Leverage and Varying Metrics of Firm Performance

Preston Jiateng Huang

Under the supervision of:
Professor Kyle Jurado, Faculty Advisor

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Abstract

This paper sets out to examine the effect of leverage on company performance. Drawing on the methodology of key prior research, this study finds that leverage has a consistent negative effect on firm growth; by contrast, no such negative impact was found on return on equity. Importantly, such patterns hold throughout the entire period under study (1970-2017), during which several disruptive economic events have occurred. These results highlight the importance of selecting appropriate company performance measures when studying the effect of debt load on a firm as well as the misalignment of incentives for policymakers and company management. Other implications are also discussed.

JEL Classification: G24; G31; G32

Keywords: Leverage; Capital Structure; Firm Performance; Investment; Firm Growth

I. Introduction

One of the most influential factors in investors' analysis of companies is that of capital structure. How a company chooses to finance its operations affects its perceived riskiness and in turn affects its valuation. The decision to raise money using debt or equity, the two main ways of raising capital, is one of the most important questions for a company's management. These financing methods help the company to acquire necessary capital, take on more projects, or pay off existing obligations. The decision to use debt or equity is often based on cost and availability of capital, and variables such as interest rate, a company's stock evaluation, and its tax burden among other considerations are evaluated as well. Therefore, when it comes to capital structure, it makes sense that a key measure like firm leverage would affect a company's performance. This presents a unique discussion opportunity in today's economic climate; as Figure 1 illustrates, corporate debt has been steadily increasing with the notable exception of the blips in 2009 and 2010 following the financial crisis. Such an increase has likely been encouraged by the low interest rate environment of the past decade as well as the rise of private equity. This research will aim to examine the effect of leverage on firm growth and performance.

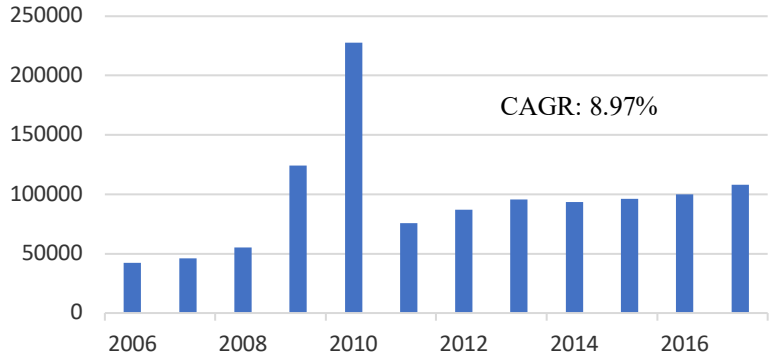

Figure 1: Total Debt of Non-Financial U.S. Corporations in millions USD deflated by Dec. 1982-based CPI Index (Board of Governors…)

Leverage is an important topic of discussion in today's economic environment for a number of reasons. The expansion of the private equity industry has helped to increase the overall corporate debt levels in the U.S. by drastic amounts. Unlike other types of funds, private equity seeks to invest capital into private companies in the form of equity or buy out public companies. Private equity companies often use large amounts of debt to fund their acquisitions; this strategy allows them to deploy their capital in into multiple investments at once and increase their internal rate of return on each investment. As private equity firms have become increasingly popular over the years, the amount of highly leveraged investments that they make has also become seemingly more popular. For example, earlier in 2018, private equity firm The Blackstone Group bought a controlling stake in the financial information arm of Thomson Reuters, funded by less than $4 billion in equity and $13.5 billion in debt, which was comprised of $9.25 billion in loans and $4.25 billion in secured and unsecured bonds (Goldfarb & Biwas, 2018). The debt used in this buyout was worth about 7.5 times EBITDA (earnings before interest, taxes, depreciation, and amortization) (Davies, 2018). In fact, in the second quarter of 2018, nearly 15% of new U.S. loans financing leveraged buyouts were issued by companies with debt of at least seven times EBITDA, which represents the highest percentage since 2014 (Goldfarb & Biwas, 2018).

This trend is fueled further by a low interest rate environment that has made debt financing for leveraged buyouts unusually cheap for such firms. As investors chase higher returns, high-yield corporate debt becomes more attractive, and credit funds associated with buyout firms have made the leveraged buyout process both cheaper and easier (Davies, 2018). As firms become more and more leveraged, the question arises whether the high debt load presents any real benefits to firms' long-term growth and performance.

Problems associated with overleverage have become increasingly public over the past decade. In particular, overleverage holds much of the blame for what has been called the retail crisis in the United States. There have been several high-profile cases in the past few years that have illustrated this point. For example, Neiman Marcus' sale from one set of investment firms to another led to its being saddled with almost $5 billion in debt in 2018. This debt burden became highly influential in the company's managerial decisions, as it represented Neiman Marcus' largest threat to viability (Rupp & Orr, 2018).

Although leverage may not be desirable from a macroeconomic perspective, individual firms are not incentivized to lower their leverage risk. Management and ownership may choose to highly lever companies to target higher returns or take on more projects. Companies owned by private equity firms in particular are burdened with large amounts of debt so that these equity funds can increase the number of portfolio companies they own and their own internal rate of return. As Minsky highlighted in his financial instability hypothesis, other firms can suffer the same fate of ever-increasing levels of debt and even financial instability during times when the economy is strong (Minsky 2008). Given the incentive to increase debt to target higher returns, a question arises of whether these risky capital structure decisions are actually benefitting these businesses. More specifically, taking on higher leverage might be sacrificing long-term growth for short-term gain. Whether these decisions will actually benefit the business is a question that can be better answered through empirical analysis.

This study seeks to address two research questions. First, does company leverage affect business performance? The landmark Modigliani-Miller theorem famously claims that a firm's capital structure does not affect its performance, but how well this applies in practice is still up

for debate. The second research question is, if there is a relationship between leverage and firm performance, what aspects of business performance are affected by changes in leverage.

The paper proceeds as follows. Section II summarizes the theoretical framework behind firm leverage effects, consensus effects of leverage on performance in academic research, and the potential for updating key studies on the topic. Section III introduces data used in the study. Section IV introduces the two-part methodology for replicating previous analyses and updating it with a wider set of variables. In Sections V through VII, leverage is shown to have a consistent negative effect through various sample periods on company growth measures while this effect does not hold on return on equity. Section VIII concludes the study.

