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A century of capital structure: The leveraging of corporate America ☆

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ABSTRACT

Unregulated US corporations dramatically increased their debt usage over the past century. Aggregate leverage—low and stable before 1945—more than tripled between 1945 and 1970 from 11% to 35%, eventually reaching 47% by the early 1990s. The median firm in 1946 had no debt, but by 1970 had a leverage ratio of 31%. This increase occurred in all unregulated industries and affected firms of all sizes. Changing firm characteristics are unable to account for this increase. Rather, changes in government borrowing, macroeconomic uncertainty, and financial sector development play a more prominent role. Despite this increase among unregulated firms, a combination of stable debt usage among regulated firms and a decrease in the fraction of aggregate assets held by regulated firms over this period resulted in a relatively stable economy-wide leverage ratio during the 20th century.

1. Introduction

This paper sheds light on the evolution and determination of corporate financial policy by analyzing a unique, panel data set containing accounting and financial market information for US nonfinancial publicly traded firms over the last century. Our analysis is organized around three questions. First, how have corporate capital structures

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changed over the past one hundred years? Second, do existing empirical models of capital structure account for these changes? And, third, if not explained by existing empirical models, what forces are behind variation in financial policy over the last century?

We begin by showing that the aggregate leverage ratio (i.e., debt-to-capital) of unregulated firms was low and stable, varying between 10% and 15%, from 1920 to 1945.[3] In contrast, leverage more than tripled, from 11% to 35%, between 1945 and 1970. Since then, leverage has remained above 35%, peaking at 47% in 1992. Combined with an increase in non-debt liabilities, the aggregate corporate balance sheet shifted from 25% liabilities in the 1930s to over 65% liabilities by 1990.

This change is robust, observed in a variety of leverage measures that reveal additional insights into the changing nature of financial policy over the last century. For example, we show that debt gradually substituted for preferred equity between 1920 and 1960, when relatively little preferred equity remained. We also show that cash holdings exhibited a secular decrease concomitant with the secular increase in debt usage. In aggregate, cash and short-term investments accounted for nearly 25% of assets in 1945, but fell to 6% by 1970 when cash began a moderate climb to just over 10% in 2010. As a result, measuring leverage net of liquid assets reveals an even more pronounced levering up of unregulated firms during the last century.

Further analysis reveals that these aggregate trends are systemic. The leverage series of each unregulated industry—defined by the Fama and French 12-industry classification—exhibits a pattern similar to that found in the aggregate. The leverage of each size-based portfolio of firms—defined by the highest, middle, and lowest quintile of the annual size distribution—also exhibits a pattern similar to that of the aggregate. The median firm had no debt in its capital structure in 1946, but by 1970 had a leverage ratio of 31%. Finally, the fraction of investment financed with debt doubled from approximately 10% in the pre-WW II era to over 20% after 1970.

These patterns are in contrast to those for nonfinancial regulated firms, for which the aggregate debt-to-capital ratio was fairly stable over the century. The changing relative indebtedness of regulated and unregulated firms, along with changes in the relative asset sizes of the two sectors, led to a largely stable economy-wide corporate leverage ratio (Frank and Goyal, 2008) that masked the secular increase experienced by most firms. Our paper focuses on this increase in leverage among unregulated firms.

Having established the dramatic increase in leverage among unregulated firms, we first ask to what extent this trend can be accounted for by changing firm characteristics identified in prior studies as capital structure determinants (e.g., Rajan and Zingales, 1995; Frank and Goyal, 2009). The answer is not much, if at all. We estimate regressions of leverage on firm characteristics using pre-WW II data and use these coefficients to make post-WW II predictions. Predicted leverage computed using realized firm characteristics is flat to declining from 1945 through the end of our sample period—in stark contrast to the increase in observed leverage over this period. Inspection of individual characteristics reveals that, with the possible exceptions of earnings volatility and firm size, none of the average or aggregate characteristics change over the century in a way that would support greater debt capacity or higher optimal leverage. Alternative estimation periods and model extensions, such as time-varying parameters and nonlinear relations, do not improve the out-of-sample fit. Thus, any explanation for these secular trends in financial policy must come from sources of variation not central to the existing capital structure literature.

The inability of firm characteristics to account for the shift in leverage policies over time suggests either omitted firm characteristics that have yet to be identified, or macroeconomic factors that altered firms' propensities to use debt. We therefore turn to our final set of analyses, which examines macroeconomic factors capturing changes in the economic environment that are theoretically relevant for financial policy. These factors capture changes to taxes, economic uncertainty, financial sector development, managerial incentives, and government borrowing. While a complete investigation into each underlying theory is beyond the scope of this paper, our results provide suggestive evidence.

Specifically, one of the more robust relations that we find is a negative association between corporate leverage and government leverage, the latter defined as the ratio of Federal debt held by the public to gross domestic product (GDP). A one standard deviation increase in government leverage is associated with a one-quarter standard deviation decrease in aggregate corporate debt-to-capital. This marginal effect on capital structure is significantly larger than that of other macroeconomic factors, such as GDP growth, inflation, and the BAA–AAA corporate bond yield spread, as well as firm characteristics, such as profit margins, asset growth, and the market-to-book equity ratio. This negative relation holds not just for the level of debt but also for the flows of debt in the two sectors. Thus, when the government reduces debt issuance, corporations increase their use of debt relative to equity, resulting in an increase in corporate leverage.

There are several potential mechanisms behind these findings. First, our results are consistent with government deficit financing crowding out corporate debt financing through competition for investor funds (Friedman, 1986). Second, and closely related, market imperfections, such as taxes (McDonald, 1983), informational frictions (Greenwood, Hanson, and Stein, 2010), and transaction costs (Krishnamurthy and Vissing-Jørgensen, 2012) generate an imperfectly elastic demand curve for corporate debt, as investors are no longer able to costlessly transform return streams from corporations to match their consumption needs. Consequently, fluctuations in the supply of government debt, a substitute for corporate debt, can shift the demand curve for corporate debt in a manner that affects equilibrium quantities.

Alternatively, the supply of government debt may proxy for latent investment opportunities. Increases in

[3] We define unregulated firms as all nonfinancial firms excluding those in the utilities, railroads and telecommunications industries.

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the supply of Treasuries tend to occur during economic downturns when firms' investment opportunities are poor and their need for external capital falls. Because debt is the primary source of external capital (Gorton and Winton, 2003), corporate leverage falls. In this case, the relation between leverage and government borrowing may reflect fluctuations in unmeasured investment opportunities.

We also find a positive relation between corporate financial policy and the output of the financial sector from business credit and equity (Philippon, 2012). This relation exists with both leverage and the fraction of investment funded with debt, implying a potentially important role for the development of financial institutions and markets. However, other measures of financial market development, such as the fraction of debt and equity held through intermediaries, are not robustly correlated with aggregate leverage.

While other macroeconomic factors appear related to corporate leverage on visual inspection, further analysis reveals that these relations are not statistically distinct from a time trend. For example, corporate taxes underwent 30 revisions over the past century and increased from 10% to 52% between 1920 and 1950. Yet, we find no significant time-series relation between taxes and the margin between debt usage and common equity, in large part because of a near decade-long delay in the response of leverage to tax changes. (As detailed below, we do however find a more robust positive relation between taxes and the use of debt relative to preferred equity in the early part of the century.) Measures of economic uncertainty and aggregate risk, both of which proxy for expected distress costs, are negatively correlated with leverage, but show no relation after controlling for other leverage determinants. Finally, we find little evidence of a relation between proxies for managerial incentives and leverage in the aggregate.

Our primary data include a comprehensive set of balance sheet and income statement variables for each industrial firm on CRSP back to 1920. Prior studies use alternative data sources to examine components of the broader trends and issues explored here. Using aggregate data, some authors note a fairly stable leverage ratio over time (Sametz, 1964; Wright, 2004; Frank and Goyal, 2008), while others note varying degrees of increase in the leverage ratio during the post-WW II era (e.g., Miller, 1977; Taggart, 1985; McDonald, 1983).[4] Using Compustat data, Gordon and Malkiel (1981), Philippon (2009), Strebulaev and Yang (2013), and DeAngelo and Roll (2014) document an increase in leverage and a decrease in the proportion of conservatively levered firms in the second half of the 20th century. Finally, Ciccolo (1982) and DeAngelo and Roll (2014) collect data extending back to the early part of the 20th century for 50 and 24 firms, respectively. The former study finds evidence of increasing debt usage and substitution of debt in place of preferred stock; the latter emphasizes within-firm variation in leverage.

The unique breadth of our data and the scope of our analyses enable us to make several contributions to the capital structure literature. First, we provide a more complete picture of capital structure that identifies three distinct eras in both the aggregate and the cross-sectional distribution of firms' financial policies over the last one hundred years and highlights a broad-based, steep increase in leverage in the middle of the 20th century. Second, we identify sharp differences between regulated and unregulated sectors, and distinct similarities among unregulated industries and firms of different sizes. Third, we show that traditional empirical models of capital structure based on firm characteristics fall short in explaining the capital structure trends that we document. Rather, changes in the broader economic and institutional environments play a more prominent role in explaining the changes in corporate financial policy over the last century. An important feature of our data is the ability to avoid the selection biases affecting samples conditioned on firm survival, such as the pre-1962 Compustat data.[5]

The remainder of the paper proceeds as follows. In Section 2 we discuss our data and sample selection. In Section 3 we examine trends in corporate financial policy over the last century at the aggregate, industry, and firm levels. In Section 4 we outline a theoretical framework for understanding why leverage has undergone such a dramatic change. Section 5 explores the ability of firm characteristics to account for the increase in leverage, while Section 6 focuses on changes in the economic environment. Recognizing that this analysis mostly documents correlations, we discuss the opportunities and challenges that remain for future research and conclude in Section 7.

2. Sample selection and summary statistics

Our sample frame begins with all firms listed in the Center for Research in Security Prices (CRSP) monthly stock files. This frame includes all firms listed on the New York Stock Exchange (NYSE) since 1925, all firms listed on the American Stock Exchange (Amex) since 1962, and all firms listed on the Nasdaq since 1972. For these firms, stock market data come from CRSP. Accounting data are obtained from two sources: Standard and Poor's (S&P) Compustat database and data hand-collected from Moody's Industrial Manuals. We exclude financial firms from all of our analysis. The end result is an unbalanced firm-year panel beginning in 1920 and ending in 2010.[6]

Because of different institutional environments, we distinguish between two sectors of the economy that we

[4] Other studies documenting varying degrees of aggregate leverage increases beginning in the middle of the 20th century include von Furstenberg (1977) and Holland and Myers (1979). Among these earlier studies identifying leverage increases, there is also disagreement about the permanence of the increase.

[5] As many authors (e.g., Opler, Pinkowitz, Stulz, and Williamson, 1999) note, pre-1962 Compustat data are backfilled to the 1950s and consequently any inferences with these data may be an artifact of survivorship bias. As such, almost all studies ignore pre-1962 Compustat data.

[6] For the years from 1920 through 1924, the sample includes all firms listed in CRSP as of December 1925. All results are robust to excluding these years.

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Table 1
Summary statistics.

The sample covers the period 1920–2010 and includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Financial firms, utilities, and railroads are excluded. All variables are expressed as percentages, with the exception of market-to-book assets and average book assets. In Panel C, averages are calculated as the equal-weighted mean of all firm-year observations within each decade. See Appendix A for variable definitions.

Panel A: Annual aggregate summary statistics

	Count	Mean	SD	Min	Max	AR(1)
Firm characteristics						
Debt / Capital	91	26.63	11.81	11.06	47.17	0.990
Debt/(Debt + Mkt equity)	86	20.10	8.14	7.59	36.69	0.898
(Debt − Cash)/ Assets	91	8.07	9.93	−16.03	21.47	0.971
EBIT / Assets	91	9.99	2.98	1.83	17.54	0.807
Intangible assets / Assets	91	15.80	9.85	5.88	38.37	0.997
Mkt assets / Book assets	86	1.27	0.25	0.57	1.90	0.798
Avg. real sales ($mm)	91	607	242	193	1,213	0.983
Investment / Assets	91	7.29	5.61	−6.42	19.64	0.684
Macroeconomic factors						
Real AAA rate	91	2.99	4.38	−11.77	16.90	0.558
BAA–AAA yield spread	91	1.19	0.69	0.37	4.26	0.838
Inflation	91	2.92	4.44	−10.94	15.63	0.564
Mkt return	85	11.69	20.50	−44.36	57.50	0.010
GDP growth	91	3.40	5.41	−13.00	18.52	0.409
Corp. tax rate	91	36.18	13.86	10.00	52.80	0.990
Govt debt / GDP	91	40.79	17.71	16.34	108.82	0.943

Panel B: Panel data summary statistics

	Count	Mean	SD	Min	Max
Debt / Capital	214,483	29.45	27.69	0.00	138.00
Debt/(Debt + Mkt equity)	207,853	25.22	25.56	0.00	95.61
(Debt − Cash)/ Assets	215,976	5.67	32.97	−85.96	82.82
EBIT / Assets	213,240	3.05	22.14	−115.15	36.62
Intangible assets / Assets	212,145	16.65	17.58	−193.37	100.00
Mkt assets / Book assets	206,229	1.76	1.62	0.36	10.77
Real sales ($mm)	212,041	677.88	1,919.14	0.00	13,834.49
Investment / Assets	193,141	17.54	56.28	−71.78	364.97

Panel C: Averages by decade

	# Obs	Debt / Capital (%)	Debt/ (Debt + Mkt equity) (%)	(Debt − Cash)/ Assets (%)	EBIT / Assets (%)	Intang. / Assets (%)	Mkt assets / Bk assets	Avg. real sales ($mm)	Invest/ Asset (%)
1921–1930	1,580	12.23	20.14	0.56	8.14	15.26	1.14	267	9.97
1931–1940	4,177	11.54	19.60	−4.00	7.41	11.98	1.04	330	0.38
1941–1950	6,197	11.85	14.81	−10.91	14.19	6.56	1.06	529	12.01
1951–1960	6,191	18.20	19.72	−0.45	12.04	5.89	1.18	761	10.90
1961–1970	12,412	27.64	22.65	11.55	10.89	9.31	1.63	762	18.75
1971–1980	28,172	34.68	35.54	17.14	10.57	10.38	1.30	645	16.52
1981–1990	37,181	34.88	27.40	11.16	0.55	13.76	1.81	521	20.44
1991–2000	47,363	30.77	23.69	3.99	−1.34	20.50	2.14	598	24.74
2001–2010	38,171	27.96	21.75	−3.10	−1.92	26.95	1.97	1,015	11.18
Total	181,444	29.45	25.22	5.67	3.05	16.65	1.76	678	17.54

loosely refer to as regulated (utilities, railroads, and telecommunications) and unregulated (all other nonfinancial industries). We recognize that regulatory status is dynamic, heterogeneous, and extends beyond our classification (e.g., airlines). Thus, we emphasize that these are merely labels used to identify a division in our data. This division permits us to avoid confounding our results with financial policy that is governed primarily by the industry-specific regulatory environment, and to maintain consistency with previous capital structure research. For the most part, we focus our attention on the unregulated sector but discuss and analyze the regulated sector where relevant.

Table 1 presents summary statistics for the unregulated sector of the economy. In addition to their descriptive value, these results provide a context for subsequent analysis.[7] Panel A presents aggregate measures of firm characteristics and macroeconomic variables. Aggregate firm characteristics are computed as the ratio of sums over firms within each year. Panel B presents results for the firm-year panel. Panel C presents average firm characteristics by decade.

