel Co.	U.S. Steel	1917-1920
General Chemical Co.	Columbia	1917-1919	Virginia-Carolina Chemical Co.	Harvard	1917-1920
General Electric Co.	Columbia	1917-1920	Virginia Iron, Coal & Coke Co.	Columbia	1917-1920
International Paper	Harvard	1917-1920	Westinghouse Air Brake Co.	Columbia	1917-1920
Lake Superior Corporation	Columbia	1917-1920			



## Appendix C: Variable definitions

Variable	Definition
Leverage (BVA)	Total debt / book value of assets (Total debt includes long and short term debt)
Leverage (MVA)	Total debt / market value of assets (market value of assets = book value of assets - book value of equity + market value of equity)
M/B	Market value of assets / book value of assets
EBIT	Earnings before interest and taxes
EBIT (1905 dollars)	EBIT adjusted to 1905 dollars using the Consumer Price Index (CPI)
EBIT / Assets	EBIT / book value of assets
Tangible Assets	PPE / book value of assets
Assets	Book value of assets
Assets (1905 dollars)	Assets adjusted to 1905 dollars using the CPI
Investment	Capital expenditures + change in net working capital
Investment (1905 dollars)	Investment adjusted to 1905 dollars using the CPI
Investment / Assets	Investment / assets
LnAssets (1905 dollars)	The natural log of Assets (1905 dollars)
Cash / Assets	Cash and marketable securities / assets
Change in leverage	A firm's change in Leverage (BVA) from the previous year.
Investment * 1917-1920 period	(Investment / assets) * indicator variable for the period 1917 to 1920
EBIT / Assets * 1917-1920 period	(EBIT / assets) * indicator variable for the period 1917 to 1920
Predicted leverage	The level of Leverage (BVA) predicted by a regression of leverage on the lagged values of M/B, LnAssets (1905 dollars), EBIT / Assets, and Tangible / Assets

## Appendix D: The relative advantage of debt and the excess profits tax

This appendix examines the relative advantage of debt financing over equity financing based on corporate and individual income tax rates for each year during the sample period. It then presents a numerical example to illustrate how the effects of the excess profits tax dominated the effects of both corporate and individual income tax rates during the 1917 to 1921 period, creating a strong bias to equity financing.

Table D1 lists the relative advantage of debt for each year. The relative advantage of debt, based on Miller (1977) is defined as  $\frac{(1-T_{Pd})}{(1-T_{Pe})(1-T_C)}$ , where  $T_{Pd}$  is the individual tax rate on debt,  $T_{Pe}$  is the individual tax rate on equity (dividends or capital gains), and  $T_C$  is the corporate tax rate. The table lists the values under three different payout scenarios: the return is composed entirely of dividends, the return is composed of 50% dividends and 50% capital gains, and the return is composed entirely of capital gains. In short, debt was slightly advantaged from 1909 to 1916, the relative advantage depended on payout policy from 1917 to 1921, and equity had a strong advantage from 1922 to 1924 (with the exception in 1924 for firms whose return was all dividends).

However, as we illustrate in the numerical example of the excess profits tax in Table D2, the excess profits tax dominated the other tax rates regardless of the payout policy, thus creating a strong bias in favor of equity financing from 1917 to 1921.<sup>1</sup> The example uses numbers similar to U.S. Steel in 1917. Table D2 presents financial information for the firm under two scenarios. In the first scenario, the firm has \$600 million of debt outstanding, \$400 million in retained earnings, and \$900 million of paid in capital, resulting in total capital of \$1,900 million. In the second scenario, the firm has the same amount of total capital, but it has no debt.

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<sup>1</sup> Based on our calculations, at least 87% of firms in our sample were exposed to the excess profits tax during the period.

Specifically, under this scenario, the firm has \$1,500 million in paid in capital, \$400 million in retained earnings, and \$1,900 million in total capital.

We assume that under both scenarios the firm generates \$500 million of EBIT and that, under the first scenario, the interest rate on the firm's debt is 4%. To calculate the excess profits tax under each scenario, we apply the graduated excess profits tax to the difference between the firm's net income and an eight percent return on its "invested capital," which was defined to be the sum of paid in capital and retained earnings (i.e., invested capital does not include capital provided by debtholders). This graduated tax rate starts at 20% for ratios of net income to invested capital above eight percent and increases to 25%, 35%, 45% and 60% for ratios above 15%, 20%, 25%, and 33%, respectively.

Under the first scenario, net income is \$476 million, calculated as EBIT (\$500 million) minus interest expense (\$24 million). In this scenario, invested capital is \$1,300 million, consisting of \$900 million of paid in capital plus \$400 million of retained earnings. Applying the graduated excess profits tax results in an excess profits tax of \$132,198,200. Corporate taxes are calculated as the corporate tax rate of six percent (i.e., the prevailing corporate tax rate in 1917) times (EBIT – interest expense – excess profits tax), resulting in corporate taxes of \$20,628,108 under scenario 1. Hence, total corporate taxes under the first scenario are \$152,826,308.

Under scenario 2, net income is \$500 million. In this scenario, invested capital is \$1,900 million, consisting of \$1,500 million of paid in capital plus \$400 million of retained earnings. Note that although total capital is identical under both scenarios, invested capital, as defined for purposes of the excess profits tax is \$600 million higher under scenario 2. Applying the graduated excess profits tax based on the higher value for invested capital results in an excess

profits tax of only \$94,848,650. Hence the excess profits tax is more than \$37 million higher when the firm has debt (i.e., scenario 1) than when it has no debt (i.e., scenario 2). Corporate taxes under scenario 2 are \$24,309,081, calculated as the six percent corporate tax rate times (EBIT – excess profits tax). Hence, total corporate taxes under scenario 2 are \$119,157,731, or over \$33 million less than corporate taxes under scenario 1. This example illustrates that, at the corporate level, the excess profits tax favored equity financing.