II. Theoretical Framework and Literature Review

The subject of leverage and firm performance has garnered great interest in academic research with numerous studies devoted to this topic. Despite an extensive stream of research, there is no definitive conclusion on the effect of leverage on firm performance. Although the key theory—the Modigliani-Miller theorem—posits a neutral relationship, the consensus effect of leverage on firm performance based on previous empirical studies appears to be significant and negative. To make matters more complicated, other empirical studies suggest that leverage can have a neutral or even positive effect on performance measures (Ibhagui & Olokoyo 2018) (Safieddine & Titman 1999).

In their seminal study of the subject, Lang, Ofek, and Stulz (1996) found that in general, there is a significant negative correlation between leverage and measures of investment, capital expenditures growth, and employee growth. Although this negative relationship does not exist for firms that have good investment opportunities, they found that for firms that are unable to

overcome significant debt overhang or do not have access to capital markets, there is a significant negative relation between leverage and performance (Lang, Ofek, & Stulz 1996). This conclusion is supported by Cai and Zhang's (2011) study on the effect of leverage change on firm performance, using stock price as a metric. Higher leverage was found to have a significant negative effect on stock price, and this effect was greater for firms with higher leverage. Fama and French (1998) confirmed this view in their cross-sectional analysis of how firm value relates to debt and dividends. They found that the amount of leverage produces agency problems that in turn predict a negative correlation between leverage and performance (Fama & French 1998) (Ibhagui & Olokoyo 2018).

Aivazian, Ge, and Qiu (2005) found similar effects in their analysis of Canadian firms, showing that leverage has a negative effect on investment that is increasingly negative for firms with lower growth opportunities. Unlike most other literature on the topic, this study acknowledged the issue of endogeneity in analyzing this relationship. To counter this, Aivazian et al. used the instrumental variable approach and confirmed that the significance of the link between firm investment and performance cannot be attributed to endogeneity.

Ibhagui and Olokoyo (2018) further confirmed this by using the Hansen threshold regression model to attempt to explain the relationship between leverage and firm performance using firm size as a threshold variable. They showed that the negative effect of leverage on performance was greatest in smaller firms, and this effect decreases as firms become larger. Another threshold study was done by Lin and Chang (2011), who examined the relationship between leverage and company performance in Taiwanese firms, using debt as a threshold. Two threshold effects were found from this analysis; when the debt ratio is low, increases in leverage

are generally followed by an increase in firm performance. On the other hand, when the debt ratio is high, there is no significant relationship between leverage and firm performance.

Contrary to the stream of research discussed above, several other studies have shown a positive effect of leverage on company performance. Safieddine and Titman (1999) demonstrated that firms that were targeted in unsuccessful buyouts often greatly increased their leverage immediately afterwards, and this leverage increase tended to improve company performance. Their study examined a small subgroup of firms that were the targets of failed takeover attempts, but the effect of leverage in this subgroup displayed significantly contrasting behavior to the general effects in previously described literature. Robb and Robinson (2014) also found positive relationships between leverage and firm performance and posited that the gains (or returns) from debt are greater than average interest on leverage. This study was also conducted on a small subset of companies, particularly entrepreneurial companies in their first year of operation.

As illustrated in the extant literature, although the generally accepted effect of leverage on company performance seems to be negative, this conclusion can vary greatly depending on the type of firm being analyzed. Such complex relationships between leverage and company performance in different settings suggest that leverage may have differing effects on different metrics of company performance.

Among prior studies, Lang, Ofek, and Stulz (1996) provided a comprehensive roadmap for examining the effect of leverage on company growth measures, and as such, their work is one of the most highly cited papers on the subject. Lang et. al (1996) explained that because of liquidity effects and debt overhang, leverage significantly hampers companies' ability to finance growth. They showed this through examining leverage effects on investment, employment

growth, and capital expenditure growth (see Appendix A). Although Lang et al. (1996) provides a sound and widely-respected foundation for decision-makers to base their judgments upon when selecting optimal leverage levels, key opportunities exist for updating and further extending this framework. Their study uses mostly macroeconomically oriented variables in its analysis; it would be of interest to see how leverage affects financial variables commonly used by decision-makers of companies included in the same dataset. In addition, it is worthwhile to examine whether the results from Lang et al. (1996) change within a more modern time frame, for the economic climate has likely changed significantly since the time period they examine (1970 to 1989).

III. Data

This study will utilize two separate datasets to analyze effects of leverage on firm performance. The first dataset consists of public company data from 1970 to 1989 and is used to to replicate the results of the work done by Lang et al. (1996). The base sample is restricted to industrial companies with Standard Industry Classification (SIC) codes between 2000 to 2999 that have at least one billion dollars in sales. Limiting the sample to industrial companies minimizes the effects of regulation on the regression analysis, which is difficult to represent with any numerical variable. They restricted the dataset to large companies for several reasons: (1) any relationship between growth and leverage is expected to be weaker for larger firms and therefore these results would be more convincing, (2) effects of leverage on company performance for larger firms have greater implications for the wider economy, and (3) using data for larger firms would reduce data omissions (Lang et al. 1996).

The second dataset consists of company financial data from 1970 until 2017 to examine continuing effects of leverage after the time period that Lang et al. examined. The purpose of this data is to extend and expand the scope of Lang et al. (1996) to the most recent period. For the purposes of this study, company financial data is pulled from CompStat from the Wharton Research Data Services, as company fundamentals can be easily sourced and examined from this source. General economic data such as consumer price index was pulled from the Federal Reserve Bank of St. Louis' database (FRED) and merged with both datasets. These general economic data fields are used to construct variables and control for inflation across time.

The first dataset contained 3,996 observations across 53 fields. Several of these fields include company identifiers such as company name, ticker, and SIC codes, industry, and sub-industry codes. Continuous variables that were extraced included common financial statement items such as total assets, total liabilities, stockholder's equity, capital expenditures, among other elements. The second dataset contained the same variable list, as the same methodology was to be performed on both datasets. The second dataset contained 13,847 data points.

One of the main issues with both of these datasets from CompStat was that there was a significant amount of missing data in multiple essential fields. For this purpose, the exact dataset from Lang et al. (1996) could not be completely replicated, but this study emulated it as closely as possible. For many companies in older observations in the mid-20th century, several fields were left empty, such as cash flow and stockholder's equity. This same pattern was also an issue in the more recent data for the second dataset as well, as depreciation was missing for a significant amount of companies in the larger dataset starting around 1996. Additionally, Lang et al. used a measure for their Tobin's q variable based on a previous study by Lang on the topic. This measure of Tobin's q was not readily and easily attainable, and therefore another measure

of Tobin's q from Chung & Pruitt (1994) was used. This measure of Tobin's q is more widely cited and utilized, and it minimizes potential for data omission as well.

