Corporate Leverage and Investment

By W. Blake Marsh, David Rodziewicz, and Karna Chelluri

The sustained growth in corporate debt over the past decade has revived concerns about potential risks to financial stability and economic growth. Highly indebted firms are more likely to default in the event of an economic downturn, which could constrain lending to businesses and households as lender balance sheets weaken. Given the substantial economic costs of severe financial strains, such as the high unemployment and tepid wage growth evident during the Great Recession, these concerns are not unfounded. However, extreme indebtedness may affect a firm's decision-making even in the absence of increased financial stability risks. Elevated corporate debt can discourage future investment and spending on capital equipment, thereby leading to lower realized economic growth today and reduced productive capacity in the longer run.

High levels of leverage—that is, high levels of debt relative to assets or income—can restrict firms' ability to finance new investment in several ways. Most importantly, leverage requires firms to make debt service payments, which reduce net income that could otherwise finance future investment. At the same time, higher debt levels drive credit costs up as default risk rises, incentivizing firms to invest in riskier projects with greater expected returns to recoup their funding costs. In an

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extreme case known as debt overhang, investors may be unwilling to finance new firm investments if they fear that any investment returns will be claimed by more senior debt holders.

In this article, we examine the relationship between high corporate leverage and future firm investment spending on structures, machinery, and equipment. In other words, we examine how debt influences the growth of a firm's capital stock or fixed assets. We find that, on average, more leveraged firms across industries tend to have lower levels of investment activity in the future. Specifically, we find that the negative relationship between debt and investment is strongest for the most highly indebted firms and is evident in both economic downturns and expansions.

Section I explores the rise of corporate leverage in recent years and discusses channels through which indebtedness can affect investment decision-making. Section II introduces a regression model to estimate the relationship between firm indebtedness and investment spending. Section III shows that highly leveraged firms spend less on investment, a result that is consistent over time and throughout the business cycle.

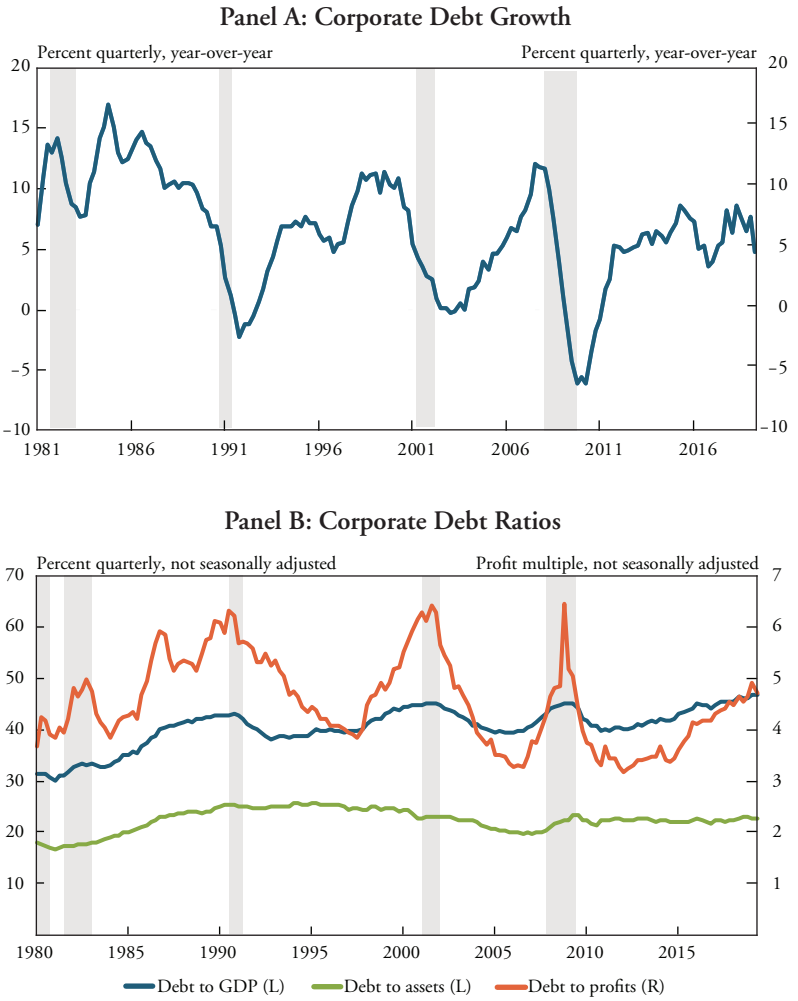
I. The Relevance of Leverage and Investment

Corporate debt growth has been prominent during the recovery from the 2008 financial crisis. Panel A of Chart 1 shows that after a dramatic decline during the post-crisis recession, growth in outstanding corporate debt increased sharply during the subsequent recovery. Since 2011, growth in outstanding corporate debt has consistently averaged more than 5 percent year-over-year, with only one period of tepid growth during the mild 2015–16 economic slowdown.