To incorporate the impact of individual taxes, we consider two extreme assumptions, one in which all equity income is paid out as a dividend, and the other in which no equity income is paid out as a dividend, i.e., all equity income takes the form of capital gains. Under the first scenario, equity income is \$323,173,692, calculated as (EBIT – interest expense – total corporate taxes). Applying the maximum individual surtax rate of 63% to the equity income, on the assumption that all equity income is paid out as a dividend, the total dollar return to equity holders after taxes \$119,574,266. Adding the total dollar return to debtholders (after the 67% individual income tax rate on the \$24 million interest payments) yields a total dollar return of \$127,494,266 under scenario 1. The corresponding total dollar return under scenario 2 is \$140,911,640.

If we assume all of the return is earned through capital gains and apply the 67% individual income tax rate to capital gains, then the total dollar return under scenario 1 is \$114,567,318. The corresponding total dollar return under scenario 2 is \$125,677,949. Note that the example does not account for the additional advantage for equity holders of timing capital gains.

In summary, the excess profits tax generated a bias for equity financing of over \$13 million under one assumption about payout policy and over \$11 million under the other assumption.

Therefore, the overall effect of tax rates on the preference for debt financing versus equity financing can be summarized as follows: debt financing held a slight advantage from 1909 to 1916. Equity then held a substantial advantage from 1917 to 1924. The advantage from 1917 to 1921 was due to the excess profits tax; the advantage from 1922 to 1924 was due to the combination of relatively high individual tax rates and the capital gains rate being reduced to 12.5%.

**Table D1: The relative advantage of debt**

The table lists the relative advantage of debt for each year under three different scenarios: the return is composed entirely of dividends, the return is composed of 50% dividends and 50% capital gains, and the return is composed entirely of capital gains. The relative advantage of debt is defined as  $\frac{(1-T_{Pd})}{(1-T_{Pe})(1-T_C)}$ , where  $T_{Pd}$  is the individual tax rate on debt,  $T_{Pe}$  is the individual tax rate on equity (dividends or capital gains), and  $T_C$  is the corporate tax rate.

Year	Return is 100% Dividend	Return is 50% Dividend	Return is 100% Capital Gain
1909	1.01	1.01	1.01
1910	1.01	1.01	1.01
1911	1.01	1.01	1.01
1912	1.01	1.01	1.01
1913	1.00	1.00	1.01
1914	1.00	1.00	1.01
1915	1.00	1.00	1.01
1916	1.00	1.01	1.02
1917	0.95	1.00	1.06
1918	0.75	0.90	1.14
1919	0.86	0.97	1.11
1920	0.86	0.97	1.11
1921	0.86	0.97	1.11
1922	0.96	0.70	0.55
1923	0.96	0.70	0.55
1924	1.03	0.84	0.71

**Table D2: Example of excess profits tax**

The table lists an example of the total dollar return to debtholders and stockholders for the same firm under two different capital structure scenarios, levered and unlevered. For each capital structure scenario, the total dollar returns are calculated under two different assumptions: equity income takes the form of dividends only or equity income takes the form of capital gains only.

	<b>1917</b>	<b>1917</b>
	<b>Levered</b>	<b>Unlevered</b>
Paid in capital	900,000,000	1,500,000,000
Retained earnings	400,000,000	400,000,000
Debt	600,000,000	-
Total Capital	1,900,000,000	1,900,000,000
Invested capital	1,300,000,000	1,900,000,000
EBIT	500,000,000	500,000,000
Interest rate	4%	
Interest payment	24,000,000	-
Net income	476,000,000	500,000,000
Excess profit tax deduction	3,000	3,000
Net profit after deduction	475,997,000	499,997,000
Tax (np<.15): rate = .20	18,200,000	26,600,000
Tax (.15<np<.20): rate = .25	16,250,000	23,750,000
Tax (.20<np<.25): rate = .35	22,750,000	33,250,000
Tax (.25<np<.33): rate = .45	46,800,000	11,248,650
Tax (.33>np): rate = .60	28,198,200	0
Excess Profits Tax 1917	132,198,200	94,848,650
Corporate Tax 1917	20,628,108	24,309,081
<b>Total Corporate Tax 1917</b>	<b>152,826,308</b>	<b>119,157,731</b>
<b>Assume Payout is all Dividend:</b>		
After-Tax Payout to Bondholders	7,920,000	-
After-Tax Dividend	119,574,266	140,911,640
<b>Total \$ Return after-tax</b>	<b>127,494,266</b>	<b>140,911,640</b>