IV. Research Methodology

The proposed regression equation for this study is shown below. Firm leverage is the main independent variable, and it is accompanied by financial control variables. The outcome variable is company performance, of which there are four measures, three from the Lang et al. study and one additional performance metric. As such, for each dataset, four separate regressions are performed to analyze the effects of leverage on firm performance.

$$Company\ Performance_{(i,t+1)} = \beta_0 + \beta_1(Leverage)_{(i,t)} + \beta_2(Capital\ Expenditures/FA)_{(i,t)} + \beta_3(Sales\ Growth)_{(i,t)} + \beta_4(Tobin's\ q)_{(i,t)} + \beta_4(Year)_{(i,t)} + \varepsilon_{(i,t)}$$

The explanatory variable in this study is firm leverage, defined as the ratio of total debt to the book value of total assets. This is the same definition as given in Lang et al. (1996), and it is a commonly used definition of leverage in literature on the topic. As the book value of assets, liabilities, and stockholder's equity vary together, there is little difference in results using any of these for the definition of leverage. Using book leverage rather than market leverage, however, provides a more stable view of the leverage variable, as market value of leverage would fluctuate with changes in equity values, which can be attributed to a variety of factors unrelated to business operations (Lang et al. 1996). Summary statistics of the leverage are as follows:

Table 1: Summary Statistics of Leverage Variable

Time Period	Observations	Mean	Std. Dev.	Min	Max
1970-1989	3,002	.2505891	.1553625	0	4.033898
1970-2017	11,135	.3033356	.4727326	0	30.70588

As displayed in these summary statistics, missing data points are an issue in both datasets, as financial data on short- and long-term debt are unavailable for some companies. The variation in leverage increased dramatically from the older dataset to the newer dataset, and average leverage increased as well, suggesting that as time went on, some companies were inclined to take on more and more amounts of leverage. Indeed, the data shows that leverage steadily increases through time rather than in a stepwise function.

Response variables in this study are firm performance, measured by current performance and firm growth. Performance can be represented in a variety of ways, as managers and investors often look at different metrics when evaluating a firm. Previous studies on the subject involved such measures as return on assets, return on equity and stock performance. This study will incorporate the performance metrics used by Lang, Ofek, and Stulz (1996) in their analysis along with return on equity to represent a more investor-oriented performance variable. Lang et al. (1996) used net investments in year +1 divided by book value of fixed assets in year 0, growth rate of real capital expenditures (ratio of capital expenditures in year +1 adjusted for inflation to capital expenditures in year 0, minus one), and the ratio of the number of employees in year +1 compared to year 0. One minor change in this study is the use of gross investment instead of net investment. This is due to the absence of depreciation data from 1996 onwards which restricts the ability to gather data about net investment (as net investment is capital expenditures minus depreciation, while gross investment is just capital expenditures). This minor modification is unlikely to affect the outcome, as the correlation between the two variables is 97% for both datasets. Capital expenditures growth rate seeks to measure the rate of change of investment, and growth rate of employment provides an alternative measure for the trend in the size of the firm (Lang et al. 1996).

To expand the scope of the Lang et al. analysis, return on equity (ROE) is investigated as well. ROE is a commonly used metric for investors to determine the profitability and success of a business' management; similarly, business executives also use the measurement as a guide for their own performance. ROE is used instead of a metric such as stock price because the latter can be easily affected by wider market fluctuations. Given that shareholders focus heavily on return on equity, managers also target higher returns on equity when considering decisions within the firm; it follows that the value of a firm has much to do with its return on equity. While growth measures used in Lang et al. (1996) provide information useful for thinking about the macroeconomy, analyzing the effect of leverage on return on equity will give insight into how company managers view decision-making. Return on equity is calculated as Earnings / Shareholder's Equity.

One major issue in this study is that the effect of leverage on firm performance could be simultaneous. That is, leverage can affect a firm's performance, but a firm's performance may very well affect how much leverage it needs. This problem of simultaneity is potentially problematic in that if leverage is endogenous, then error terms in the regression may not be well behaved. Interestingly, most literature on the topic fails to address this simultaneity issue; almost all studies do not mention this issue and/or do not attempt to remedy it. There does not exist a wide array of indicator variables for leverage, and a widely-cited one used by Aivazan et al. (2005), tangible assets to total assets, was unfit for the purposes of this study (correlation was too low with leverage). Because of this, a time lag was used in this study as a remedy for the simultaneity issue (similar to Lang et al. (1996)). Outcome measures were either performance measures at year + 1 or one-year growth rates to ensure that the regression was not capturing effects of performance on leverage. As the correlation between leverage and times 0 and +1 for

both sample periods is about 0.8, the time lag looks to be a sufficient method for addressing the issue. This is not a perfect solution, especially for more stable firms, in which leverage does not vary widely. However, considering that the vast majority of prior studies on the subject makes no attempts to remedy this issue, the method used here seems an adequate solution that addresses the problem as much as possible.

Table 2: Correlations among dependent variables used in this study (1970-1989)

	Investment	Employee Growth	Capital Expenditures Growth	ROE
Investment	1.0000	0.2780	0.5470	0.0172
Employee Growth	0.2780	1.0000	0.2580	0.0071
Capital Expenditures Growth	0.5470	0.2580	1.0000	0.0762
ROE	0.0172	0.0071	0.0762	1.0000

Table 3: Correlations among dependent variables used in this study (1970-2017)

	Investment	Employee Growth	Capital Expenditures Growth	ROE
Investment	1.0000	0.0987	0.2033	-0.0047
Employee Growth	0.0987	1.0000	0.0298	-0.0022
Capital Expenditures Growth	0.2033	0.0298	1.0000	0.0058
ROE	-0.0047	-0.0022	0.0058	1.0000

Correlations between dependent variables are given in Tables 2 and 3 for the two sample periods. As shown, none of the dependent variables are very highly correlated, with exception of the investment and capital expenditures growth variables. This is expected, as the investment variable calculates capital expenditures in the next period divided by fixed assets in the current period. Investment is moderately correlated with employee growth in the older sample period, however not enough to warrant further analysis. One thing to note is that return on equity has a very low correlation with the other variables; regressions of ROE on leverage may yield very different results from the other three regressions, which all use growth measures as outcome variables.