Sustained growth in corporate debt has consequently driven aggregate leverage measures higher in the United States. Panel B of Chart 1 shows three such measures: the debt-to-GDP ratio, the debt-to-profits ratio, and the debt-to-assets ratio. Specifically, Panel B shows that total outstanding corporate debt has reached an all-time high relative to GDP, as the debt-to-GDP ratio (blue line) has climbed steadily higher during the recovery. Similarly, the debt-to-profits ratio (orange line) has reached post-crisis highs and continues to climb, but to date remains within its longer-run historical range. While these ratios are a rough proxy for firms' ability to repay outstanding debt, they do not fully convey the value of the collateral backing outstanding debt.

Chart 1

Corporate Debt Growth and Leverage



Notes: Gray bars denote National Bureau of Economic Research (NBER)-defined recessions. Corporate debt includes debt securities and bank loans. Profits are corporate profits before tax with inventory valuation and capital consumption adjustments.

Sources: Federal Reserve Board Flow of Funds (Z.1) Release and NBER.

The debt-to-assets ratio (green line), which accounts for this value, has increased modestly during the post-crisis recovery, reflecting that firms have also accumulated assets as debt growth has accelerated.[1]

High levels of leverage may factor into corporate decision-making through their effect on profit usage and increased firm riskiness. One of the primary uses of firm debt is financing new investment projects.[2] However, researchers are divided on whether debt acts as a disciplining device or a deterrent for investment spending. On the one hand, debt requires firm managers to make payments to bondholders, who can claim the assets of the firm under bankruptcy. This promise to pay could incentivize firms to invest prudently in projects that increase the value of the firm and generate income sufficient to cover debt liabilities (Jensen 1986). On the other hand, debt reduces internal funds available for investment and increases firms' default probability, thereby increasing the cost of future debt issuance. In extreme cases, investors may be unwilling to issue new equity financing because any investment returns will accrue to existing bondholders, a condition known as debt overhang (Meyers 1977). [3]

Most previous studies generally find a negative relationship between debt and investment, though these studies disagree on when the relationship affects firm behavior. For example, Lang, Ofek, and Stulz (1996) test debt overhang theories for the 1970–89 period and find a negative relationship only for firms that have poor investment opportunities. Other studies have found a more widespread relationship between debt and investment. Kalemli-Özcan, Laeven, and Moreno (2019), for example, find that European firms with high levels of debt—particularly those with more short-term debt or that are reliant on weak banks for funding—reduced investment during recent European banking crises. Borensztein and Ye (2018) find a negative relationship between leverage and investment for firms in emerging market countries driven primarily by highly leveraged firms. In contrast, Popov and others (2018) find that highly leveraged European firms in their sample actually invest *more* if they have promising investment opportunities; the negative relationship they find between leverage and investment is instead largely driven by firms with greater short-term debt levels.

II. Measuring Leverage and Investment

To assess whether the negative relationship between indebtedness and investment holds more contemporaneously among U.S. public firms, we collect quarterly public financial filings from the S&P Global Market Intelligence Compustat database.[4] Our sample includes firms incorporated in the United States that reported filings in U.S. dollars from 1985:Q1 to 2019:Q2.[5] We drop firms in the real estate and finance sectors, firms without industry classifications, firms with acquisitions larger than 5 percent of their total assets, international firms trading on U.S. exchanges (American depository receipts or "ADRs"), and firms with fewer than 12 reporting quarters.[6]

We follow previous studies in creating two investment measures. Our first investment measure—capital expenditure or "capex"—is a firm's spending on acquiring, maintaining, and upgrading physical assets. We divide reported capex over a four-quarter period by average total assets to generate a firm-specific measure of capital spending relative to size. Our second investment measure is the growth of a firm's capital stock over a given horizon. We follow Ottonello and Winberry (2019) to construct a firm's capital stock as its initial stock of gross property, plant, and equipment (PP&E). We then add net changes in PP&E over the subsequent quarter.[7] The change in the capital stock is approximately equal to capex spending over a given horizon. Therefore, the capital stock growth rate is roughly equivalent to capex spending scaled by total capital stock in the base period. Following Ottonello and Winberry (2019), we trim outliers in these investment measures outside the 1st and 99th percentiles.

We use a standard leverage definition of the total book value of a firm's debt divided by the total book value of its assets.[8] Using book values of debt and assets omits the influence of market default expectations on firm investment. Moreover, using book values yields a more stable leverage measure: unlike some leverage measures, such as the ratio of debt to earnings before interest, tax, depreciation, and amortization (EBITDA), our measure is not subject to sharp profitability and market changes. Thus, our measure better reflects a firm's desired leverage level rather than the level obtained due to changes in the business cycle.[9]

We include several firm characteristics in the regression to control for differences in firms' profitability, size, and past investment patterns,

which influence future investment beyond firms' leverage levels. For example, larger firms are more likely to have access to productive capital, such as new technologies, and can thus vary their capital intensity in ways small firms cannot. As a result, we include the log of total assets as a proxy for firm size. In addition, firms with more total cash flow generated through lower expenses or greater sales growth are likely to have more internal funds available for investment. To control for these differences in profitability and thereby funds available for investment, we include sales growth and the ratio of cash flow to total assets. We also include lagged capex as a share of fixed assets to control for persistence in firm investment.