3. Trends in corporate leverage

3.1. Aggregate trends

Fig. 1 examines long-run trends in aggregate leverage ratios for unregulated firms. Panel A presents the aggregate time-series for two measures of leverage. The solid line represents the ratio of all interest bearing debt (i.e., Total debt) to financial capital (i.e., capital), the latter of which is defined as the sum of total debt and the book value of equity. The figure reveals three periods of distinct corporate leverage behavior. From 1920 to 1945, leverage among unregulated firms is fairly stable and relatively low, with total debt-to-capital falling from 17% to 11% during this quarter century. From 1946 to 1970, leverage increased steadily and significantly—more than tripling—from approximately 11% in 1945 to almost 35% in 1970. Since 1970, leverage has remained fairly stable, but for an increase during the 1980s that gradually reversed over the next two decades. We observe similar broad patterns when we restrict our sample to firms listed on the NYSE or only include the 500 largest firms each year, both of which mitigate a changing sample composition.[8]

The dashed line in Panel A shows the ratio of long-term debt (maturity greater than one year) to capital. Comparing the dashed and solid lines reveals that while much of the increase in financial leverage was due to long-term debt, a significant portion came from the increased use of short-term debt starting in the late 1960s, coinciding with the growth in commercial paper issuance by nonfinancial firms in the wake of the 1966 credit crunch (Hurley, 1977).

The measures in Panel A isolate variation in leverage to that associated with changes in *financial* liabilities (Welch, 2011). However, the debt-to-capital measure excludes non-debt liabilities, which, like financial debt, represent a claim on the firm's assets that is senior to equity. As such, we examine the ratio of total liabilities to total assets in Panel B. Complementing the increase in financial leverage observed in Panel A is a secular increase in non-debt liabilities, such as pensions and accounts payable, beginning in 1970.[9] The combined result is a dramatic shift in the composition of corporate balance sheets. Total liabilities represented between 20% and 25% of assets in the 1920s and 1930s, but increased to over 65% of assets by the early 1990s before declining to 56% by 2010.

Fig. 2 presents time-series of several alternative leverage measures. Thus far all the presented measures of leverage are in book, or accounting terms. While book value ratios are often the focus of financing decisions, particularly as they pertain to credit (Chava and Roberts, 2008), some authors have argued that market value ratios are more economically meaningful for some firms (e.g., Welch, 2004).[10] As such, the dashed line in Panel A presents a market-based measure of leverage that replaces the book value of equity in our definition of capital with the equity market capitalization of the firm. We must still rely on a book value of debt because of data constraints, but the variation in equity dominates that of debt even in market terms (Schaefer and Strebulaev, 2008). The results show a more volatile time-series driven by fluctuations in equity market valuations but a broadly similar pattern in which initially low leverage increases to a higher level post-1970. One noticeable difference is in the timing and duration of the leverage run-up, which starts only in the mid-1960s and peaks around 1974. Market leverage is fairly stable until the 1960s due to rising equity values in the 1950s, and experiences a sharp decline coinciding with the bull market of the 1990s.

The solid line in Panel A treats preferred equity as debt and thus includes it in the numerator and denominator of the debt-to-capital ratio (e.g., Fama and French, 2005; Huang and Ritter, 2009). The ratio of debt plus preferred equity to capital is quite stable between 1940 and 1960, suggesting that much of the increase in leverage over this period was due to substitution between debt and preferred equity rather than substitution between debt and common equity. Indeed, preferred stock was over 13% of aggregate assets in the early 1920s, but only 2% of assets in 1960. While there are several components affecting the timing of the overall secular shift, the alternative measures in Panel A continue to show the same broad pattern: a substantial shift toward higher leverage in the middle of the century.

Finally, Panel B shows that corporate cash holdings also underwent a significant change over the last century that mirrors the change in leverage. The solid line shows the aggregate ratio of cash and marketable securities to assets. It has been well documented that corporate cash holdings have increased over the past three decades (Bates, Kahle,

[7] Appendix A details the data sources and variable construction.

[8] DeAngelo and Roll (2014) study the leverage series of 24 firms that survived over a similar sample period. They note that long leverage drifts (both levering and delevering) are common among these firms.

[9] The temporary spike in non-debt liabilities in the early 1940s was due mainly to increases in Federal income tax reserves reflecting a sharp increase in war-related tax obligations.

[10] On the other hand, if assets in place support more debt capacity than do future investment opportunities (Myers, 1977), book leverage may be the more appropriate measure.

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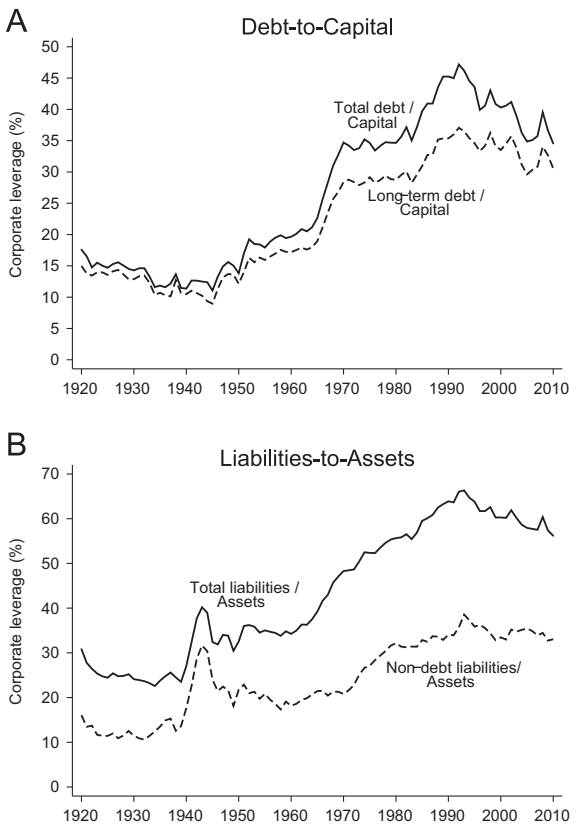

Fig. 1. Annual aggregate leverage ratios. The sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals from 1920 through 2010. Financial firms, utilities, and railroads are excluded. Panel A presents the annual ratio of aggregate total debt (solid line) and long-term debt (dashed line) to aggregate financial capital, measured as total debt plus book equity. Panel B displays annual ratios of aggregate total (solid line) and non-debt (dashed) liabilities to total assets.

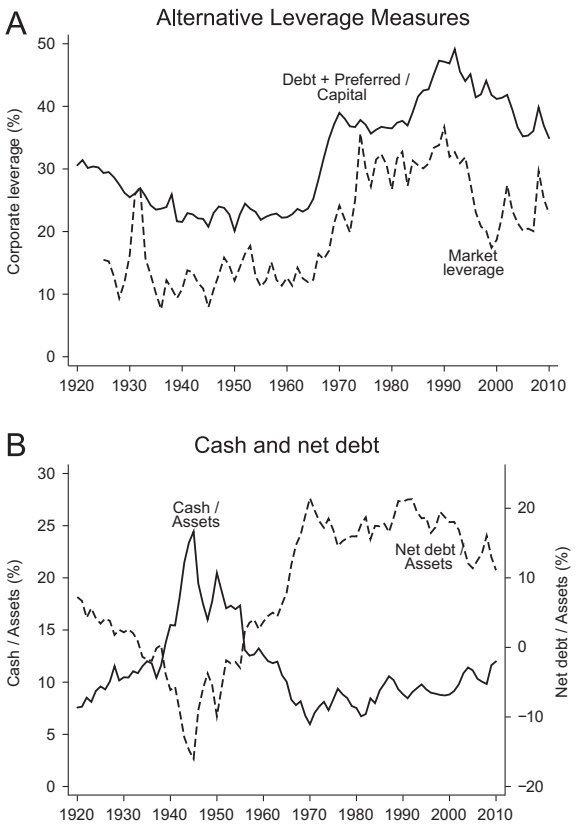

Fig. 2. Alternative leverage measures. The sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals from 1920 through 2010. Financial firms, utilities, and railroads are excluded. In Panel A, the solid line shows the aggregate ratio of debt plus preferred stock to total book capital. The dashed line displays the aggregate ratio of total debt to the sum of book debt and market value of equity. Panel B displays aggregate cash and short-term investments to assets (solid line) and net debt to assets (dashed line). Net debt is total debt minus cash and marketable securities.

and Stulz, 2009). Notably, looking across the century, we see that cash holdings peaked at nearly 25% of assets in 1945, and then steadily declined through 1970, roughly the same period over which leverage increased.[11] As a result, the ratio of net debt (debt minus cash) to assets has changed even more dramatically, from −16% in 1945 to 21% in 1970.

Because of the similarity of results across samples and leverage definitions, we focus our analysis and discussion on the ratio of total debt to capital. Doing so avoids redundancy in exposition. Nonetheless, the majority of our analysis is repeated using the alternative leverage definitions just discussed, as well as on various subsamples. We note when differences or similarities in results have a material effect on our inferences.

[11] Opler, Pinkowitz, Stulz, and Williamson (1999) also note a decline in cash to asset ratios in the 1950s and 1960s for subsamples of small and large firms using Compustat data. However, the authors note that because they are limited to Compustat, they cannot discern whether this trend is an artifact of the aforementioned survivorship bias. Our data allow us to overcome this limitation.

3.2. Cross-sectional and industry trends

Fig. 3 examines the evolution of the cross-sectional leverage distribution by plotting the annual quartiles of leverage year-by-year. Evident from Panel A is that the change in aggregate leverage observed in Fig. 1 reflects a broad-based shift in financial policy. All three quartile breakpoints move in tandem. Interestingly, the median firm was unlevered in the late-1930s and the mid-1940s and at least a quarter of the sample firms were unlevered in each year from 1920 through 1950. Thus, the secular increase in leverage was associated with an increase in leverage across the entire distribution of firms and an increase in the propensity to use debt.

Also apparent is a thickening left tail of the leverage distribution in recent decades for the full sample (top left plot). While the third quartile has remained fairly stable, the median and especially first quartile of the full sample leverage distribution have steadily declined since 1980. By the end of the sample period, the first quartile is back near its pre-war level of zero. Contrasting the full sample distribution to that of NYSE-listed firms (upper right plot) suggests that the decline

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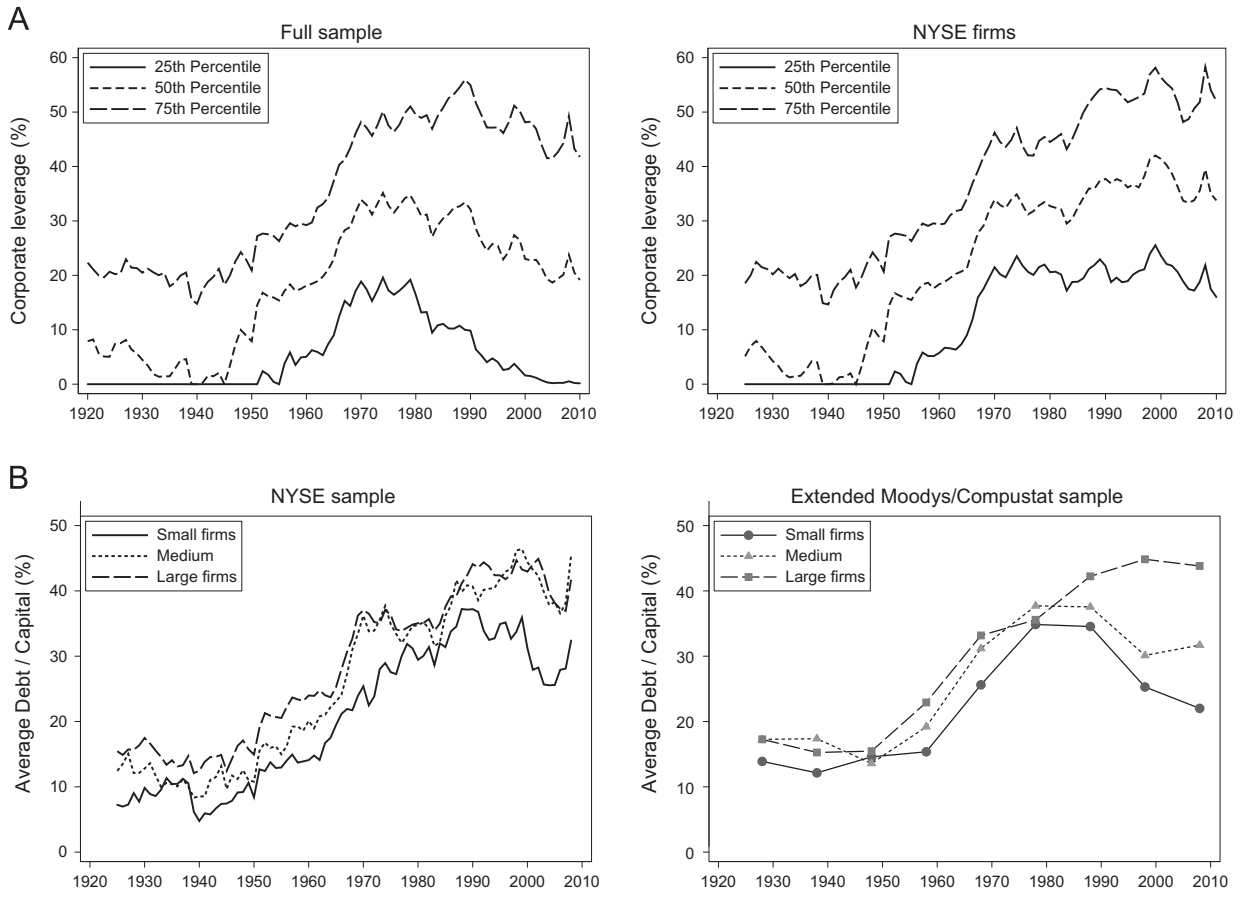

Fig. 3. Cross-sectional distribution of corporate leverage. Panel A presents, for each year from 1920 to 2010, the cross-sectional median and first and third quartiles of the ratio of total debt (short-term plus long-term) to capital (total debt plus book value equity). In Panel B, firms are sorted into quintiles each year based on book assets and the average debt-to-capital ratio is computed within the smallest, middle, and upper size quintiles. The sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Financial firms, utilities, and railroads are excluded. The right-hand plot in Panel B reports data once per decade (years ending in "8") and includes all firms covered in the Moody's Industrial Manuals, regardless of whether they are covered in the CRSP database. Panel A: Quartile breakpoints by year, Panel B: Average leverage by firm size.

in the median and first quartile of leverage since 1980 might be related to the entry of smaller, Nasdaq-listed firms. When we restrict our attention to NYSE firms, all three quartile breakpoints remain fairly stable from 1970 through the end of the sample period. We explore this phenomenon in more detail in Section 4 below.

Panel B of Fig. 3 shows that the increasing trend in leverage was shared by firms of all sizes. The plots display average debt-to-capital each year for portfolios of firms constructed from the first, third, and fifth quintiles of the book assets distribution. To mitigate the impact of the change in sample composition, we use two different samples. The left plot shows results using only NYSE-listed firms. The right plot uses an extended sample consisting of all firms reported in the Moody's Industrial Manual, regardless of whether they are also covered in CRSP.[12] This sample includes a large number of smaller firms listed on regional exchanges in the first half of our sample period. Using this extended sample, the average book assets (in real dollars) for the small firm group is roughly constant over the whole sample period.

In both samples, we see that the increase in leverage over the century was not confined to large firms. Firms of all sizes increased their use of debt. In recent decades, there is a reversal of the trend for small firms, while large firms continue their high leverage policies. This result mimics that found above in the left plot of Panel A. As mentioned above, we investigate the cause of this phenomenon below in Section 4.

Fig. 4 shows that the aggregate leverage pattern is evident in every unregulated industry, defined by the Fama-French 12-industry classification.[13] Each subpanel in the figure plots the aggregate debt-to-capital ratio for the indicated industry (solid line) and the aggregate debt-

[12] Due to data entry costs, Moody's data for non-CRSP firms (the extended sample) are gathered only once every ten years, beginning in 1928.

[13] This classification aggregates Standard Industrial Classification (SIC) codes into economic industries and can be found on Ken French's Web site at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/ftp/Siccodes12.zip.