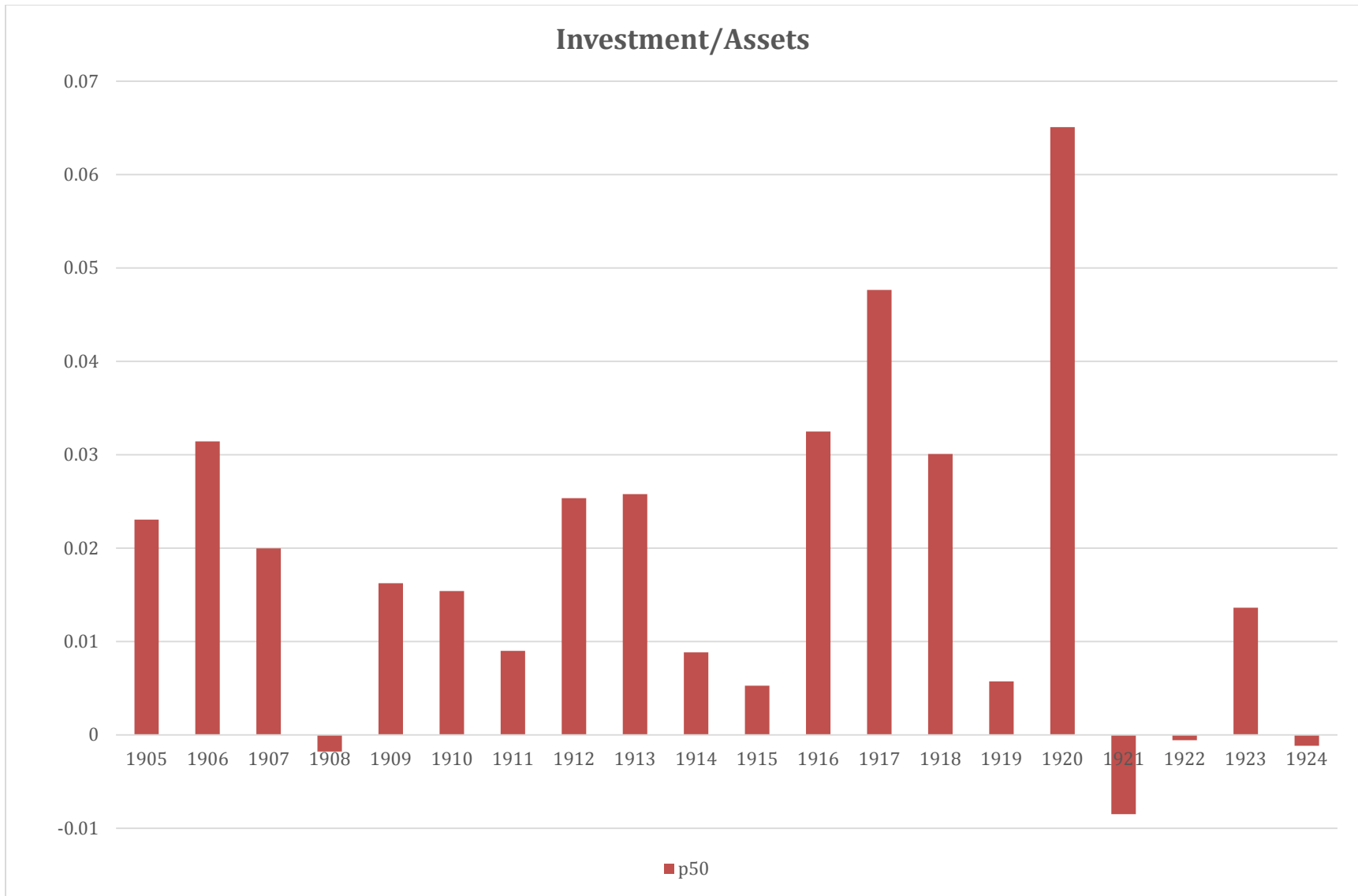
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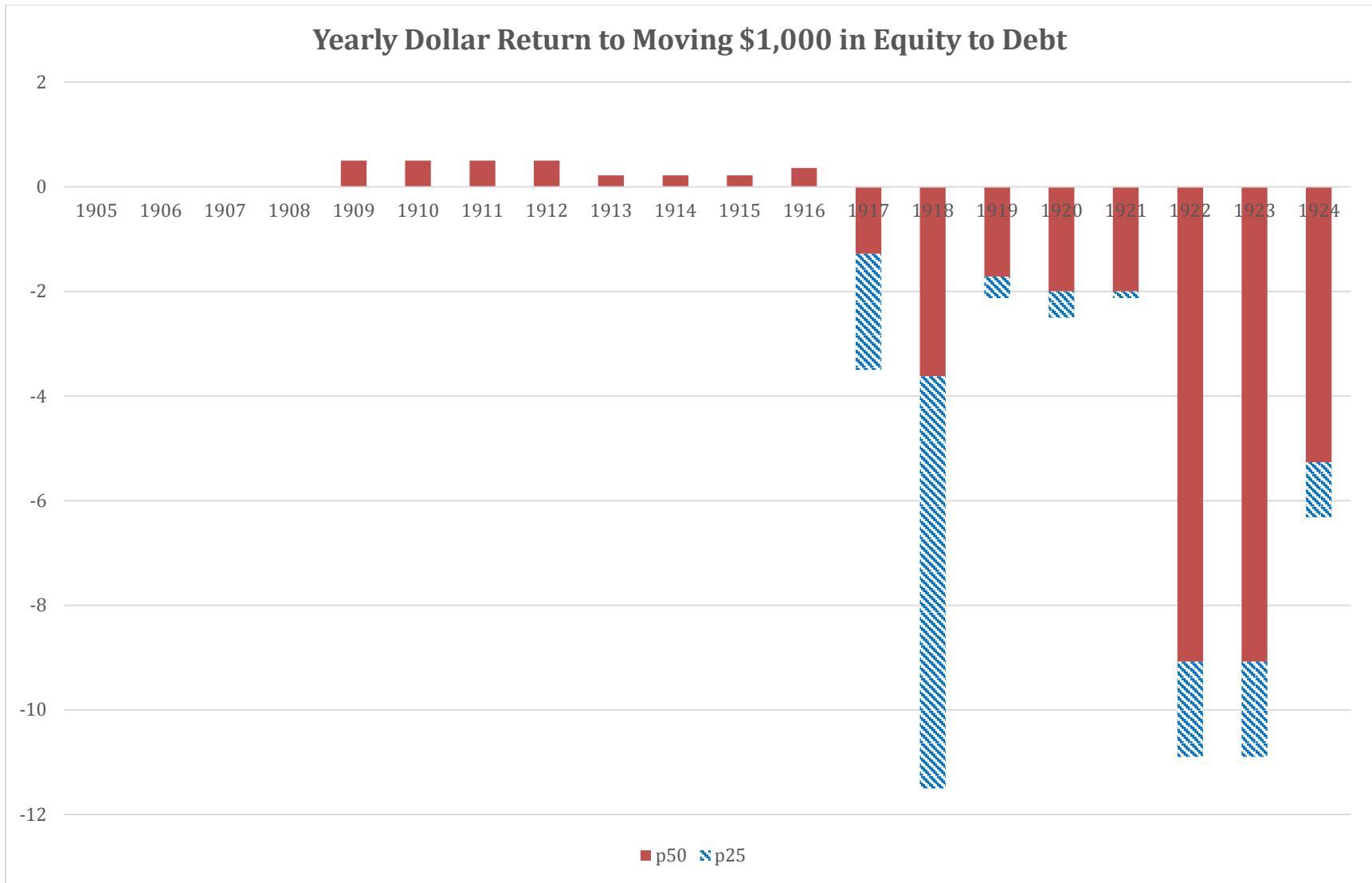


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**Fig. 1:** For each year, the median value of the investment to assets ratio across firms is plotted.



