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Shareholders valuation of long-term debt and decline in firms' leverage ratio☆

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ABSTRACT

The median U.S. non-regulated firm reports a 47% decline in leverage ratio between 1980 and 2010. We investigate whether the cost-benefit tradeoff to *shareholders*, captured by the valuation impact of an additional dollar of debt on owners' equity, is an explanation for the observed change in leverage. Using Faulkender and Wang (2006) methodology, we find that shareholders view increasing debt to have a negative impact on their wealth, that is, shareholders perceive firms to be over-levered. Further, the net cost of issuing additional debt has increased steadily for three decades beginning in 1980 before declining marginally after 2010. This trend holds for different groups of firms classified on factors known to affect capital structure decisions. Managers respond to the changing cost to shareholders by reducing (increasing) leverage when the cost of debt increases (decreases). The time-series pattern in the marginal cost of debt persists after controlling for firm-specific characteristics. We find that macroeconomic factors, such as federal debt, play a role in explaining the marginal value of debt.

1. Introduction

According to the tradeoff theory of capital structure, firms determine their long-term leverage ratio by balancing the costs and benefits of debt.[1] Firms that deviate from their "optimal" leverage can increase their market value by moving the debt-equity mix towards the target. Consistent with this argument Graham (2000) and Binsbergen et al. (2010) find that firms are under-levered and suggest that firms can increase value by adding debt and capturing the tax-shield benefits of interest payments. The tradeoff theory therefore posits that changes in leverage ratios reflect changing dynamics of the cost-benefit tradeoff of debt.

A time-series examination of the capital structure of non-financial, and unregulated public U.S. firms between 1980 and 2014 reveals a long-term trend in firms' leverage ratios. We find a general decline in long-term debt ratios from 1980 until 2010. The median (average) firm reported a long-term leverage ratio of 25.10 (26.78) percent in 1980, and this ratio fell to 13.39 (19.04) percent in 2010, a decline of approximately 47% (29%). Additionally, the median (mean) firm's leverage ratio in the 1980s was

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[1] The tradeoff theory is one of several explanations for capital structure decisions. Other explanations include the pecking order theory (Myers and Majluf, 1984) and the market timing theory (Baker and Wurgler, 2002).

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higher than that in the 1990s and the leverage ratio was at its lowest in the 2000s.[2] The end of the latest final crisis in 2010 was followed by a gradual rebound in long-term debt-to-asset ratios, but the leverage ratio in 2014 is below the levels in the first two decades of the sample period. Further, the time-series trend in leverage is present in firms grouped by size, growth opportunities, corporate governance, leverage, and any other factors known to affect capital structure.

In the context of the tradeoff theory, the trend in firms' leverage ratios suggests that the costs and benefits of debt are changing over time. The pervasive decline in debt levels in the first three decades of the sample period indicates that either the benefits of debt declined over that interval, or the costs steadily increased, or both. The subsequent increase in leverage ratios beginning in 2011 suggests that this trade-off has reversed after the recent financial crisis and the net benefits of issuing debt have increased.

Prior studies that have tested the tradeoff theory (e.g., Bradley et al., 1984; Shyam-Sunder and Myers, 1999) do so from the viewpoint of the *firms*. In cross-sectional tests, these papers regress leverage or changes in leverage on several variables that capture the costs and benefits of debt to determine factors that affect firms' capital structure choices, making assumptions about the target capital structure, bankruptcy costs, etc. However, these studies provide limited insights about the relative importance of the different factors on firm valuation and do not present explanations for the pattern in leverage ratios described above.

In this paper we investigate the cost-benefit tradeoff of debt from the viewpoint of *shareholders* by estimating the net value that firms' owners place on an incremental dollar of debt. We argue that focusing on the tradeoff from the equity holders' perspectives provides a more comprehensive valuation of the net contribution of an additional dollar of debt. Shareholders consider not only the cost of borrowing and the implication on financial distress and bankruptcy but also how the proceeds from the debt issue are used to fund investment opportunities, manage agency costs, determine payout policy, increase tax shields, thus incorporating benefits, costs, as well as the relative significance of these factors in determining the net valuation impact of issuing debt. Additionally, examining the variation in the annual net value of additional debt across the sample period allows us to ascertain whether shareholders view the cost-benefit tradeoff to be changing over time.

We use the Faulkender and Wang (2006) methodology to determine the value that firms' owners place on an incremental dollar of long-term debt. In this model a firm's excess stock return is regressed on changes in several investment and financial policy factors and the coefficient on the independent variables reflects the net cost (negative coefficient) or benefit (positive coefficient) to equity holders. In our study we concentrate on the coefficient for the change in long-term debt variable that captures the net effect of issuing an additional dollar of debt on the wealth of the firms' owners.

We find that between 1980 and 2014, shareholders of U.S firms value *an additional dollar* of long-term debt to be −$0.28. This result suggests that for shareholders of the average firm, the cost of increasing long-term debt exceeds the benefits.[3] Given that the annual change in net debt (defined as debt issues less repurchases) is approximately 2.29% of prior year's equity, the decline in shareholders' wealth of the average firm is 0.64% (0.28 ∗ 2.29%) and this is comparable to announcement period returns at debt issues documented by prior studies (e.g., Mikkelson and Partch, 1986; Smith, 1986). The negative impact of increasing debt on shareholders' wealth is robust; we find consistent results when we use the Fama and French (1998) or the Pinkowitz and Willaimson (2002) models. Our results suggest that, on average, shareholders view firms to be overleveraged which contradicts the conclusions of prior theoretical studies of Graham (2010) and Binsbergen et al. (2010) that firms should be issuing additional debt. This result is, however, in agreement with recent empirical evidence in Kahle and Stulz (2017) and Michaely et al. (2017) that U.S firms are reducing leverage over an extended period of time.

We proceed to explore whether the model's annual long-term debt coefficient changes over the sample period to determine whether investors view the cost-benefit tradeoff of debt to be changing over time. We find that the average net cost of a dollar of debt increases steadily from $0.20 in the 1980s to $0.32 in the 1990s and rises to $0.44 in the 2000s, before falling to $0.30 in 2010s.[4] This result suggests that shareholders perceive issuing long-term debt to be increasingly more expensive over the first three decades of the sample period. There is a shift in shareholders' valuation of additional debt after the end of the financial crisis in 2010; in the last five years equity holders view issuing debt more favorably relative to the preceding two decades. Over the sample period the average annual increase in the net cost of issuing additional debt over is about 0.70% that translates to an increase of about 25 percentage points from 1980 to 2014. The time-series pattern of the net cost of issuing debt is generally present in different groups of firms classified by several factors that impact the capital structure decision, suggesting that the trend is pervasive.

We investigate whether changes in the net cost of issuing debt is a possible explanation for the general time series pattern of declining firms' leverage ratios. Assuming that managers are working in the best interest of shareholders, the marginal cost of debt to shareholders should be an important consideration in executives' capital structure decisions. Consistent with this argument, we document that firms are more likely to reduce (increase) debt in a given year when the net cost of debt to shareholders are high (low) and that the fraction of debt issued/repurchased is significantly related to the marginal cost of debt to investors.

[2] Michaely et al. (2017) find that leverage ratios peaked in 1992. More recently, Kahle and Stulz (2017) report similar findings. Strebulaev and Yang (2013) and D'Mello and Guskin (2013) document a dramatic increase in the fraction of firms with less than five percent leverage ratio between 1980 and 2010, and find that this shift to lower leverage cannot be explained by traditional determinants of capital structure. Additionally, Custódio et al. (2013) report a decline in debt maturity over time.

[3] While we do not explicitly model the impact of information asymmetries (Leland and Pyle, 1977), agency costs (Jensen and Meckling, 1976), debt maturity (Barclay and Smith, 1995), tax rates (Graham, 2006) etc. in calculating how shareholders view an additional dollar of debt. The underlying assumption of our model is that shareholders' reaction to changes in firms' capital structure implicitly incorporates these factors. Our measure of how shareholders value an additional dollar of debt, thus, is the composite measure of all of these costs, as viewed by the shareholders. A similar assumption is made in Fama and French (1998), Faulkender and Wang (2006), Pinkowitz et al. (2006), Bates et al. (2017), among others.

[4] We use 1980s, 1990s, 2000s, and 2010s to refer to the periods 1980–1989, 1990–1999, 2000–2009, and 2010–2014, respectively.

These findings indicate that changes in the net cost of debt to shareholders influence managers' decision to alter firms' capital structure The recapitalization associated with the increasing costs of additional debt to equity holders partially explains the observed trends in decreasing leverage.

Having documented trends in the marginal cost of debt to shareholders over the sample period we proceed to investigate factors that can explain the pattern. We find that the trend persists in both, young firms and firms that have been listed for >5 years; none of the firm age related or survival bias related changes explain the trend. We also document that variation in firm characteristics that are commonly known to effect cost and benefits of debt (e.g. non-debt tax shields, investment opportunities, governance, financial constraints, etc.) can explain some of the time-series pattern in the marginal cost of debt. However, even after controlling for these factors individually and simultaneously, the trend of an increasing net cost of additional debt until 2010 persists.

Finally, we examine the role of macroeconomic factors in explaining the variation in the marginal net cost of debt. Greenwood et al. (2010) and Badoer and James (2016) argue that federal debt competes with corporate debt. Additionally, Graham et al. (2015) document that increasing government debt over time explains some of the decrease in corporate debt ratios. In multivariate regressions we find that increasing federal debt significantly increases the cost of corporate debt to shareholders, consistent with the argument of prior studies that federal debt competes with and crowds out corporate debt. Also, the cost to shareholders of issuing debt increased during the Dot-Com bubble years in the late 1990s and decreased during the recent financial crisis of 2007.

Our paper contributes to existing literature in several ways. First, it adds to the growing literature explaining the changing leverage among U.S. firms. Empirical findings of Denis and McKeon (2017), Kahle and Stulz (2017), and Michaely et al. (2017) indicate that firms have been reducing leverage beginning in the early 1990s, contradicting the implications of the models in Graham (2006), Binsbergen et al. (2010), and Korteweg (2010) that firms are under-levered and are leaving money on the table (as potential tax benefits). Recent studies have provided some explanations from the firm's perspective. Corrado et al. (2009) and Falato et al. (2013) find that the increase in the proportion of difficult to collateralize intangible assets over time made it harder for firms to raise debt, a finding also supported by Bates et al. (2009). Denis and McKeon (2017) suggest that the proportion of firms with negative operating cash flow has increased and such firms hold less debt.

Our results suggest an alternate explanation of debt level in U.S. firms. Examining the issue from the perspective of shareholders we find that increasing long-term debt is value destroying to firms' owners. Further, the way investors view costs and benefits of debt is not static and shareholders have been displaying an increasing aversion to issuing additional debt since the 1980s that lasted till the end of the recent great recession. Managers respond to equity holders' perception of increasing net cost of debt by reducing the fraction of leverage in firms' capital structures. Beginning in 2011, debt levels have increased with declining marginal cost of issuing long-term debt while the corporate tax structure has not changed drastically. Overall, our results seem to indicate that tax benefits are one of many considerations that investors focus on (including governance, access to financial markets, etc.) when valuing debt. Shareholders consider many other "factors" (e.g. investment opportunities, corporate governance, financial constraints, etc.) when valuing leverage decisions of firms (e.g. see Frank and Goyal, 2009) and this process is not static.

Second, we contribute to the growing number of studies that quantify the value of corporate decisions from the perspective of equity holders (e.g., Faulkender and Wang, 2006 and Pinkowitz et al., 2006). Denis and Sibilkov (2010), Dittmar and Mahrt-Smith (2007), Bates et al. (2017), and others have added to that literature. However, all of these papers look at the value of an additional dollar of cash. Ours is the first paper that looks at the value of an additional dollar of debt using this framework. Further, the approach of this paper can explain the changing levels of debt between 1980 and 2014, which encompasses periods of expansion, recession, crises, and many other changes that potentially affects leverage decisions.

Finally, our study also adds to the growing literature that examines trends in corporate activities.[5] Studies have examined time series patterns in firms' dividend policies (DeAngelo, DeAngelo, and Skinner, 2004), investment decisions (Falato et al., 2013), operating performance (Denis and McKeon, 2017), security listing (Doidge et al., 2017 and Gao et al., 2013), financing policies (Graham et al., 2015), debt choices (Custódio et al., 2013), and cash policies (Bates et al., 2017). We show that changing shareholder valuation of debt affects firms' decisions – by extension, we suggest that changing shareholder valuation of corporate activities may play an important role in determining corporate decisions over time.

This paper proceeds as follows. In Section 2, we describe our sample construction, variables, summary statistics, and some preliminary findings. We provide details of the methodology used in Section 3. We report results in Section 4 and offer a concluding discussion in Section 5.

2. Sample selection and preliminary analysis

Our initial sample consists of all firms in the COMPUSTAT database between 1980 and 2014 that also have valid stock price information available in the CRSP database.[6] Similar to Bates et al. (2017) and Strebulaev and Yang (2013), we exclude firms not headquartered in the U.S. and those that are classified as utility and financial service firms. We also require that firm-year

[5] Kahle and Stulz (2017) present a comprehensive analysis of changing characteristics of U.S. corporations over time.