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to-capital ratio for all unregulated industries (dashed line) as a point of reference. Industry leverage is somewhat more volatile than aggregate leverage due in part to smaller sample sizes, particularly in the first half of the century. What is most notable, though, is the striking similarity in the leverage time-series across every industry. Each industry reveals a strong positive trend between 1945 and 1970. Further, this upward trend tends to taper off after 1970. Thus, the increase in leverage experienced in the middle half of the 20th century was an economy-wide phenomenon among firms in unregulated industries.

3.3. Net flows of debt and equity

While the previous evidence is indicative of a structural change in financial policy, the leverage figures conflate debt growth with possible equity or asset shrinkage. Fig. 5

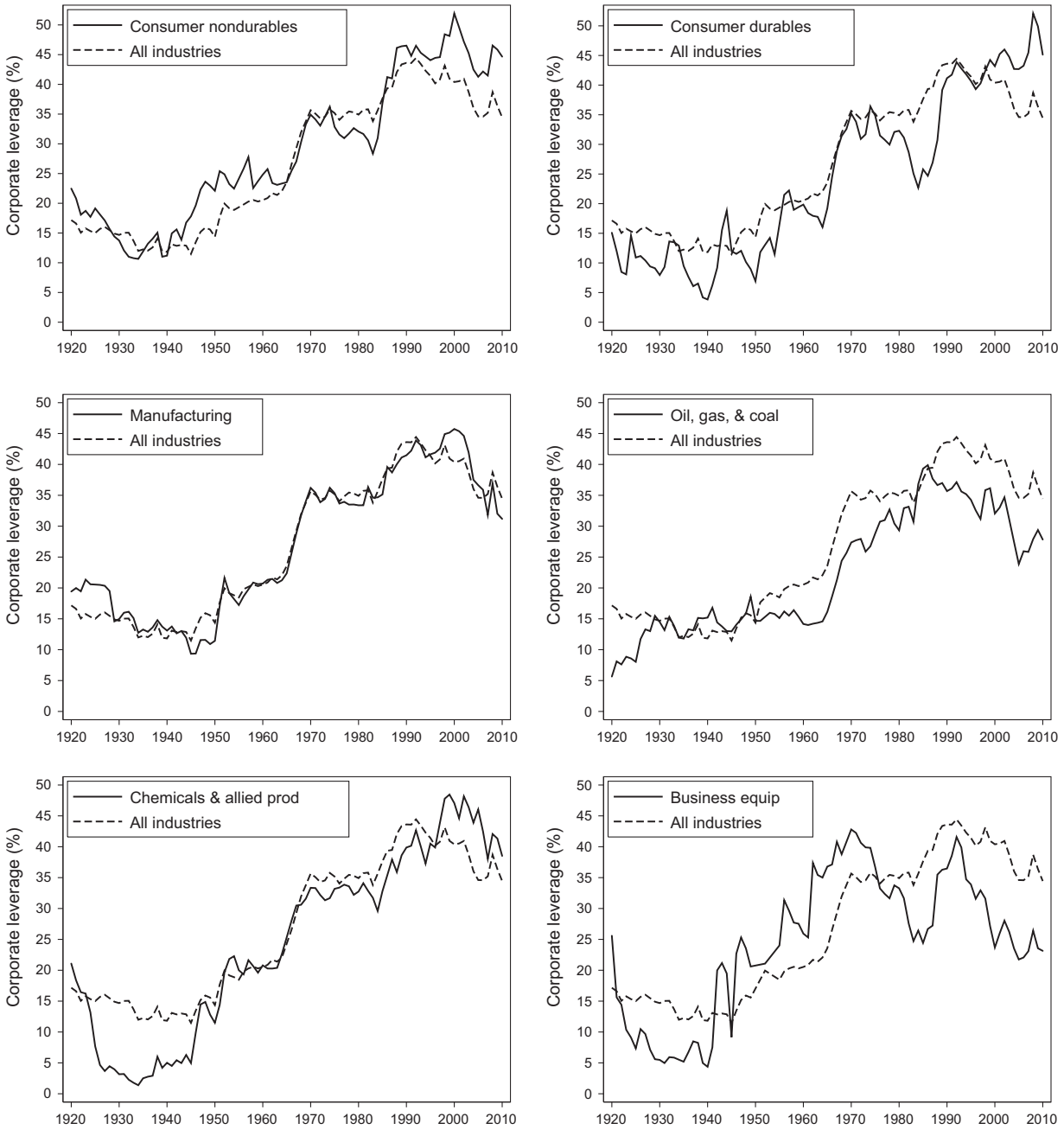

Fig. 4. Industry leverage. The solid line presents the asset value-weighted average leverage ratio for each of the 12 Fama and French industry classifications, excluding utilities, telecommunications, and finance. The dashed line presents the value-weighted average leverage ratio for all industrial firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Industry-years with fewer than ten firms are excluded.

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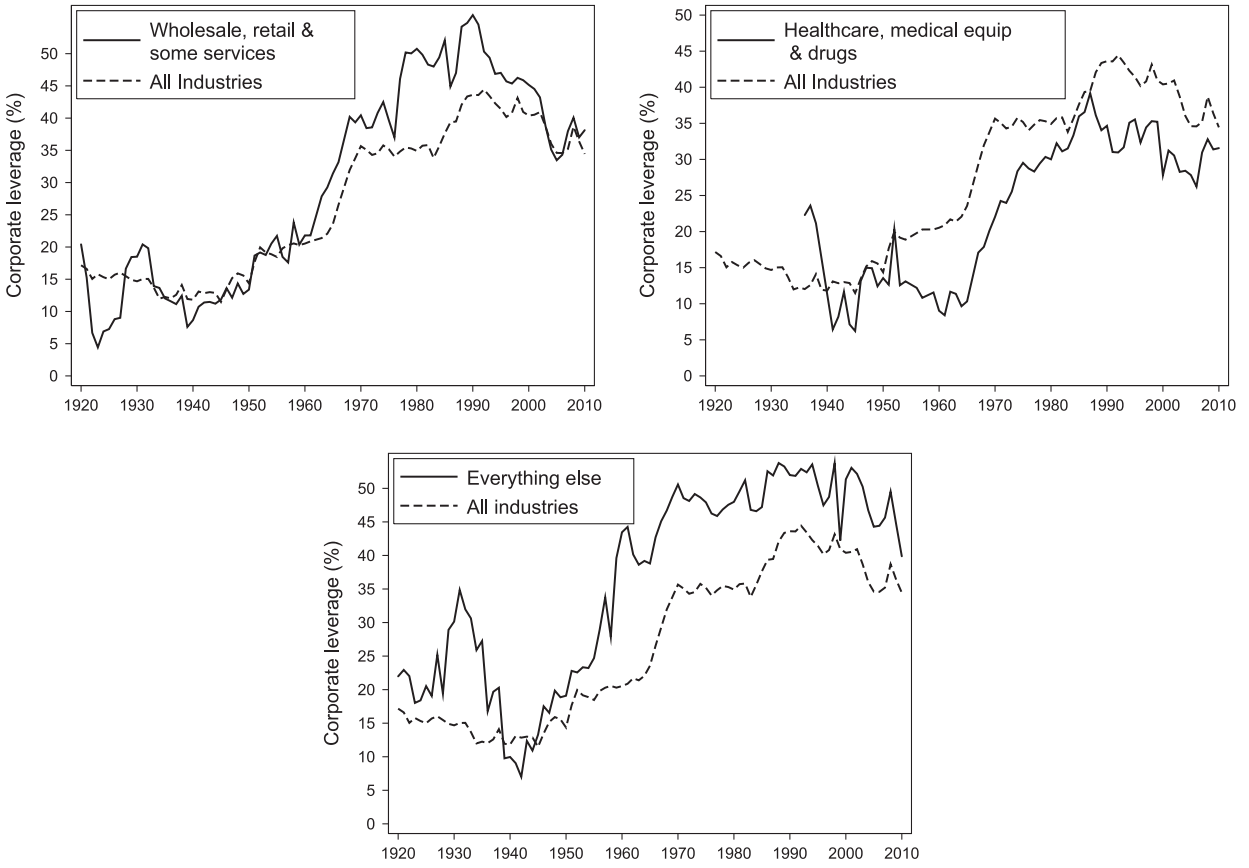

Fig. 4. (*continued*)

isolates financial flows to highlight the effects of financial policy on leverage. Panel A of Fig. 5 plots net debt and net equity issuances scaled by lagged assets for each year. To ease the interpretation of the figure, we plot a five-year moving average (MA) of each series. While both series exhibit a great deal of volatility, the increase in the relative use of debt financing can be seen after 1945 and especially in the late 1960s. Equity issuances also increased, but did not reach the heights of the late 1920s again until the turn of the next century. More importantly, at low levels of leverage, and particularly so for the very low levels in the pre-World War II era, the leverage-increasing effect of net debt issuances is greater than the leverage-decreasing effect of net equity issuances.

Also evident in Panel A is the correlation between debt and equity issuance, which is expected if demand for all types of external capital is driven by investment activity. In Panel B, we control for investment demand by plotting the fraction of investment financed with debt. That is, for the subsample of firms with positive investment, we divide aggregate net debt issuance by aggregate investment. Again, we present a five-year moving average. For comparison, we also plot the aggregate debt-to-capital ratio. The figure highlights the increased use of debt financing through the first half of the sample period. External debt accounted for only 5% to 10% of investment in the 1920s and 1930s but steadily increased to over 30% by the late 1960s. This shift toward a greater reliance on debt as a funding source appears to be a key factor driving the increase in leverage.

3.4. Reconciling with other leverage aggregates

Appendix B provides a detailed reconciliation with alternative aggregate data sources, such as the Flow of Funds and Statistics of Income. Here we briefly mention the key implications of this exercise. Previous studies relying on these alternative data sources document a more temporally stable aggregate leverage process than that shown in Fig. 1 (e.g., Sametz, 1964; Wright, 2004; Frank and Goyal, 2008). One potential explanation for this difference is sample selection bias generated from our non-random sampling scheme that includes only publicly held firms. As we show in Appendix B, however, this is not the reason for the difference between our aggregate leverage series and that found in previous studies. Rather, the stability of economy-wide leverage found in previous studies is due to two countervailing forces at work in the regulated and unregulated sectors of the economy.

In particular, the leverage for the regulated sector displays a remarkably stable capital structure. Long-term debt-to-capital varies between approximately 40% and 50% for 70 years. Before 1945, the long-term debt-to-capital ratio in the regulated sector was approximately

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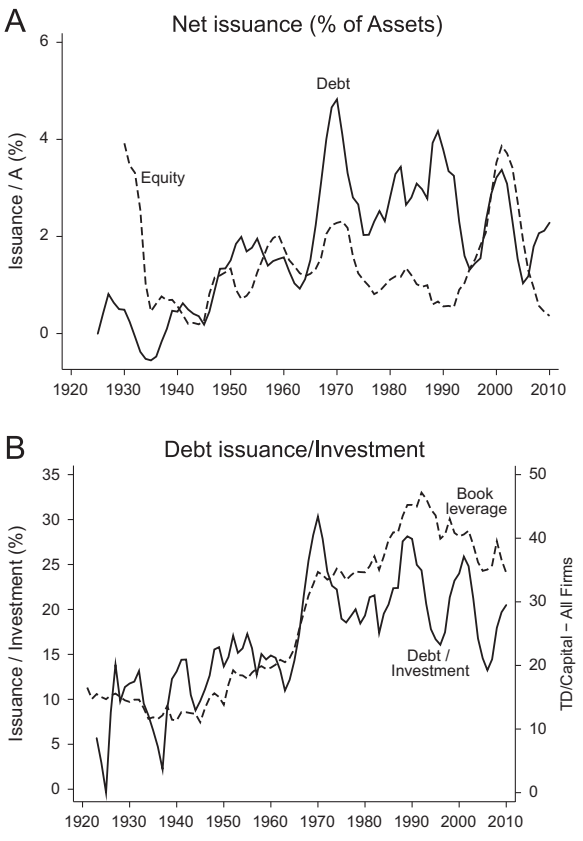

Fig. 5. Aggregate security issuance. Aggregate net debt issuance is defined each year as the change in balance sheet debt summed across firms divided by the sum of lagged book assets. Net equity issuance is defined as the split-adjusted change in shares outstanding times the average of the beginning and end-of-year stock price. In Panel B, we calculate investment as the change in (gross) long-term assets plus the change in inventory from the balance sheet. The sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals from 1920 through 2010. Financial firms, utilities, and railroads are excluded. 5-year moving averages plotted in both graphs.

four times that of the unregulated sector. Starting in 1950, however, leverage for the unregulated sector increased rapidly (to the point that regulated and unregulated sectors converged to within 10 percentage points of each other by the end of the century). At the same time, the share of assets for the regulated sector declined from a peak of 43% in 1934 to 26% by 1950. The net effect is a relatively stable economy-wide aggregate capital structure. This stability at the broad aggregate level is consistent with the equilibrium described by Miller (1977), but it masks substantial heterogeneity in leverage trends at the sectoral level.

3.5. *Summary of financial policy trends*

Our analysis of corporate balance sheet data from 1920 through 2010 reveals the following stylized facts:

1. The composition of the aggregate balance sheet of the unregulated industrial sector underwent a transformation over the past century, from less than 25% liabilities in the 1930s to more than 60% by 1990.
2. This shift was largely driven by a systemic change in financial leverage that affected firms of all sizes and all unregulated industries. The median firm was unlevered in 1945 but had a debt-to-capital ratio exceeding 30% by 1970.
3. Cash balances fell from nearly 25% of assets at the end of WW II to 6% of assets in 1970, leading to an even greater change in net leverage. The aggregate cash ratio has rebounded in recent decades but not to previous levels.
4. Preferred stock accounted for 10–15% of assets in the 1920s, but all but disappeared from corporate balance sheets by the 1960s. Corporate debt appears to have replaced this disappearing preferred equity.
5. By contrast, the leverage ratio and financial policy of the regulated sector has been remarkably stable, with a long-term debt-to-capital ratio that varies between 40% and 50%. The aggregate debt ratio for the economy also remained relatively stable.

Why did regulated industries' leverage ratios remain both high and stable for so long? Why did leverage ratios in unregulated industries increase so dramatically? A complete answer to either question is beyond the scope of any one paper. In the remainder of our study, we focus attention on the latter, for which existing theory is most applicable and for consistency with the existing capital structure literature. The former question requires an investigation into the industry-specific regulatory structures that govern the behavior of regulated industries, such as railroads and utilities. We postpone this analysis to future research.

4. Theoretical framework

While many theories of capital structure have been developed, most are presented in a cross-sectional, microeconomic context. Because we are interested in understanding changes in aggregate leverage, we now discuss a model that highlights predictions in an aggregate context. Taggart (1985) points out that aggregate leverage is determined by the interaction of the supply of securities by firms and demands for those securities by investors. Fig. 6 presents some intuition based on a generalization of Miller (1977). On the horizontal axis is the aggregate quantity of corporate debt (D), and on the vertical axis is the risk-adjusted return on debt (r_D^*) and equity (r_E^*). Using returns on the y-axis instead of prices implies, as in Miller (1977), that the slopes of the supply and demand curves are reversed from traditional exposition. Investment is held fixed so that movements along the horizontal axis correspond to substitutions between debt and equity.