Our final sample includes 379,966 unique company-quarter observations drawn from 11,706 unique companies. Table 1 shows summary statistics for the variables of interest after eliminating the capex-to-assets outliers. On average, firms in our sample have a debt-to-assets ratio of about 31 percent and an average three-year capital growth of 10 percent. The median firm holds about $160 million in total assets, while the average firm holds over $2.6 billion, indicating that our sample includes many extremely large firms as measured by total assets. On average, firms in our sample increase sales about 1 percent annually, which generates a cash flow of about 11 basis points relative to assets.

To examine the relationship between leverage and firm investment, we estimate the following model:

$$investment_{i,s,t+h} = \alpha_0 + \alpha_1 leverage_{i,s,t} + \alpha_2 X_{i,s,t} + \gamma_i + \eta_{s,t} + \varepsilon_{i,s,t}, \quad (1)$$

where $investment_{i,s,t+h}$ denotes investment at firm i in sector s at some future horizon $t+h$, $X_{i,s,t}$ denotes a set of firm characteristics, γ_i denotes firm fixed effects, and $\eta_{s,t}$ denotes sector-time fixed effects.[10]

We include firm fixed effects to allow us to control for time-invariant firm characteristics. Such characteristics may include long-run management strategies, firm investment culture, or other time-invariant or slow-moving changes unique to a specific firm. More concretely, the firm fixed effect estimates a firm-specific parameter that represents the average relative capital spending or capital stock growth of a firm over the full sample. Thus, the fixed effect captures the investment strategy or philosophy unique to a firm and controls for differentials that may arise between firms that are more risk-averse or that otherwise pursue different investment strategies.

Table 1

Summary Statistics

Variable	Mean	Standard deviation	25th percentile	Median	75th percentile
Debt/assets	31.34	43.41	7.57	24.55	41.17
Cash flow/assets	0.11	51.95	–1.18	0.81	3.56
Sales growth	0.91	23.28	–2.40	0.68	4.03
Log assets	5.09	2.52	3.28	5.07	6.90
Assets	2,627.09	15,350.79	26.54	158.46	981.58
Tobin's Q	1.61	1.32	0.90	1.32	1.89
Capex/fixed assets	6.62	229.20	1.89	4.02	7.78
Capital growth (one year)	2.35	26.83	–6.71	0.80	10.21
Capital growth (three years)	10.20	57.40	–13.62	7.90	32.85

Notes: Assets and log assets are in millions of dollars. All other statistics are in percentages.
Sources: S&P Global Market Intelligence Compustat and authors' calculations.

In addition, we include a set of sector-time fixed effects that allow us to control for time-varying shocks at the sector level. We define industries using two-digit Global Industry Classification Standard (GICS) codes and multiply these codes by a full set of quarterly indicators. These parameters absorb any time-specific shocks to a given industry but allow for differential effects across industries and time periods. For example, a sharp drop in the price of oil will affect all industries that either trade oil-based products or use oil-based products in their production processes. The sector-time fixed effects, in this example, would at least partially estimate the sector-specific effect of a change in oil prices in a given quarter on each industry. Including sector-time fixed effects allows us to interpret the coefficient on the leverage ratio as the effect of higher leverage *relative to a firm's industry peers* at time *t.* This consideration is important because some industries are more highly leveraged than others, and investment patterns can differ materially across them. Without sector-time fixed effects, our results would only capture average investment patterns in more leveraged industries.

Standard errors are clustered at the firm level to account for any correlations within a given firm's set of observations. The implicit assumption is that errors are uncorrelated across firms but not across time within a firm. Given that firm and sector-time fixed effects are included, this is not a strong assumption.

Finally, in some specifications, we control for investment opportunities using Tobin's Q. Tobin's Q is a measure of the market value of a firm's assets relative to the book value of its assets. Conceptually, Tobin's Q measures the investment opportunities available to a firm. Firms with good investment opportunities will be rewarded with a greater market value of common stock relative to their book value and will thus have a higher Tobin's Q. Likewise, firms with fewer investment opportunities will see less investor demand to hold common stock and consequently will have a lower market value relative to book value and thus a lower Tobin's Q.

We follow Ottonello and Winberry (2019) to calculate Tobin's Q and define the market value of assets as the book value of assets plus the market value of common stock, deferred taxes, and investment credits less the book value of common stock.[11] We calculate the market value of common stock using share prices and shares outstanding from Compustat. However, the widest sample available to us only provides market data for firms in the S&P 1500 index since 1994. For this reason, we report these regressions as robustness checks on our main specification.