[6] Our sample period ends in 2014 because some of the regression specifications require two years of lead data for several independent variables.

observations have valid information about total assets (AT), sales (SALE), and total long-term debt, which is the sum of long-term debt that matures in more than a year, DLTT, and long-term debt in current liabilities, DLC. This definition of long-term debt has been used by recent papers that examine capital structure and related issues.[7] Our final sample consists of 125,960 firm-year observations.[8]

We present the summary statistics of our sample in Table 1. Market-to-Book ratio (M/B) is defined as the book value of assets plus the difference between the market and book value of equity divided by year-end assets. For research and development (R&D) expenditure, we assign zero for all observations with missing values. We use two definitions of leverage. The first, $L(FW)$ is the Faulkender and Wang (2006) definition where leverage is defined as the total long-term debt divided by the year-end sum of debt and market value of equity. The second, L, is total long-term debt divided by market equity of the previous year. Changes in the variables are relative to the previous year and are standardized by market value of equity. We winsorize all variables at the 1 and the 99% levels.

Summary statistics of our sample are similar to those presented in Faulkender and Wang (2006) and Bates et al. (2017).[9] For example, the mean $L(FW)$ of 0.237 and median annual excess return of −9.20% is similar to 0.278 and −8.45% reported in Faulkender and Wang. Similarly, our average cash ratio of 0.178 is the very close to that reported in Bates et al. On average, firms issue debt but net debt financing is negative suggesting that firms repurchase more debt than they issue over the sample period, consistent with Bates et al. (2009).

Table 2 presents the median and mean long-term debt standardized by year-end assets over the 35-year sample period. We observe a general decrease in firms' debt ratios in 1990s and 2000s. For example, the median firm reports a leverage ratio of 25.10% in 1980, 20.27% in 1995, and only 12.96% in 2005. However, beginning in 2011 when the recent financial crisis ended the trend reversed and in 2014, the last year of our sample, the median firm's leverage is 19.24%. Examining the firms' capital structure by decades, we find the average debt ratio for the median firm is 23.57% in the 1980s, decreasing by approximately 12% in the 1990s to 20.71%, and falling further by approximately 25% in the 2000s to 15.50%, before rising about 4% to 16.11% in 2010s.[10] Analyzing debt ratios of the mean firm also yields a similar pattern; the debt ratio falls from 26.34% in the 1980s, to 24.22% in the 1990s (decline of 8.0%), to 20.89 (further decline of 13.7%) percent in 2000s, and then declines marginally to 20.87 in 2010s. This time series trend is consistent with the findings of Kahle and Stulz (2017) and Michaely et al. (2017) that leverage of non-financial US corporations peaked in 1992.

We examine the generality of our findings by analyzing the time-series trend of firms classified into quartiles based on the leverage ratio. In untabulated results we find that the pattern of declining leverage ratios, while strongest in the first two quartiles of firms, holds across all groups of firms. For firms in the lowest debt ratio (quartile 1), the median firm holds no long-term debt after 2000 while for firms in the second quartile, the mean and median debt ratio in the last decade and a half is less than half that in the 1980s.[11] The decline in debt ratios for quartile 3 firms is approximately six percentage points or 14% while that for firms with the highest leverage the mean (median) decline is about 3% (6%) over the same interval.

We also investigate whether the pattern documented above is a reflection of a change in capital structure or merely a substitution of long-term debt with current liabilities and vice versa (e.g. see Custódio et al., 2013; Denis and McKeon, 2017). We find that the ratio of current liabilities to total assets of the average firm displays little variation across the sample period; the average ratio is 20.54% in the 1980s, 21.10% in the 1990s, 20.77% in the 2000s, and 19.86% in the 2010 to 2014 interval. That the decline (increase) in the average level of long-term debt is not accompanied by increases (decreases) in short-term debt leads us to conclude that choices relating to firms' long-term debt are independent of total liabilities decisions.

We proceed to investigate whether the time-series pattern extends across firms classified on different factors that the literatures suggests impact firms' capital structure, similar to the analysis by Graham et al. (2015). The factors employed are debt tax-shield, investment opportunities, corporate governance, financial constraints, information asymmetry, and risk. For each of these factors we use multiple proxies and for each proxy we divide firms into groups, generally quartiles.[12] We then compare the average (median) long-term debt to total asset ratio for each of the three decades for every group to determine whether there is a decline in leverage ratios.

We find that for about 90% of the groups, the mean and median debt levels in the 1980s are higher than that in the 1990s and the leverage ratios in 2000s are the lowest. This fraction falls to 70%, when we compare the leverage ratios in the 2010 to 2014 interval with those in the preceding decade. In general, these results suggest that the pattern of declining leverage generally holds across broad sub-groups of firms classified on different dimensions indicating that this phenomenon is both comprehensive and persistent.

[7] For example, see Lemmon and Zender (2010), Leary and Roberts (2010), Devos et al. (2012), D'Mello and Guskin (2013), Strebulaev and Yang (2013), and Kahle and Stulz (2017).

[8] Working with sample of publicly listed U.S. firms limits our ability to test the validity of our explanations for large number of firms choosing not to list in public markets (e.g. see Doidge et al., 2013; Doidge et al., 2017, for the issue of firms' decreasing propensity to list in the U.S.). We contend that the marginal cost of debt we calculate, and the time-series trends, should be representative of similar cost for non-listed firms.

[9] Faulkender and Wang's sample covers 1971 to 2001 while Bates et al. analyze the 1980 to 2009 interval.

[10] The last interval spans only five years.

[11] This consistent with the Korteweg (2010), Strebulaev and Yang (2013), and D'Mello and Guskin (2013).

[12] See Appendix A for the proxies for each factor and the groupings. This grouping results in 43 groups per decade of our sample period. Univariate results comparing leverage ratios of firms for these factors are not included in the main paper for brevity.

Table 1
Summary statistics.
This table presents summary statistics for variables used in measuring the marginal value of leverage using Faulkender and Wang (2006) methodology. The sample includes U.S. firms from the Compustat database from 1980 to 2014 that have positive values for assets, sales, and also have valid data for total long-term debt. The sample excludes all financial firms (SIC codes 6000–6999) and utilities (4900–4999). The variables are defined in Appendix B and are winsorized at the top and bottom one percentile. The subscript t-1 and t indicates whether the value of the variable is at of the end of the prior or the current fiscal year t. The final sample consists of a total of 125,960 firm-year observations.

Variables	Mean	Std. Dev.	Q1	Q2	Q3
$r_{i,t} - R_{i,t}$	0.010	0.665	−0.380	−0.092	0.226
AT_{t-1}	1503.195	4710.250	40.395	159.012	718.649
M/B_{t-1}	2.057	1.829	1.066	1.440	2.241
RD_{t-1}	25.610	103.832	0.000	0.000	7.010
$L(FW)_t$	0.237	0.241	0.024	0.165	0.383
L_t/MV_{t-1}	0.560	1.085	0.019	0.179	0.577
C_{t-1}/MV_{t-1}	0.178	0.240	0.033	0.095	0.220
NE_t/MV_{t-1}	0.033	0.129	0.000	0.001	0.011
Debt Financing$_t$	0.515	0.456	0.000	0.666	0.991
Net Debt Financing$_t$	−3.182	15.110	−0.467	0.000	0.324
$\Delta L_t/MV_{t-1}$	0.023	0.295	−0.027	0.000	0.059
$\Delta C_t/MV_{t-1}$	0.009	0.154	−0.035	0.001	0.040
$\Delta D_t/MV_{t-1}$	0.000	0.008	0.000	0.000	0.000
$\Delta E_t/MV_{t-1}$	0.017	0.268	−0.039	0.007	0.049
$\Delta I_t/MV_{t-1}$	0.002	0.034	−0.003	0.000	0.006
$\Delta NA_t/MV_{t-1}$	0.057	0.511	−0.040	0.040	0.170
$\Delta RD_t/MV_{t-1}$	0.001	0.024	0.000	0.000	0.002

3. Methodology

The tradeoff theory posits that firms weigh the marginal costs and benefits of debt in determining their capital structure and changes in this relation lead to changes in firms' leverage ratios. In this paper we focus on the cost-benefit tradeoff from the shareholders' perspective. Unlike creditors who primarily focus on the cost of borrowing and the implication on financial distress, shareholders consider all of the advantages and drawbacks of debt in determining the valuation impact of changing firm's leverage policy. Thus, we argue, examining the cost-benefit tradeoff from shareholders' view point provides a more complete and comprehensive assessment of the net contribution of an additional dollar of debt.

We measure the marginal impact of an incremental dollar of long-term debt on shareholders' wealth using the Faulkender and Wang (2006) model that is defined as:

$$R_{i,t}-R^B{}_{i,t} = \gamma_0 + \gamma_1 \frac{\Delta L_{i,t}}{MV_{i,t-1}} + \gamma_2 \frac{\Delta C_{i,t}}{MV_{i,t-1}} + \gamma_3 \frac{\Delta E_{i,t}}{MV_{i,t-1}} + \gamma_4 \frac{\Delta AT_{i,t}}{MV_{i,t-1}} + \gamma_5 \frac{\Delta R\&D_{i,t}}{MV_{i,t-1}} + \gamma_6 \frac{\Delta I_{i,t}}{MV_{i,t-1}} + \gamma_7 \frac{\Delta Div_{i,t}}{MV_{i,t-1}} + \gamma_8 \frac{C_{i,t-1}}{MV_{i,t-1}} + \gamma_9 \frac{L_{i,t-1}}{MV_{i,t-1}} + \gamma_{10} \frac{NE_{i,t}}{MV_{i,t-1}} + \varepsilon_{i,t} \tag{1}$$

where $R_{i,t} - R^B{}_{i,t}$ is the excess return of firm i in year t relative to the benchmark portfolio based on Fama and French (1993) 25 size and BE/ME portfolios, C is cash, E is earnings before interest and extraordinary items, AT is total assets net of cash, R&D is research and development expenses, I is interest expense, Div is annual dividends, L is total long-term debt, NE is net equity financing, subscripts t and $t-1$ represent values of the variables in the current and prior year, and Δ represents change relative to the previous year.[13] Because all of the variables are standardized by market value of equity in the previous year, the coefficients capture the marginal value to shareholders of an additional dollar of each of the independent variable.[14]

As argued by Faulkender and Wang, this model, which is similar to an annual event study, analyzes the relation between changes in debt and shareholders' wealth, controlling for concurrent changes in firms' profitability, financing, and investment policy. Faulkender and Wang examine firms' liquidity and find that the average marginal value of an incremental dollar of cash is less than a dollar. Using similar regressions, Denis and Sibilkov (2010) find that the value of cash is impacted by financial constraints; Dittmar and Mahrt-Smith (2007) find the value of cash is related to governance at the firm; and Bates et al. (2017) document an increasing value of cash over time.

Our regression differs from Faulkender and Wang on two dimensions. First, we decompose net financing into net debt financing (ΔL) and net equity financing (ΔNE) which allows us to isolate the effect of net debt issues on shareholders' wealth. Second, we use total debt of the previous year divided by market value of equity in that year to be consistent with the other independent

[13] The portfolio returns, R^B, are available from Dr. Kenneth R. French's web page. The definition of the variables used is available in Appendix B.

[14] Binsbergen et al. (2010) use an alternative model that is based on the marginal cost curve of debt using the Graham (2000) methodology. The underlying assumption of this paper is that for financially unconstrained and non-distressed firms their debt choices represent the optimum capital structure. Korteweg (2010) develops a model based on the market values of debt and equity and the respective betas. Our approach differs from these studies by directly examining shareholders' perception of the incremental value of debt.

Table 2
Mean and median long-term debt-to-asset ratio.
This table shows mean and median values of total long-term debt-to-asset ratio for sample firms. Total long-term debt is defined as sum of long-term debt that matures in more than a year and debt in current liabilities. The sample includes U.S. firms from the Compustat database from 1980 to 2014 that have positive values for assets, sales, and also have valid data for total long-term debt. The sample excludes all financial firms (SIC codes 6000–6999) and utilities (4900–4999).

Year	All Firms	
	Mean	Median
1980	26.78	25.10
1981	25.83	23.76
1982	26.13	23.65
1983	24.92	21.56
1984	25.07	21.81
1985	26.05	22.88
1986	26.80	23.65
1987	26.81	24.22
1988	27.15	24.39
1989	27.80	24.64
1990	27.86	24.79
1991	26.35	23.23
1992	24.19	20.68
1993	22.62	18.86
1994	22.49	18.97
1995	23.22	20.27
1996	22.70	19.15
1997	23.28	18.99
1998	24.67	20.54
1999	24.82	21.58
2000	23.69	19.33
2001	22.89	16.91
2002	21.69	16.23
2003	20.29	15.59
2004	19.35	14.50
2005	18.60	12.96
2006	19.25	13.77
2007	20.20	14.64
2008	22.46	16.60
2009	20.51	14.51
2010	19.04	13.39
2011	19.56	14.73
2012	20.89	15.95
2013	21.59	17.24
2014	23.26	19.24

variables in the regression. Faulkender and Wang use leverage in the current year standardized by the concurrent sum of debt and market equity. Our main results are not significantly impacted by this alternative definition.