The supply curve represents the willingness of firms to supply debt at different yields. The determinants of its shape and level have been discussed at length in prior literature. Frank and Goyal (2008) provide an excellent review. The tax shield and agency benefits of debt shift the supply curve up. As leverage increases along the horizontal axis, though, firms begin to incur expected distress and

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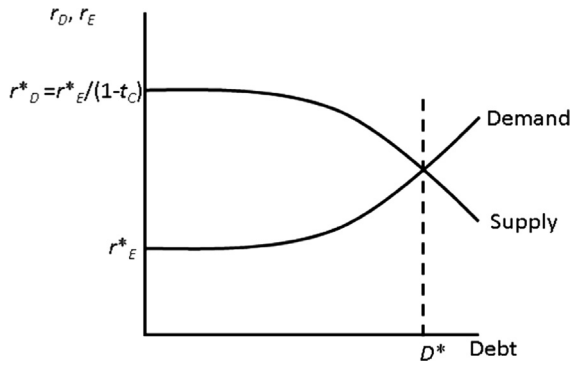

Fig. 6. Supply and demand for corporate debt. The figure shows theoretical demand and supply curves for corporate debt. On the horizontal axis is the aggregate quantity of corporate debt (D), on the vertical axis the risk-adjusted return on debt (r^*_D) and equity (r^*_E).

agency costs and expected tax benefits wane, causing the supply curve to slope down. As a result, the same frictions expected to influence cross-sectional differences in firms' leverage decisions also influence aggregate leverage. For example, if firms' exposures to the agency costs or the distress costs of debt increase on average, we would expect a steeper slope of the aggregate supply curve and a decline in equilibrium leverage holding demand fixed.

The demand curve represents investors' willingness to hold corporate debt at different yields. Demand for corporate debt securities depends on households' demands for different return streams, as well as the transaction costs they face in financial markets. For example, if investors (through financial intermediaries) can costlessly exchange cash flows from one security for those of another, they will be unwilling to pay a premium for any particular corporate security, even if it matches their preferred return profile. Thus, in the presence of both investor heterogeneity and transaction costs, the demand curve need not be perfectly elastic. For example, in Miller's (1977) model, investors face differing personal tax rates and tax arbitrage restrictions. Low tax bracket investors are willing to hold debt at the same risk-adjusted yield as equity. Debt investors that face higher personal tax rates on interest income demand higher yields to compensate for the tax disadvantage of holding debt, leading to an upward-sloping demand schedule.

As discussed by Taggart (1985), taxes are not the only friction capable of producing an upward-sloping demand curve. More generally, any cost that impedes investors from exchanging return streams from one security for another can lead to an upward-sloping demand curve in the presence of investor heterogeneity. This heterogeneity across investors may come, for example, from differences in transaction costs, risk aversion, or cash flow expectations.[14]

An imperfectly elastic demand curve has several implications for the determinants of aggregate leverage. First, investor characteristics, such as risk preferences and tax rates, may play a role in determining aggregate leverage. As the segment of the population exhibiting high degrees of risk aversion, pessimistic cash flow expectations, or low personal tax rates grows, the demand curve will flatten and the aggregate amount of corporate debt will increase. Second, when different securities are imperfect substitutes, changes in the supply of competing securities (e.g., government bonds) may affect relative yields and the equilibrium mix of corporate debt and equity. Specifically, increases in the supply of competing securities shifts the corporate debt demand curve up and to the left, leading to a reduction in the equilibrium level of corporate debt. Third, development of the financial intermediation sector should decrease the cost of transforming return streams from one security to another. All else equal, we expect the demand curve to become more elastic (and demand factors to matter less) and corporate debt usage to increase as financial markets develop.

In sum, the shape and level of the supply and demand curves for corporate debt are determined by firms' aggregate exposures to various market frictions, investors' aggregate preferences for different return streams, and the transaction costs investors face in financial markets. In our empirical analysis below, we evaluate these predictions in two steps. We first ask whether changes in the characteristics of publicly traded firms increased their willingness to supply corporate debt as the 20th century progressed. We then examine whether changes in the economic environment in which firms operate, such as tax rates, supplies of competing securities, and development of the financial sector, may have shifted the demand curve (or supply curve, in the case of corporate taxes) in a way that led to an increase in aggregate leverage.

5. Changes in firm characteristics

In this section we examine the ability of previously identified firm characteristics to explain the financing trends documented in Section 2. In other words, we ask whether firms have changed over the last century in a manner that would predict a large increase in leverage. Previous research has identified a number of firm characteristics that (1) proxy for the frictions generating an imperfectly elastic supply curve, and (2) correlate with capital structures (e.g., Rajan and Zingales, 1995; Frank and Goyal, 2009). Thus, our analysis allows us to comment on both the empirical relevance of existing models for explaining long-run trends and the role of supply curve variation in shaping corporate capital structures.

5.1. Firm characteristics and leverage trends

We begin with a visual inspection of average firm characteristics in Fig. 7. In light of the changing sample composition, we report values separately for NYSE, Amex, and Nasdaq firms. We first note that, among NYSE firms, there is a general upward trend in firm size (measured as log of real sales) through the century. However, relating this trend to the trend in leverage may be problematic on statistical grounds. With positive economic growth, firm size is asymptotically non-stationary. We return to this

[14] See Greenwood, Hanson, and Stein (2010) and Krishnamurthy and Vissing-Jørgensen (2012) for recent examples of inelastic demand resulting from alternative sources of investor heterogeneity and arbitrage restrictions.

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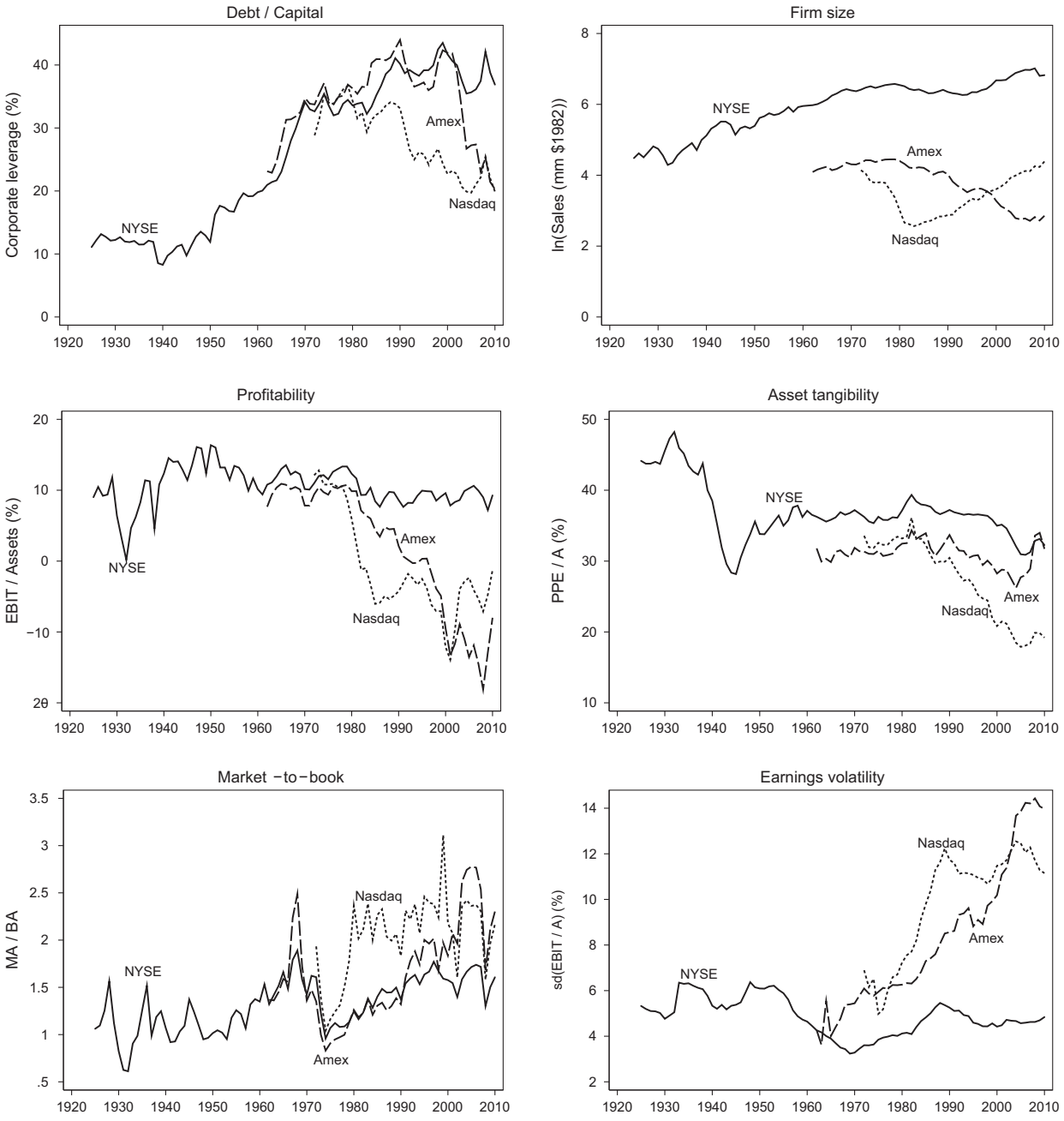

Fig. 7. Firm characteristics by stock exchange listing. The solid, long-dash, and dashed lines present cross-sectional averages of each firm characteristic for, respectively, NYSE, Amex, and Nasdaq firms. See Appendix A for variable definitions. The sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals from 1920 through 2010. Financial firms, utilities, and railroads are excluded.

issue in our regressions below. Further, the increasing size of NYSE firms is offset in recent decades by the introduction of small Nasdaq firms and the smaller size of Amex firms.

Profitability increased significantly between 1932 and 1950. For NYSE firms, profitability then declined gradually from 1950 until 1992, after which it has been fairly stable. The profitability trends for Amex and Nasdaq firms were similar to that of NYSE firms during the 1960s and 1970s. However, profitability among Amex and Nasdaq firms declined precipitously between 1980 and 2000. The steady decline in profitability following WW II can potentially explain the gradual increase in leverage over the same period. There was also a run-up in profitability leading up to and during the war associated with a modest decline in leverage over the same period. Notably though, the level of profitability at the start of our sample period is virtually identical to that at the end of our period, in contrast to leverage.

Asset tangibility, despite large fluctuations in the 1940s and 1950s, generally declined over the century. Not only does this pattern miss some of the important turning points in

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leverage, it is also difficult to reconcile with existing empirical evidence (e.g., Frank and Goyal, 2009) and theory (e.g., Shleifer and Vishny, 1992), which suggests that decreasing asset tangibility decreases debt capacity because there is less collateral to secure debt. The market-to-book ratio, despite a sharp drop in the 1970s, was largely flat or modestly increasing over the century. This pattern is also difficult to reconcile with the large movements in leverage and existing empirical evidence showing a strong negative correlation between leverage and market-to-book. Finally, earnings volatility declined between 1950 and 1970, the period over which the bulk of the leverage increase occurred. However, it has increased somewhat since then, and dramatically so for Amex and Nasdaq firms.

Overall, the plots give little indication that characteristics changed in a manner that would lead to a sustained increase in corporate debt supply. Nonetheless, we undertake a more formal regression analysis below to estimate the quantitative impact of changes in firm characteristics on expected leverage ratios.

5.2. Cross-sectional relationships through time

Table 2 presents the results of panel regressions of the debt-to-capital ratio on firm size (log of real sales), profitability, tangible assets, and the market-to-book assets ratio. To facilitate comparison of magnitudes, we report marginal effects by multiplying the estimated coefficients by the standard deviation of each independent variable within each decade. Panel A presents the results using book leverage as the dependent variable, Panel B using market leverage. This analysis provides insight into the stability of previously documented relationships.

The first two columns of Panel A indicate that, with the exception of the 1930s, leverage has had a consistently positive and negative association with firm size and profitability, respectively. Both relationships strengthened between the 1920s and 1980s before weakening somewhat in recent decades. By contrast, the positive and negative associations documented by prior studies between leverage and, respectively, property, plant, and equipment (PP&E) and market-to-book are robust features of the data only in more recent decades. Comparison with the results for the NYSE sample indicates that the cross-sectional relationships between leverage and tangibility and market-to-book are primarily driven by the introduction of Nasdaq firms to the sample. More specifically, Nasdaq firms have, on average, less tangible assets, higher market-to-book ratios, and lower leverage than firms on the NYSE. This additional variation appears largely responsible for the increased importance of these relations in recent decades.

Results in Panel B reveal that these variables are more consistent over time in explaining market leverage. However, in the case of market-to-book, the negative relationship is likely dominated by the variation in market equity, which appears in the numerator of the independent variable and the denominator of the dependent variable.

With few exceptions, the results in Table 2 suggest that the empirical relations between leverage and its

Table 2
Relation between firm characteristics and leverage.

The sample includes all firms in the CRSP database that are also covered either in Compustat or the Moody's Industrial Manuals from 1920–2010. Financial firms, utilities, and railroads are excluded. Panel regressions with firm fixed effects are estimated each decade of corporate leverage on firm size (log of real sales), EBIT / Assets, net PP&E / Assets, and market-to-book assets. The dependent variable is book debt-to-capital in Panel A and book debt divided by the sum of book debt and market equity in Panel B. See Appendix A for other variable definitions. ***, **, And * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Full sample					NYSE sample				
	Size	EBIT / A	PP&E / A	MA / BA	Adj. R^2	Size	EBIT / A	PP&E / A	MA / BA	Adj. R^2
Panel A: Book debt / Capital										
1925–30	8.19***	−3.25***	1.19	1.23**	0.08	8.19***	−3.25***	1.19	1.23**	0.08
1931–40	0.94	−1.07**	1.93	1.42***	0.02	0.94	−1.07**	1.93	1.42***	0.02
1941–50	7.57***	−3.37***	1.55**	0.28	0.09	7.57***	−3.37***	1.55**	0.28	0.09
1951–60	5.87***	−4.34***	0.26	0.00	0.13	5.87***	−4.34***	0.26	0.00	0.13
1961–70	15.00***	−5.58***	2.24***	−0.22	0.20	15.65***	−7.19***	0.18	0.81**	0.30
1971–80	10.07***	−6.12***	5.69***	−0.28	0.16	7.26***	−5.32***	3.34***	0.70	0.15
1981–90	15.75***	−8.04***	5.62***	−2.04***	0.13	6.94***	−5.08***	−0.60	1.47*	0.06
1991–00	12.54***	−6.92***	5.67***	−1.38***	0.10	8.11***	−5.83***	1.26	−1.80***	0.09
2001–10	7.50***	−5.19***	5.07***	−0.95***	0.04	−0.03	−3.80***	1.46	−0.55	0.04
Panel B: Market leverage										
1925–30	12.36***	−5.99***	2.39	−1.83***	0.15	12.36***	−5.99***	2.39	−1.83***	0.15
1931–40	0.42	−3.64***	5.67***	−2.57***	0.09	0.42	−3.64***	5.67***	−2.57***	0.09
1941–50	6.91***	−4.10***	3.25***	−3.40***	0.11	6.91***	−4.10***	3.25***	−3.40***	0.11
1951–60	4.30***	−4.72***	1.16	−4.24***	0.15	4.30***	−4.72***	1.16	−4.24***	0.15
1961–70	13.97***	−6.06***	1.39**	−4.51***	0.30	13.4***	−7.70***	0.15	−4.21***	0.33
1971–80	10.05***	−6.98***	3.99***	−6.41***	0.23	9.44***	−7.36***	1.89**	−3.55***	0.23
1981–90	11.94***	−5.83***	4.10***	−6.29***	0.19	7.81***	−5.40***	0.60	−5.00***	0.18
1991–00	11.14***	−5.00***	3.62***	−4.64***	0.16	9.51***	−6.04***	1.97***	−5.73***	0.24
2001–10	6.06***	−3.85***	5.51***	−4.33***	0.11	2.48**	−4.32***	4.51***	−6.54***	0.19

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Table 3
Actual and predicted leverage.

The sample includes firms in the CRSP database that are also covered either in Compustat or the Moody's Industrial Manuals. Financial firms, utilities, and railroads are excluded. Predicted leverage in columns 2 and 7 is estimated based on coefficients from a panel regression with firm fixed effects, estimated over 1925–1945, of debt-to-capital on firm size, net PP&E / Assets, market-to-book assets, EBIT / Assets, earnings volatility, and asset growth. See Appendix A for variable definitions. Period fixed effects in columns 4 and 9 are the estimated coefficients on indicators for each given five-year period from a panel regression of debt-to-capital on the same set of control variables, estimated over the whole sample period. *** Indicates statistical significance at the 1% level. To calculate the predicted change in leverage in columns 5 and 10 for a given five-year period t to $(t+4)$, we first estimate the same panel regression described above over 1925 to $(t-1)$. The predicted change in leverage is then the average predicted value over t to $(t+4)$ minus the average fitted value over $(t-5)$ to $(t-1)$.