III. The Persistent Effects of High Leverage on Investment

We find a strong negative relationship between increased leverage and investment. Table 2 reports the results of estimating equation (1). Column 1 of Panel A shows results for the full sample using capex relative to fixed assets one year ahead. The results show that a 1 percentage point increase in a firm's debt-to-assets ratio would reduce its relative capex spending one year ahead by about 7 basis points. Columns 2 and 3 of Panel A show results for the smaller sample of S&P 1500 firms and reveal a similar effect of increased leverage on investment. Specifically, a 1 percentage point increase in a firm's debt-to-assets ratio is associated with about a 17 basis point decline in capex spending relative to total assets in the next year.

Next, we test whether this relationship holds after controlling for differences in investment opportunities. Column 4 of Panel A shows results from a robustness check interacting Tobin's Q with our measure of leverage. The coefficient of 0.031 is positive and statistically significant, suggesting leveraged firms invest more when they have better investment opportunities. However, the increase in investment is small—

Table 2

Association between Leverage and Investment Outcomes

Panel A: Capex to Fixed Assets

	(1)	(2)	(3)	(4)
Variable	Full sample	Tobin's Q sample		
Debt/assets	–0.067***	–0.171***	–0.165***	–0.228***
	(0.009)	(0.022)	(0.021)	(0.032)
Cash flow/fixed assets	0.032**	0.183***	0.163***	0.164***
	(0.015)	(0.031)	(0.030)	(0.030)
Capex/fixed assets	0.0004***	0.482***	0.465***	0.465***
	(0.00008)	(0.025)	(0.024)	(0.024)
Sales growth	0.101***	0.294***	0.264***	0.262***
	(0.017)	(0.030)	(0.028)	(0.028)
Log assets	–4.122***	–5.641***	–5.195***	–5.011***
	(0.357)	(0.606)	(0.571)	(0.568)
Tobin's Q			2.935***	2.578***
			(0.381)	(0.378)
Debt/assets × Tobin's Q				0.031***
				(0.013)
Constant	46.378***	61.268***	52.186***	51.425***
	(2.240)	(4.916)	(4.830)	(4.795)
Observations	297,919	67,310	67,310	67,310
Firms	11,103	2,356	2,356	2,356
Adjusted R^2	0.04	0.21	0.23	0.23

Panel B: One-Year Capital Stock Growth

	(1)	(2)	(3)	(4)
Variable	Full sample	Tobin's Q sample		
Debt/assets	–0.048***	–0.220***	–0.216***	–0.304***
	(0.005)	(0.020)	(0.019)	(0.033)
Cash flow/fixed assets	0.019*	0.193***	0.176***	0.177***
	(0.010)	(0.024)	(0.023)	(0.023)
Capex/fixed assets	0.0001**	0.260***	0.245***	0.245***
	(0.00005)	(0.019)	(0.018)	(0.018)
Sales growth	0.079***	0.340***	0.312***	0.310***
	(0.010)	(0.033)	(0.032)	(0.032)
Log assets	–4.171***	–6.551***	–6.109***	–5.859***
	(0.226)	(0.485)	(0.470)	(0.473)
Tobin's Q			2.516***	2.003***
			(0.317)	(0.331)
Debt/assets × Tobin's Q				0.042***
				(0.014)
Constant	25.319***	57.818***	49.557***	48.619***
	(1.454)	(4.069)	(4.056)	(4.046)
Observations	323,019	75,075	75,075	75,075
Firms	11,226	2,397	2,397	2,397
Adjusted R^2	0.05	0.14	0.15	0.15

Table 2 (continued)

Panel C: Three-Year Capital Stock Growth

	(1)	(2)	(3)	(4)
Variable	Full sample	Tobin's Q sample		
Debt/assets	−0.120***	−0.473***	−0.461***	−0.650***
	(0.012)	(0.051)	(0.049)	(0.076)
Cash flow/fixed assets	0.031**	0.315***	0.281***	0.281***
	(0.012)	(0.050)	(0.049)	(0.049)
Capex/fixed assets	0.0001***	0.265***	0.237***	0.238***
	(0.00005)	(0.039)	(0.038)	(0.038)
Sales growth	0.111***	0.508***	0.448***	0.444***
	(0.011)	(0.060)	(0.059)	(0.059)
Log assets	−22.158***	−24.479***	−23.623***	−23.067***
	(0.663)	(1.367)	(1.326)	(1.320)
Tobin's Q			5.110***	4.036***
			(0.545)	(0.554)
Debt/assets × Tobin's Q				0.092***
				(0.033)
Constant	166.978***	242.561***	225.931***	223.515***
	(4.686)	(11.466)	(11.261)	(11.212)
Observations	275,856	69,085	69,085	69,085
Firms	10,061	2,197	2,197	2,197
Adjusted R^2	0.11	0.22	0.23	0.23

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

Note: Firm clustered standard errors are shown in parentheses.
Sources: S&P Global Market Intelligence Compustat and authors' calculations.

about 3 basis points for every 1 percentage point increase in a firm's leverage ratio, given their Tobin's Q ratio.