**Fig. 2:** For each year, the 25<sup>th</sup> and 50th percentile value of the Dollar Return across firms is plotted. The Dollar Return is defined as the total change in dollar return to shareholders and debtholders for the year if the firm had been financed with \$1,000 less of equity and \$1,000 more of debt.

**Table 1: Summary statistics**

The sample includes firm-years from the 1905 to 1924 for all U.S. industrial firms that were publically traded in 1905 with financial statement information available in *Moody's Manuals*. Utilities, railroads, and mining companies are excluded from the sample. *Leverage (BVA)* is ratio of the total debt to the book value of assets. *Leverage (MVA)* is the ratio of the total debt to the market value of assets. *M/B* is the ratio of the market value of assets (book value of assets – book value of equity + market value of equity) to the book value of assets. *EBIT* is the earnings before interest and taxes. *EBIT (1905 dollars)* is EBIT adjusted to 1905 dollars using the Consumer Price Index (CPI). *EBIT / Assets* is the ratio of EBIT to the book value of assets. *Tangible / Assets* is the ratio of PPE to the book value of assets. *Assets* is the book value of assets. *Assets (1905 dollars)* is the book value of assets adjusted to 1905 dollars using the CPI. *Investment* is the sum of capital expenditures and the change in working capital. *Investment (1905 dollars)* is investment adjusted to 1905 dollars using the CPI. *Investment / Assets* is the ratio of investment to the book value of assets. The columns list the number of observations, the mean value, the median value, the standard deviation, the minimum value and the maximum value for the sample.

Variable	N	Mean	Median	StDev	Minimum	Maximum
Leverage (BVA)	1,107	0.1437	0.1152	0.1354	0.0000	0.5536
Leverage (MVA)	1,072	0.2378	0.2036	0.2214	0.0000	0.9149
M/B	1,072	0.7169	0.6745	0.3098	0.0411	2.3416
EBIT	1,105	7,274,599	2,508,549	26,693,118	-20,590,006	493,802,947
EBIT (1905 dollars)	1,105	4,937,099	1,912,265	16,600,000	-8,989,554	305,000,000
EBIT / Assets	1,037	0.0636	0.0557	0.0529	-0.1412	0.4722
Tangible / Assets	1,105	0.6107	0.6520	0.2253	0.0000	0.9727
Assets	1,107	107,555,240	51,297,288	276,462,663	3,369,439	2,571,617,200
Assets (1905 dollars)	1,107	76,262,728	38,375,692	195,318,322	1,830,827	1,686,522,700
Investment	1,041	2,905,955	585,634	15,620,826	-99,459,696	191,968,160
Investment (1905 dollars)	1,041	1,984,467	476,855	10,288,247	-84,589,504	111,933,712
Investment / Assets	1,041	0.0276	0.0156	0.0986	-0.6270	1.1140

**Table 2: Investment spikes**

The table summarizes investment spikes during the 1917-1920 period. An investment spike is defined as an investment to assets ratio greater than 150% of the firm's median investment to assets ratio over the pre-war (1905 to 1916) period. Panel A lists the total number investment spikes and the number of spikes with a link to WWI in the firm's annual reports by firm-year and by firm. The number of firm-year spikes per year is also tabulated. Panel B summarizes the nature of the investment spikes based on the management discussion section of the annual reports.

	N	WWI Link	Investment spikes by Year			
			1917	1918	1919	1920
Firm-years with Inv/Assets > 1.5 times median pre-war Inv./Assets	114	41	32	27	19	36
Firms with Inv/Assets > 1.5 times median pre-war Inv./Assets	52	34				

**Panel B:**

Summary of the Nature of WWI-Related Investment (source: Management Discussion in Annual Report)

Type of Investment	Number
Construction of new manufacturing facilities or expansion of existing facilities for production needed to meet War-related product demand	22
Expansion of raw materials or finished goods inventory due to large war-related product demand	14
Expansion of net working capital necessitated by war-related disruptions in supply markets	6
Building of new facilities required due to changes in raw materials markets	1
Development of new war-related products	1
Expansion of receivables tied to unusually large war-related product demand	1

**Table 3: Yearly tax rate**

The table lists the highest marginal yearly federal tax rates during the 1909 to 1924 period for the corporate income tax, the normal individual income tax, the individual income surtax, the total individual income tax, the capital gains tax, and the excess profits tax. The capital gains rate listed for 1922 to 1924 is the tax rate on investments held at least two years. The excess profits tax in 1918 was defined as the maximum of two separate taxes. The highest marginal rate for each is listed.

Year	Top Corporate Rate	Normal Individual Rate	Top Individual Surtax Rate	Top Total Individual Rate	Top Capital Gains Rate	Top Excess Profits Tax Rate
1909	1%					
1910	1%					
1911	1%					
1912	1%					
1913	1%	1%	6%	7%	7%	
1914	1%	1%	6%	7%	7%	
1915	1%	1%	6%	7%	7%	
1916	2%	2%	13%	15%	15%	
1917	6%	4%	63%	67%	67%	60%
1918	12%	12%	65%	77%	77%	65%, 80%
1919	10%	8%	65%	73%	73%	40%
1920	10%	8%	65%	73%	73%	40%
1921	10%	8%	65%	73%	73%	40%
1922	12.5%	8%	50%	58%	12.5%	
1923	12.5%	8%	50%	58%	12.5%	
1924	12.5%	6%	40%	46%	12.5%	

**Table 4: Summary statistics by period**

The sample includes firm-years from the 1905 to 1924 for all U.S. industrial firms that were publically traded in 1905 with financial statement information available in *Moody's Manuals*. Utilities, railroads, and mining companies are excluded from the sample. The table breaks the sample into five four year sub-periods: 1905-1908, 1909-1912, 1913-1916, 1917-1920, and 1921-1924. For each firm, the median value of the variable over the sub-period is calculated. The table lists the mean and median values across all firms in each sub-period. The *p-value* from a difference in means (Wilcoxon rank-sum) test between each period and the other four periods is listed beneath the mean (median).