	Full sample					NYSE sample				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Avg. D/Cap	Predicted D/Cap	Actual − Predicted	Period fixed effects	Predicted Δ D/Cap	Avg. D/Cap	Predicted D/Cap	Actual − Predicted	Period fixed effects	Predicted Δ D/Cap
1945–49	12.5	10.2	2.3	3.1***	−0.6	12.5	10.2	2.3	3.5***	−0.6
1950–54	16.9	10.7	6.2	6.7***	0.7	16.9	10.7	6.2	7.0***	0.7
1955–59	19.2	11.7	7.5	7.8***	1.0	19.2	11.7	7.5	7.7***	1.0
1960–64	22.5	11.2	11.3	10.5***	−0.7	21.5	12.1	9.4	9.5***	0.5
1965–69	31.1	10.9	20.2	17.8***	−0.6	30.0	12.8	17.2	16.8***	1.0
1970–74	33.6	8.8	24.8	20.4***	−3.0	33.7	12.0	21.7	19.6***	−1.2
1975–79	34.3	7.8	26.5	20.8***	−3.4	33.2	11.5	21.7	19.5***	−2.2
1980–84	32.9	7.8	25.1	19.9***	−0.8	33.7	11.6	22.1	18.7***	−0.5
1985–89	35.7	7.0	28.7	25.1***	−2.0	39.1	11.0	28.1	24.9***	−2.8
1990–94	30.8	7.5	23.3	23.0***	−0.2	38.8	10.8	28.0	25.2***	−0.2
1995–99	30.3	8.8	21.5	24.6***	0.6	41.4	11.2	30.2	28.2***	0.0
2000–04	27.8	8.3	19.5	23.6***	0.8	37.9	11.1	26.8	26.7***	0.7
2005–10	27.9	8.4	19.5	23.8***	−0.0	38.2	11.1	27.1	27.3***	0.0

determinants are relatively stable. As such, we examine in Table 3 and Fig. 8 the ability of these characteristics to account for the temporal variation in leverage documented above. The first (sixth) column in Table 3 reports the average debt-to-capital ratio by decade for our full (NYSE) sample. In the next column, we first estimate a panel regression, with firm fixed effects, over the period from 1925–1945, of leverage on the set of firm characteristics reported in Fig. 7 and asset growth. Using these estimated coefficients, we calculate a predicted leverage ratio for each firm-year after 1945 and in the table report the average within each five-year period (we report annually in Fig. 8). The short-dashed line in Fig. 8, labeled "Predicted (1)," displays average predicted leverage when firm size is defined as total real sales. The results indicate that only a small portion of the leverage increase is explained by variation in firm characteristics (about one-third of the increase from 1945 to 1960 is explained, but very little after 1960).

Thus far we have defined firm size in a manner consistent with that found in most previous research focusing on cross-sectional variation. However, this definition is inappropriate for our aggregate analysis. As the number of time periods gets large, the relation between leverage and firm size—measured in levels—must converge to zero because these variables have different orders of integration: leverage is trend-stationary, size is not. So, relating the aggregate or average level of assets (or sales) with aggregate leverage is theoretically problematic. As a practical matter, leverage during our sample horizon exhibits a clear trend (see Fig. 1). Consequently, regressing a trending variable on another trending variable can generate a spurious correlation, which stems not from a meaningful economic relation but, rather, the presence of common trends (Granger and Newbold, 1974). Therefore, the long-dashed line denoted Predicted (2) in Fig. 8 and columns 2 and 7 of Table 3 present results from a specification in which we scale firm sales by GDP in order to ensure stationarity. (In unreported results, we examine sales growth and find qualitatively similar results.) The results in columns 2 and 7 indicate that average predicted leverage is either flat (NYSE sample) or declining (full sample) from 1945 through 2010. This specification indicates that essentially none of the increase in leverage over the past century is attributable to changes in characteristics of our sample firms. Fig. 8 shows that a similar result holds for market leverage.

One limitation of the prior approach is that it assumes stability in the parameters of the leverage specification between 1945 and the end of the sample period. While this assumption seems plausible in light of the results of Table 2, some exceptions were noted above. We take two approaches to address this concern. First, we estimate a panel regression over the entire sample period 1925–2010 and add indicators for each five-year period after 1945. Columns 4 and 9 of Table 3 report the coefficients on these indicators, which measure the average residual in each period (relative to the omitted period 1925–1945). The results show that the average residual increases at approximately the same rate as the average actual leverage. Thus, firm-specific information has little ability to explain the temporal patterns in average leverage even when we do not restrict the parameters to be estimated using only pre-WW II data.

In columns 5 and 10 we alternatively estimate rolling regressions in which the estimation window is extended

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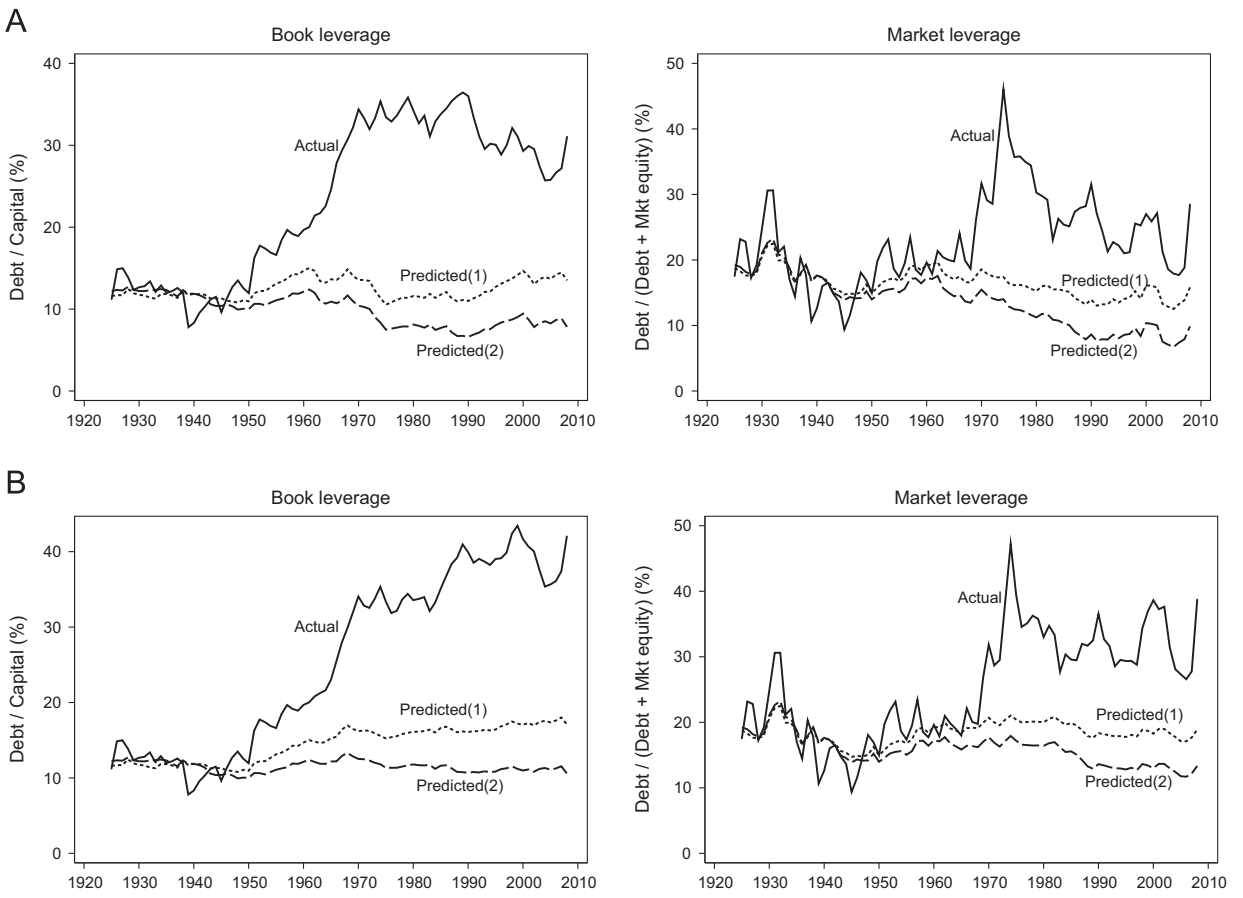

Fig. 8. Average actual and predicted leverage ratios. Predicted values are calculated as fitted values from panel regressions of total debt to capital on firm size, profitability, tangibility, market-to-book, earnings volatility, and asset growth, estimated over 1925–1945. We report predicted values for two specifications. In Predicted(1) (short dash), firm size is defined as the natural log of real sales. In Predicted(2) (long dash), firm size is defined as the natural log of the ratio of sales to GDP. The sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals from 1920 through 2010. Financial firms, utilities, and railroads are excluded.

for each successive five-year window. Thus, to predict leverage in period t to $t+4$, we estimate the leverage regression over 1925 to $t-1$. We then calculate the predicted change in leverage as the average predicted value over t to $t+4$ minus the average fitted value from $t-5$ to $t-1$. Results are similar. Predicted leverage changes are modest or negative in each period. In contrast to the observed increase in leverage, cumulative predicted changes over 1945 to 2010 are -8.2% and -3.6% for the full and NYSE samples, respectively.

While changes in firm characteristics are unable to explain the increase in leverage over time, the evidence in Fig. 7 suggests they may be able to account for the thickening left tail of the leverage distribution in recent decades documented in Fig. 3. The 1980s and 1990s saw a large influx of Nasdaq firms into the Compustat/CRSP sample. As shown in Fig. 7, these firms are substantially smaller, less profitable, have more volatile earnings and higher growth opportunities but fewer tangible assets than pre-existing firms. Fig. 9 displays how these features relate to the changes in the leverage distribution since 1980.

Panel A demonstrates the effect of new entrants on the leverage distribution. The left plot shows the annual quartiles of the leverage distribution for the sample of firms in the database as of 1980 (including NYSE, Amex, and Nasdaq firms). In other words, the sample consists of all surviving firms and varies over time only because of exit (e.g., bankruptcy, merger, acquisition, buyout). Despite a slight decline since 2000—possibly due to the sample selection criterion—this distribution is quite stable over time. Thus, reduction in the lower end of the full sample leverage distribution was not the result of low-leverage firms levering down. Rather, this decline was driven by new, low-leverage firms entering the sample. The right plot of Panel A shows the quartiles of the leverage distribution for new entrants into the sample. Thus, the sample changes each year. Each quartile in almost every year is well below that of the corresponding quartile for the sample of existing firms.

Panel B of Fig. 9 indicates that these leverage differences are at least partly driven by differences in firm characteristics. Using the parameters from a panel regression estimated over 1925–1979, we calculate predicted leverage for each firm from 1980 through 2010. The left plot shows predicted leverage quartiles each year based on the sample of firms in the database as of 1980. The right plot shows quartiles of the distribution of predicted leverage for the sample of new

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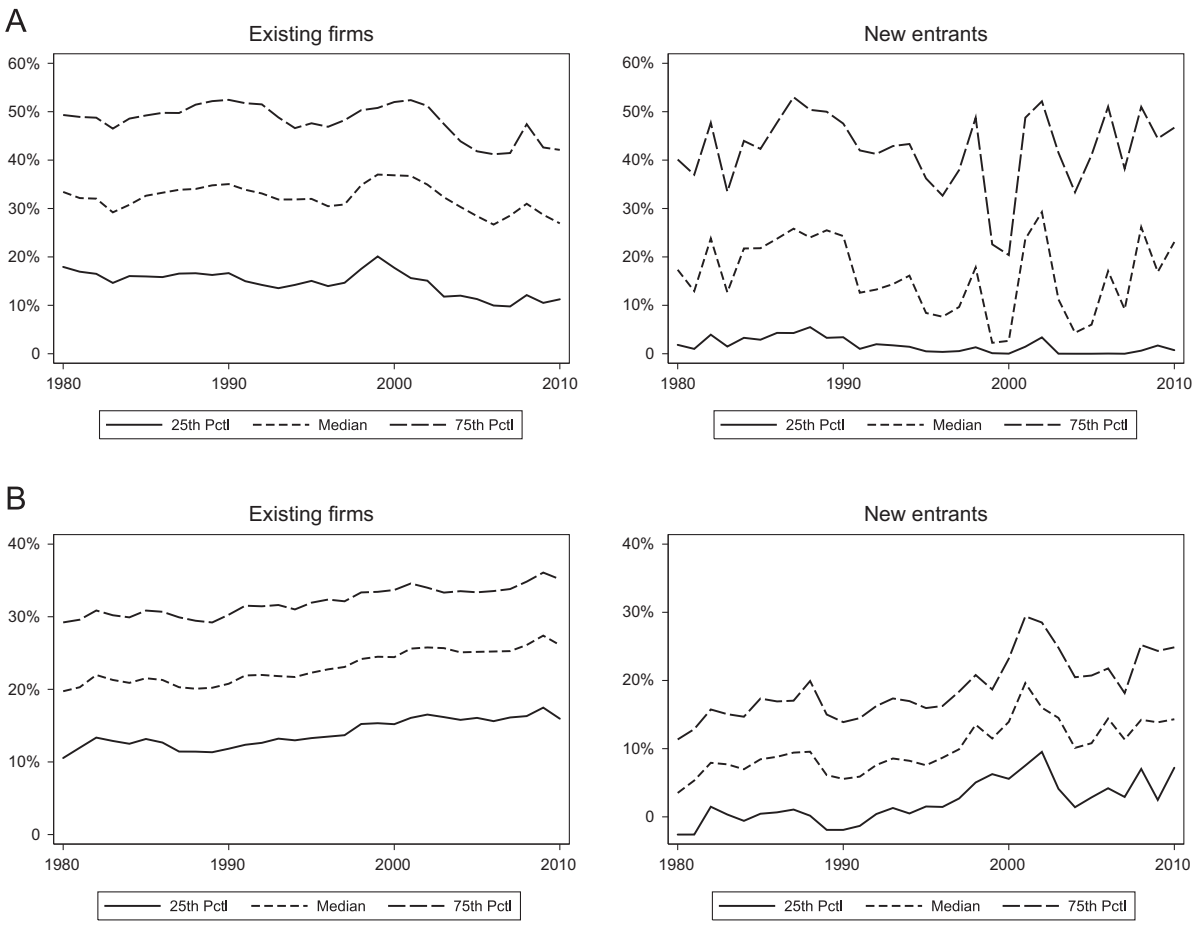

Fig. 9. Quartile breakpoints each year of actual (Panel A) and predicted (Panel B) debt-to-capital for the sample of firms in the database in 1980 (left plot) and firms entering the sample each year (right plot). The sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals from 1920 through 2010. Financial firms, utilities, and railroads are excluded. Panel A: Actual leverage distribution, Panel B: Predicted leverage distribution.

entrants each year. Comparing the two plots, we note that the quartiles of predicted leverage for new entrants are significantly lower than those for existing firms. Thus, new entrants beginning in 1980 had different characteristics than existing firms, leading them to choose different leverage ratios.

Taken together, our evidence suggests that firm characteristics in general do not explain the increase in leverage over the past century in the US, but do help us understand the thickening left tail of the leverage distribution in recent decades. The differing characteristics of new entrants in the 1980s and 1990s led to low predicted leverage for these firms, and offers a natural explanation for the apparent drop in leverage since 1980 among low-levered firms. Ignoring these new firms, the distribution of leverage has been stable in recent decades. In contrast, aggregate or average firm characteristics do not change over time in a way that explains the across-the-board increase in leverage from 1945–1970.