Given the emphasis of our paper on the value of issuing an incremental dollar of debt, the coefficient of interest is γ_1 in Eq. (1). In an ideal world, with no transaction costs or information asymmetry, a dollar raised in the debt market is expected to increase assets and liabilities each by a dollar, that is, γ_1 is 0. In imperfect capital market, however, the change in asset value might be different from the amount of debt issued depending on the costs and benefits of issuing debt. For example, when access to capital markets is constrained, shareholders of firms that can issue debt and use the proceeds to fund positive NPV projects will find the benefits of issuing new debt (that is, the increase in market value of assets) exceeding the cost (that is, the increase in liabilities). In the context of the model, the coefficient of the change in leverage variable, γ_1, will be positive. Alternatively, if shareholders perceive that the marginal cost of increasing debt exceeds the benefits, γ_1 will be negative. Further, if shareholders' view the cost-benefit tradeoff to be changing over time, annual γ_1 estimates will vary over the sample period.

4. Results

4.1. The marginal net cost of debt to shareholders

We begin our analysis by investigating the marginal impact of long-term debt on shareholders' wealth using the pooled sample, similar to the analysis in Faulkender and Wang.[15] We estimate Eq. (1) and present the results in Table 3. In the first column

[15] See Table II, model 1 of Faulkender and Wang (2006).

Table 3
Long-term debt ratios classified by firm fundamental quintiles.
This table presents the coefficient estimates of the main equations used in our study to estimate the cost of increasing long-term debt. The sample includes U.S. firms from the Compustat database from 1980 to 2014 that have positive values for assets, sales, and also have valid data for total long-term debt. The sample excludes all financial firms (SIC codes 6000–6999) and utilities (4900–4999). Continuous variables are winsorized at the top and bottom one percentile. We estimate a variation of the model from Faulkender and Wang (2006), Fama and French (1998) and Pinkowitz and Willaimson (2002). Unreported p-values are calculated based on standard errors that are clustered at firm level. Test statistics include White's (1980) correction for heteroskedaticity. ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively. Definitions of the variables are present in the Appendix B.

Model	Faulkender and Wang (2006)	Fama and French (1998)		Pinkowitz and Willaimson (2002)	
Specification	(1)		(2)		(3)
Intercept	−0.10***	Intercept	0.13***	Intercept	1.14***
$\Delta L_t/MV_{t-1}$	−0.28***	L_t/A_t	−1.14***	L_t/A_t	−1.03***
$\Delta C_t/MV_{t-1}$	0.98***	$\Delta L_t/A_t$	0.00*	$\Delta L_t/A_t$	0.00*
$\Delta E_t/MV_{t-1}$	0.40***	$\Delta L_{t+2}/A_t$	0.00*	$\Delta L_{t+2}/A_t$	0.00**
$\Delta NA_t/MV_{t-1}$	0.31***	E_t/A_t	−3.04***	E_t/A_t	−1.97***
$\Delta RD_t/MV_{t-1}$	1.02***	$\Delta E_t/A_t$	1.27***	$\Delta E_t/A_t$	1.06***
$\Delta I_t/MV_{t-1}$	−1.17***	$\Delta E_{t+2}/A_t$	−0.62***	$\Delta E_{t+2}/A_t$	−0.23***
$\Delta D_t/MV_{t-1}$	3.32***	$\Delta NDA_t/A_t$	0.88***	$\Delta NDA_t/A_t$	0.84***
C_{t-1}/MV_{t-1}	0.36***	$\Delta NDA_{t+2}/A_t$	1.23***	$\Delta NDA_{t+2}/A_t$	0.94***
L_{t-1}/MV_{t-1}	0.01***	RD_t/A_t	5.72***	RD_t/A_t	5.15***
$\Delta NE_{t-1}/MV_{t-1}$	0.47***	$\Delta RD_t/A_t$	1.36**	$\Delta RD_t/A_t$	1.19***
		$\Delta RD_{t+2}/A_t$	5.68***	$\Delta RD_{t+2}/A_t$	4.74***
		I_t/A_t	−0.11	I_t/A_t	−1.89***
		$\Delta I_t/A_t$	−1.07	$\Delta I_t/A_t$	−0.16
		$\Delta I_{t+2}/A_t$	0.50	$\Delta I_{t+2}/A_t$	−0.57
		D_t/A_t	15.37***	D_t/A_t	13.40***
		$\Delta D_t/A_t$	5.30***	$\Delta D_t/A_t$	5.58***
		$\Delta D_{t+2}/A_t$	14.69***	$\Delta D_{t+2}/A_t$	13.31***
		$\Delta M_{t+2}/A_t$	−0.26***	ΔM_{t+2}	−0.20***
Adj. R squared	16.49%		30.29%		40.43%
N	117,086		78,195		78,195
Clustered standard errors	Yes		Yes		Yes

the coefficient γ_1 is −0.28 and statistically significant. This result implies that issuing (repurchasing) a dollar of long-term debt has an adverse (beneficial) impact on shareholders wealth leading to a reduction (increase) in owners' equity of 28 cents. These findings suggest that from the shareholders' perspective, firms, on average, are not underleveraged as suggested by previous theoretical studies and therefore issuing debt does not increase owners' equity.

We measure the impact (percentage change) on shareholders' equity resulting from the change in leverage by multiplying the coefficient, γ_1, by the average actual change in leverage. During the sample period, the change in the average firm's leverage relative to the beginning-of-the-year equity value is 2.29%. Thus, the increase in debt levels leads to a decrease in shareholders' equity value of −0.64% on average.[16] This result is comparable to prior studies that have examined the stock price effects at the announcements of bond issues. For example, Mikkelson and Partch (1986) and Smith (1986) report a decline of approximately 0.23% for straight debt issues while the stock returns at convertible debt issue announcements are more negative.[17]

The coefficients for the other independent variables presented in column 1 of Table 3 are similar to Faulkender and Wang (2006) in signs and comparable in magnitude.[18] We test the robustness of the finding that increasing (repurchasing) long-term debt has an adverse (beneficial) impact on equity value in two ways. First, we estimate a regression that is similar to Fama and French (1998), except that we add debt levels as an additional independent variable and the change in assets is restricted to those funded by non-debt sources.[19] We therefore estimate the following regression:

$$M_{i,t} = \alpha + \beta_1 \frac{E_{i,t}}{AT_{i,t}} + \beta_2 \frac{\Delta E_{i,t}}{AT_{i,t}} + \beta_3 \frac{\Delta E_{i,t+2}}{AT_{i,t}} + \beta_4 \frac{\Delta NDA_{i,t}}{AT_{i,t}} + \beta_5 \frac{\Delta NDA_{i,t+2}}{AT_{i,t}} + \beta_6 \frac{RD_{i,t}}{AT_{i,t}} + \beta_7 \frac{\Delta RD_{i,t}}{AT_{i,t}} + \beta_8 \frac{\Delta RD_{i,t+2}}{AT_{i,t}} + \beta_9 \frac{I_{i,t}}{AT_{i,t}} + \beta_{10} \frac{\Delta I_{i,t}}{AT_{i,t}} + \beta_{11} \frac{\Delta I_{i,t+2}}{AT_{i,t}} + \beta_{12} \frac{D_{i,t}}{AT_{i,t}} + \beta_{13} \frac{\Delta D_{i,t}}{AT_{i,t}} + \beta_{14} \frac{\Delta D_{i,t+2}}{AT_{i,t}} + \beta_{15} \Delta M_{i,t+2} + \beta_{16} \frac{L_{i,t}}{AT_{i,t}} + \beta_{17} \frac{\Delta L_{i,t}}{AT_{i,t}} + \beta_{18} \frac{\Delta L_{i,t+2}}{AT_{i,t}} + \varepsilon_{i,t} \quad (2)$$

where M is the market-to-book ratio defined as the market value of equity plus book value of debt less book value of assets divided by book value of assets.[20] AT is the value of total assets, E is earnings before extraordinary items, NDA is assets financed by non-long-term debt sources defined as change in total assets less change in long-term debt, RD is R&D expenses, I is interest, D is

[16] We observe qualitatively similar results when we estimate the Faulkender and Wang regression without the interest variable.
[17] Masulis (1980, 1983) documents a positive reaction to leverage increasing transactions but only focus on exchange offers.
[18] The sample period covered in these studies are different which might explain the marginal differences in the magnitude of the coefficients.
[19] Similar variations of the Fama-French model have been made in Pinkowitz et al. (2006), Dittmar and Mahrt-Smith (2007), and Pinkowitz and Willaimson (2002).
[20] Faulkender and Wang (2006) argue that the dependent variable of the Fama-French model, market-to-book ratio, is difficult to measure and does not controls for "time-series variations in risk factors".

Table 4
Value of marginal long-term debt: annual estimates, 5-year moving averages, and 10-year moving averages.
The annual estimates and the 5-year and 10-year moving averages of the marginal value of leverage from 1980 to 2014. Annual marginal cost is estimated using Eq. (1). The sample includes U.S. firms from the Compustat database from 1980 to 2016 that have positive values for assets, sales, and also have valid data for total long-term debt. The sample excludes all financial firms (SIC codes 6000–6999) and utilities (4900–4999). We conduct *t*-test to evaluate if the annual estimates of the marginal value of leverage are significantly different from zero. ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively.

Year	Annual estimates	5-Year moving average	10-Year moving average
1980	−0.22***		
1981	−0.20***		
1982	−0.21***		
1983	−0.27***		
1984	−0.18***	−0.22	
1985	−0.27***	−0.23	
1986	−0.18***	−0.22	
1987	−0.03	−0.19	
1988	−0.20***	−0.17	
1989	−0.22***	−0.18	−0.20
1990	−0.12***	−0.15	−0.19
1991	−0.21***	−0.16	−0.19
1992	−0.32***	−0.22	−0.20
1993	−0.21***	−0.22	−0.19
1994	−0.25***	−0.22	−0.20
1995	−0.38***	−0.28	−0.21
1996	−0.29***	−0.29	−0.22
1997	−0.38***	−0.30	−0.26
1998	−0.49***	−0.36	−0.29
1999	−0.56***	−0.42	−0.32
2000	−0.48***	−0.44	−0.36
2001	−0.38***	−0.46	−0.37
2002	−0.31***	−0.44	−0.37
2003	−0.39***	−0.42	−0.39
2004	−0.35***	−0.38	−0.40
2005	−0.59***	−0.40	−0.42
2006	−0.42***	−0.41	−0.43
2007	−0.78***	−0.50	−0.47
2008	−0.37***	−0.50	−0.46
2009	−0.38***	−0.51	−0.44
2010	−0.46***	−0.48	−0.44
2011	−0.33***	−0.46	−0.44
2012	−0.22***	−0.35	−0.43
2013	−0.42***	−0.36	−0.43
2014	−0.07	−0.30	−0.40

common dividends, and L is the leverage ratio. Subscript i denotes a sample firm and subscript t denotes the fiscal year. We follow the convention that $\Delta X_{i,t}$ represents change in variable X for firm i between years t and $t-1$, while $\Delta X_{i,t+2}$ represents the change in variable X at time $t+2$ relative to year t.

Second, we estimate Eq. (2) but with M being that market value of equity and adding changes in debt financed assets as an additional incremental variable, which is similar in spirit to Pinkowitz and Willaimson (2002). In both of these specifications the focus is on the coefficient on debt, β_{16}, which captures the marginal impact of debt on the market value of equity. We present the results in columns 2 and 3 of Table 3. The coefficients for debt-to-asset ratio are negative and significant in both the specifications. These results suggest that our result using the Faulkender and Wang model that increasing debt has a negative impact on shareholders' wealth is robust and supports the conclusion of Fama and French (1998) and the findings of Pinkowitz and Willaimson (2004).

The estimates in Table 3 provide the average effect for the sample period. A question that remains unanswered is whether shareholders view the net impact of debt, that is, the cost-benefit tradeoff, to be changing over time. To answer this, we estimate the Faulkender and Wang regression annually and present the results in Table 4. In the interest of brevity, we only report the coefficient for the change in long-term debt variable (γ_1). We find that, on average, the value of an incremental dollar of debt is always negative to shareholders varying from −\$0.03 in 1987 to −\$0.78 in 2007.[21] While there might be specific instances where issuing additional debt might be viewed positively by shareholders of certain firms, our results confirm the finding in the literature that debt issue announcement period returns are negative on average.[22]

The result suggests that the impact of increasing long-term debt is viewed more negatively by shareholders in some years than in others implying that the tradeoff between the costs and benefits of debt is not constant. The economic impact or percentage change in equity value from changing long-term debt ranges from −3.66% in 1998 (when the coefficient is −0.49 and the in-

[21] We interpret the negative coefficient on the incremental dollar of long-term debt variable as the cost of an incremental dollar. Thus, a coefficient of −0.03 can be viewed as a cost of 0.03 or as a value of −0.03. We use the cost and value interpretations interchangeably, with caution to the sign of the coefficient.
[22] For example, shareholder reaction are influenced by the level of information asymmetry, use of debt, etc. (e.g. see Harvey et al., 2004)

crease in long-term debt is approximately 7.47% of previous year's equity) to 2.54% in 2009 (when the coefficient is −0.38 and change is −6.70%, that is, firms repurchase more debt than they issue).