Variable	1905 - 1908		1909 - 1912		1913 - 1916		1917 - 1920		1921 - 1924	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Leverage - BVA	0.1482	0.1135	0.1460	0.1463	0.1459	0.1108	0.1376	0.1156	0.1349	0.0937
<i>p-value</i>	0.729	0.763	0.836	0.793	0.843	0.978	0.752	0.832	0.644	0.687
Leverage - MVA	0.2379	0.2115	0.2363	0.2253	0.2587	0.2642	0.2093	0.1835	0.2271	0.1822
<i>p-value</i>	0.874	0.783	0.923	0.962	0.381	0.535	0.361	0.511	0.809	0.757
Market-to-book	0.7094	0.6560	0.7281	0.6925	0.7064	0.6587	0.6860	0.6752	0.7319	0.6841
<i>p-value</i>	0.936	0.822	0.645	0.970	0.859	0.707	0.468	0.902	0.596	0.476
EBIT	4,293,131	2,098,906	4,785,580	2,143,760	5,445,753	2,162,284	13,712,432	4,817,271	7,854,860	2,772,414
<i>p-value</i>	0.313	0.066*	0.418	0.057*	0.516	0.282	0.022**	0.000***	0.805	0.466
EBIT (1905 dollars)	4,146,023	2,013,574	4,353,340	1,852,687	4,528,348	1,823,018	6,790,991	2,498,445	3,883,688	1,370,409
<i>p-value</i>	0.728	0.928	0.824	0.588	0.846	0.767	0.212	0.048**	0.634	0.215
EBIT / Assets	0.0562	0.0514	0.0510	0.0455	0.0529	0.0478	0.0898	0.0832	0.0552	0.0510
<i>p-value</i>	0.345	0.366	0.038**	0.045*	0.084*	0.066*	0.000***	0.000***	0.276	0.415
Tangible	0.6452	0.7133	0.6504	0.6997	0.6473	0.6855	0.5427	0.5699	0.5557	0.5719
<i>p-value</i>	0.186	0.052*	0.126	0.064*	0.175	0.147	0.014**	0.003***	0.057*	0.018**
Assets	83,252,137	41,541,118	87,736,609	48,995,768	96,419,484	49,846,640	134,204,719	62,396,172	139,992,952	68,205,680
<i>p-value</i>	0.472	0.042**	0.556	0.173	0.693	0.539	0.417	0.060*	0.343	0.023**
Assets (1905 dollars)	80,186,059	40,071,192	78,768,746	43,658,016	79,924,695	42,226,364	66,609,585	31,641,812	69,258,905	33,652,800
<i>p-value</i>	0.811	0.438	0.858	0.509	0.893	0.479	0.730	0.203	0.823	0.350
Investment	1,685,602	568,405	1,821,600	494,436	2,352,944	695,598	7,392,984	2,666,293	835,982	129,051
<i>p-value</i>	0.392	0.792	0.444	0.482	0.627	0.668	0.000***	0.000***	0.150	0.006***
Investment (1905 dollars)	1,643,316	546,736	1,620,475	424,135	1,939,237	585,610	3,783,799	1,553,044	399,592	68,625
<i>p-value</i>	0.774	0.597	0.746	0.817	0.935	0.925	0.012**	0.001***	0.067*	0.004***
Investment / Assets	0.0226	0.0157	0.0210	0.0139	0.0243	0.0125	0.0540	0.0423	0.0005	0.0040
<i>p-value</i>	0.732	0.708	0.522	0.506	0.851	0.617	0.000***	0.000***	0.000***	0.000***



**Table 5: Within firm variation in leverage**

The sample includes firm-years from the 1905 to 1924 for all U.S. industrial firms that were publically traded in 1905 with financial statement information available in *Moody's Manuals*. Utilities, railroads, and mining companies are excluded from the sample. For each firm in the sample, the table lists the mean, median, and standard deviation of Leverage (BVA) over the sample period. It also lists the minimum and maximum value over the sample period and the difference between the maximum and minimum values. The mean and median values of each column are tabulated at the bottom of the table.