6. Changes in the economic environment

Results in the previous section indicate that changes in firm characteristics have limited ability to explain the trends in capital structure that we document. In this section, we explore whether changes in the economic environment (taxes, distress costs, information and agency frictions, and supplies of competing securities) affected the demand and supply of corporate debt. While the evidence here is largely descriptive, it is suggestive of the economic forces behind the thus far unexplained shifts in financial policy.

6.1. Graphical analysis

Fig. 10 presents time-series plots of several macroeconomic series that are theoretically relevant for capital structure. In each figure, we also plot aggregate leverage for comparison. Panel A displays the (top) corporate tax rate and a measure of the debt tax incentive net of personal taxes.[15] The statutory corporate tax rate

[15] Following Taggart (1985), we define the net debt tax incentive as $1-(1-t_c)/(1-t_p)$, where t_c is the corporate tax rate and t_p the personal income tax rate (on interest income). This formula derives from Miller (1977), with the simplifying assumption that the effective tax rate on income to equityholders is zero. We use the lowest personal tax rate to

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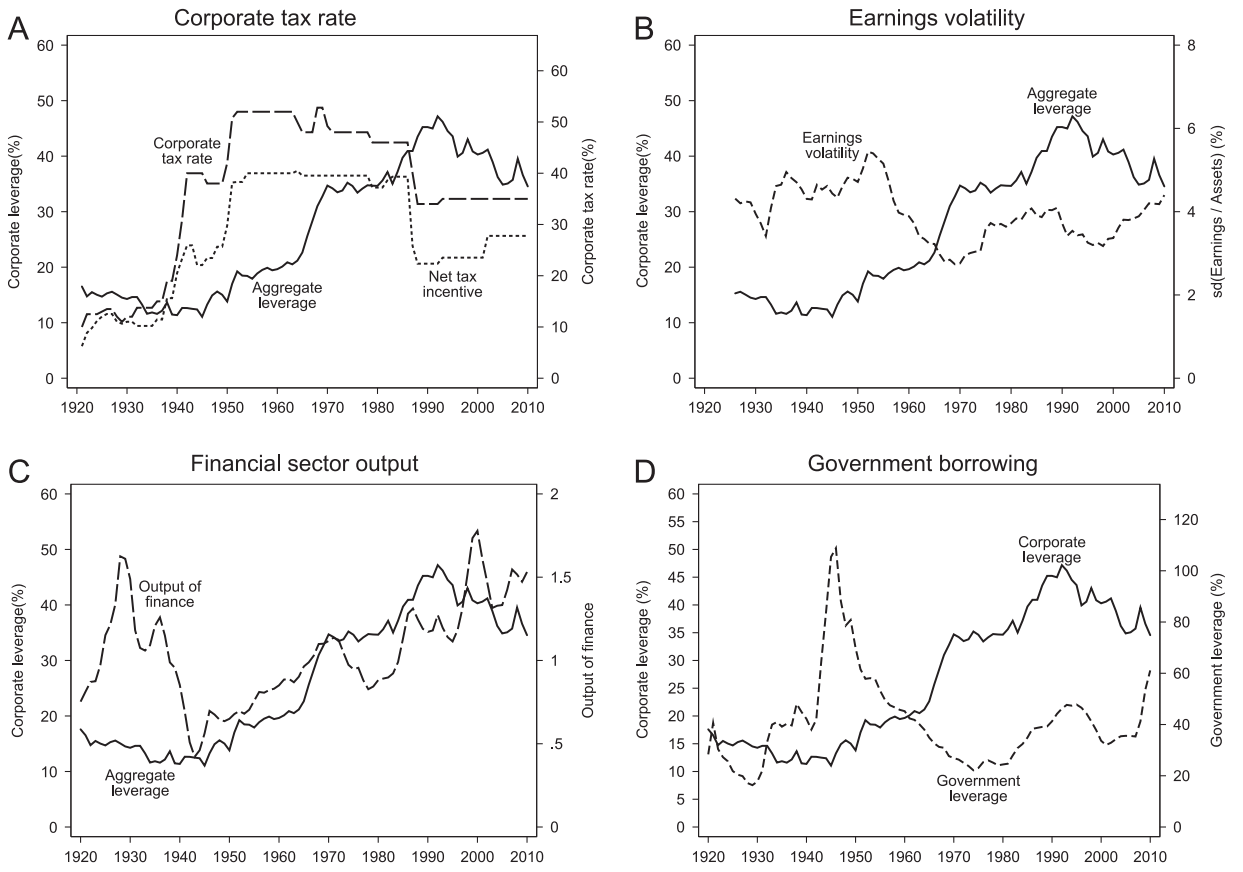

Fig. 10. Leverage and macroeconomic factors. The solid line in each panel plots the aggregate ratio of corporate debt to capital, where capital is defined as total debt plus book equity. Earnings volatility (Panel B) is defined as the cross-sectional asset-weighted average of the within-firm standard deviation of EBIT/assets using (up to) the trailing ten years of data for each firm-year. Panel C plots an estimate of the business credit and equity component of financial sector output from Philippon (2012). Government leverage (Panel D) is the ratio of Federal debt held by the public to GDP. The sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals from 1920 through 2010. Financial firms, utilities, and railroads are excluded.

underwent 30 changes during the last century. Rates were relatively low at the start of our sample period, staying below 15% from 1920 until the late 1930s. By the mid-1950s, however, the corporate income tax rate exceeded 50%. Tax rates remained near 50% until the mid-1980s, and have been steady near 35% since. The plot suggests a positive relation between corporate tax rates (or the net tax incentive) and leverage, particularly in the mid-20th century. Indeed, several past authors have interpreted this visual association as causal (e.g., Hickman, 1953; Sametz, 1964).

Panel B presents the cross-sectional asset-weighted average of the within-firm standard deviations of return on assets, which we interpret as a proxy for expected financial distress costs (e.g., Robichek and Myers, 1966; Scott, 1976). The figure shows visual evidence that the increase in leverage coincided with a marked reduction in earnings volatility. While the decline in volatility appears to start after the initial increase in leverage, the pattern is similar, with a higher and relatively stable level prior to 1950 and a lower and moderately increasing level post-1970. Alternative measures of economic uncertainty, conditional GDP growth volatility and the equity market risk premium (Bansal, Coleman, and Lundblad, 2011), are not shown but reveal similar patterns. Panel C plots the business credit and equity component of the financial sector's output (Philippon, 2012).[16] Financial intermediaries play an important role in facilitating access to capital by mitigating information asymmetry and agency costs (Diamond, 1984; Leland and Pyle, 1977), frictions that are central to theories of capital structure (e.g., Myers, 1984; Jensen and Meckling, 1976; Myers, 1977). The plot shows aggregate leverage and this measure of financial sector output followed similar patterns. However, consistent with the findings of Demirguc-Kunt and Maksimovic (1996), the financial sector continued to grow in the last two decades,

(*footnote continued*)
quantify t_p because few investors actually paid the highest tax rate during the middle of the century. (The top personal rate exceeded 90% for 16 out of the 20 years from 1944 through 1963.)

[16] We thank Thomas Philippon for sharing these data, which can be found on his Web site: http://pages.stern.nyu.edu/~tphilipp/research.htm.

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even as aggregate leverage leveled off, reducing the visual relation between leverage and financial sector output.

Finally, Panel D plots government leverage, defined as the ratio of Federal debt held by the public to gross domestic product (GDP). Fluctuations in the supply of competing securities shift the demand curve for corporate debt in the opposite direction. One such substitute receiving significant theoretical attention is government bonds (e.g., Taggart, 1985; McDonald, 1983; Friedman, 1986). During the last century, government debt experienced several notable transitions, beginning with a dramatic expansion to fund World War II. From its peak of 109% of GDP in 1946, government debt as a share of income fell steadily until 1972, when it leveled off at approximately 25% of GDP. The 1980s saw a renewed increase in public sector leverage that persisted until the mid-1990s. In 2008, public debt-to-GDP began another significant increase in response to the most recent recession, financial crisis, and wars.

A negative relation between the two series is apparent. As government leverage increased sharply from 1920 to 1945, corporate leverage declined from 17% to 11% over this same period.[17] From 1945 to 1970, as government debt fell, corporate leverage increased more than threefold to 35%. After 1980, the visual association is less clear.

Though not shown in Fig. 10, we also examine the relation between managerial incentives, as measured by the structure of executive compensation, and capital structure (e.g., Jensen and Meckling, 1976; Hart and Moore, 1994). For compensation to provide an explanation for the mid-century increase in the use of debt, it should be the case that incentives deriving from executive pay contracts have become weaker over the past century, particularly from WW II to 1970, increasing the marginal agency benefit of debt. Consistent evidence is provided by Jensen and Murphy (1990), who argue that pay-performance sensitivity was sharply higher in the 1930s than in the 1970s and 1980s. More recent studies, however, have reached the opposite conclusion. Hadlock and Lumer (1997) show that the sensitivity of executive turnover to firm performance has actually increased since the 1930s. They further demonstrate that after controlling for firm size, pay-performance sensitivity has been either flat (large firms) or increasing (small firms) over time. Frydman and Saks (2010) provide the most comprehensive time-series data on executive compensation to date. They report that the sensitivity of executive pay to firm performance was similar from the 1930s to the 1980s, a time span that entirely encompasses the increase in aggregate leverage in our sample.

[17] One aspect of this association is the lack of a decline in leverage associated with the dramatic rise in government borrowing during WW II. However, this is understandable in light of the previously documented fact that most firms already had low leverage ratios in the early 1940s (with more than half already at zero debt). More striking is the effect that the flood of Treasuries had on the flow of corporate debt issues, which fell to near or below zero from 1942 until the end of the war.

6.2. Regression analysis

Table 4 presents ordinary least squares (OLS) regression results for several models of aggregate corporate leverage. Specifically, we estimate the following regressions

$$CL_t = \alpha + \beta EE_t + \Gamma X_t + \phi_t + \epsilon_t, \quad (1)$$

and

$$\Delta CL_t = \alpha + \beta \Delta EE_t + \Gamma \Delta X_t + \phi_t + \eta_t. \quad (2)$$

Corporate leverage is denoted *CL*, *EE* represents the proxies for the economic environment discussed above, and *X* includes aggregate firm characteristic and macroeconomic control variables. Our firm-level control variables are motivated by the discussion of Section 4. We include the growth rate in the Consumer Price Index (CPI) as a proxy for expected inflation. The return on the 3-month Treasury bill and the credit spread between BAA and AAA bonds are included to capture the general level of interest rates in the economy and credit conditions. Real GDP growth captures variation in economic conditions and the equity market return represents the cost of a debt-alternative financing source.

We include a time trend, *t*, in the level specification to absorb any finite sample time trends. We use Δ to denote the first-difference operator ($\Delta CL = CL_t - CL_{t-1}$). We focus on corporate leverage, measured as the ratio of total debt to capital, but note that the results are robust to alternative definitions of leverage discussed earlier. Serial correlation in the error term of both equations is addressed with Newey-West (1987) standard errors assuming a two-period lag structure.

The results in Panels A and B of Table 4 reveal the following inferences. First, while the shift in leverage policy was preceded by a substantial increase in corporate tax rates, there is little statistical association between tax rates and aggregate leverage once we control for common trends and other leverage determinants (column 1). Coefficients on the net tax incentive are insignificant both in levels and first differences.[18] Closer inspection of Fig. 10 reveals a significant delay between changes in tax rates and movements in aggregate leverage.[19] If recapitalization is costly, corporate leverage may not respond immediately to an increase in tax rates, but taxes may still affect the choice of security the next time a firm raises external capital. However, even when we account for the possibility of a delayed reaction to the tax law change using a distributed lag model with up to eight lags of the corporate tax rate (unreported), we fail to find a positive relationship between tax rates and aggregate leverage in either the short- or long-run.

In column 7, we do find a significant positive relation between corporate tax rates and the choice between debt and preferred stock financing. Economically, a one percentage point increase in the net tax incentive is associated

[18] Results using the statutory corporate tax rate as the proxy for tax incentives are similar.

[19] This finding is consistent with that of Miller (1963), who notes little change in aggregate leverage between the 1920s and 1950s, despite the large increase in tax rates over that time.

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Table 4
Aggregate corporate leverage and the economic environment.

The sample includes all unregulated industrial firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals from 1925–2010. The table presents results of OLS regressions of aggregate corporate book leverage (Debt-to-capital) on various proxies for changes in the economic environment along with aggregate firm characteristics and macroeconomic control variables. See Appendix A for variable definitions. The dependent variable in columns 1 through 6 is the annual aggregate debt-to-capital ratio, and in column 7 is the aggregate ratio of debt to the sum of debt and preferred stock. The regressions are performed in levels in Panel A and first-differences in Panel B. Newey and West (1987) standard errors assuming two non-zero lags are used to compute all *t*-statistics (in parentheses). Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Panel A: Level regressions

	Debt / Capital						Debt / (Debt+Pref.)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Net tax incentive	−0.113					−0.224**	0.572***
	(−1.23)					(−2.23)	(4.67)
GDP growth vol.		−0.051**				0.013	
		(−2.50)				(0.86)	
Intermediary share debt			−0.104			0.079	
			(−1.40)			(1.35)	
Intermediary share equity			−0.274			−0.388***	
			(−1.38)			(−3.07)	
Output of finance				13.107***		14.210***	
				(4.49)		(4.80)	
Gov't leverage					−0.085***	−0.080**	
					(−2.76)	(−2.09)	
Macroeconomic factors							
3-month T-bill rate	1.027***	0.837***	1.099***	0.486**	0.618**	0.262	1.017***
	(4.36)	(3.53)	(4.53)	(2.14)	(2.32)	(1.45)	(4.08)
BAA–AAA yield spread	−3.412***	−3.559***	−4.103***	−4.279***	−4.527***	−4.163***	−2.436**
	(−3.28)	(−3.49)	(−3.65)	(−4.31)	(−4.31)	(−5.37)	(−2.27)
Inflation	−0.024	0.153	−0.085	0.102	0.103	0.049	−0.484***
	(−0.20)	(1.26)	(−0.84)	(0.95)	(1.02)	(0.45)	(−3.44)
Market return	−0.477	1.577	0.803	2.888*	1.789	4.893***	−1.856
	(−0.30)	(1.04)	(0.46)	(1.98)	(1.28)	(3.63)	(−1.08)
Real GDP growth	0.072	0.086	0.064	0.116*	−0.003	0.083	−0.126
	(0.89)	(1.15)	(0.77)	(1.70)	(−0.05)	(1.07)	(−1.16)
Firm characteristics							
Profitability	−1.269***	−1.406***	−1.270***	−1.388***	−1.409***	−1.186***	−0.358
	(−4.12)	(−4.46)	(−3.72)	(−4.82)	(−4.31)	(−5.27)	(−1.36)
Intangible assets	−0.286	−0.109	−0.150	−0.634***	−0.210*	−0.610***	−0.033
	(−1.61)	(−0.93)	(−0.80)	(−4.36)	(−1.71)	(−3.98)	(−0.17)
Market-to-book assets	−5.779***	−8.526***	−8.470***	−13.131***	−8.680***	−16.690***	1.494
	(−2.66)	(−3.35)	(−3.01)	(−4.95)	(−3.41)	(−6.07)	(0.72)
Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	85	85	84	85	85	84	85
Adjusted R^2	0.940	0.943	0.942	0.958	0.946	0.970	0.972

Panel B: First difference regressions

	Debt / Capital						Debt / (Debt+Pref.)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Net tax incentive	0.055					0.039	0.207
	(1.05)					(0.58)	(1.63)
GDP growth vol.		0.001				0.019*	
		(0.09)				(1.84)	
Intermediary share debt			−0.047			−0.001	
			(−0.55)			(−0.01)	
Intermediary share equity			−0.179			−0.188	
			(−1.07)			(−1.10)	
Output of finance				5.508**		5.261*	
				(2.07)		(1.78)	
Gov't leverage					−0.078***	−0.072***	
					(−2.97)	(−2.66)	
Macroeconomic factors							
3-month T-bill rate	−0.034	−0.042	−0.042	−0.009	−0.093	−0.052	0.102
	(−0.25)	(−0.32)	(−0.30)	(−0.07)	(−0.63)	(−0.34)	(0.95)
BAA–AAA yield spread	0.918	0.927	0.681	0.849	0.594	0.238	0.370
	(1.62)	(1.64)	(1.21)	(1.55)	(1.19)	(0.44)	(0.68)

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Table 4 (*continued*)

Panel B: First difference regressions

	Debt / Capital						Debt / (Debt+Pref.)
Inflation	0.103**	0.108**	0.097*	0.095*	0.077*	0.040	−0.043
	(2.15)	(2.10)	(1.81)	(1.84)	(1.76)	(0.82)	(−0.55)
Market return	−0.593	−0.578	−0.482	0.558	−0.453	0.291	0.082
	(−0.68)	(−0.64)	(−0.55)	(0.52)	(−0.55)	(0.30)	(0.09)
Real GDP growth	−0.054	−0.053	−0.051	−0.023	−0.084**	−0.059	−0.058
	(−1.64)	(−1.57)	(−1.42)	(−0.60)	(−2.62)	(−1.41)	(−1.21)
Firm characteristics							
Profitability	−0.095	−0.103	−0.108	−0.160	−0.150	−0.235	0.178
	(−0.63)	(−0.68)	(−0.66)	(−1.04)	(−1.11)	(−1.65)	(0.83)
Intangible assets	0.037	0.007	−0.035	−0.131	−0.036	−0.187	−0.125
	(0.16)	(0.03)	(−0.15)	(−0.50)	(−0.15)	(−0.64)	(−0.87)
Market-to-book assets	−0.275	−0.290	−0.900	−3.423	−0.164	−3.307	−0.716
	(−0.19)	(−0.20)	(−0.55)	(−1.49)	(−0.13)	(−1.49)	(−0.49)
Observations	84	84	83	84	84	83	84
Adjusted R^2	0.121	0.115	0.112	0.172	0.188	0.198	0.080

with a 57 basis points increase in the ratio of debt to fixed charge finance. The total increase in net tax incentive between the late 1930s and early 1950s was about 27%. This would translate into an increase of about 15% in the $D/(D+P)$ ratio, roughly half of the total increase in the ratio over that time span. Statistical significance for the preferred stock tax effect weakens in the first-difference specification in Panel B. However, in unreported analysis we find a highly significant long-run multiplier when using the distributed lag model discussed above.