Summary statistics for each response variable are provided in Tables 4 through 7.

Table 4: Summary Statistics of ROE

Time Period	Observations	Mean	Std. Dev.	Min	Max
1970-1989	2,622	.1709242	.915257	-4.970013	41.55556
1970-2017	10,363	.1699882	2.921479	-194.4576	141.7419

Table 5: Summary Statistics of Gross Investment

Time Period	Observations	Mean	Std. Dev.	Min	Max
1970-1989	2,606	.0975382	.0692205	.0004803	1.863636
1970-2017	10,171	.1805411	4.258981	0	333

Table 6: Summary Statistics of Capital Expenditures Growth

Time Period	Observations	Mean	Std. Dev.	Min	Max
1970-1989	2,562	.0972456	.4515692	-.8573099	7.136143
1970-2017	10,080	.1049277	1.07011	-1	89.77778

Table 7: Summary Statistics of Employment Growth

Time Period	Observations	Mean	Std. Dev.	Min	Max
1970-1989	2,557	.0319349	.5230502	-.7380952	20
1970-2017	9,784	.0847853	3.674238	-1	344

Control variables used in this study include Tobin's q, cash flow, and sales growth. Tobin's q is the ratio of a company's book value of debt and equity to the replacement cost of its assets. Because this study uses a differing estimation for Tobin's q from Lang et al. (1996), the resulting coefficient for Tobin's q number in this regression can be somewhat different. In addition, depending on how large of an impact Tobin's q number has on the regression, this difference in variables is likely to have an impact on the whole of the results as well. The cash flow variable is taken gross of interest payments to capture effects of leverage, and this is divided by total assets to account for it being a flow variable. Sales growth is also included in the regression to capture a possible multiplier effect. In addition, indicator variables for each year are included in the regression to capture business cycle effects.

Summary statistics for control variables are given in Tables 8 through 11.

Table 8: Summary Statistics of Cash Flow / Total Assets

Time Period	Observations	Mean	Std. Dev.	Min	Max
1970-1989	373	.0318102	.0543213	-.1646463	.513217
1970-2017	7,548	.0265955	.054587	-1.406393	.6093664

Table 9: Summary Statistics of Capital Expenditures / Fixed Assets

Time Period	Observations	Mean	Std. Dev.	Min	Max
1970-1989	2,600	.0969943	.0549862	.0039871	1.014504
1970-2017	10,481	.078616	.0705781	0	2.682089

Table 10: Summary Statistics of Sales Growth

Time Period	Observations	Mean	Std. Dev.	Min	Max
1970-1989	2,653	.1283265	.6376596	-.5662443	30.6109
1970-2017	10,704	.1030806	.7941207	-.8270082	70.0128

Table 11: Summary Statistics of Tobin's q

Time Period	Observations	Mean	Std. Dev.	Min	Max
1970-1989	2,438	.8412439	.7362266	-.4301353	12.87909
1970-2017	9,667	1.397872	8.95792	-.6146427	873.0306

Summary statistics are provided on cash flow to total assets (Cash Flow / TA) even though the variable is not used in the regression. Lang et al. used Cash Flow / TA as one of their control variables (1996). However, as shown in Table 8, there is a significant reduction of observations in the Cash Flow / TA variable for the older dataset. This is due to the fact that most companies in this CompStat data do not have the cash flow variable. Because the scope of companies that have observations for Cash Flow / TA is so limited, this variable was omitted to maximize the robustness of the analysis.

There is also a pattern of greater variation in these control variables as well as performance variables in the larger dataset. Similar to the pattern with the leverage variable, there does not appear to be a specific event to trigger the greater variability in these variables. The higher variability could be attributed to an increase in data availability in later time periods after 1989, as financial statement information is more consistently recorded and accessible.

There are two separate analyses conducted in this study. The first consists of regressions of the four company performance measures upon leverage and control variables on the older sample period. The three macroeconomic company growth measures (investment, capital expenditures growth, and employee growth) here are used as a benchmark to ensure that the regression methodology is sound and reflects that of Lang et al. (1996). These results are then compared to the results of the regression of ROE on leverage for the same dataset to contrast macroeconomically oriented performance variables and financial performance variables that are more likely to be used by company management.

The second half of the analysis sees the same four regressions performed on the 1970 to 2017 dataset to capture any effects of firm leverage on company performance after the horizon of the Lang et al. study. The regression outputs from these different performance measures are compared with each other as in the previous dataset, and the results of these regressions are compared to those of the previous dataset as well to examine how effects of leverage on company performance change over time.

An exploratory data analysis for this regression leads to the following scatterplots in Figures 2 through 5, as well as correlations and bivariate regression coefficients in Tables 12 and 13, for the 1970-1989 dataset.

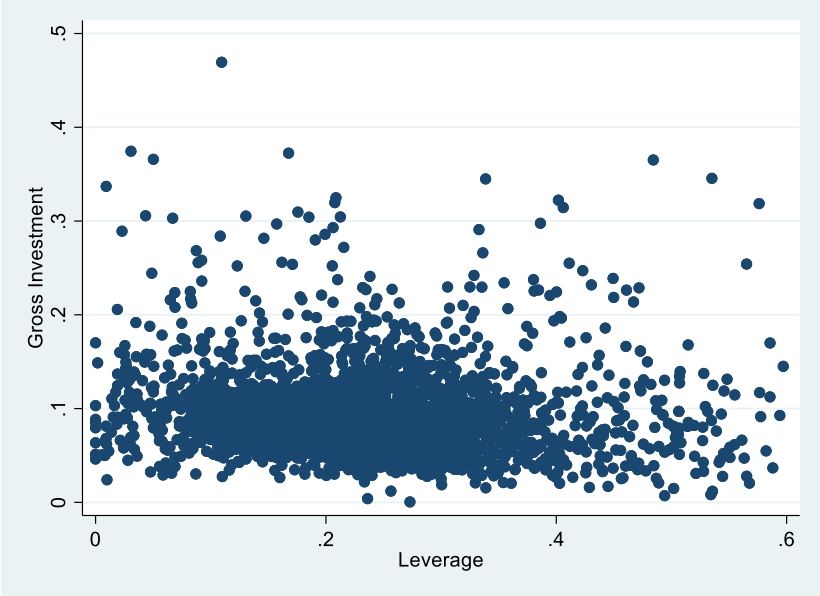

Figure 2: Leverage vs. Gross Investment (1970-1989) (Leverage < 0.6, Investment < 0.5)