Name	Mean	Median	StDev	Min	Max	Max - Min
United States Realty & Improvement Co.	0.345	0.391	0.134	0	0.454	0.454
American Tobacco Co.	0.147	0.086	0.159	0.007	0.434	0.427
Virginia-Carolina Chemical Co.	0.297	0.285	0.111	0.161	0.554	0.393
United Fruit Co.	0.130	0.092	0.125	0.006	0.398	0.392
American Cement Co.	0.223	0.181	0.126	0.046	0.400	0.354
American Agricultural Chemical Co.	0.237	0.242	0.095	0.068	0.414	0.347
Quaker Oates	0.109	0.086	0.092	0	0.346	0.346
Allis-Chalmers Co.	0.067	0.000	0.114	0	0.277	0.277
Virginia Iron, Coal & Coke Co.	0.316	0.364	0.094	0.155	0.421	0.266
Swift & Co.	0.289	0.282	0.071	0.156	0.420	0.263
New York Air Brake Co.	0.237	0.227	0.082	0.134	0.393	0.260
American Steel Foundries Co.	0.107	0.069	0.100	0	0.259	0.259
Pittsburgh Coal Co.	0.208	0.251	0.096	0.073	0.328	0.254
American Cotton Oil Co.	0.191	0.188	0.075	0.105	0.357	0.252
American Smelting & Refining Co.	0.091	0.071	0.087	0	0.249	0.249
International Paper	0.259	0.291	0.065	0.084	0.325	0.241
United States Rubber Co.	0.253	0.219	0.080	0.139	0.378	0.238
Lehigh Coal & Navigation Co.	0.387	0.403	0.070	0.247	0.476	0.229
Central Leather Co.	0.299	0.298	0.066	0.191	0.412	0.221
Union Bag and Paper Co.	0.157	0.128	0.068	0.063	0.279	0.216
General Electric Co.	0.104	0.098	0.054	0.024	0.229	0.205
Diamond Match Co.	0.073	0.062	0.080	0	0.203	0.203
American Sugar Refining Co.	0.031	0.000	0.072	0	0.193	0.193
Railway Steel Spring Co.	0.085	0.111	0.076	0	0.187	0.187
Colorado Fuel & Iron Co.	0.432	0.455	0.061	0.324	0.510	0.186
American Hide & Leather Co.	0.166	0.183	0.058	0.075	0.261	0.186
American Linseed Co.	0.066	0.032	0.067	0	0.176	0.176
Sloss-Sheffield Steel & Iron Co.	0.169	0.166	0.032	0.062	0.228	0.166
Pacific Mail Steamship	0.043	0.000	0.058	0	0.163	0.163
American Locomotive Co.	0.084	0.093	0.051	0.005	0.164	0.159
Distillers Securities Corporation	0.237	0.263	0.053	0.120	0.278	0.158
American Woolen Co.	0.084	0.085	0.040	0.027	0.177	0.150
United States Steel Co.	0.303	0.339	0.053	0.224	0.359	0.135
Westinghouse Air Brake Co.	0.013	0.000	0.040	0	0.133	0.133
American Can Co.	0.052	0.060	0.047	0	0.130	0.130
National Lead Co.	0.039	0.001	0.050	0	0.125	0.125
Pressed Steel Car Co.	0.032	0.000	0.046	0	0.120	0.120
Republic Iron & Steel	0.159	0.150	0.039	0.109	0.227	0.118
General Asphalt Co.	0.109	0.103	0.028	0.071	0.166	0.095
Corn Products Co.	0.068	0.069	0.026	0.023	0.114	0.091
United States Reduction & Refining Co.	0.128	0.115	0.028	0.107	0.196	0.088
Lake Superior Corporation	0.189	0.174	0.029	0.158	0.242	0.085
Electric Storage Battery Co.	0.006	0	0.020	0	0.081	0.081
Cambria Steel Co.	0.022	0.024	0.022	0	0.079	0.079
American Malting Co.	0.088	0.092	0.024	0.040	0.117	0.078
Streets Western Stable Car Line	0.222	0.223	0.015	0.196	0.245	0.049
Pacific Coast Co.	0.236	0.235	0.015	0.218	0.264	0.046
New York Dock Co.	0.384	0.389	0.014	0.362	0.406	0.045
Rubber Goods Mfg. Co.	0.025	0.019	0.013	0.011	0.044	0.033
United States Cast Iron Pipe & Foundry Co.	0.027	0.029	0.006	0.015	0.035	0.020
General Chemical Co.	0.004	0	0.007	0	0.020	0.020
National Biscuit Co.	0.003	0	0.006	0	0.017	0.017
American Grass Twine Co.	0	0	0	0	0.002	0.002
American Car & Foundry Co.	0	0	0	0	0	0
American Snuff Co.	0	0	0	0	0	0
National Carbon Co.	0	0	0	0	0	0
Pullman Co.	0	0	0	0	0	0
Mean	0.141	0.136	0.055	0.067	0.236	0.169
Median	0.109	0.093	0.053	0.023	0.229	0.163

**Table 6: Multivariate analysis of leverage**

The sample includes firm-years from the 1905 to 1924 for all U.S. industrial firms that were publically traded in 1905 with financial statement information available in *Moody's Manuals*. Utilities, railroads, and mining companies are excluded from the sample. The dependent variable is Leverage (BVA) in models (1) and (2) and Leverage (MVA) in models (3) and (4). Models (1) and (3) include yearly indicator variables for 1909 to 1924. Models (2) and (4) include period indicator variables for 1909-1912, 1913-1916, 1917-1920, and 1921-1924. *LnAssets (1905 dollars)* is the natural log of Assets (1905 dollars). The other variables are defined in Table 1. The continuous variables are winsorized at 0.01 and 0.99. Each specification includes firm indicator variables. *P-values* are in brackets and are based on standard errors clustered by firm. Coefficients denoted with \*\*\*, \*\*, or \*, are significant at the 1%, 5%, or 10% level, respectively.

	(1)	(2)	(3)	(4)
	Leverage (BVA)	Leverage (BVA)	Leverage (MVA)	Leverage (MVA)
1909	0.0009		-0.0194*	
	[0.880]		[0.053]	
1910	0.0003		-0.0068	
	[0.969]		[0.543]	
1911	-0.0106		-0.0124	
	[0.246]		[0.329]	
1912	-0.0057		-0.0023	
	[0.575]		[0.888]	
1913	0.0085		0.0311*	
	[0.411]		[0.081]	
1914	0.0060		0.0276	
	[0.567]		[0.157]	
1915	-0.0039		-0.0036	
	[0.727]		[0.853]	
1916	0.0154		0.0266	
	[0.163]		[0.202]	
1917	0.0405***		0.0506**	
	[0.008]		[0.047]	
1918	0.0419**		0.0439	
	[0.020]		[0.124]	
1919	0.0216		0.0125	
	[0.223]		[0.634]	
1920	0.0436**		0.0531*	
	[0.028]		[0.070]	
1921	0.0009		-0.0017	
	[0.964]		[0.958]	
1922	0.0067		0.0160	
	[0.748]		[0.619]	
1923	0.0101		0.0452	
	[0.630]		[0.182]	
1924	-0.0011		0.0287	
	[0.964]		[0.417]	
1909-1912 period		-0.0033		-0.0093
		[0.635]		[0.351]
1913-1916 period		0.0065		0.0204
		[0.519]		[0.239]
1917-1920 period		0.0349**		0.0367
		[0.027]		[0.142]
1921-1924 period		0.0043		0.0230
		[0.827]		[0.456]
M/B	0.0562**	0.0500*	-0.0925*	-0.1047**
	[0.034]	[0.054]	[0.051]	[0.027]
LnAssets (1905 dollars)	0.0690**	0.0685**	0.0866**	0.0889**
	[0.035]	[0.026]	[0.027]	[0.017]
EBIT / Assets	-0.6387***	-0.5941***	-0.9296***	-0.8313***
	[0.000]	[0.000]	[0.000]	[0.000]
Tangible / Assets	-0.0011	-0.0008	0.0367	0.0365
	[0.989]	[0.993]	[0.760]	[0.759]
Constant	-0.6902	-0.6802	-0.6146	-0.6486
	[0.188]	[0.166]	[0.316]	[0.263]
Observations	1,003	1,003	1,003	1,003
Firm Indicators	Yes	Yes	Yes	Yes
Cluster errors	Firm	Firm	Firm	Firm
Adjusted R-squared	0.783	0.784	0.783	0.783