To reduce the impact of volatility on the annual estimates of the net impact of issuing debt we present 5- and 10-year moving averages of the annual cost in the last two columns of Table 4, similar to Bates et al. (2017). An interesting pattern emerges when we compare the average annual net cost to shareholders of issuing an additional dollar of debt across the three and a half decades. We find that net cost increases from approximately \$0.20 in the 1980s to about \$0.32 cents in the 1990s and rises further to \$0.44 in the 2000s and reduces to \$0.30 between 2010 and 2014.[23] The dramatic jump in the marginal cost in 2000s could be a result of the latest financial crisis which started in 2007 and not part of the general trend of increasing net cost. Eliminating years 2007 to 2009 results in the average marginal cost for the 2000 to 2006 interval to be 0.41, which is \$0.09 cents, or 28% higher than the average in the 1990s implying that the crisis was not an explanation for the rising cost of debt to shareholders.

We explore whether there is a time-trend in the cost of incremental long-term debt by estimating the following regression:

$$\text{Annual Cost}_t = \alpha + \beta * \text{Trend} + \varepsilon_t \tag{3}$$

where annual cost is obtained from Eq. (1) and Trend is a time trend variable that takes values that are monotonically increasing by 1 each year. The coefficient, β, is −0.007 implying that the annual cost of issuing long-term debt is *increasing* by about 70 basis points for each additional dollar raised in long-term debt. This implies that over the 35-year sample interval the annual cost of issuing long-term debt increases by 24.5 percentage points (0.07 ∗ 35), which is statistically significant and appears to be economically significant as well. Additionally, the adjusted R-squared is about 0.22 suggesting that time period explains a sizeable amount of the variation in the marginal cost to shareholders of issuing debt and the correlation between the two variables is −0.49. Overall, these results provide strong support for the conclusion that equity investors view the net costs of issuing debt to be increasing over most of the sample period.

We proceed to examine if the pattern of the net cost of additional debt during our sample period holds for groups of firms classified on different sample characteristics. To do so we first form groups annually based on the proxies for the same firm characteristics that we used to examine the time-series pattern of leverage ratios (defined in Appendix A). For example, when we investigate how the net cost of issuing additional long-term debt has changed over the sample period for firms classified on tax shields, we use the amount of depreciation expense, income taxes paid, and tax-loss carryforwards (each as a fraction of total assets) as proxies. We then estimate the net cost of issuing additional long-term debt for each group of firms (e.g., quartiles of depreciation, of income taxes paid, and the presence/absence of tax-loss carryforwards) by estimating Eq. (1) annually and then average the coefficient across each decade.

We present the results for each group by decade in Table 5. In general, we observe that the time series trend in the net cost of debt documented earlier holds for different groupings of firms by decade and characteristics; the net costs are higher in the 1990s than they are in the 1980s and costs in the 2000s are higher than the costs in the 1990s before declining in 2010s. The pattern deviates a little when looking at technology firms in the 1990s and also for firms holding the highest quartile of cash in the 1990s. Both of these groups, we know, could be affected by the dot-com bubble in the late 1990s. The pattern of increasing net cost of incremental debt over time holds for firms grouped by corporate governance, financial constraints, and risk classification criteria. These results confirm our earlier conclusion that for the majority of the sample period the net cost (benefit) of debt as viewed by shareholders is increasing (decreasing) over time – results in Table 5 further show that the pattern holds when considering different firm characteristics known to affect debt issuances.

4.2. The cost of debt and changes in capital structure

The results presented so far show that the leverage ratio of firms has generally been steadily declining and that the net costs to shareholders of issuing additional long-term debt has been steadily increasing over most of the sample period. We examine the relation between these variables by plotting in Fig. 1 the 10-year moving average of leverage of the median firm and the corresponding 10-year moving average of the marginal cost of issuing long-term debt. The graph shows an inverse relation between the two variables; as the marginal cost to shareholders of issuing debt increases, the median firm's leverage decreases. The implication of this is that the change in the leverage ratio of the median firm is related to varying shareholder perception of the net cost of issuing additional long-term debt.

We proceed to investigate whether the changing marginal cost of debt to the firm's owners plays a role in the manager's decision to issue/repurchase debt.[24] While a rational manager needs debt capital to finance long-term projects, she can vary the amount of new debt issued (beyond just rolling over the maturity by issuing debt to replace old debt which does not increase long-term debt). We would expect the manager, who is assumed to work in the best interest of the firm's existing owners, to issue more debt when debt issuance is viewed less unfavorably by shareholders and even retire debt when it is viewed more unfavorably by the owners.

[23] Given that the latest period has only five years, average values are significantly influenced by outliers. Eliminating 2014 when the marginal net cost of debt was −0.07 causes the average to be about −0.36.

[24] Recent studies by Huang and Ritter (2016) and McLean and Palazzo (2016) examine motivations for debt financing decisions. While Huang and Ritter find that proceeds from net debt issues fund immediate spending needs, McLean and Palazzo find that market conditions play a bigger role in issuing decisions.

Table 5
Marginal cost of long-term debt ratios classified by firm fundamentals.
This table presents the average marginal cost of long-term debt ratio to shareholders for firms classified on different dimensions for the three decades in the sample period. Annual marginal cost is estimated using Eq. (1) and this is then averaged across the decade. The sample includes U.S. firms from the Compustat database from 1980 to 2014 that have positive values for assets, sales, and also have valid data for total long-term debt. The sample excludes all financial firms (SIC codes 6000–6999) and utilities (4900–4999). Continuous variables other than *E-Index* are winsorized at the top and bottom one percentile. Definitions of the variables are present in the Appendix B. Panel A through E provide the data for different proxies within each factor (as described in Appendix A).

Panel A: Non-debt tax shields

	Dep/TA			
Period	Quartile 1	Quartile 2	Quartile 3	Quartile 4
1980–1989	−0.10	−0.30	−0.26	−0.17
1990–1999	−0.21	−0.45	−0.33	−0.34
2000–2009	−0.50	−0.40	−0.54	−0.45
2010–2014	−0.20	−0.60	−0.33	−0.27

	Tax Rate			
Period	Quartile 1	Quartile 2	Quartile 3	Quartile 4
1980–1989	−0.07	−0.20	−0.32	−0.30
1990–1999	−0.23	−0.31	−0.39	−0.49
2000–2009	−0.33	−0.44	−0.48	−0.59
2010–2014	−0.31	−0.30	−0.38	−0.34

	TLCF/TA	
Period	No	Yes
1980–1989	−0.28	−0.12
1990–1999	−0.50	−0.27
2000–2009	−0.46	−0.43
2010–2014	−0.32	−0.38

Panel B: Investment opportunities

	R&D/TA		
Period	=0	≤Median	>Median
1980–1989	−0.16	−0.24	−0.30
1990–1999	−0.26	−0.37	−0.51
2000–2009	−0.41	−0.51	−0.50
2010–2014	−0.25	−0.33	−0.62

	M/B			
Period	Quartile 1	Quartile 2	Quartile 3	Quartile 4
1980–1989	−0.16	−0.23	−0.34	−0.61
1990–1999	−0.22	−0.42	−0.48	−0.84
2000–2009	−0.35	−0.52	−0.71	−0.76
2010–2014	−0.27	−0.13	−0.45	−0.73

	Industry classification	
Period	Non-technology firm	Technology firm
1980–1989	−0.18	−0.44
1990–1999	−0.29	−0.35
2000–2009	−0.42	−0.52
2010–2014	−0.33	−0.51

Panel C: Corporate governance

	E-Index (governance)	
Period	Less effective	More effective
1991–1999	−0.44	−0.43
2000–2009	−0.58	−0.67
2010–2014	−0.51	−0.42

Panel D: Financial constraints

	SA index		
Period	Group 1	Group 2	Group3
1980–1989	−0.11	−0.24	−0.22

(continued on next page)

Table 5 *(continued)*

Panel D: Financial constraints

Period	SA index Group 1	Group 2	Group3
1990–1999	−0.28	−0.38	−0.22
2000–2009	−0.51	−0.44	−0.35
2010–2014	−0.22	−0.34	−0.17

Period	Bond Ratings No	Yes
1990–1999	−0.09	−0.21
2000–2009	−0.38	−0.34
2010–2014	−0.59	−0.41

Period	Cash/TA Quartile 1	Quartile 2	Quartile 3	Quartile 4
1980–1989	−0.19	−0.23	−0.21	−0.30
1990–1999	−0.31	−0.36	−0.31	−0.55
2000–2009	−0.39	−0.50	−0.51	−0.46
2010–2014	−0.22	−0.37	−0.46	−0.67

Panel E: Information asymmetry

Period	Assets Quartile 1	Quartile 2	Quartile 3	Quartile 4
1980–1989	−0.23	−0.20	−0.26	−0.12
1990–1999	−0.24	−0.41	−0.39	−0.26
2000–2009	−0.37	−0.44	−0.38	−0.49
2010–2014	−0.16	−0.30	−0.26	−0.29

Period	PPE/TA Quartile 1	Quartile 2	Quartile 3	Quartile 4
1980–1989	−0.18	−0.28	−0.31	−0.12
1990–1999	−0.19	−0.44	−0.35	−0.27
2000–2009	−0.33	−0.53	−0.42	−0.45
2010–2014	−0.33	−0.46	−0.33	−0.28

Panel F: Risk.

Period	*Std. Dev. ROA* Quartile 1	Quartile 2	Quartile 3	Quartile 4
1980–1989	−0.12	−0.18	−0.21	−0.17
1990–1999	−0.40	−0.29	−0.26	−0.30
2000–2009	−0.35	−0.48	−0.38	−0.35
2010–2014	−0.27	−0.19	−0.41	−0.28

We initially investigate this hypothesis by modeling the decision to reduce debt using a logit regression where the decision to issue or repurchase debt is regressed on the marginal cost of debt, using firm-specific variables and macroeconomic factors as controls. This regression is defined as follows:

$$PR\left(Y_{i,t}=1\right)=F\left(\hat{\beta}_i X_{i,t}\right) \tag{4}$$

For any given year t, the dependent variable takes a value of 1 if a firm reduces debt ratio relative to the prior year, and zero otherwise. The firm-specific independent variables are natural log of assets (proxy for information asymmetry and access to capital markets), leverage, M/B (proxy for growth opportunities), and ROA (proxy for profitability). However, firms' decision to change its debt ratio is also influenced by macroeconomic factors such as yield spread, market returns, tax rates, and investment sentiment. Firms are less (more) likely to issue (repurchase) bonds when the spreads are high and are more likely to issue equity when stock prices are high (S&P returns are high) or when market sentiments are high.

We present the results of our regression analysis in Table 6, Panel A. In model 1, all independent variables are measured in the year of the debt reduction. However, given that recapitalization is costly, firms' might not respond quickly to changes in the independent variables and restructure their capital structure with some delay. Therefore, we also use independent variables that are lagged by a year and by two years in models 2 and 3, respectively. We find that the marginal cost of debt in any given year influences the firm's decision to reduce leverage for at least the subsequent two years. The coefficients in all columns are negative

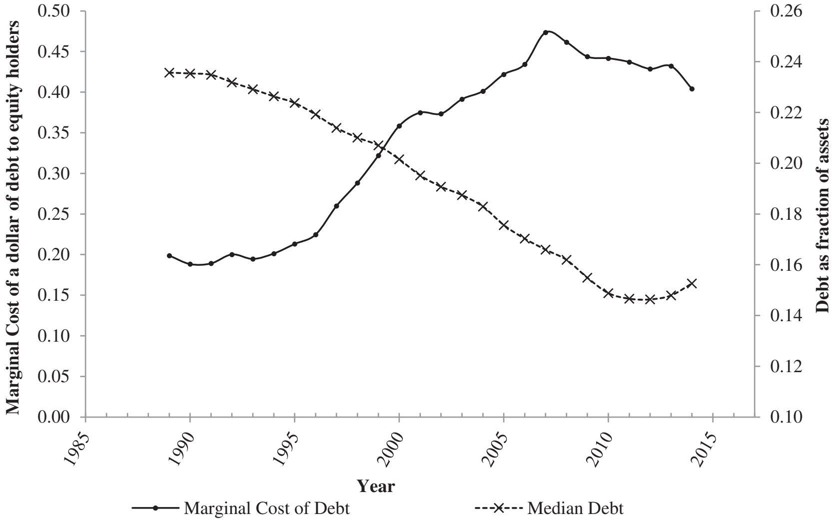

Fig. 1. The dashed line shows the 10-year moving average of the annual marginal cost of debt, estimated using Eq. (1). The solid line shows the 10-year moving average of the annual median debt-to-asset ratio. The sample includes U.S. firms from the Compustat database from 1980 to 2014 that have positive values for assets, sales, and also have valid data for total debt. The sample excludes all financial firms (SIC codes 6000–6999) and utilities (4900–4999).

and significant implying that firms are more likely to repurchase debt and reduce leverage in a given year if the cost of debt in that year and/or either of the prior two years increases (i.e., becomes more negative).

We also investigate whether the decision to increase debt is influenced by the cost of debt.[25] We estimate Eq. (4) but the dependent variable takes the value of 1 if the firm's debt ratio increases relative to the previous year, and 0 otherwise. We expect the coefficient for the marginal cost of debt to be positive, that is, as the benefits of debt to shareholders' increase, the firm will issue debt. The results presented in Panel B support this hypothesis. We find the coefficients for the annual cost of marginal debt to be positive in all three regressions implying that firms are more likely to increase leverage if there is an increase (decrease) in the benefit (cost) of issuing debt to the shareholders.