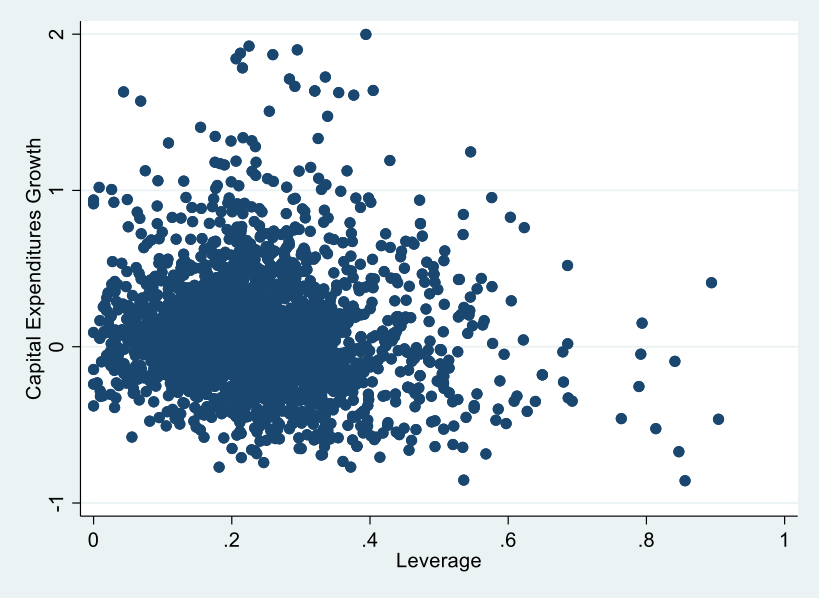

Figure 3: Leverage vs. Capital Expenditures Growth (1970-1989) (Leverage < 1, Capex Growth < 2)

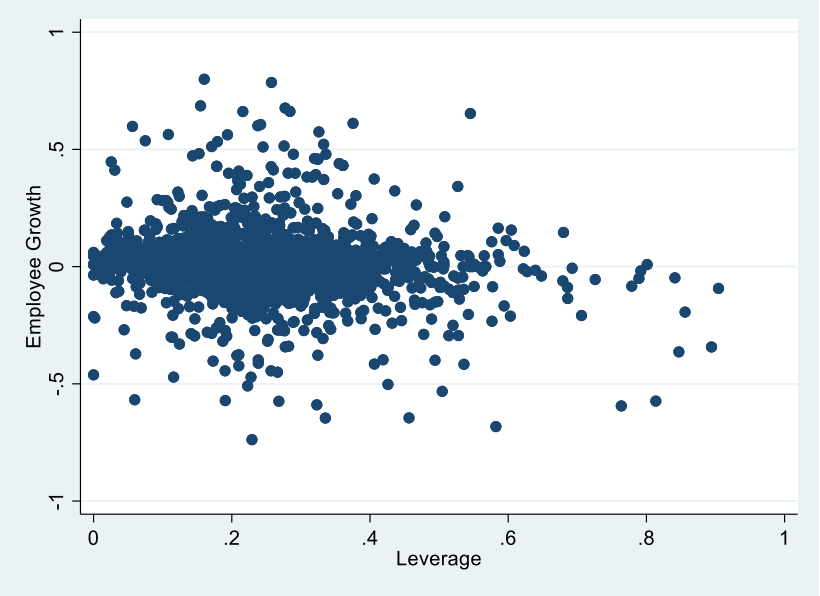

Figure 4: Leverage vs. Employee Growth (1970-1989) (Leverage < 1, Employee Growth < 0.8)

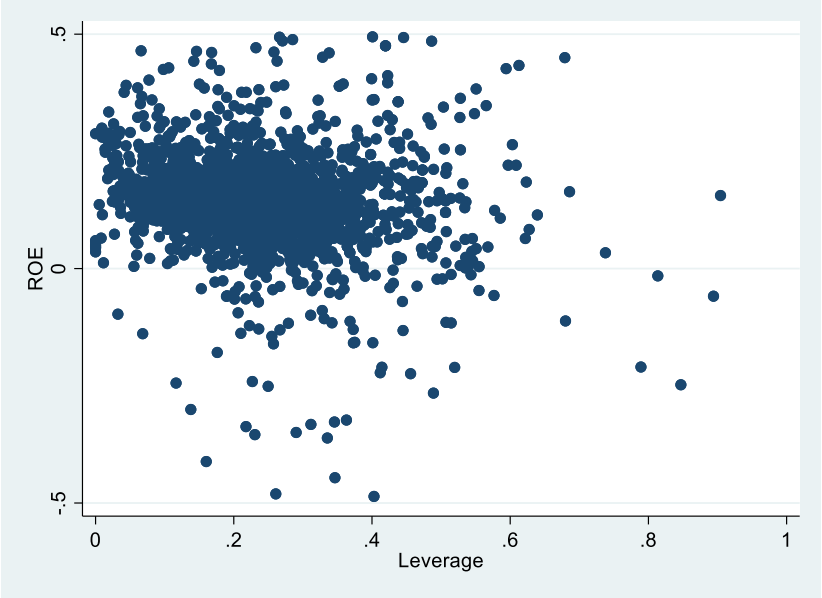

Figure 5: Leverage vs ROE (1970-1989) (Leverage < 1, -0.5 < ROE < 0.5)

Table 12: Correlations between Leverage and Performance Variables (1970-1989)

	Investment	CapEx Growth	Employee Growth	ROE
Leverage	-0.0875	.-0.0876	-0.1229	-0.1643

Table 13: Coefficients for Bivariate Regressions of Performance Variables on Leverage (1970-1989)

	Investment	CapEx Growth	Employee Growth	ROE
Leverage Coefficient	-0.0207124	-0.1990298	-0.2892426	-0.0163039
P-Value	0.043	0.007	0.001	0.909

Ranges of each variable have been restricted in the scatterplots to control for outliers. Through these scatterplots and correlation tables, it appears that leverage has a negative effect on all four measures of company performance, with its effect on investment and capital expenditures growth being the weakest. This is partially confirmed through the bivariate regression coefficients; regressions of investment, capital expenditures growth, and employee growth yielded significant negative coefficients for the leverage variable, with the coefficient for

investment on leverage significantly smaller than the others. Leverage has a statistically insignificant effect on return on equity in the bivariate regression.

Exploratory data analysis on the 2005-2017 sample period is shown in Figures 6 through 9 and Tables 14 and 15.