**Table 7: Summary statistics for the lowest and highest quartiles of change in leverage during 1917-1920**

The sample includes firm-years from the 1905 to 1924 for all U.S. industrial firms that were publically traded in 1905 with financial statement information available in *Moody's Manuals*. Utilities, railroads, and mining companies are excluded from the sample. Panel A summarizes the entire sample period, Panel B summarizes only the four year period 1917 to 1920. *Change in leverage* is the firm's change in Leverage (BVA) from the previous year. *Cash / Assets* is the ratio of cash and marketable securities to the book value of assets. Each panel lists the mean and median values of the variables for the lowest quartile of firm-years based on change in leverage and the highest quartile of firm-years based on change in leverage. For each variable, the *p-value* based on a difference in mean (Wilcoxon rank-sum) test between the highest and lowest change in leverage quartiles is listed beneath the mean (median) of the high quartile group.

<i>Panel A: All years</i>				
	Low Quartile		High Quartile	
	Mean	Median	Mean	Median
Investment / Assets	0.0112	0.0088	0.0593	0.0370
<i>p-value</i>			0.000***	0.000***
EBIT / Assets	0.0759	0.0639	0.0480	0.0441
<i>p-value</i>			0.000***	0.000***
Cash / Assets	0.0535	0.0352	0.0394	0.0305
<i>p-value</i>			0.001***	0.025**
Change in leverage	-0.0414	-0.0292	0.0437	0.0215
<i>p-value</i>			0.000***	0.000***

<i>Panel B: 1917 - 1920</i>				
	Low Quartile		High Quartile	
	Mean	Median	Mean	Median
Investment / Assets	0.0322	0.0257	0.1335	0.0906
<i>p-value</i>			0.000***	0.000***
EBIT / Assets	0.1169	0.0960	0.0691	0.0690
<i>p-value</i>			0.000***	0.001***
Cash / Assets	0.0696	0.0532	0.0591	0.0540
<i>p-value</i>			0.298	0.916
Change in leverage	-0.0441	-0.0348	0.0739	0.0708
<i>p-value</i>			0.000***	0.000***

**Table 8: Investment spikes, financing gaps, and changes in leverage**

This table summarizes changes in leverage for firms exhibiting an investment spike during the World War I (1917 to 1920) period. An investment spike is defined as an investment to assets ratio greater than 150% of the firm's median investment to assets ratio over the pre-war (1905 to 1916) period. We first partition the spikes on the basis of whether or not the spike creates a financing gap for the firm in the year of the spike. We define the financing gap as either the difference between the level of investment in the year of the spike and EBIT (Panel A) or the difference between the level of investment and the sum of EBIT and the firm's cash holdings (Panel B). We then report changes in leverage for the year of the spike and for the two years including the year of and the year prior to the spike. We also report the frequency of common stock issues within each subset.

**Panel A: Using Investment - EBIT to define financing gap:**

	# firm years	Investment / Assets	EBIT / Assets	Investment - EBIT	Change Leverage BVA	2year Change Leverage BVA	Common stock issues	Preferred stock issues
<b>For 114 investment spikes</b>								
Investment > EBIT	53	0.1697	0.0886	0.0811	0.0386	0.0403	5	1
Investment ≤ EBIT	61	0.0625	0.1047	-0.0422	-0.0049	-0.0092	0	0
<b>For 41 investment spikes with links to WWI</b>								
Investment > EBIT	24	0.2166	0.1012	0.1154	0.0667	0.0632	2	0
Investment ≤ EBIT	17	0.0766	0.1260	-0.0494	0.0048	-0.0075	0	0

**Panel B: Using Investment - (EBIT + Cash) to define financing gap:**

	# firm years	Investment / Assets	EBIT / Assets	Investment - (EBIT + Cash)	Change Leverage BVA	2year Change Leverage BVA	Common stock issues	Preferred stock issues
<b>For 114 investment spikes</b>								
Investment > EBIT + Cash	24	0.2310	0.1011	0.0645	0.0645	0.0582	4	1
Investment ≤ EBIT + Cash	90	0.0807	0.0962	-0.0914	0.0022	0.0020	1	0
<b>For 41 investment spikes with links to WWI</b>								
Investment > EBIT + Cash	13	0.2817	0.1081	0.0913	0.0884	0.0831	1	0
Investment ≤ EBIT + Cash	28	0.1014	0.1131	-0.0946	0.0190	0.0110	1	0

**Table 9: Change in leverage over the 1917-1920 period and the 1921-1924 period**

The sample includes firm-years from the 1905 to 1924 for all U.S. industrial firms that were publically traded in 1905 with financial statement information available in *Moody's Manuals*. Utilities, railroads, and mining companies are excluded from the sample. For each firm with leverage data in 1920, the table lists Leverage (BVA) for 1920, the change in leverage from the beginning of 1917 to the end of 1920, and the change in leverage from the beginning of 1921 to the end of 1924.