The results presented above suggest that marginal cost of debt to owners influences the likelihood of firms altering their capital structure. We proceed to examine whether changes in long-term debt, that is, the fraction issued or repurchased, is influenced by current and lagged cost of debt. We estimate an OLS regression where the dependent variable is change in debt level relative to the previous year standardized by book value of assets and the independent variables are those in Panel B. We add an additional dummy variable if the firm was all-equity in the preceding year to control for the findings of previous studies that an increasing fraction of firms have no leverage for extended periods of time.[26] We present the results in Panel C. We find the coefficient for the marginal cost of debt in the current year as well as in the preceding two years to be positive and significant. This finding suggest that as the cost of debt increases there is a greater reduction in the amount of long-term debt in the firm's capital structure. Similarly, firms issue more debt as the benefits of leverage to shareholders increase.

Based on the findings in Table 6, we conclude that marginal cost of debt to shareholders significantly influences firms' capital structure policies. When equity holders perceive this cost to be increasing, managers, working as agents of shareholders, take action to reduce firm leverage ratios. Similarly, when the benefits of debt to shareholders are increasing (i.e. the net cost of debt is decreasing), managers are more likely issue debt. Thus, we argue that the increasing cost of debt to shareholders is an explanation for the decreasing levels of leverage in firms' capital structure.

4.3. Impact of changing sample composition on marginal cost of long-term debt

We next investigate potential explanations for the time-series trend in the cost to shareholders of issuing debt. A possible reason for the pattern that we observe could be changes in the sample composition. With the passage of time, (young) firms that have a higher cost of debt enter the sample resulting in lower net benefit of debt in the latter part of the sample period and hence lower leverage ratios for firms. This argument has been put forward by Fama and French (2001) in their study of the disappearing dividends puzzle; by Custódio et al. (2013) in their examination of a declining trend in firms' debt maturity structure; by D'Mello and Guskin (2013) in the analysis of firms with low leverage; by Denis and McKeon (2017) in their analysis of firms with negative cash flows; by Falato et al. (2013) in their analysis of firms with intangible assets; and also, more broadly, by Kahle and Stulz (2017) in their analysis of trends of U.S. firms' characteristics.[27] These studies suggest that the entry of new firms

[25] Recent studies by Denis and McKeon (2012), Huang and Ritter (2016) and McLean and Palazzo (2016) examine motivations for debt financing decisions.
[26] Adding this independent variable does not affect the significance or conclusion of the results in Panels A and B.
[27] Also see Bates et al. (2009) and Bates et al. (2017).

Table 6
The decision to change capital structure and the marginal cost of debt.
The table presents results of logit regression where the dependent variable captures the decision to reduce (Panel A) and increase (Panel B) debt and OLS regression where the dependent variable is the change in debt relative to the previous year standardized by year-end assets (Panel C). The independent variables are the annual marginal cost of debt, firm-specific variables and macroeconomic factors, as described in Appendix B. The dependent variable in Panel A (Panel B) takes the value of 1 in a given year if the firm's debt in that year was less (more) than that in the preceding year and 0 otherwise. The independent variables are concurrent in model 1, lagged by a year in model 2, and lagged by 2 years in model 3. The sample includes U.S. firms from the Compustat database from 1980 to 2014 that have positive values for assets, sales, and also have valid data for total long-term debt. The sample excludes all financial firms (SIC codes 6000–6999) and utilities (4900–4999). Reported *p*-values (in parentheses) calculated based on standard errors that are clustered at firm level. ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively. Test statistics include White's (1980) correction for heteroskedaticity.

Panel A: Decision to reduce debt			
Timing of control variables	$t = 0$	$t = -1$	$t = -2$
Specification	(1)	(2)	(3)
Intercept	0.20*** (0.00)	0.00 (0.99)	−0.18*** (0.00)
Marginal cost of debt	−0.41*** (0.00)	−0.33*** (0.00)	−1.24*** (0.00)
Yield curve	8.88*** (0.00)	5.13*** (0.00)	−1.76*** (0.00)
GDP change	−4.27*** (0.00)	−7.40*** (0.00)	−0.77** (0.04)
Sentiment Index	0.00 (0.89)	0.03** (0.02)	0.01 (0.34)
S&P return	−0.14*** (0.00)	−0.14*** (0.00)	−0.79*** (0.00)
Tax dummy 1987–1993	0.15*** (0.00)	0.16*** (0.00)	0.20*** (0.00)
Tax dummy 1984–1986	−0.03 (0.15)	0.06*** (0.00)	−0.20*** (0.00)
Zero-debt dummy	−1.70*** (0.00)	−17.24*** (0.00)	−2.20*** (0.00)
Assets	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)
Leverage	−1.61*** (0.00)	0.21*** (0.00)	0.36*** (0.00)
M/B	−0.01*** (0.00)	−0.04*** (0.00)	−0.03*** (0.00)
ROA	−0.06*** (0.00)	−0.43*** (0.00)	−0.17*** (0.00)
Pseudo R-squared	8.41%	20.55%	11.18%
N	118,835	118,835	118,835

Panel B: Decision to increase debt			
Timing of control variables	$t = 0$	$t = -1$	$t = -2$
Specification	(1)	(2)	(3)
Intercept	−0.22*** (0.00)	0.03 (0.40)	0.06* (0.05)
Marginal cost of Debt	0.50*** (0.00)	0.39*** (0.00)	1.36*** (0.00)
Yield Curve	−9.37*** (0.00)	−5.26*** (0.00)	0.85 (0.11)
GDP Change	5.01*** (0.00)	7.44*** (0.00)	1.67*** (0.00)
Sentiment Index	0.01 (0.26)	−0.01 (0.44)	0.02* (0.06)
S&P Return	0.20*** (0.00)	0.12*** (0.00)	0.91*** (0.00)
Tax Dummy 1987–1993	−0.17*** (0.00)	−0.18*** (0.00)	−0.25*** (0.00)
Tax Dummy 1984–1986	−0.01*** (0.00)	−0.11*** (0.00)	0.10 (0.11)
Zero-Debt Dummy	−16.80*** (0.00)	−1.22*** (0.00)	−1.01*** (0.00)
Assets	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)
Leverage	1.66*** (0.00)	−0.17*** (0.00)	0.00 (0.92)
M/B	0.01 (0.11)	0.02*** (0.01)	0.01*** (0.00)
ROA	0.06** (0.03)	0.27*** (0.00)	0.13*** (0.00)
Pseudo R-squared	23.66%	5.62%	4.67%
N	118,835	118,835	118,835

Panel C: Change in long-term debt			
Timing of control variables	$t = 0$	$t = -1$	$t = -2$
Specification	(1)	(2)	(3)
Intercept	0.00 (0.62)	−0.04*** (0.00)	0.05*** (0.00)
Marginal Cost of Debt	0.03*** (0.00)	0.06*** (0.00)	0.10*** (0.00)
Yield Curve	−0.62*** (0.00)	−0.23*** (0.00)	0.13*** (0.00)
GDP Change	0.55*** (0.00)	0.57*** (0.00)	0.20*** (0.00)
Sentiment Index	0.00** (0.03)	0.00*** (0.00)	0.00*** (0.00)
S&P Return	0.03*** (0.00)	0.07*** (0.00)	0.06*** (0.00)
Tax Dummy 1987–1993	−0.01*** (0.00)	−0.01*** (0.00)	−0.02*** (0.00)
Tax Dummy 1984–1986	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
Zero-Debt Dummy	−0.02*** (0.00)	−0.01*** (0.00)	−0.01*** (0.00)
Assets	0.00*** (0.00)	0.00** (0.04)	0.00* (0.07)
Leverage	0.15*** (0.00)	−0.05*** (0.00)	−0.03*** (0.00)
M/B	0.00** (0.01)	0.00*** (0.00)	0.00*** (0.00)
ROA	0.02*** (0.00)	0.01*** (0.00)	0.00 (0.32)
Pseudo R-squared	6.88%	1.99%	1.35%
N	118,835	118,835	118,835

with valuable growth opportunities that find issuing long-term debt to be expensive, for example, technology firms in the 1990s, can partially explain the change in firms' financing characteristics over time.

We investigate whether changes in sample composition resulting from the entry of new firms could have a significant impact on the marginal cost of long-term debt across the sample period. We estimate the following pooled regression equation:

$$\begin{aligned} R_{i,t}-R^{B}{}_{i,t} = {} & \gamma_0+\gamma_1\frac{\Delta L_{i,t}}{MV_{i,t-1}}+\gamma_2\frac{\Delta L_{i,t}*D_{1990s}}{MV_{i,t-1}}+\gamma_3\frac{\Delta L_{i,t}*D_{2000s}}{MV_{i,t-1}}+\gamma_4\frac{\Delta L_{i,t}*D_{2010s}}{MV_{i,t-1}}+\gamma_5 D_{FT}+\gamma_6\frac{\Delta L_{i,t}*D_{FT}}{MV_{i,t-1}} \\ & +\gamma_7\frac{\Delta L_{i,t}*D_{FT}*D_{1990s}}{MV_{i,t-1}}+\gamma_8\frac{\Delta L_{i,t}*D_{FT}*D_{2000s}}{MV_{i,t-1}}+\gamma_9\frac{\Delta L_{i,t}*D_{FT}*D_{2010s}}{MV_{i,t-1}}+\gamma_{10}\frac{\Delta C_{i,t}}{MV_{i,t-1}}+\gamma_{11}\frac{\Delta E_{i,t}}{MV_{i,t-1}} \\ & +\gamma_{12}\frac{\Delta NA_{i,t}}{MV_{i,t-1}}+\gamma_{13}\frac{\Delta R\&D_{i,t}}{MV_{i,t-1}}+\gamma_{14}\frac{\Delta I_{i,t}}{MV_{i,t}}+\gamma_{15}\frac{\Delta Div_{i,t}}{MV_{i,t-1}}+\gamma_{16}\frac{C_{i,t-1}}{MV_{i,t-1}}+\gamma_{17}\frac{L_{i,t-1}}{MV_{i,t-1}}+\gamma_{18}\frac{\Delta NE_{i,t}}{MV_{i,t-1}}+\gamma_{19}D_{1990s} \\ & +\gamma_{20}D_{2000s}+\gamma_{21}D_{2010s}+\gamma_{22}D_{FT}*D_{1990s}+\gamma_{23}D_{FT}*D_{2000s}+\gamma_{24}D_{FT}*D_{2010s}+\varepsilon_{i,t} \end{aligned} \tag{5}$$

We control for the impact of time period on stock returns by adding dummy variables for the 1990s, 2000s, and the 2010s (D_{1990s}, D_{2000s}, and D_{2010s}).[28] We account for changes in sample composition by introducing a dummy variable for firm type, D_{FT}, and interact this with both, the change in leverage and the time period dummies. The double interaction term captures the interaction between change in leverage and firm type in the 1980s. The triple-interaction term captures the interaction of change in leverage, firm type, and indicator variables capturing the 1990s, the 2000s, and the 2010s and thus help us understand the time trend in value of debt for a certain firm type, relative to the 1980s. If the change in sample composition is an explanation for the time series pattern in the marginal cost of debt, the coefficients for the double- and triple-interaction terms that include firm type should be statistically significant while the coefficients γ_1, γ_2, $\gamma_{3,}$ and γ_4 should be different relative to when the dummy variable, D_{FT}, is not included.

We present the results of our analysis in Table 7. Reported *p*-values are adjusted for the temporal dependence of the error terms using cluster-robust standard errors. Column 1 presents the base case regression with time period dummies, that is, when firm type is not included. As documented earlier, there is a significant increase in the marginal cost of debt over time even after controlling for the time period. The average annual cost to shareholders of issuing a dollar of long-term debt increases from \$0.20 in the 1980s to \$0.26 in the 1990s (0.20 + 0.06), to \$0.42 (0.20 + 0.22) in the 2000s, and then decreases a little to \$0.38 (0.20 + 0.18) in 2010s.

In column 2 we present the results of the impact of new firms entering the sample on the marginal cost of debt over time. New firms are defined as firms that are listed for the first time in CRSP or COMPUSTAT, whichever is earlier, in the preceding five year and D_{FT} takes the value of 1 for new firms and 0 otherwise.[29] We find that the coefficients on change in leverage variables for each of the periods, that is, γ_1, γ_2, $\gamma_{3,}$ and γ_4, are similar to the base case regression. This result suggests that firms that have been listed for at least five years, that is, firms that are not "new", display an increasing cost of debt over time. Additionally, the coefficients for variables interacted with the new firm dummy (γ_6, γ_7, $\gamma_{8,}$ and γ_9) are insignificant in all cases suggesting that entrance of new firms in the sample is not an explanation to the time-series pattern of increasing marginal cost of long-term debt documented earlier.

As a robustness test, we also investigate whether the pattern holds for firms that have been in existence throughout the sample period, that is, *Survivor firms*. We estimate Eq. (2) but redefine D_{FT} to take a value of 1 for firms that have data available in our sample for each of the 35 years, and zero otherwise. The results are presented in the last column of the table. We continue to observe a significant increase in the average marginal cost of long-term debt for non-survivor sample firms over the three decades. For survivor firms, the average marginal cost of issuing long-term debt in the 1980s was significantly more negative compared to other firms. However, the cost in the later periods has not significantly changed. In general, the results presented in this table suggest that the trend in the marginal cost of debt over time continues to persist even after controlling for changing sample composition.