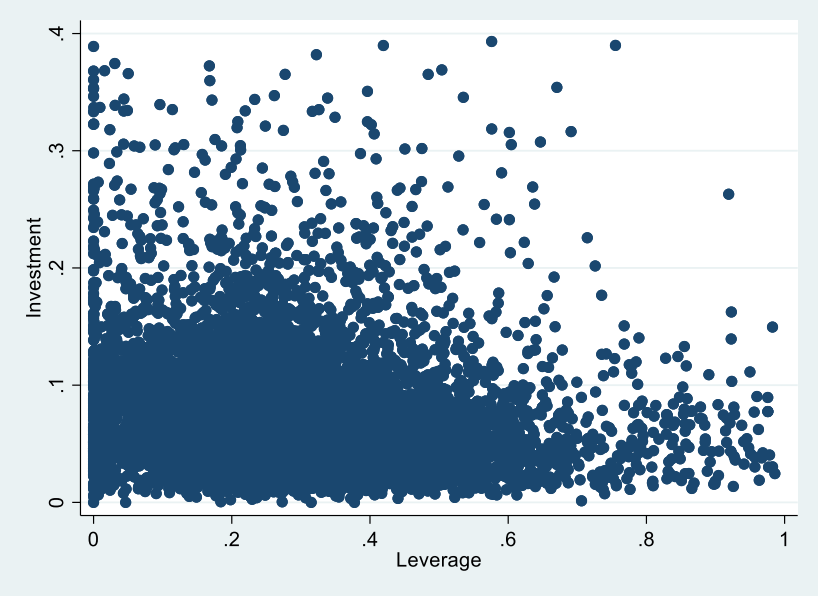

Figure 6: Leverage vs. Gross Investment (1970-2017) (Leverage < 1, Investment < 0.4)

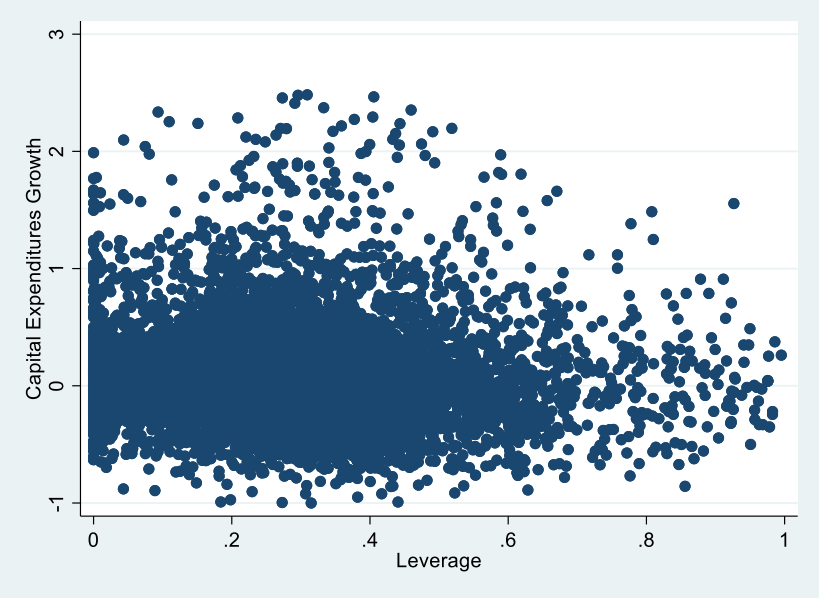

Figure 7: Leverage vs. Capital Expenditures Growth (1970-2017) (Leverage < 1, Capex Growth < 2.5)

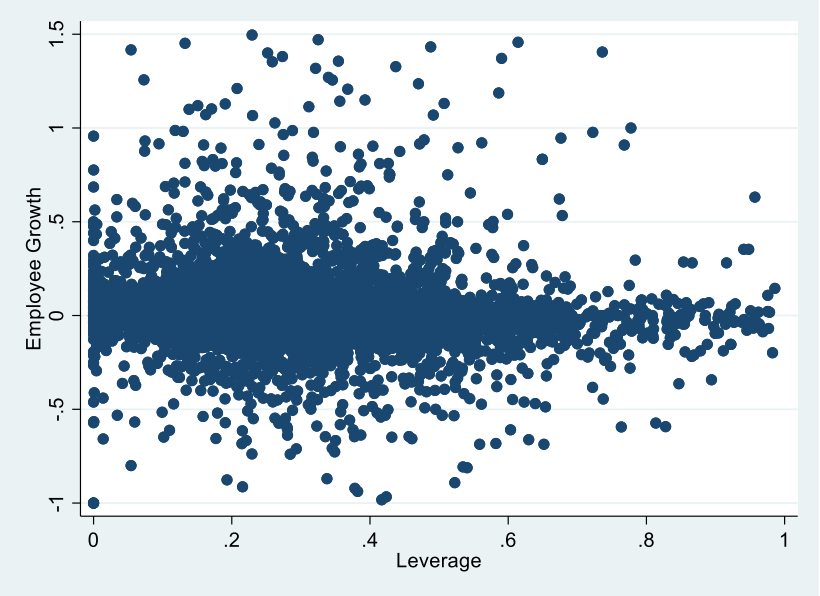

Figure 8: Leverage vs. Employee Growth (1970-2017) (Leverage < 1, Employee Growth < 1.5)

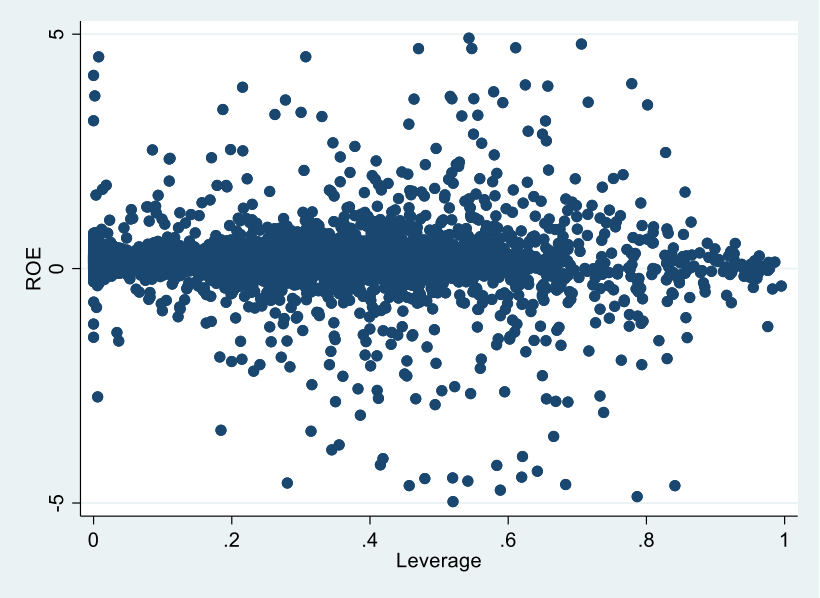

Figure 9: Leverage vs ROE (1970-2017) (Leverage < 1, -5 < ROE < 5)