Moreover, the negative overall effect of leverage still holds taking account of Tobin's Q, and the effect is stronger. The average firm in our sample has a Tobin's Q of 1.61, suggesting that a 1 percentage point increase in leverage would decrease investment by about 17 basis points, similar to what we found in the S&P 1500 sample. For the interaction effect to dominate, Tobin's Q would need to be about 7.4, or more than four standard deviations above our mean Tobin's Q level. This level is well above even the 75th percentile observed in our sample and is unlikely to occur. Thus, we interpret these results to mean that the leverage effect dominates, suggesting highly leveraged firms are likely to invest less than their less-leveraged peers.

To test whether this relationship holds using an alternative measure of investment, we next estimate a similar model using the one-year-ahead growth of capital stock (Table 2, Panel B). Column 1 of Panel B shows that for the full sample without Tobin's Q, increased leverage is associated with slower growth in capital spending. Specifically, a 1 percentage point increase in a firm's debt-to-assets ratio is associated with a 5 basis point decline in the one-year-ahead growth rate of its capital stock. As with capex-to-fixed assets, this relationship is stronger in the smaller sample of S&P 1500 firms shown in columns 2 through 4. In this sample, a 1 percentage point increase in a firm's debt-to-assets ratio is associated with about a 22 basis point drop in capital stock growth even after controlling for investment opportunities. We find a similarly dominant effect when controlling for the interaction between debt and investment opportunities.

The negative relationship between leverage and investment persists over a longer horizon when investment is measured by growth in the capital stock. Panel C of Table 2 reports results using a three-year growth horizon for capital stock. In the full sample, a 1 percentage point increase in leverage is associated with a 12 basis point decline in capital stock growth. For the Tobin's Q sample, the associated decline is nearly 50 basis points, and the relationship continues to hold even after controlling for differences in investment opportunities.

The results in Table 2 suggest a strong, statistically significant, negative relationship between increased leverage and future investment. The results are economically significant as well. For example, a one-standard-deviation increase in leverage among the full sample of firms is associated with about a 3 percentage point drop (-0.067×43.41) in capital spending relative to assets in the following quarter. For larger firms in the S&P 1500, this decline is even greater.

However, the results in Table 2 do not control for the relative leverage levels of firms within industries. Just as some industries are more highly leveraged, on average, than others, some firms may be more highly leveraged than their peers, raising the possibility that these highly leveraged firms are driving our results. To account for this possibility, we split the sample into terciles based on the firms' debt-to-assets ratios within industry groups. Low-leverage firms are those in the bottom third of the leverage distribution within their two-digit GICS industry,

medium-leverage firms are in the middle third, and high-leverage firms are in the top third.

The results in Table 3 show that after splitting the sample by industry leverage, the negative relationship between leverage and investment strengthens as a firm's leverage increases relative to its industry. With this specification, we can interpret the coefficients as relative to the firm's own industry group. Column 1 of Panel A reports the results for the full sample. A medium-leverage firm—a firm in the middle third of its industry leverage distribution—has about 8.4 percentage points lower capex relative to fixed assets in the next year than its less leveraged industry peers. A high-leverage firm—a firm in the upper third of its industry leverage distribution—has over 14 percentage points lower capex relative to fixed assets than firms in the bottom third of the leverage distribution.

Again, the relationship is stronger when we measure investment using capital stock growth. Column 1 of Panel B shows that for the full sample, medium-leverage firms have more than 5 percentage points lower growth in their capital stock one year later than low-leverage firms, while high-leverage firms have nearly 11 percentage points slower growth than low-leverage firms. The results in columns 2 and 3 of Panel B show that the relationship holds qualitatively for large firms and after controlling for Tobin's Q, though the results are somewhat weaker. Specifically, a medium-leverage firm's capital stock grows about 3.7 percentage points more slowly after controlling for investment opportunities, while a high-leverage firm's capital stock grows about 7 percentage points more slowly.

This result again holds over longer horizons. Panel C of Table 3 reports the results for capital stock growth three years into the future. In the full sample, a medium-leverage firm's capital stock grows more than 11 percentage points more slowly three years later than a low-leverage firm's capital stock, while a high-leverage firm's capital stock grows about 20 percentage points more slowly. The results hold qualitatively for the largest firms, though the total effect is somewhat smaller.[12]

One concern is whether our results may be driven by recessionary periods or other times when debt service costs rise substantially. To address this concern, we examine the relationship between leverage and investment at different points in the business cycle. Specifically,

Table 3

Differential Association of Leverage and Investment

Panel A: Capex to Fixed Assets

	(1)	(2)	(3)
Variable	Full sample	Tobin's Q sample	
Medium leverage	−8.377***	−3.943***	−3.614***
	(0.514)	(0.532)	(0.507)
High leverage	−14.438***	−6.516***	−6.142***
	(0.649)	(0.753)	(0.729)
Cash flow/fixed assets	0.031**	0.183***	0.164***
	(0.015)	(0.031)	(0.030)
Capex/fixed assets	0.0004***	0.484***	0.467***
	(0.00007)	(0.025)	(0.024)
Sales growth	0.100***	0.295***	0.265***
	(0.017)	(0.030)	(0.028)
Log assets	−3.269***	−5.513***	−5.088***
	(0.345)	(0.594)	(0.563)
Tobin's Q			2.914***
			(0.380)
Constant	47.680***	59.384***	50.396***
	(2.119)	(4.838)	(4.739)
Observations	297,919	67,310	67,310
Firms	11,103	2,356	2,356
Adjusted R^2	0.05	0.21	0.23