4.4. The incremental cost of debt and firm characteristics

We next investigate whether changing firm characteristics can explain some of the observed trends in the changing value of long-term debt. A recent study by Kahle and Stulz (2017) documents a dramatic evolution in firm characteristics over the last four decades. Changes in firm characteristics could potentially explain the variation in the marginal value of long-term debt. For example, if growth opportunities (profitability) increase over the sample period, then the net cost of long-term debt will increase (decrease). In Table 8, we analyze each of the factors considered earlier - namely, non-debt tax shields, investment opportunities, corporate governance, financial constraints, information asymmetry, and risk - and considers proxies for each factor. We report, by decade, the mean and median value of the proxy for each factor to get a sense of the changes in sample characteristics.

As observed in Panels A and B, there is a pattern in most proxies for all firm characteristics. Compared to the 1980s, depreciation has not changed appreciably in the 1990s and the 2010s but there is an increase in tax-loss carryforwards and a decrease in

[28] The usage of decade dummies is similar to Bates et al. (2009) and Bates et al. (2017).

[29] By interacting changes in debt with the decade we are implicitly creating cohorts of debt changes by decades. This allows the possibility that these cohorts behave differently because they have different characteristics. The model specification also controls for change in the frequency of IPOs subsequent to 2000 as documented by Gao et al. (2013) and Doidge et al. (2013, 2017).

Table 7
Change in marginal cost of debt and sample composition.
The table presents results of a regression analysis of Eq. (5). The dummy variable, D_{1990s}, D_{2000s}, and D_{2010s} are set to 1 if the data corresponds to the relevant time periods, i.e. between 1990 and 1999, 2000 and 2009, and 2010 and 2014, respectively, and 0 otherwise. The firm-type dummy variable, D_{FT}, is set to 1 in model 2 (model 3) if the firm is classified as new (survivor) firm based on Compustat and CRSP. "New firms" are listed for the first time in the preceding five years, while "Survivor firms" are listed in each of the 31-year sample interval. The other independent variables are defined in Appendix A. Test statistics are based on standard errors clustered by firm. The sample includes U.S. firms from the Compustat database from 1980 to 2014 that have positive values for assets, sales, and also have valid data for total long-term debt. The sample excludes all financial firms (SIC codes 6000–6999) and utilities (4900–4999). The intercept is omitted for conciseness. Reported *p*-values (in parentheses) calculated based on standard errors that are clustered at firm level. ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively. Test statistics include White's (1980) correction for heteroskedaticity.

Firm type	Base	New firms	Survivor firms
Specification	(1)	(2)	(3)
$\Delta L_{t-1}/MV_{t-1}$	−0.20*** (0.00)	−0.21*** (0.00)	−0.19*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{1990s}$	−0.06*** (0.00)	−0.06*** (0.01)	−0.07*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2000s}$	−0.22*** (0.00)	−0.22*** (0.00)	−0.22*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2010s}$	−0.18*** (0.00)	−0.18*** (0.00)	−0.19*** (0.00)
D_{FT}		−0.01* (0.07)	0.07*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{FT}$		0.05* (0.10)	−0.13*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{1990s} * D_{FT}$		−0.01 (0.86)	0.09 (0.27)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2000s} * D_{FT}$		0.01 (0.83)	−0.05 (0.60)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2010s} * D_{FT}$		−0.12 (0.25)	0.11 (0.53)
$D_{FT} * D_{1990s}$		−0.05*** (0.00)	−0.02* (0.07)
$D_{FT} * D_{2000s}$		−0.05*** (0.00)	−0.01 (0.22)
$D_{FT} * D_{2010s}$		−0.10*** (0.00)	0.00 (0.89)
$\Delta C_t/MV_{t-1}$	0.99*** (0.00)	0.97*** (0.00)	0.98*** (0.00)
$\Delta E_t/MV_{t-1}$	0.39*** (0.00)	0.39*** (0.00)	0.39*** (0.00)
$\Delta NA_t/MV_{t-1}$	0.32*** (0.00)	0.32*** (0.00)	0.31*** (0.00)
$\Delta RD_t/MV_{t-1}$	1.06*** (0.00)	1.07*** (0.00)	1.06*** (0.00)
$\Delta I_t/MV_{t-1}$	−1.24*** (0.00)	−1.22*** (0.00)	−1.23*** (0.00)
$\Delta D_t/MV_{t-1}$	3.39*** (0.00)	3.32*** (0.00)	3.35*** (0.00)
C_{t-1}/MV_{t-1}	0.35*** (0.00)	0.36*** (0.00)	0.36*** (0.00)
L_{t-1}/MV_{t-1}	0.02*** (0.00)	0.01*** (0.00)	0.02*** (0.00)
$\Delta NE_t/MV_{t-1}$	0.46*** (0.00)	0.50*** (0.00)	0.47*** (0.00)
D_{1990s}	0.02*** (0.00)	0.04*** (0.00)	0.02*** (0.00)
D_{2000s}	0.07*** (0.00)	0.08*** (0.00)	0.07*** (0.00)
D_{2010s}	0.02*** (0.00)	0.04*** (0.00)	0.02*** (0.00)
Adj. R squared	16.79%	17.07%	16.87%
N	117,086	117,086	117,086

tax rates, suggesting that benefits of tax-shields of debt are changing over time making long-term debt less valuable. Similarly, there is an increase in investment opportunities over the sample period as the proxies are generally increasing over the three decades (and reduced only slightly since 2010), reducing the benefits of long-term debt. There is an increase in *E-Index*, suggesting governance has become less effective. Financial constraints seem to be easing; the fraction of firms with bond ratings as well as firms' cash ratios is rising. We also find that firm size is getting larger and the amount of tangible assets is decreasing, indicating an increase in the cost of issuing long-term debt. Finally, risk, proxied by standard deviation of ROA, is increasing as well. We find the values for all these variables in the 1980s are significantly different from those in the subsequent decades and the values in the 1990s are also significantly different from those in the 2000s. The trends we observe firm characteristics are largely similar to those reported in Bates et al. (2009), Kahle and Stulz (2017) and Denis and McKeon (2017) for similar time periods.

To investigate how the value of long-term debt changes with changes in each factor in a multivariate setting using the entire sample, we estimate Eq. (5) but substitute the "Firm Type" variable with the individual proxies. We present the regression results in Table 9. Due to difficulty in presenting all factors in one table, we show the results in two panels, A and B and only report coefficients for the time period dummies, change in leverage, and the interaction terms. Panel A (B) shows results for factors related to non-debt tax shields and investment opportunities (corporate governance, financial constraints, information asymmetry, and risk).

The first set of regressions in Panel A of Table 9 control for non-debt tax shield factors. Column 1 shows results using depreciation as the proxy for this factor. The coefficient of the change in leverage variable, which represents the cost of an additional dollar of long-term debt to equity holders in 1980 after controlling for the effects of depreciation, is −0.27. While this cost did not change appreciably in the 1990s, it soars dramatically in the 2000s (cost increases from \$0.27 by an additional \$0.19, to become \$0.46), before reducing slightly to become \$0.44 in 2010s. The coefficients in column 2 (3) show a similar trend of dramatic increase in the cost of an additional dollar of long-term debt over the three decades after controlling for taxes (tax-loss carryforwards). These results suggest that while investors react negatively to increases in long-term debt, the reaction is not significantly affected by changing non-tax debt shields of firms in the 1990s, 2000s, and 2010s.

Columns 4 through 6 display a similar trend in the cost of long-term debt to shareholders, when we control for proxies related to investment opportunities. Falato et al. (2013) and Corrado et al. (2009) find that intangible capital at U.S. firms has increased, resulting in different financing needs and also find that intangible assets are correlated with R&D expense. As shown in column 4

Table 8
Time series pattern of firm characteristics.
This table presents the mean (1st row) and median (2nd row) values of firm characteristics for each period of the sample period. The sample includes U.S. firms from the Compustat database from 1980 to 2014 that have positive values for assets, sales, and also have valid data for total debt. The sample excludes all financial firms (SIC codes 6000–6999) and utilities (4900–4999). Continuous variables other than Tax-loss Carryforwards, *E-Index*, and Bond ratings are winsorized at the top and bottom one percentile. Variables are as defined in Appendix B. Panel A (B) provides data for proxies related to non-debt tax shields and investment opportunities (financial constraints, governance and risk) factors.

Panel A: Non-debt tax shields & investment opportunities

	Non-debt tax shields			Investment opportunities		
Years	Dep/TA	Tax rate	Tax-loss carryforwards	R&D/TA	M/B	Technology firm
1980–1989	0.05	0.28	0.28	0.03	1.68	0.18
	0.04	0.36	0.00	0.00	1.23	0.00
1990–1999	0.05	0.22	0.30	0.06	2.07	0.22
	0.04	0.32	0.00	0.00	1.46	0.00
2000–2009	0.05	0.18	0.43	0.08	2.05	0.26
	0.04	0.27	0.00	0.01	1.50	0.00
2010–2014	0.04	0.17	0.69	0.07	2.11	0.21
	0.04	0.25	0.00	0.01	1.59	0.00

Panel B: Governance, financial constraints, information asymmetry, and risk

	Governance	Financial constraints			Information asymmetry		Risk
Years	*E-Index*	SA index	Bond ratings	Cash/TA	Assets	PPE/TA	Std. Dev. ROA
1980–1989	–	−2.43	0.09	0.13	1105.87	0.34	0.07
		−2.56	0.00	0.06	111.36	0.30	0.04
1990–1999	2.19	−2.48	0.18	0.16	1231.19	0.30	0.09
	2.00	−2.61	0.00	0.07	126.02	0.23	0.04
2000–2009	2.56	−2.71	0.25	0.22	2073.69	0.24	0.10
	3.00	−2.85	0.00	0.13	284.01	0.17	0.05
2010–2014	3.86	−2.84	0.31	0.23	3144.46	0.24	0.09
	4.00	−3.01	0.00	0.14	531.00	0.15	0.04

(5), after controlling for positive (higher than median) R&D expense (M/B), the average cost of an incremental dollar of long-term debt in the 1980s is 0.21 (0.22) which increases by 0.05 (0.07) in the 1990s, by 0.22 (0.21) in the 2000s, and by 0.20 (0.17) in the 2010s. Controlling specifically for the information technology industry, another source of intangible asset creation (Falato et al.) shows a similar trend in the cost of an additional dollar of long-term debt increasing dramatically in the 2000s compared to the 1980s, and then decrease slightly in 2010s. That we continue to observe the net cost of long-term debt to be increasing suggests that changes in investment opportunities also do not fully explain the observed trend.

As shown in column 1 of Panel B, the cost of an additional dollar of long-term debt after controlling for corporate governance (using *E-Index*), is \$0.32. The dummy variable used to proxy for governance takes a value of 1 when the *E-Index* is less than 2 (more effective corporate governance), and zero otherwise. The first year *E-Index* data is available is in 1990, so we cannot include 1990s dummy. The coefficient on the double-interaction term, capturing change in leverage with better corporate governance, is negative and significant. We interpret this negative sign to indicate that increasing long-term debt is a value decreasing proposition for firms with effective corporate governance in the 1990s. This is in line with the disciplinary effect of long-term debt (Leland and Pyle, 1977) often attributed to benefits of monitoring by bondholders reducing agency costs (Jensen, 1986) for firms with weak corporate governance. However, the higher magnitude in the later periods, indicates lower cost of long-term debt for firms with better corporate governance in the 2000s and 2010s. Dittmar and Mahrt-Smith (2007) find that the cash holdings of firms with better corporate governance are valued higher than that of firms with poor corporate governance. Our result that equity holders value increases in long-term debt at firms with better corporate governance complements these results.[30]

We next consider proxies for financial constraints. Market value of firms having higher SA Index increases with debt. Increasing long-term debt was valued positively by investors of firms with high SA index in the 2000s, as indicated by the positive tripe-interaction term, although not statistically significant. However, the results for the other two proxies of financial constraints do not provide evidence that shareholders' valuation of marginal debt is impacted by constraints; the coefficients for the change in debt interacted with the decade dummies are similar to the base case scenario in Table 7, model 1. We do find some evidence that information asymmetry affects the value of additional debt to shareholders in the 1990s. However, this result is sensitive to

[30] We do not have a 1990s indicator variable in this regression because data for *E*-Index is available starting 1990.

Table 9

The table presents results of a regression analysis of Eq. (5). The dummy variable, D_{1990s}, D_{2000s}, and D_{2010s} are set to 1 if the data corresponds to the relevant time periods, i.e. between 1990 and 1999, 2000 and 2009, and 2010 and 2014, respectively, and 0 otherwise. The other independent variables are defined in Appendix B. Test statistics are based on standard errors clustered by firm. The sample includes U.S. firms from the Compustat database from 1980 to 2014 that have positive values for assets, sales, and also have valid data for total long-term debt. The sample excludes all financial firms (SIC codes 6000–6999) and utilities (4900–4999). The intercept is omitted for conciseness. Panel A (B) provides results for proxies related to non-debt tax shields and investment opportunities (Governance, Financial Constraints, Information Asymmetry, and Risk) factors. Panel C provides results when one proxy from multiple factors, as indicated, is picked simultaneously. For Non-Debt Tax Shield we pick the proxy indicating presence of tax-loss carryforwards, for Investment Opportunities we use the market-to-book ratio, for Financial Constraints we pick cash and for Information Asymmetry we pick asset size. Reported p-values (in parentheses) calculated based on standard errors that are clustered at firm level. ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively. Test statistics include White's (1980) correction for heteroskedaticity.