Table 14: Correlations between Leverage and Performance Variables (1970-2017)

	Investment	CapEx Growth	Employee Growth	ROE
Leverage	-0.1416	-0.0559	-0.0737	-0.0409

Table 15: Coefficients for Bivariate Regressions of Performance Variables on Leverage (1970-2017)

	Investment	CapEx Growth	Employee Growth	ROE
Leverage Coefficient	-.3084801	-.127421	-.2058692	.4204672
P-Value	0.037	0.011	0.141	0.002

Again, ranges for the scatterplots are reduced to control for outliers. Though not entirely visible from the scatterplots, leverage appears to have a negative correlation with each of the company performance variables. When compared to just the 1970-1989 dataset, the wider dataset has smaller correlations with leverage for capital expenditures growth, employee growth, and return on equity, but a larger correlation with investment. This negative correlation with company growth measures is at least partially confirmed by the bivariate correlation coefficients,

as there is a sizable and statistically significant negative coefficient for leverage for regressions with both investment and capital expenditures. There is also a sizable and significant positive coefficient for the regression of return on equity on leverage, which is converse from the correlation between return on equity and leverage.

The bivariate regression outputs for the three performance measures used in Lang et al. have matching signs for the leverage coefficient from the 1970-1989 to the 1970-2017 datasets, implying that it is reasonable to expect the results from Lang et al. to remain consistent through the larger dataset spanning later than 1989. However, leverage coefficient in the employee growth regression becomes statistically insignificant in the larger dataset, which may suggest that the effect of leverage on employee growth diminishes through time. In the bivariate regression of return on equity on leverage, the leverage coefficient goes from negative and statistically insignificant to very statistically significant and positive, insinuating that the effect of leverage on return on equity may increase in later time periods.

A potential issue in these datasets is heteroskedasticity, as variance is not equal for all measures of leverage; few companies tend to have extreme measures of variance. Additionally the error term for individual companies is plausibly correlated within industries (Lang et al. 1996). White's test confirmed this for the most part, as it yielded significant chi-squared statistics in most attempted regressions, implying that the variance of the standard errors is likely not constant. The White adjustment for robust standard errors was used to remedy this issue.

V. Regressions of performance on leverage and other firm characteristics (1970–1989)

In Table 16, ordinary least squares (OLS) regressions of company performance measures on leverage, control variables, and a constant are displayed for the 1970-1989 sample period.

Investment (measured as gross investment) is expressed as the ratio of capital expenditures in year +1 to book value of fixed assets in year 0. Employee growth is expressed as a percentage, as is capital expenditures growth. Return on equity is expressed as the ratio of earnings to book value of stockholder's equity. All explanatory variables are computed in the base year. Coefficients for the year indicator variables are not included in the table. Given that all outcome variables are ratios, the magnitude of the regression coefficients are relatively small. The White adjustment for heteroskedasticity was used for all regressions.

Table 16: Regressions of Performance Measures on Leverage for 1970-1989

	Investment	Employee Growth	Capital Expenditures Growth	ROE
Leverage	-0.0353	-0.0785	-0.224	-0.0152
	(0.000)	(0.049)	(0.019)	(0.922)
Capital Expenditures / FA	0.500	0.254	-1.512	0.144
	(0.000)	(0.001)	(0.000)	(0.497)
Sales Growth	-0.00169	0.0112	0.0756	0.0000261
	(0.033)	(0.609)	(0.000)	(0.995)
Tobin's q	0.00806	0.0101	0.0244	0.0575
	(0.000)	(0.021)	(0.072)	(0.000)
Constant	0.0311	-0.00245	0.108	0.0311
	(0.000)	(0.887)	(0.009)	(0.484)
Observations	2299	2254	2288	2295
R^2	0.3848	0.0286	0.0982	0.0291

p-values in parentheses

Table 16 shows the results of the regression on the 1970-1989 dataset. Note that the cash flow variable has been excluded from these results, as the limited number of observations made it difficult to make definitive statistical inferences (regression results including cash flow in Appendix B). The results from this table find statistically significant negative coefficients for

leverage for the three of the four performance metrics, specifically the three company growth measures. To this end, the attempt to replicate Lang et al. (1996) is successful in generating negative coefficients for leverage, as Lang et al. also found consistent significant negative relationships between these company growth measures and leverage. However, the magnitude of the leverage coefficient differs between these results and the results of Lang et al. In particular, Lang et al. found the leverage coefficient from the investment regression to be -0.105 while the coefficient from this analysis is -0.0353, which differs by a wide margin. This could be due to a variety of reasons. Using gross investment instead of net investment likely leads to changes in regression coefficients. In addition, the elimination of the cash flow variable and the use of a different measure for Tobin's q plausibly has some impact on changes in the regression output as well. The effect of leverage on capital expenditures growth is also significantly smaller than the effect found by Lang et al.; this regression shows a leverage coefficient of -0.224 while Lang et al. found a coefficient of -0.48. Lang et al.'s results for the regression of employee growth on leverage are similar in magnitude to the results in Table 16.

Although the differences are not trivial, the coefficients produced by this study still appear to be economically significant. For example, the mean leverage of this data sample is 25% and the mean capital expenditures growth is 9.72%. Therefore, a company with half the average leverage is predicted to have capital expenditures growth of about 12.5%, which is about a 30% increase, an economically important effect. Similarly, a firm with half the average leverage can expect its employee growth to be 4.17%, which is also about a 30% increase from average firm employee growth. In the gross investment case, however, the leverage coefficient is not as economically significant. A company with half the average leverage is predicted to have a gross investment to fixed assets ratio of 0.102, which is only a difference of about 4%.

In the return on equity case, leverage does not appear to have a statistically significant relation with this performance measure at all. This supports the previous literature that predicts an ambiguous relationship between leverage and company performance. While Lang et al. shows strong negative relations between leverage and company performance measures, leverage may not have convincing effects on other performance measures that are more commonly examined in practice, such as return on equity.