Name	Leverage (BVA) in 1920	Change leverage (BVA) 1917-1920	Change leverage (BVA) 1921-1924
United Fruit Co	0.014	-0.210	-0.002
Virginia Iron, Coal & Coke Co	0.207	-0.168	-0.049
Railway Steel Spring Co	0.000	-0.150	0.000
Lehigh Coal & Navigation Co	0.327	-0.138	-0.079
Pittsburg Coal Co	0.086	-0.136	-0.013
Union Bag and Paper Co	0.130	-0.132	0.144
International Paper	0.084	-0.116	0.176
American Woolen Co.	0.056	-0.081	0.038
United States Realty & Improvement Co	0.359	-0.081	-0.359
Republic Iron & Steel	0.109	-0.071	0.067
United States Steel Co.	0.241	-0.061	-0.018
Giant Portland Cement Co. (successor to American Cement Co.)	0.123	-0.058	-0.077
Colorado Fuel & Iron Co.	0.451	-0.044	0.012
American Steel Foundries Co.	0.011	-0.035	-0.011
American Can Co.	0.073	-0.035	-0.020
American Locomotive Co.	0.021	-0.034	-0.016
Corn Products Co	0.041	-0.028	0.026
Cambria Steel Co.	0.024	-0.023	NA
New York Dock co	0.368	-0.021	-0.002
Pacific Coast Co	0.231	-0.020	0.034
U. S. Food Products Corp (Distillers Securities Corporation)	0.228	-0.012	NA
Lake Superior Corporation	0.163	-0.009	-0.006
Sloss-Sheffield Steel & Iron Co	0.171	-0.007	0.058
United States Cast Iron Pipe & Foundry Co	0.022	-0.005	-0.007
Allis-Chalmers Manufacturing Company	0.0	0.0	0.0
American Car & Foundry Co.	0.0	0.0	0.0
American Sugar Refining Co.	0.000	0.000	0.184
American Snuff Co.	0.0	0.0	0.0
Electric Storage Battery Co	0.0	0.0	0.0
National Biscuit Co	0.0	0.0	0.0
Pacific Mail Steamship	0.000	0.000	0.135
Pressed Steel Car Co	0.000	0.000	0.120
Pullman Co	0.0	0.0	0.0
American Agricultural Chemical Co	0.3	0.0	0.1
Virginia-Carolina Chemical Co	0.305	0.034	0.248
Central Leather Co.	0.310	0.064	-0.120
United States Rubber Co	0.350	0.065	0.007
American Hide & Leather Co.	0.184	0.076	-0.105
American Tobacco Co. (The)	0.094	0.078	-0.087
General Asphalt Co	0.166	0.086	-0.054
National Lead Co	0.097	0.097	-0.020
Swift & Co	0.420	0.115	-0.146
American Smelting & Refining Co.	0.152	0.121	0.083
Westinghouse Air Brake Co	0.127	0.127	-0.127
Quaker Oates	0.306	0.139	-0.285
American Cotton Oil Co.	0.323	0.140	NA
General Electric Co	0.229	0.155	-0.179
American Linseed Co.	0.176	0.176	-0.046
New York Air Brake Co	0.330	0.189	-0.184
Diamond Match Co	0.203	0.203	-0.203



**Table 10: Multivariate analysis of change in leverage**

The sample includes firm-years from the 1905 to 1924 for all U.S. industrial firms that were publically traded in 1905 with financial statement information available in *Moody's Manuals*. Utilities, railroads, and mining companies are excluded from the sample. The dependent variable is Change in leverage. The predicted value of leverage, estimated from a regression of Leverage (BVA) on the lagged values of M/B, LnAssets (1905 dollars), EBIT / Assets, and Tangible / Assets, is included as an independent variable in models (2) and (3). Investment \* 1917-1920 period is the interaction between Investment / Assets and the 1917-1920 period indicator variable. EBIT \* 1917-1920 period is the interaction between EBIT / Assets and the 1917-1920 period indicator variable. The other independent variables are defined in the previous tables. The independent variables include period indicator variables for 1909-1912, 1913-1916, 1917-1920, and 1921-1924. The continuous variables are winsorized at 0.01 and 0.99. *P-values* are in brackets and are based on heteroscedasticity-consistent standard errors. Coefficients denoted with \*\*\*, \*\*, or \*, are significant at the 1%, 5%, or 10% level, respectively.

	(1)	(2)	(3)
	CHG_Leverage	CHG_Leverage	CHG_Leverage
Investment / Assets	0.1936*** [0.000]	0.1977*** [0.000]	0.1817*** [0.000]
Investment * 1917-1920 period			0.0387 [0.485]
EBIT / Assets	-0.3024*** [0.000]	-0.3306*** [0.000]	-0.3143*** [0.000]
EBIT / Assets * 1917-1920 period			-0.0321 [0.678]
Lag Leverage (BVA)	-0.0634*** [0.000]	-0.0615*** [0.000]	-0.0618*** [0.000]
Lag M/B	0.0158*** [0.008]	0.0136** [0.025]	0.0130** [0.050]
Lag LnAssets (1905 dollars)	0.0006 [0.606]	0.0031 [0.102]	0.0032* [0.099]
Lag Cash / Assets	-0.0691** [0.017]	-0.0807*** [0.007]	-0.0838*** [0.005]
Predicted Leverage (BVA)		-0.0842 [0.129]	-0.0842 [0.136]
1909-1912 period	-0.0017 [0.588]	-0.0040 [0.266]	-0.0039 [0.278]
1913-1916 period	-0.0007 [0.838]	-0.0026 [0.484]	-0.0026 [0.480]
1917-1920 period	0.0070 [0.105]	0.0032 [0.479]	0.0040 [0.589]
1921-1924 period	0.0048 [0.236]	0.0022 [0.606]	0.0020 [0.656]
Constant	0.0033 [0.865]	-0.0227 [0.380]	-0.0237 [0.363]
Observations	999	939	939
Adjusted R-squared	0.211	0.220	0.220