Panel B: One-Year Capital Stock Growth

	(1)	(2)	(3)
Variable	Full sample	Tobin's Q sample	
Medium leverage	−5.414***	−4.012***	−3.719***
	(0.334)	(0.466)	(0.458)
High leverage	−10.641***	−7.446***	−7.112***
	(0.430)	(0.626)	(0.612)
Cash flow/fixed assets	0.017*	0.193***	0.177***
	(0.010)	(0.024)	(0.023)
Capex/fixed assets	0.0001**	0.263***	0.249***
	(0.00004)	(0.019)	(0.018)
Sales growth	0.079***	0.341***	0.314***
	(0.010)	(0.033)	(0.032)
Log assets	−3.492***	−6.471***	−6.051***
	(0.220)	(0.476)	(0.463)
Tobin's Q			2.495***
			(0.319)
Constant	25.680***	55.255***	47.084***
	(1.388)	(3.952)	(3.942)
Observations	323,019	75,075	75,075
Firms	11,226	2,397	2,397
Adjusted R^2	0.05	0.13	0.14

Table 3 (continued)

Panel C: Three-Year Capital Stock Growth

	(1)	(2)	(3)
Variable	Full sample	Tobin's Q sample	
Medium leverage	−11.095***	−8.803***	−8.184***
	(0.901)	(1.176)	(1.141)
High leverage	−20.659***	−15.341***	−14.649***
	(1.175)	(1.542)	(1.500)
Cash flow/fixed assets	0.029**	0.313***	0.279***
	(0.011)	(0.050)	(0.049)
Capex/fixed assets	0.0001**	0.272***	0.244***
	(0.00005)	(0.039)	(0.038)
Sales growth	0.112***	0.514***	0.454***
	(0.011)	(0.060)	(0.059)
Log assets	−20.622***	−24.351***	−23.530***
	(0.650)	(1.349)	(1.314)
Tobin's Q			5.089***
			(0.547)
Constant	165.515***	237.290***	220.792***
	(4.578)	(11.236)	(11.033)
Observations	275,856	69,085	69,085
Firms	10,061	2,197	2,197
Adjusted R^2	0.11	0.21	0.22

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

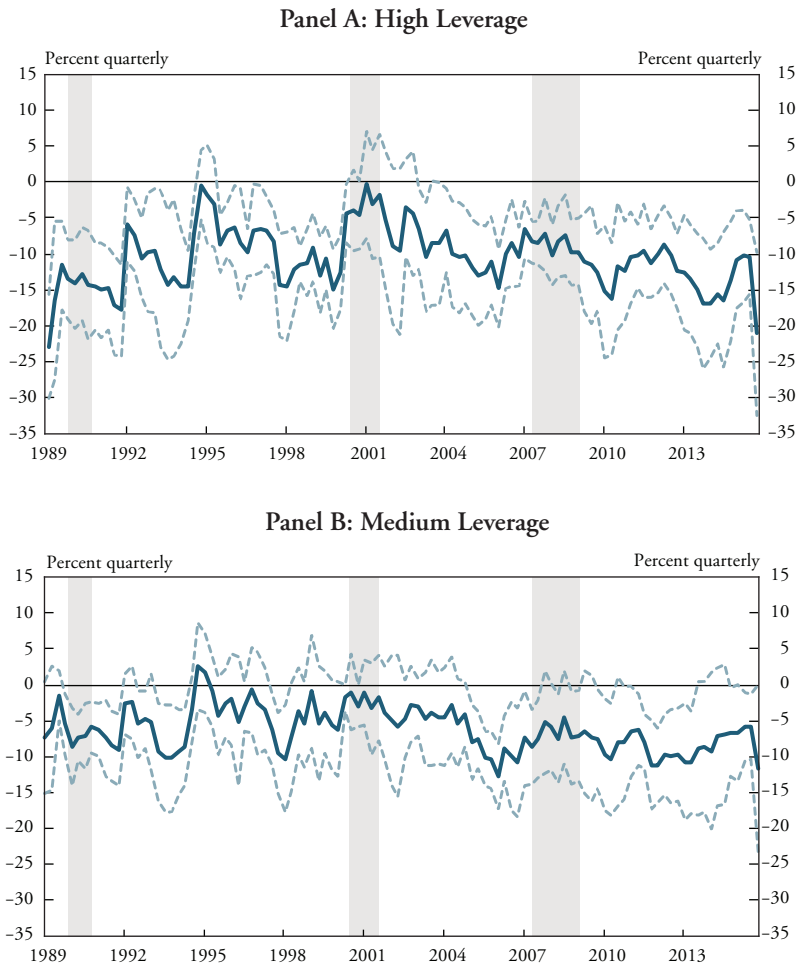
Notes: Estimates include firm fixed effects. Firm clustered standard errors are shown in parentheses.
Sources: S&P Global Market Intelligence Compustat and authors' calculations.