Panel A: Non-debt tax shields & investment opportunities

Factor	Non-debt tax shields			Investment opportunities		
Proxy	Dep/TA	Tax rate	Tax-loss carryforwards	R&D > 0	M/B > median	Technology firm
Specification	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta L_{t-1}/MV_{t-1}$	−0.27*** (0.00)	−0.17*** (0.00)	−0.23*** (0.00)	−0.21*** (0.00)	−0.22*** (0.00)	−0.20*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{1990s}$	0.00 (0.96)	−0.08*** (0.00)	−0.06*** (0.01)	−0.05*** (0.01)	−0.07*** (0.00)	−0.07*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2000s}$	−0.19*** (0.00)	−0.25*** (0.00)	−0.18*** (0.00)	−0.22*** (0.00)	−0.21*** (0.00)	−0.21*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2010s}$	−0.17*** (0.01)	−0.21*** (0.00)	−0.16** (0.02)	−0.20*** (0.00)	−0.17*** (0.00)	−0.19*** (0.00)
Proxy	−0.33*** (0.00)	0.07*** (0.00)	−0.06*** (0.00)	0.09 (0.14)	−0.01** (0.05)	0.02** (0.03)
$(\Delta L_{t-1}/MV_{t-1})$ * Proxy	1.35*** (0.00)	−0.13*** (0.00)	0.09*** (0.00)	0.84 (0.11)	0.09*** (0.00)	0.02 (0.74)
$(\Delta L_{t-1}/MV_{t-1}) * D_{1990s}$ * Proxy	−1.30*** (0.01)	0.05 (0.38)	0.01 (0.79)	−0.82 (0.21)	0.02 (0.63)	0.09 (0.18)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2000s}$ * Proxy	−0.67 (0.33)	0.10* (0.09)	−0.09* (0.08)	−0.71 (0.27)	0.02 (0.72)	−0.09 (0.29)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2010s}$ * Proxy	−0.36 (0.73)	0.15 (0.11)	−0.06** (0.48)	0.36 (0.67)	−0.02 (0.80)	0.08 (0.54)
Proxy * D_{1990s}	0.79*** (0.00)	−0.05*** (0.00)	0.05*** (0.00)	0.24*** (0.00)	−0.02** (0.02)	0.07*** (0.00)
Proxy * D_{2000s}	1.03*** (0.00)	−0.02 (0.25)	0.04*** (0.00)	−0.20*** (0.00)	−0.09*** (0.00)	−0.05*** (0.00)
Proxy * D_{2010s}	0.57*** (0.01)	−0.03** (0.04)	0.05*** (0.00)	−0.38*** (0.00)	−0.02 (0.15)	−0.04*** (0.00)
D_{1990s}	−0.02** (0.02)	0.04*** (0.00)	0.01 (0.17)	0.01* (0.10)	0.03*** (0.00)	0.00 (0.30)
D_{2000s}	0.02** (0.02)	0.08*** (0.00)	0.06*** (0.00)	0.08*** (0.00)	0.11*** (0.00)	0.08*** (0.00)
D_{2010s}	0.00 (0.74)	0.04*** (0.00)	0.01* (0.09)	0.04*** (0.00)	0.03*** (0.00)	0.03*** (0.00)
Adj. R squared	16.89%	16.85%	16.85%	16.91%	16.98%	16.92%
N	116,923	117,076	117,086	117,086	117,084	117,086

Panel B: Governance, financial constraints, information asymmetry and risk

Factor	Governance	Financial Constraints			Information Asymmetry		Risk
Proxy	*E-Index* (more effective)	SA index	Bond ratings	Cash/TA > median	Assets > median	PPE/TA > Median	Std. Dev. ROA > median
Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta L_{t-1}/MV_{t-1}$	−0.32*** (0.00)	0.06 (0.33)	−0.20*** (0.00)	−0.20*** (0.00)	−0.19*** (0.00)	−0.24*** (0.00)	−0.27*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{1990s}$	–	−0.09 (0.37)	−0.07*** (0.01)	−0.08*** (0.00)	−0.06*** (0.01)	0.02 (0.55)	−0.03 (0.25)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2000s}$	−0.30*** (0.00)	0.19 (0.17)	−0.18*** (0.00)	−0.25*** (0.00)	−0.21*** (0.00)	−0.17*** (0.00)	−0.18*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2010s}$	−0.13* (0.08)	0.14 (0.67)	−0.22*** (0.00)	−0.13*** (0.01)	−0.18*** (0.00)	−0.15** (0.03)	−0.16*** (0.00)
Proxy	0.02 (0.12)	−0.01 (0.22)	−0.02 (0.15)	−0.02*** (0.00)	0.00*** (0.00)	−0.06*** (0.00)	−0.42*** (0.00)
$(\Delta L_{t-1}/MV_{t-1})$ * Proxy	−0.16** (0.04)	0.11*** (0.00)	0.02 (0.62)	0.00 (0.87)	0.00*** (0.00)	0.13** (0.02)	0.92*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{1990s}$ * Proxy	–	−0.01 (0.78)	−0.05 (0.37)	0.04 (0.35)	0.00 (0.38)	−0.25*** (0.00)	−0.40** (0.04)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2000s}$ * Proxy	0.24** (0.04)	0.14*** (0.01)	−0.22*** (0.00)	0.12** (0.04)	0.00 (0.51)	−0.13 (0.20)	−0.51** (0.03)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2010s}$ * Proxy	0.02 (0.93)	0.10 (0.37)	−0.02 (0.84)	−0.21** (0.02)	0.00 (0.45)	−0.08 (0.59)	−0.46 (0.15)
Proxy * D_{1990s}	–	0.02** (0.04)	0.00 (0.77)	0.02** (0.02)	0.00 (0.20)	0.01 (0.58)	0.40*** (0.00)
Proxy * D_{2000s}	−0.01 (0.58)	−0.04*** (0.00)	0.07*** (0.00)	−0.07*** (0.00)	0.00 (0.38)	0.20*** (0.00)	0.24*** (0.00)
Proxy * D_{2010s}	−0.03 (0.37)	−0.11*** (0.00)	0.08*** (0.00)	−0.06*** (0.00)	0.00** (0.04)	0.04 (0.14)	0.08 (0.25)
D_{1990s}	–	0.06*** (0.00)	0.01 (0.18)	0.01* (0.09)	0.02*** (0.00)	0.01* (0.09)	0.01 (0.23)
D_{2000s}	0.07*** (0.00)	−0.05** (0.06)	0.04*** (0.00)	0.10*** (0.10)	0.06*** (0.00)	0.01 (0.31)	0.07*** (0.00)
D_{2010s}	0.03*** (0.00)	−0.29*** (0.00)	−0.01 (0.14)	0.05*** (0.00)	0.01** (0.04)	0.01 (0.50)	0.04*** (0.00)
Adj. R squared	15.68%	17.02%	17.63%	16.94%	16.85%	16.86%	17.24%
N	22,186	117,086	117,086	117,086	117,086	117,086	96,028

Table 9 (*continued*)

Panel C: Multiple factors simultaneously.

		Non-debt tax shields	Investment opportunities	Financial constraints	Information asymmetry
$\Delta L_{t-1}/MV_{t-1}$	−0.144*** (0.00)				
$(\Delta L_{t-1}/MV_{t-1}) * D_{1990s}$	−0.100*** (0.01)				
$(\Delta L_{t-1}/MV_{t-1}) * D_{2000s}$	−0.209*** (0.00)				
$(\Delta L_{t-1}/MV_{t-1}) * D_{2010s}$	−0.154** (0.05)				
Proxy		0.070*** (0.00)	−0.008 (0.23)	−0.012* (0.09)	0.005 (0.46)
$(\Delta L_{t-1}/MV_{t-1})$ * Proxy		−0.107*** (0.00)	0.068** (0.02)	−0.010 (0.72)	−0.094*** (0.00)
$(\Delta L_{t-1}/MV_{t-1}) * D_{1990s}$ * Proxy		0.051 (0.38)	0.031 (0.53)	0.022 (0.60)	0.028 (0.47)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2000s}$ * Proxy		0.099* (0.09)	0.005 (0.94)	0.088 (0.13)	−0.056 (0.25)
$(\Delta L_{t-1}/MV_{t-1}) * D_{2010s}$ * Proxy		0.109 (0.23)	−0.006 (0.95)	−0.214** (0.02)	−0.004 (0.96)
Proxy * D_{1990s}		−0.050*** (0.00)	−0.029*** (0.00)	0.029*** (0.00)	−0.007 (0.45)
Proxy * D_{2000s}		−0.030** (0.03)	−0.076*** (0.00)	−0.040*** (0.00)	0.011 (0.26)
Proxy * D_{2010s}		−0.050*** (0.00)	−0.001 (0.92)	−0.037*** (0.00)	0.059*** (0.00)
D_{1990s}	−0.008 (0.49)				
D_{2000s}	0.076*** (0.00)				
D_{2010s}	−0.165*** (0.00)				
Adj. R squared	17.37%				
N	117,074				

the proxy used and is not strong when we use firm size. Finally, the last column presents the results for risk. Once again, we find that the coefficients for changes in debt across the three decades are similar to the base case scenario.

Considering these factors do not operate in isolation, in Panel C we present the regression results when we consider many of the factors simultaneously using only one proxy for each factor. For Non-debt Tax Shields we pick the proxy indicating presence of tax-loss carryforwards, for Investment Opportunities we use the market-to-book ratio, for Financial Constraints we select cash, and for Information Asymmetry we choose asset size. We exclude the Governance factor as data is not available prior to 1990 and Risk as the regression is non-singular. For ease of exposition we report results for the different factors in separate columns. We find that even after controlling for the factors simultaneously, there continues to be an increase in the marginal cost of debt over time and the coefficients for the change in debt variable continues to be significant.[31] However, relative to the base case scenario (Table 7, model 1) we find that these factors do play a role in explaining the time series pattern. For example, in the base case the coefficient for 2000s was −0.42 (−0.20–0.22) and this declines (becomes less negative) to −0.353 (−0.144–0.209). The similar numbers for 2010s are −0.38 and −0.298, for the base case and when including a representative factor from each category, respectively. Thus, we conclude that even though changes in firm-specific characteristics explain some of the variation in the cost of debt over the sample period, the pattern documented earlier continues to persist.

4.5. Marginal cost of debt and macroeconomic factors

Results presented so far suggest that firm characteristics provide only a limited explanation of the time series trend in the marginal value of debt to shareholders. To complete our analysis, we examine whether the value of debt to shareholders is affected by macroeconomic factors. Several studies argue that macroeconomic factors play a major role in firms' debt choices. For example, Greenwood, Hanson, and Stein (2010) suggest that clienteles for different debt maturity structures explain firm's debt issuance decisions, which they refer to as the gap-filling theory. Similarly, Badoer and James (2016) find that debt issued by corporations is impacted by the supply of long-term government bonds. They find a negative relation between investment grade long-term bonds (with duration > 20 years) and the proportion of long-term U.S. Treasury bonds, consistent with the gap-filling hypothesis.

Graham et al. (2015) extend this argument by examining the relation between corporate and federal debt. They argue that government debt crowds out corporate debt – that an increase in the supply of federal debt significantly reduces the demand for corporate debt. Consistent with this, they document a negative relation between government borrowing and corporate debt issuance. They conclude that the time series pattern in leverage in U.S. firms can be explained, to a certain extent, by the U.S. federal debt issuance. In the context of our paper, these results imply that federal debt might have a significant impact on shareholders' valuation of incremental debt.

We find a negative correlation (coefficient −0.187) between the U.S. federal debt issued, as a fraction of U.S. Gross Domestic Product (GDP), and our calculated annual value of cost of incremental debt. This suggests that as the fraction of federal debt issued increases, the marginal cost of debt to shareholders increases as well. This is in line with the interpretation that federal debt crowds out corporate debt by making corporate debt issuance more costly for firms.

[31] We consider several other combinations of proxies from each of the factors and find similar conclusions for our main variables. We exclude them for brevity.

Table 10
Marginal cost of debt and macroeconomic factors.
The table presents results of a regression analysis of Eq. (6). Federal Debt/GDP is the percentage of federal debt to the country's GDP, Spread is the difference in interest rates of BAA and AAA rated bonds, S&P Return is the annual returns for the S&P 500 index, Sentiment Index is obtained from Baker and Wurgler (2006), Dot-Com Dummy takes the value of 1 for 1998 and 1999 and 0 otherwise, and Crisis Dummy takes the value of 1 for the years 2007 to 2009 and 0 otherwise. ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively.