In column 2 of Panel A, we find a negative relation between GDP growth volatility and leverage. However, this is not a robust relation. The coefficient becomes statistically and economically insignificant when we estimate the model in first differences (Panel B) or when controlling for other measures of the economic environment (column 6). Results using the other proxies for uncertainty—earnings volatility and the market risk premium—are similar but statistically even weaker.

Turning to proxies for financial market development, in column 4 we find a significant relation between aggregate leverage and the output of the financial sector from business credit and equity issuance. This coefficient is significantly positive in both levels and first differences, and remains significant when controlling for the other measures of the economic environment in column 6. This suggests an association between the growth of financial intermediation and corporate leverage. On the other hand, in column 3 we do not find a robust significant relationship between leverage and an alternate measure of the extent of intermediation, the fraction of debt held through intermediaries. While this fraction increased sharply between the 1930s and 1950s, much of the change occurred in the decade prior to the shift in leverage policies.

Last, we find a robust significant relation between government leverage and corporate leverage, both in levels and first differences. From column 5 of Panel A, we see that a one percentage point increase in government leverage is associated with an 8.5 basis point decrease in corporate leverage. Combined with the summary statistics in Panel A of Table 1, this estimate implies that a one standard deviation increase in government leverage (17.7%) leads to a 1.5% decline in aggregate corporate leverage.[20]

Table 5 presents analysis of net issuance decisions. In particular, we estimate similar regressions to those of Table 4, but now the dependent variables are aggregate net debt and net equity issuances scaled by lagged aggregate assets (Panels A and B, respectively) or aggregate debt issuance as a fraction of aggregate investment (Panel C). The controls consist of both macroeconomic factors and firm characteristics found in Table 4. Flow control variables are contemporaneous with the dependent variable, stock and price control variables are lagged one year to avoid incorporating any future information on the right-hand side.[21]

Results are generally consistent with those in Table 4. Tax rates, volatility, and the shares of debt and equity held by intermediaries show no statistically significant relations with debt or equity issuance decisions. Perhaps unsurprisingly, more output from the financial sector is associated with more issuance of both debt and equity. More interestingly, in Panel C we find that firms fund a larger fraction of their investment with debt as the financial sector grows.

In the right-most column, we examine the relation between corporate debt and equity issuance and government debt issuance, defined as the change in Federal debt held by the public scaled by lagged GDP. Panel A shows a significant negative relation between corporate and government net debt issuing activity. A one percent increase

[20] Graham, Leary, and Roberts (2014) show that the impact of government borrowing extends to corporate investment and explore the mechanisms behind these relations.

[21] Flow variables include government debt issuance, output of the financial sector, firm profitability, inflation, market return, and real GDP growth. Stock variables include tax rates, GDP growth volatility, intermediary shares of debt and equity holdings, interest rates, intangible assets, and the market-to-book ratio.

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Table 5
Aggregate security issuance and economic environment proxies.

The sample includes all unregulated industrial firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals from 1925–2010. The table presents results of OLS regressions of aggregate net debt (Panels A and C) and equity issuance (Panel B) on various proxies for changes in the economic environment along with aggregate firm characteristics and macroeconomic control variables. See Appendix A for variable definitions. Aggregate issuance is scaled by lagged aggregate assets in Panels A and B and by contemporaneous aggregate investment in Panel C. Newey-West standard errors assuming two non-zero lags are used to compute all *t*-statistics (in parentheses). Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Panel A: Debt issuance / A_{t-1}	Net tax incentive	GDP growth vol.	Interm. share debt Interm. share equity	Output of finance	Gov't debt issuance
Proxy	−0.044	−0.001	0.009	3.198***	−0.044***
	(−1.03)	(−0.08)	(0.27)	(2.72)	(−2.65)
Interm. share equity			0.080		
			(0.95)		
Trend	Yes	Yes	Yes	Yes	Yes
Macro vars	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Observations	85	84	85	85	85
Adjusted R^2	0.453	0.443	0.442	0.491	0.460
Panel B: Equity issuance / A_{t-1}	Net tax incentive	GDP growth vol.	Interm. share debt Interm. share equity	Output of finance	Gov't debt issuance
Proxy	−0.022	−0.003	−0.006	2.100**	−0.016
	(−0.63)	(−0.72)	(−0.20)	(2.19)	(−1.22)
Interm. share equity			0.033		
			(0.74)		
Trend	Yes	Yes	Yes	Yes	Yes
Macro vars	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Observations	85	84	85	85	85
Adjusted R^2	0.507	0.500	0.500	0.539	0.507
Panel C: Debt issuance / Investment	Net tax incentive	GDP growth vol.	Interm. share debt Interm. share equity	Output of finance	Gov't debt issuance
Proxy	−0.068	0.014	−0.035	14.747***	−0.175*
	(−0.32)	(0.30)	(−0.21)	(2.70)	(−1.97)
Interm. share equity			0.390		
			(0.85)		
Trend	Yes	Yes	Yes	Yes	Yes
Macro vars	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Observations	85	84	85	85	85
Adjusted R^2	0.375	0.374	0.377	0.413	0.385

in the relative flow of government debt is associated with a 4.4 basis-point reduction in the flow of corporate debt relative to assets. Panel B shows that net equity issues are also negatively related to government debt issues. However, this relation is less than half the magnitude as documented in the net debt issuance specification and becomes statistically insignificant once we control for firm characteristics. Finally, in Panel C we partially control for changing investment opportunities by showing that the fraction of investment funded by debt is also significantly negatively associated with net debt issuances by the government.

In sum, we identify several changes in the economic environment that may be relevant for understanding the large unexplained increase in aggregate corporate leverage—tax rates, uncertainty, growth in financial intermediation, and variation in government borrowing. Of these, changes in government borrowing and growth of financial intermediation appear most statistically robust (although in the latter case, this does not hold for all measures of intermediation). While a full investigation of these forces is beyond the scope of this paper, the evidence here suggests these may be fruitful areas for future research.

7. Conclusions and directions for future research

We document a substantial shift in corporate financial policy in US firms over the past century. Aggregate corporate leverage and the leverage of the regulated sector have remained quite stable over time. In contrast, leverage

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of unregulated firms has increased significantly, approaching the level of indebtedness of regulated firms.

Interestingly, neither changes in the characteristics of firms, nor changes in the relationships between these characteristics and leverage decisions, are able to explain much, if any, of the shift in financial policies. Firms appear to have increased their propensity to use debt financing over the century, with the bulk of this change unexplained by standard leverage models. We highlight several changes in the economic environment that plausibly increased firms' willingness to issue, or investors' willingness to hold, corporate debt. These include increased corporate tax rates, reductions in aggregate uncertainty, growth in financial intermediation, and a large reduction in government borrowing in the decades following World War II. Aggregate regression analyses suggest these latter two relations, those between leverage and financial intermediation and between corporate debt and supplies of competing securities, are the most statistically robust and may represent the most promising areas for future research.

While the lack of evidence in support of taxes questions the relevance of this friction behind many theoretical models of leverage determination, our results do not necessarily rule out a role for taxes. The need to control for common trends in time-series regressions may mask the underlying relationship. Future research examining cross-sectional implications of changes in tax rates, incorporating more precise measures of tax incentives, and carefully considering the political economy surrounding tax changes may be fruitful.

The relation between leverage and growth of the financial sector suggests that the monitoring and information-gathering functions of financial intermediaries may have been important in expanding firms' debt capacities. However, the precise channels through which this association occurs, and the mechanisms behind the association, are unclear. Equally important is the role of financial regulation, which underwent significant changes during our sample period. Future research integrating an analysis of the development of the financial sector with the evolution of financial regulation may provide new insight.

Finally, the negative association documented here between government borrowing and corporate debt issuance is consistent with the supply of competing securities, such as Treasury debt, affecting aggregate leverage by shifting the demand curve for corporate debt. Of course, our evidence cannot entirely rule out contemporaneous debt supply curve shifts or endogenous investment responses. A further unresolved question is which economic mechanisms are behind the imperfectly elastic demand curve required for a relation between government and corporate finance to exist. We leave these issues to future research.

Appendix A. Variable definitions

This appendix provides details on the data sources, sample construction, and variable construction. We use the acronym GFD for Global Financial Database, a source for many macroeconomic series.

A.1. Government debt

Government leverage in our analyses is defined as the ratio of Federal debt held by the public to GDP. We focus on Federal debt because it comprises the majority of total government debt and is responsible for most of its variation over time. This fact is made apparent in Fig. A1, which presents a stacked area chart of government debt divided by GDP. In fact, the estimates of state and local debt are somewhat misleading. A significant fraction of state and local assets consists of US Treasuries (on average, $0.5 trillion between 2000 and 2010). Thus, state and local governments can act as a pass-through for Federal debt by issuing their own debt claims against these assets. We focus on the debt held by the public to avoid including in our measure a significant fraction of US Treasuries held by other government entities, such as the Social Security Administration.

A.2. Variable definitions

Gross Domestic Product Implicit Price Deflator: Source=GFD, Series=USGDPD, Annual data from 1947 to 2010.

United States Annualized Exports of Goods and Services: Source=GFD, Series=USEXPGSQ, Annual data from 1947 to 2010.

United States Annualized Exports of Goods and Services: Source=GFD, Series=USIMPGSQ, Annual data from 1947 to 2010.

United States Gross Federal Debt Held by the Public (Bil. of $, NA): Source=GFD, Series=USFYGFDPUBA, Annual data from 1938 to 2010. This series is extended back in time by assuming that total Federal debt is equal to Federal debt held by the public. Pre-1938 Federal debt data are obtained from, http://www.usgovernmentspending.com/Federal_state_local_debt_chart.html.

Corporate Income Tax Rate: This rate corresponds to the top corporate income tax rate. Source="Corporation Income Tax Brackets and Rates, 1909-2002", http://www.

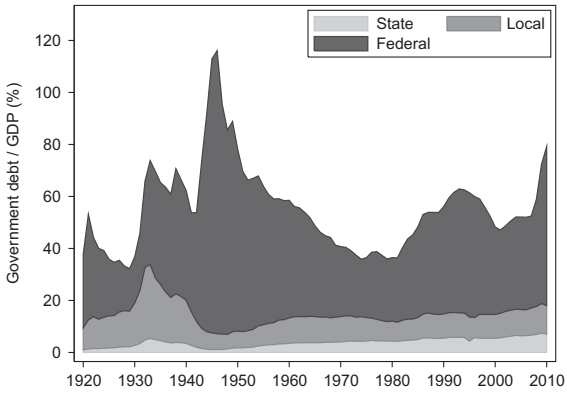

Fig. A1. Government leverage. The figure presents a stacked area chart of government debt at the Federal, state, and local levels. We normalize these levels by GDP.

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irs.gov/pub/irs-soi/02corate.pdf. Annual data from 1909 to 2010.

United States M1 Money Stock: Source=GFD, Series=USM1W, Year-end monthly data from 1929 to 2010.

United States M2 Money Stock: Source=GFD, Series=USM2W, Year-end monthly data from 1947 to 2010.

United States State and Local Debt: Source=US government spending (http://www.usgovernmentspending.com/Federal_state_local_debt_chart.html), Annual data from 1902 to 2010.

United States Nominal GDP: Source=GFD, Series=GDPUSA, Year-end annual data from 1790 to 2010.

United States Unemployment Rate: Source=GFD, Series=UNUSAM, Year-end annual data from 1890 to 1928. Year-end monthly data from 1929 to 2010.

International Holdings of US Debt: Source=Flow of Funds, Series=Foreign Holdings of US Treasuries. Annual data from 1945 to 2010. Prior to 1945, we assume that there are no foreign holdings of US Treasuries.

USA Government 90-day T-Bills Secondary Market: Source=GDP, Series=ITUSA3D, Year-end monthly data from 1920 to 2010.

USA 10-year Bond Constant Maturity Yield: Source GFD, Series, IGUSA10D, Year-end monthly data from 1790 to 2010.

United States BLS Consumer Price Index NSA: Source GFD, Series, IGUSA10D, Annual data from 1820 to 1874. Monthly data from 1875 to 2010 collapsed to an annual series by averaging within years.

Moody's Corporate AAA Yield: Source GFD, Series, MOCAAAD, Year-end monthly data from 1857 to 2010.

Moody's Corporate BAA Yield: Source GFD, Series, MOCBAAD, Year-end monthly data from 1919 to 2010.

A.3. Variable construction

Inflation=[CPI(t)−CPI($t-1$)]/CPI(t) where CPI(t) is the consumer price index in year t computed as the average monthly CPI for the year.

US net exports=[US exports − US imports]/US GDP.

GDP growth=[GDP(t)−GDP($t-1$)]/GDP($t-1$) where GDP(t) is US gross domestic product in year t.

Government leverage=US public debt held by the public in year t/GDP(t).

Net debt issuances by the US government=Change in US public debt held by the public from year $t-1$ to t/GDP ($t-1$).

Book Leverage=Total debt/Total book value of assets.

Market leverage=Total debt/(Total debt + Equity market capitalization).

Net debt leverage=(Total debt−cash)/Total book value of assets.

Net debt issuance=[Total debt(t)−Total debt($t-1$)]/Total book value of assets($t-1$).

Net equity issuance=[Equity issues(t)−Equity repurchases(t)]/Total book value of assets($t-1$).

Market-to-book equity ratio=Equity market capitalization/Book equity.

Profitability=Operating income before depreciation/Total book value of assets.

Tangibility=Net property, plant, and equipment/Total book value of assets.

Firm size=natural log of total sales in constant (1982) dollars.

Relative firm size=natural log of the ratio of total sales to US GDP, in basis points.