we look at the 12 quarters following any given date (the "base period") and define a firm's leverage level as of the preceding quarter. In other words, we consider a firm highly leveraged if it was in the upper third of its industry leverage distribution one quarter before the base period. Our dependent variable is the three-year growth rate of capital stock beginning at the base period. All remaining control variables are averaged over the 12-quarter period, which accounts for a firm's prevailing business conditions during that period. We include sector fixed effects in each regression and cluster the standard errors by sector.

We repeat this exercise for each quarter in our sample from 1989:Q3 to 2016:Q2.[13] Chart 2 shows the coefficients for each leverage category, as well as a 95 percent confidence interval, for each quarter in our sample. Both medium-leverage (Panel A) and high-leverage (Panel B) firms have lower three-year capital growth rates

Chart 2

Time-Varying Correlation of Leverage and Investment



Notes: Dashed lines denote 95 percent confidence intervals. Gray bars denote NBER-defined recessions.
Sources: S&P Global Market Intelligence Compustat, NBER, and authors' calculations.

than their low-leverage peers. Three-year capital growth rates are, on average, around 6 to 7 percent lower for medium-leverage firms than low-leverage firms, though the result is not always statistically significant at the 5 percent level. For high-leverage firms, the correlation is much stronger and nearly always statistically significant: their three-year capital stock growth rates are more than 10 percentage points lower, on average, than for low-leverage firms.

Overall, our results show a persistent negative relationship between indebtedness and investment at the firm level. Higher leverage is associated with relatively lower investment in both short-term (one-year ahead) and longer-term (three-year ahead) horizons. In addition, this negative relationship is stronger for the most highly indebted firms and persists across time and throughout the business cycle.

Conclusion

Policymakers have grown increasingly concerned about rising corporate debt during the current recovery. However, most have focused on the risks that elevated leverage poses to financial stability—should corporate defaults increase, financial firms that are under stress might tighten lending standards. In this article, we argue that increased leverage may also have a direct effect on firms' investment decisions. We find that the most highly leveraged firms have lower investment spending relative to their industry peers. This relationship holds across a large sample of highly diverse firms and also holds across time, suggesting that indebtedness can matter to economic outcomes even during nonrecessionary periods.

An important caveat is that our analysis cannot address the total investment level in the economy. Instead, our results only speak to the investment levels for firms relative to their peers in a given time period. All firms could be increasing their capital spending by a robust amount; our results simply suggest that the most highly leveraged firms will likely increase their capital spending more slowly.

Nonetheless, our results indicate that high leverage levels appear to be a significant and perennial headwind for firm investment. Overall, we find support for the idea that the most indebted firms may have trouble raising additional investment capital, whether from internal funds or external financial markets.

Endnotes

[1]As debt levels have increased, interest coverage ratios, or the ratio of income to interest expenses, have declined as well—though they remain historically high due to low interest rates (Kumbhat, Palomino, and Perez-Orive 2017). However, these data suggest firms are allocating relatively more income to debt payments and will retain less income for future investment.

[2]Debt can also be used for noninvestment purposes, such as funding buybacks and dividends, or for mergers and acquisitions. For a discussion on the uses of debt and recent patterns, see Kovner and Zborowski (2019).

[3]As an example of the debt-overhang problem, consider a firm that owes $100 to debt holders at year-end. The firm expects to generate $110 with a 50 percent probability and $70 with a 50 percent probability. The firm can pursue an investment opportunity that costs $1 and pays $5 with certainty. The expected value of the firm is $110 × 0.5 + $70 × 0.5 = $55 + $35 = $90, which is less than the $100 the firm owes at year-end. Should the bad state occur where the firms earn only $70, then the $5 return generated by the investment would accrue only to the existing debt holders and the new investors would not earn a return. Given this possibility, new investors would supply the necessary capital only if the investment opportunity paid at least $10. In that case, the new investors would begin to realize a return on their investment because expected income would meet or exceed the debt holders' payment value. See Allen and others (2008) and Chatterjee (2013) for additional examples of debt overhang.

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[5]Because we use three-year-ahead growth rates for capital growth, our regression sample stops in 2016:Q2.

[6]Our sample selection closely follows previous studies. See, for example, Ottonello and Winberry (2019), Rodziewicz (2018), and Rodziewicz and Sly (2019). The results are robust to several variations in sample construction, such as including firms with large acquisitions or extending the reporting periods.

[7]See the data appendix of Ottonello and Winberry (2019) for computational details.

[8]All financial ratio components are calculated as four-quarter averages for stock variables and four-quarter sums for flow variables. This limits the amount of volatility from the reported quarterly numbers and reduces the influence of outliers.