Specification	(1)	(2)	(3)
Intercept	−0.03 (0.70)	−0.03 (0.75)	0.01 (0.97)
Federal Debt/GDP	−0.50*** (0.00)	−0.50*** (0.00)	−0.52* (0.09)
Spread			−0.01 (0.94)
S&P Return			0.06 (0.57)
Sentiment Index		−0.00 (0.91)	−0.01 (0.89)
Dot-Com Dummy	−0.20*** (0.00)	−0.20*** (0.00)	−0.21*** (0.00)
Crisis Dummy	0.21* (0.07)	0.21* (0.07)	0.21 (0.18)
Adj. R squared	23.21%	23.23%	23.21%
N	35	35	35

To further examine this relation in a multivariate setting, we regress the annual value of incremental debt (obtained from Eq. (1)) on the fraction of federal debt to GDP controlling for several of the macro variables of Graham et al. (2015) and McLean and Palazzo (2016). We introduce additional macro variables that can have a potential impact on corporate debt; the Sentiment Index from Baker and Wurgler (2006) and dummy variables for the Dot-Com bubble and the recent Financial Crisis. We therefore estimate the following regression:

$$\text{Annual Cost}_t = \alpha + \beta_1 * \text{Federal Debt/GDP}_t + \beta_2 * \text{Spread}_t + \beta_3 * S\&P \text{ Return}_t + \beta_4 * \text{Investor Sentiment}_t + \beta_5 * \text{Dot-Com Dummy} + \beta_6 * \text{Crisis Dummy} + \varepsilon_t \quad (6)$$

where Annual Cost is obtained from estimating Eq. (1) for our sample firms annually, Federal Debt/GDP is the U.S. federal-debt-to-GDP ratio, S&P Return is the return on the S&P500 index, Spread is the difference in interest rate between BAA-rated and AAA-rated corporate bonds, Investor Sentiment is from Baker and Wurgler (2006), the Dot-Com dummy takes a value of 1 for years 1998 and 1999 and 0 otherwise, the Crisis Dummy takes on the value of 1 for years between 2007 and 2009, and 0 otherwise, and the subscript t represents the time period.

We estimate different specifications of Eq. (6) and report the results in Table 10. In model 1, the coefficient for the Federal Debt/GDP variable is −0.50, and statistically significant. That is, a 10% increase in the supply of federal debt increases the cost of corporate debt by 5%. Given the average annual cost of increasing debt based on Table 4 is −$0.28, this translates to an increase of −$0.014. This result holds in different regression specifications suggesting that the fraction of federal borrowing is a significant driver of the cost of debt. We also find the coefficient for the Dot-Com dummy to be −0.20 and significant (p-value of 0.00) which suggests that during the dot-com bubble, the benefit of debt to shareholders decreased. During the financial crisis, the net cost to shareholders of issuing decreased, that is, the coefficient is positive. A possible explanation for this finding is that during this interval capital flow was severely restricted and issuing debt in these conditions would be viewed positively.[32] However, this result is not robust as the coefficient is insignificant in model 3. In general the results indicate that the value of debt changes during certain events and that macroeconomic factors play an important role in explaining the time-series variation in the cost to shareholders of issuing additional debt.

5. Conclusion

There has been a persistent decline in long-term leverage ratios among non-financials and unregulated U.S. firms between 1980 and 2010. The median (average) firm reports a decrease in debt-to-asset ratio of about 47 (29) percent over the interval, falling from 25.10 (26.78) percent in 1980 to 13.39 (19.04) percent in 2010. While there is a subsequent marginal increase in leverage until 2014, the ratios are significantly lower than those in the 1980 to 2000 interval. The pattern is pervasive and is observed for firms classified by leverage or by other factors that the literature has shown to affect capital structures. This general trend contradicts the conclusion of theoretical models of Graham (2000) and Binsbergen et al. (2010) that firms are under-levered and should be increasing leverage to maximize firm value but support the empirical findings of Michaely et al. (2017) and Kahle and Stulz (2017).

We investigate whether the time-series trend in leverage can be explained by the cost-benefit tradeoff of debt to *shareholders*. We argue that this approach provides a more comprehensive analysis than the one taken by previous studies that examine this issue from the firm's viewpoint because equity holders are expected to incorporate all of the costs and benefits of debt in determining the net valuation impact of increasing debt.

Using a methodology similar to Faulkender and Wang (2006), we estimate the value that a firm's owners assign to an incremental dollar of debt. We document that the average annual value to equity holders of issuing a dollar of additional debt over the

32 See Campello et al. (2011). The study finds that access to credit lines was beneficial and important as it allowed firms to make capital and other “real side” investments.

sample period is -$0.28 which translates to a decline in shareholder wealth of approximately 0.64%. This result suggests that equity investors do not view firms to be under-levered and therefore issuing additional debt does not increase shareholder value as suggested by previous studies.

We also report that the net cost (benefit) to shareholders of issuing additional debt has been steadily increasing (declining) over most of the sample period and this trend holds for groups of firms classified on different dimensions. The time-series pattern of increasing net costs of debt coincides with the general persistent decline in leverage. We find that the decreasing value of debt to equity holders is an explanation for the observed trend of decreases in leverage; firms are more likely to reduce (increase) leverage when the estimated annual cost of debt is high (low) and that the annual change in debt levels is significantly related to the net costs to shareholders.

We investigate explanations for the time series pattern in the marginal costs of debt. We find that the trend in costs holds even after controlling for changing sample composition resulting from the entrance of new firms. There is limited support that firm-specific characteristics can explain the cost pattern; the time-series trend holds even after simultaneously controlling for several factors that are known to impact capital structure policies. We find that certain macroeconomic factors are significant in explaining the variation in the marginal value of debt; an increase in government borrowing negatively impacts the cost of corporate debt, consistent with Graham et al.'s (2015) argument that federal debt competes and crowds out corporate debt. The marginal cost of debt to shareholders is also impacted by certain time periods; shareholders' view issuing debt to be more expensive during the Dot-Com bubble and less expensive during the recent financial crisis. We leave for future investigation whether the changing ownership structure (Jensen and Meckling, 1976) of U.S. firms, led by the documented increase in the role of institutional investors (Michaely et al., 2017), is changing how shareholders value an additional dollar of debt.

Appendix A. Groups of firm based on time and firm characteristics

To create different groups of firms based on time and firm characteristics, we first create groups based on time period. We roughly divide the sample period into decades (1980–1989, 1990–1999, and 2000–2019) and create one additional group for the remaining five years (2010–2014) of the sample period. We further divide the period groups into different groups based on either rank (quartiles, or above/below median) or presence/absence of a particular proxy variable for the factor. We consider six factors and for each factor we consider multiple groups based on one or more proxies. In this appendix, we list the factors considered and the proxies for each factor. Together, the six factors result in 43 groups per decade.

A.1. Factor: Non-debt tax shields

For this factor we consider the following three proxies resulting in 10 groups.

1. Depreciation: We consider groups based on quartiles of the variable *Dep/TA*.
2. Taxes: We consider groups based on quartiles of the variable *Tax Rate*.
3. Tax-loss Carryforward: We consider groups based on the variable *Tax-loss Carryforwards*. If the value of this variable is 1 (zero), the firm year observation is considered to be part of the group "Yes" ("No").

A.2. Factor: Investment opportunities

For this factor we consider the following three proxies resulting in 9 groups.

1. R&D: We consider groups based on the variable *R&D/TA*. We consider three groups: one where R&D/TA is missing or zero, two where the value of R&D/TA is below the sample median, and three where this value is above median.
2. Market-to-Book: We consider groups based on quartiles of the variable *M/B*.
3. Industry Classification: We consider two groups for industry classification. One where the variable *Technology Firm* takes a value of 1 and the second where it takes a value of zero (i.e. *Non-technology Firm*). As defined in Appendix B, membership in these groups is based on industry definition in Loughran and Ritter (2004).

A.3. Factor: Corporate governance

For this factor we consider the following one proxy resulting in 2 groups.

E-Index (Governance): We consider groups based on the variable *E-Index*. If an observation has an *E-Index* value lower (higher) than 2, it is part of the group "more effective." ("less effective"). *E-Index* data is only available after 1990

A.4. Factor: Financial constraints

For this factor we consider the following three proxies resulting in 10 groups.

1. SA Index: We consider groups based on quartiles of the variable *SA Index*.
2. Bond Ratings: We consider two groups based on 1 or zero values of the variable *Bond Ratings*.
3. Cash: We consider groups based on quartiles of the variable *Cash/TA*.

A.5. Factor: Information asymmetry

For this factor we consider the following two proxies resulting in 8 groups.
Assets: We consider groups based on quartiles of the variable *Assets*

1. PPE/TA: We consider groups based on quartiles of the variable *PPE/TA*.

A.6. Factor: Risk

For this factor we consider the following one proxy resulting in 4 groups.
Standard deviation of ROA: We consider groups based on quartiles of the variable *Std. Dev. ROA*.

Appendix B. Variable definitions

AT Book value of assets (Compustat item: AT).
Assets The book value of total assets (AT), adjusted for inflation, in 2010 dollars.
Bond Ratings Binary variable that takes a value of 1 if a firm year observation has existing bond ratings in the COMPUSTAT database (SPLTICRM), zero otherwise.
Cash/TA Cash (CHE) divided by total assets (AT).
Crisis Dummy Binary variable that takes a value of 1 if the time is between 2007 and 2009, zero otherwise.
Debt Financing New debt issued (DLTIS) divided by the sum of new debt issued (DLTIS) plus New equity issued (SSTK).
Dep/TA Depreciation (DP) divided by total assets (AT).
Div/TA Dividends (DVC + DVP) divided by total assets (AT).
Dot-Com Dummy Binary variable that takes a value of 1 if the time is either 1998 or 1999, zero otherwise.
E-Index The Corporate governance index of Bebchuk et al. (2009) based on six provisions in the Risk Metrics database.
GDP Change The yearly percent change in real gross domestic product extracted from the Bureau of Economic Analysis website (http://www.bea.gov).
Leverage Long-term debt (DLTT + DLC) divided by total assets (AT). Also see *L*.
Marginal Cost of Debt Coefficient γ_1 on the change in Leverage variable in Eq. (1) of the paper, estimated annually for each year in the sample period.
D_{1990s} Binary variable that takes a value of 1 if the year is between 1990 and 1999, zero otherwise
D_{2000s} Binary variable that takes a value of 1 if the year is between 2000 and 2009, zero otherwise.
D_{2010s} Binary variable that takes a value of 1 if the year is between 2010 and 2014, zero otherwise.
M/B Total Assets (AT) less common equity (CEQ) and deferred taxes (TXDB) plus market value of equity (PRCC_F * CSHO) divided by total assets (AT).
Net Debt Financing New debt issued (DLTIS) minus old debt repurchased (DLTR) divided by the sum of new debt issued (DLTIS) plus new equity issued (SSTK).
Net Leverage Long-term debt (DLTT + DLC) minus cash (CHE) divided by total assets (AT).
New Firms A firm is classified as new if earliest data for the firm is available in Compustat only within the last five years.
PPE/TA Net property, plant, and equipment (PPENT) divided by total assets (AT).
ROA Earnings before interest (NI + XINT) divided by total assets (AT).
R&D/TA Research and development expenses (XRD) divided by total assets (AT).
Std. Dev. ROA Standard deviation of unadjusted return on assets (*ROA*) for the five preceding years.
SA Index Hadlock and Pierce's (2010) index of financial constraints.
S&P Return Annual return on the Standard and Poor's 500 equity index.
Sentiment Index Investor sentiment index as defined in Baker and Wurgler (2006).
Survivor Firms A binary variable that takes a value of 1 for a firm if the firm is listed on the Compustat database for the entire 35-year sample period.
Tax Dummy 1987–1993 Binary variable that takes a value of 1 if the year is between 1987 and 1993, zero otherwise.
Tax Dummy 1984–2010 Binary variable that takes a value of 1 if the year is between 1984 and 2010, zero otherwise
Tax Rate Income Taxes (TXT) divided by net income (NI) plus income taxes (TXT).
Technology Firm A binary variable that takes a value of 1 if a firm is classified as technology based on the SIC codes of Loughran and Ritter (2004), zero otherwise. Observations
where this variable takes a value of zero are also referred to as *Non-technology firms*.
Tax-loss Carryforward Tax Loss Carry Forward (TLCF) divided by total assets (AT). If this value is non-missing, then the binary variable takes a value of 1 (or Yes), zero (or No) otherwise.
Yield Curve The difference between a 10 year U.S. Treasury bond and a 3 month U.S. Treasury bill.
Zero-Debt Dummy Binary variable that takes a value of 1 if the firm has zero debt (see definition for *L*), zero otherwise.

B.1. Faulkender and Wang (2006) variables:

$r_{i,t}$-$R_{i,t}$ The return on a firm *i*'s stock adjusted by the return on the closest of the 25 size and book-to-market matched portfolio, see Fama and French (1993).

MV Market value of equity (PRCC_F * CSHO).

E Earnings before extraordinary items (IB), plus deferred taxes (TXDI), plus tax credits (ITCI).

RD Research and development expenses (XRD).

L(*FW*) Market Leverage, as defined in Faulkender and Wang (2006).

L Long-term debt (DLTT + DLC). Also see definition for *Leverage*. ΔL is the change in leverage between year *t*-1 and *t*.

C Cash (CHE).

D Dividends (DVC + DVP).

I Interest Expense (XINT).

NE Net equity financing is equity issuance (SSTK) less repurchases (PSTKC).

NA Assets net of cash (AT - CHE).

B.2. Fama and French (1998) and Pinkowitz and Willaimson (2002) variables:

NDA Non debt financed assets (AT – DLTT - DLC).

M Same as market-to-book ratio as defined in Pinkowitz and Willaimson (2002).

ΔX_t Change in *X* between year *t*-1 and *t*. X can be *E*, *NA*, *NDA*, *RD*, *D*, *I*, or *M*.

ΔX_{t+2} Change in *X* between year *t*-2 and *t*. X can be *E*, *NA*, *NDA*, *RD*, *D*, *I*, or *M*.

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