Earnings volatility=standard deviation of the ratio of EBIT/Total book value of assets, calculated over the trailing ten years. We require at least four years of trailing EBIT data to calculate the standard deviation. For firms with at least four, but less than ten years of available data, it is calculated over all available trailing years.

Intangible assets=[Total assets−(Net PP&E + cash and marketable securities + accounts receivable + inventories)]/Total assets.

Asset growth=[Total book value of assets(t)−Total book value of assets($t-1$)]/Total book value of assets(t).

Investment=change in (gross) long-term assets plus the change in inventory from the balance sheet.

Appendix B. Reconciliation with alternative data sources

Panel A of Fig. A2 presents the time-series of aggregate leverage from Flow of Funds (solid line). Consistent with Frank and Goyal (2008), the average aggregate book leverage stays within a fairly narrow band of 0.24 to 0.34 since 1945, the inception of Flow of Funds data, until 2010. The dashed line shows the analogous series from our sample. As in Fig. 1, our series reveals a near tripling of leverage, from less than 10% in the 1940s to 30% in the 1990s.

Our sample differs from Flow of Funds data in two important ways that may drive the different leverage trends. First, Flow of Funds represents an aggregate of all public and privately held corporations, while our data are limited to publicly traded firms (and NYSE firms prior to 1960). Second, Flow of Funds reports aggregate balance sheets for all nonfinancial corporate businesses, while our sample excludes regulated industries such as utilities and railroads. In order to examine which of these differences is behind the different patterns, we use an additional source of data, Statistics of Income (SOI) collected by the Internal Revenue Service and reported in Historical Statistics of the United States. SOI reports aggregate balance sheets for all US firms filing corporate tax returns. Like Flow of Funds, SOI includes private firms.

Panel B of Fig. A2 shows that leverage ratios calculated from SOI data are similar to those calculated from Flow of Funds, both in level and time-series pattern.[22] However, the SOI data have two advantages for our purposes. First, they are available from 1926 until 1997, more closely covering the time span of our sample. Second, SOI reports aggregate balance sheets separately by one-digit SIC sector, which allows us to control for differences in industry coverage between our sample and the Flow of Funds data. A disadvantage of the SOI data is that they aggregate accounts payable with short-term debt.

[22] In these figures, debt includes trade accounts payable because SOI does not report short-term debt separately from accounts payable.

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Fig. A2. Comparing aggregate leverage series. In Panel A, the solid line is the aggregate ratio of total debt to book value of assets (historical cost) for the nonfinancial corporate sector from U.S. Flow of Funds. The dashed line shows the comparable series for our sample of firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. In Panel B, the solid line shows the aggregate ratio of total debt to assets (left plot) or total debt to capital (right plot) by year for the nonfinancial corporate sector from U.S. Flow of Funds. The dashed line shows the analogous series from the Statistics of Income data. In both cases, total debt includes accounts payable. Panel C presents total debt-to-capital (left plot) and long-term debt-to-capital (right plot) by year for industrial sectors excluding utilities, railroads, and telecommunications, from Statistics of Income (dashed line) and the sample of firms from Compustat or Moody's Industrial Manuals described in Fig. 1. Accounts payable are included in total debt only. Panel D presents aggregate total debt-to-capital (left plot) and long-term debt-to-capital (right plot) by year from Statistics of Income for utilities, railroads, and telecommunications firms (solid line) and all other industrial firms (dashed line). (a) Panel A: Moodys/Compustat vs. Flow-of-Funds (Debt / Assets), (b) Panel B: Flow of Funds vs. Statistics of Income (SOI) data, (c) Panel C: Moodys vs. Statistics of Income data: Unregulated sectors, (d) Panel D: Statistics of Income data: Regulated vs. unregulated sectors.

In the left-hand plot of Panel C, we compare aggregate debt-to-capital for all unregulated sectors (i.e., excluding utilities, transportation, and telecommunications) from SOI (dashed line) to that from our sample (solid line). The two series follow the same time-series pattern, though the SOI series is consistently about 5 percentage points above the series from our sample. This wedge is likely due to smaller and private firms making heavier use of accounts payable, as suggested by the similar time-series in the right-hand plot showing the long-term debt-to-capital ratio. Thus, the inclusion of private firms is unlikely responsible for the differences in leverage stability implied by our data and Flow of Funds.

Rather, the difference in trends between our sample and Flow of Funds is due to the exclusion of regulated industries—railroads and utilities in particular. Panel D makes this clear by showing the debt-to-capital series for utilities, transportation, and communications and for all other nonfinancial industries, both from SOI data. Unlike the unregulated sectors, leverage for the regulated sector displays a remarkably stable capital structure that varies between approximately 40% and 50% for 70 years (40% to 55% for total debt including accounts payable). Before 1945, the long-term debt-to-capital ratio in the regulated sector was approximately four times that of the unregulated sector. By the 1990s, however, leverage for the regulated and unregulated sectors converged to within 10 percentage points of each other. At the same time, the share of assets for the regulated sector declines from a peak of 43% in 1934 to 26% by 1950. The net effect is a relatively stable economy-wide aggregate capital structure that reflects these two countervailing forces, but masks a significant increase in the use of debt financing and leverage for much of the corporate sector.

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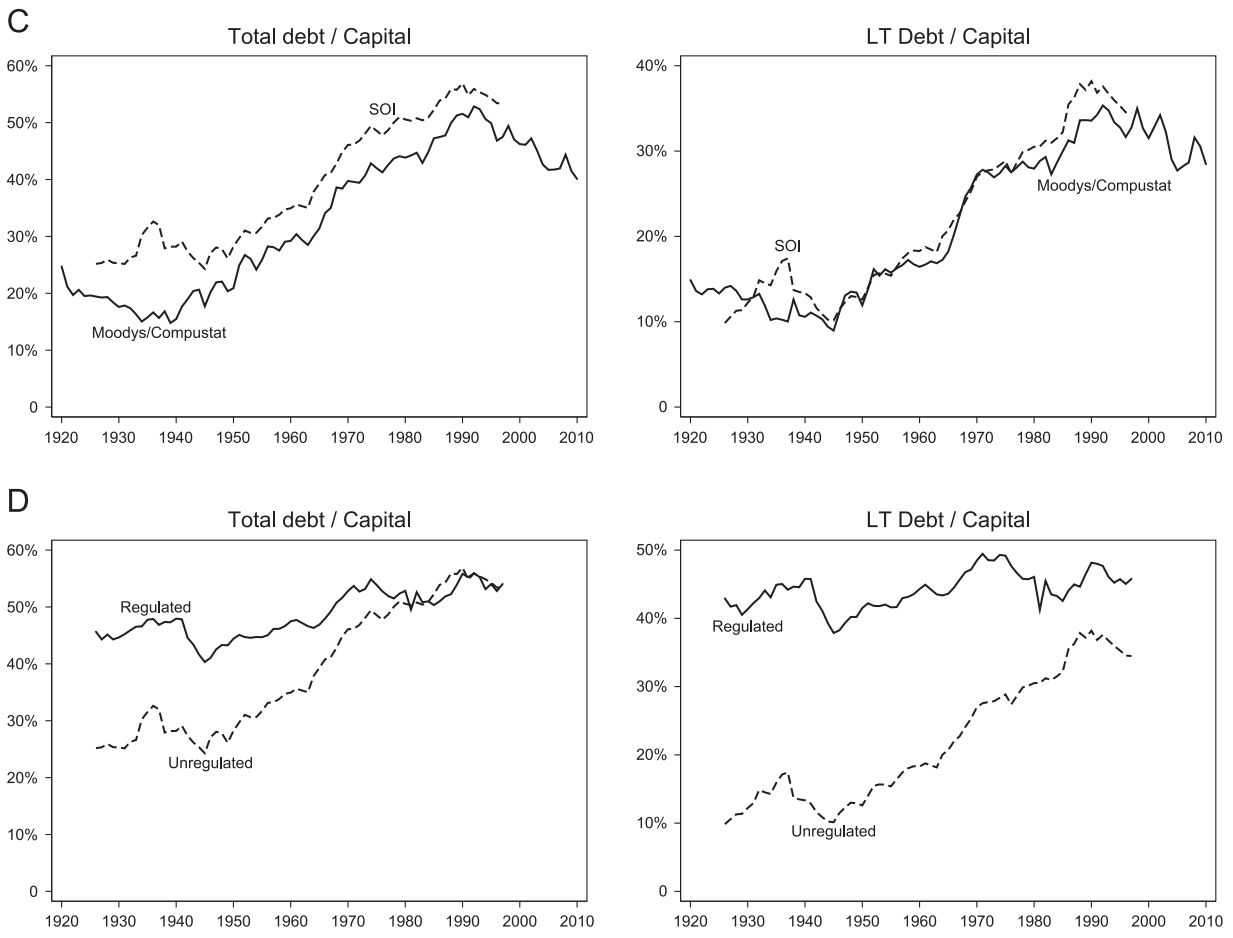

Fig. A2. (*continued*)

References

Bansal, R., Coleman, J., Lundblad, C., 2011. Endogenous liquidity supply. Unpublished working paper. Duke University and University of North Carolina at Chapel Hill.

Bates, T., Kahle, K., Stulz, R., 2009. Why do US firms hold so much more cash than they used to? Journal of Finance 64, 1985–2021.

Chava, S., Roberts, M., 2008. How does financing impact investment? The role of debt covenants. Journal of Finance 63, 2085–2121.

Ciccolo Jr., J., 1982. Changing balance sheet relationships in the US manufacturing sector. In: Friedman, B. (Ed.), The Changing Roles of Debt and Equity in Financing US Capital Formation, University of Chicago Press, Chicago, IL, pp. 65–74.

DeAngelo, H., Roll, R., 2014. How stable are corporate capital structures? Journal of Finance, forthcoming.

Demirguc-Kunt, A., Maksimovic, V., 1996. Stock market development and financing choices of firms. World Bank Economic Review 10, 341–371.

Diamond, D., 1984. Financial intermediation and delegated monitoring. Review of Economic Studies 51, 393–414.

Fama, E., French, K., 2005. Financing decisions: Who issues stock?. Journal of Financial Economics 76, 549–582.

Frank, M., Goyal, V., 2008. Trade-off and pecking order theories of debt. In: Eckbo, E. (Ed.), Handbook of Corporate Finance, vol. 2. , Elsevier, North Holland, pp. 135–202.

Frank, M., Goyal, V., 2009. Capital structure decisions: Which factors are reliably important?. Financial Management 38, 1–37.

Friedman, B., 1986. Implications of government deficits for interest rates, equity returns, and corporate financing. In: Friedman, B. (Ed.), Financing Corporate Capital Formation, University of Chicago Press, Chicago, IL, pp. 67–90.

Frydman, C., Saks, R., 2010. Executive compensation: a new view from a long-term perspective, 1936–2005. Review of Financial Studies 23, 2099–2138.

Gordon, R., Malkiel, B., 1981. Corporation finance. In: Aaron, H., Pechman, J. (Eds.), How Taxes Affect Economic Behavior, The Brookings Institution, Washington, DC, pp. 131–192.

Gorton, G., Winton, A., 2003. Financial intermediation. In: Constantinides, G., Harris, M., Stulz, R. (Eds.), Handbook of the Economics of Finance, vol. 1. , Elsevier, North Holland, pp. 431–552.

Graham, J., Leary, M., Roberts, M., 2014. How does government borrowing affect corporate financing and investment?. Unpublished working paper. Duke University, Washington University in St. Louis, and University of Pennsylvania.

Granger, C., Newbold, P., 1974. Spurious regression in econometrics. Journal of Econometrics 2, 111–120.

Greenwood, R., Hanson, S., Stein, J., 2010. A gap-filling theory of corporate debt maturity choice. Journal of Finance 65, 993–1028.

Hadlock, C., Lumer, G., 1997. Compensation, turnover, and top management incentives: historical evidence. Journal of Business 70, 153–187.

Hart, O., Moore, J., 1994. A theory of debt based on the inalienability of human capital. Quarterly Journal of Economics 109, 841–879.

Hickman, W., 1953. The Volume of Corporate Bond Financing Since 1900. Princeton University Press, Princeton, NJ.

Holland, D., Myers, S., 1979. Trends in Corporate Profitability and Capital Costs. In: Lindsay, R. (Ed.), The Nation's Capital Needs: Three Studies. Committee for Economic Development.

Huang, R., Ritter, J., 2009. Testing theories of capital structure and estimating the speed of adjustment. Journal of Financial and Quantitative Analysis 44, 237–271.

Hurley, E., 1977. The commercial paper market. Federal Reserve Bulletin 63, 525–536.

Please cite this article as: Graham, J.R., et al., A century of capital structure: The leveraging of corporate America. Journal of Financial Economics (2014), http://dx.doi.org/10.1016/j.jfineco.2014.08.005

Jensen, M., Meckling, W., 1976. A theory of the firm: managerial behavior, agency costs, and ownership structure. Journal of Financial Economics 3, 305–360.
Jensen, M., Murphy, K., 1990. Performance pay and top-management incentives. Journal of Political Economy 98, 225–264.
Krishnamurthy, A., Vissing-Jørgensen, A., 2012. The aggregate demand for Treasury debt. Journal of Political Economy 120, 233–267.
Leland, H., Pyle, D., 1977. Informational asymmetries, financial structure, and financial intermediation. Journal of Finance 32, 371–387.
McDonald, R., 1983. Government debt and private leverage: an extension of the Miller theorem. Journal of Public Economics 22, 303–325.
Miller, M., 1963. The corporation income tax and corporate financial policies. In: Commission on Money and Credit, Stabilization Policies. Prentice Hall, Englewood Cliffs, NJ.
Miller, M., 1977. Debt and taxes. Journal of Finance 32, 261–275.
Myers, S., 1977. Determinants of corporate borrowing. Journal of Financial Economics 5, 147–175.
Myers, S., 1984. The capital structure puzzle. Journal of Finance 39, 575–592.
Newey, W., West, K., 1987. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica 55, 703–708.
Opler, T., Pinkowitz, L., Stulz, R., Williamson, R., 1999. The determinants and implications of corporate cash holdings. Journal of Financial Economics 52, 3–46.
Philippon, T., 2009. The bond market's q. Quarterly Journal of Economics 124, 1056–1101.
Philippon, T., 2012. Has the US finance industry become less efficient?. Unpublished working paper, New York University.
Rajan, R., Zingales, L., 1995. What do we know about capital structure? Some evidence from international data. Journal of Finance 50, 1421–1460.
Robichek, A., Myers, S., 1966. Problems in the theory of optimal capital structure. Journal of Financial and Quantitative Analysis 2, 1–35.
Sametz, A., 1964. Trends in the volume and composition of equity finance. Journal of Finance 19, 450–469.
Schaefer, S., Strebulaev, I., 2008. Structural models of credit risk are useful: evidence from hedge ratios on corporate bonds. Journal of Financial Economics 90, 1–19.
Scott, J., 1976. A theory of optimal capital structure. Bell Journal of Economics and Management Science 7, 33–54.
Shleifer, A., Vishny, R., 1992. Liquidation values and debt capacity: a market equilibrium approach. Journal of Finance 47, 1343–1366.
Strebulaev, I., Yang, B., 2013. The mystery of zero-leverage firms. Journal of Financial Economics 109, 1–23.
Taggart, R., 1985. Secular patterns in corporate finance. In: Friedman, B. (Ed.), Corporate Capital Structures in the United States, University of Chicago Press, Chicago, pp. 13–80.
von Furstenberg, G., 1977. Corporate investment: Does market valuation matter in the aggregate?. Brookings Papers on Economic Activity 2, 347–397.
Welch, I., 2004. Capital structure and stock returns. Journal of Political Economy 112, 106–131.
Welch, I., 2011. Two common problems in capital structure research: the financial debt-to-assets ratio and issuing activity versus leverage changes. International Review of Finance 11, 1–17.
Wright, S., 2004. Measures of stock market value and returns for the US nonfinancial corporate sector, 1900–2002. Review of Income and Wealth 50, 561–584.

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