[9]Changes in financial ratios generated by changes in market conditions rather than by firm actions are well-known in the financial landscape. For instance, many loans include maintenance covenants that require firms to meet financial ratio targets on an ongoing basis as opposed to incurrence covenants that consider changes only when a firm takes an action. See Nini, Smith, and Sufi (2012) for more information.

[10]In an unreported robustness check, we also include a firm-specific time trend to control for steady increases in firm level variables. Our results are not qualitatively changed in that specification from those reported here.

[11]We also calculate an alternative annual value of Tobin's Q according to Chung and Pruitt (1994). The results are qualitatively similar using this measure.

[12]Our results continue to hold in unreported robustness checks that remove the firm fixed effects and in samples that drop all firms that do not shift leverage groups. In the first case, including firm fixed effects generates zeros in the leverage variable for firms that do not shift leverage groups during the sample period. This will cause our standard errors to be artificially small. We check that our inference holds by repeating the regression only for the sample that has firms that do shift leverage groups. This implies that firms in the high leverage group must have moved there from below.

[13]The earliest part of our sample contains few observations per quarter, so we start in 1989:Q3 to increase the sample size on a per quarter basis.

References

Allen, Franklin, Sudipto Bhattacharya, Raghuram Rajan, and Antoinette Schoar. 2008. "The Contributions of Stewart Meyers to the Theory and Practice of Corporate Finance." *Journal of Applied Corporate Finance,* vol. 20, no. 4, pp. 8–19. Available at https://doi.org/10.1111/j.1745-6622.2008.00200.x

Borensztein, Eduardo, and Lei Sandy Ye. 2018. "Corporate Debt Overhang and Investment: Firm-Level Evidence." World Bank Group, working paper no. 8553, August. Available at https://doi.org/10.1596/1813-9450-8553

Chatterjee, Satyajit. 2013. "Debt Overhang: Why Recovery from a Financial Crisis Can Be Slow." Federal Reserve Bank of Philadelphia, *Business Review*, vol. 96, no. 2, pp. 1–9.

Chung, Kee H., and Stephen W. Pruitt. 1994. "A Simple Approximation of Tobin's Q." *Financial Management*, vol. 23, no. 3, pp. 70–74.

Jensen, Michael C. 1986. "Agency Costs of Free Cash Flow, Corporate Finance and Takeovers." *American Economic Review*, vol. 76, no. 2, pp. 323–329.

Kalemli-Özcan, Şebnem, Luc Laeven, and David Moreno. 2019. "Debt Overhang, Rollover Risk, and Corporate Investment: Evidence from the European Crisis." European Central Bank working paper, no. 2241, February. Available at http://doi.org/10.2866/975246

Kovner, Anna, and Brandon Zborowski. 2019. "Is There Too Much Business Debt?" Federal Reserve Bank of New York, *Liberty Street Economics* (blog), May 29.

Kumbhat, Ashish, Francisco Palomino, and Ander Perez-Orive. 2017. "The Potential Increase in Corporate Debt Interest Rate Payments from Changes in the Federal Funds Rate." Board of Governors of the Federal Reserve System, *FEDS Notes*, November 15. Available at https://doi.org/10.17016/2380-7172.2076

Lang, Larry, Eli Ofek, and René M. Stulz. 1996. "Leverage, Investment, and Firm Growth." *Journal of Financial Economics*, vol. 40, no. 1, pp. 3–29. Available at https://doi.org/10.1016/0304-405X(95)00842-3

Meyers, Stewart C. 1977. "Determinants of Corporate Borrowing." *Journal of Financial Economics*, vol. 5, no. 2, pp. 147–175. Available at https://doi.org/10.1016/0304-405X(77)90015-0

Nini, Greg, David C. Smith, and Amir Sufi. 2012. "Creditor Control Rights, Corporate Governance, and Firm Value." *Review of Financial Studies*. vol. 25, no. 6, pp. 1713–1761. Available at https://doi.org/10.1093/rfs/hhs007

Ottonello, Pablo, and Thomas Winberry. 2019. "Financial Heterogeneity and the Investment Channel of Monetary Policy." National Bureau of Economic Research, working paper 24221, June. Available at https://doi.org/10.3386/w24221

Popov, Alexander A., Francesca Barbiero, and Marcin Wolski. 2018. "Debt Overhang and Investment Efficiency." European Central Bank, working paper no. 2213, December.

Rodziewicz, David. 2018. "Energy Investment Variability with the Macroeconomy." Federal Reserve Bank of Kansas City, *Economic Review*, vol. 103, no. 3, pp. 53–75. Available at https://doi.org/10.18651/ER/3q18Rodziewicz

Rodziewicz, David, and Nicholas Sly. 2019. "Capital Reallocation and Capital Investment." Federal Reserve Bank of Kansas City, *Economic Review*, vol. 104, no. 2, pp. 33–52. Available at https://doi.org/10.18651/ER/2q19RodziewiczSly