Increases in capital expenditures are related to increases in investment and employee growth and decreases in capital expenditures growth, which makes economic sense. Capital expenditures did not have a significant effect on return on equity. Among control variables, Tobin's q has a positive effect on all performance measures, implying that firms with better growth opportunities valued by the market have better performance. The sales growth multiplier has a negative effect on investment and a statistically insignificant effect on employee growth, which differs from the results in Lang et al. (1996). Additionally, sales growth does not have a significant effect on return on equity. However, sales growth is included purely as a controlling multiplier effect, and for this reason, the results of this variable are not of particular significance.

VI. Effect of leverage on firm performance for extended time period (1970–2017)

As the effects from Lang et al. are successfully reproduced in the 1970-1989 sample period, it is appropriate to apply the same methodology to the extended sample period to inspect whether the effects remain consistent. In Table 17, results from the regression of all four performance metrics on leverage and other company characteristics for the wider 1970-2017 sample period are displayed. Coefficients for year indicator variables are not included in this

table. The cash flow control variable is excluded from these results as well (results including cash flow in Appendix C).

Table 17: Regressions of Performance Measures on Leverage for 1970-2017

	Investment	Employee Growth	Capital Expenditures Growth	ROE
Leverage	-0.0190	-0.0483	-0.168	0.782
	(0.000)	(0.003)	(0.000)	(0.214)
Capital Expenditures / FA	0.573	0.273	-1.081	-0.907
	(0.000)	(0.115)	(0.000)	(0.086)
Sales Growth	0.00122	-0.0225	0.160	-0.0182
	(0.594)	(0.768)	(0.024)	(0.430)
Tobin's q	0.00643	0.0112	0.0298	0.112
	(0.000)	(0.001)	(0.000)	(0.002)
Constant	0.0224	-0.0101	0.0432	-0.126
	(0.000)	(0.615)	(0.294)	(0.488)
Observations	8784	8574	8786	8761
R^2	0.5135	0.0062	0.0169	0.0100

p-values in parentheses

As seen in Table 17, there continues to be a negative effect of leverage on the three growth measures used by Lang et al., and the effect on return on equity is not statistically significant. Interestingly, the magnitude of the leverage coefficient in the cases of all three growth measures are smaller than in the 1970-1980 sample set, making many of these measures less economically significant. These results imply that when the range of the study is extended beyond 1989 into modern times, the effect of leverage on company performance weakens. For instance, the average company book leverage for this dataset was 30.3%, and the average gross investment to fixed assets ratio is 18.1%. For a company with half the average leverage, the gross investment to fixed assets ratio would be predicted to be 18.3%, which is only a 1.6%

increase. This even less economically significant than in the previous dataset. Additionally, a firm with half the average leverage would have an employee growth of 9.21%, which is only a 8.6% increase. This is a significant decrease from the 30% effect in employee growth that halving leverage had in the 1970-1989 sample period. A company with half the mean leverage would have a capital expenditures growth of 13.0%, which represents a 24% increase. While this is economically important, it is still less than the 30% effect that halving leverage had on capital expenditures growth in the previous dataset.

These results imply that the conclusions that Lang et al. drew about the relationship between leverage and company growth are still relevant, although their exact effects may have changed slightly. Although the magnitudes of leverage effects on the three growth measures are different from in the previous sample period's regressions, the coefficients remain statistically significant and continue to have the same signs. The effect of leverage on return on equity continues to be statistically insignificant, although the p-value for the leverage coefficient is lower in this sample period. This is again consistent with literature that suggests that leverage has an ambiguous effect on company performance. Overall, the result implies that there are contrasting effects here, just as in the previous sample period: while leverage has a negative effect on company growth rates examined by Lang et al., those who only look at traditional variables such as return on equity will not see these effects.

The behavior of the control variables remains generally the same from the older sample period to the updated sample period with some minor caveats. Tobin's q has a small but statistically significant positive effect on all measures of performance. The sales growth multiplier only has a statistically significant impact on capital expenditures growth. Capital

expenditures does not have a significant effect on employee growth, but it does have a negative effect on return on equity, that is significant at the 10% level.

VII. Post-Recession effect of leverage on firm performance (2008–2017)

There is reason to suspect that there might be a structural break in the dataset after the Great Recession, as the economic climate has changed greatly (ultra low interest rate, quantitative easing, higher financial regulation, etc.). Therefore, it is plausible that the relationship between leverage and company performance could have been affected by these exogenous macroeconomic conditions. If the relationship has changed, then this structural break could explain some of the minor differences between the 1970-1989 regression and the 1970-2017 regression. To investigate the possibility of a structural break, a more recent sample of 2008-2017 was isolated and analyzed using the same empirical methodology (summary statistics in Appendix D). Similar to the previous results, coefficients for year indicator variables have been omitted ,and the White adjustment is used for the regression. In contrast to the previous regressions, cash flow data is readily available during this sample period, so the Cash Flow / TA control variable is included in the regressions. The results of this analysis are presented in Table 18.

Table 18: Regressions of Performance Measures on Leverage for 2008-2017

	Investment	Employee Growth	Capital Expenditures Growth	ROE
Leverage	-0.0244	-0.0496	-0.200	2.292
	(0.000)	(0.193)	(0.000)	(0.113)
Cash Flow / TA	0.0968	0.267	1.166	1.810
	(0.004)	(0.057)	(0.000)	(0.108)
Capital Expenditures / FA	0.537	0.260	-0.841	0.534
	(0.000)	(0.001)	(0.000)	(0.374)
Sales Growth	0.0117	0.0512	0.260	-0.0908
	(0.023)	(0.007)	(0.002)	(0.209)
Tobin's q	0.00772	0.00688	0.0385	0.0574
	(0.000)	(0.049)	(0.011)	(0.416)
Constant	0.0146	-0.0394	-0.109	-0.634
	(0.001)	(0.026)	(0.001)	(0.159)
Observations	2321	2258	2308	2308
R^2	0.4993	0.0269	0.0858	0.0715

p-values in parentheses

The results of the analysis on the 2008-2017 period do not vary too much with the results of the wider dataset. Again, a statistically significant negative relation between leverage and the company growth variables used in Lang et al. continues to exist. However, the effect of leverage on ROE in this period is positive and large in magnitude; in contrast to prior analyses, it is only marginally statistically insignificant at the 10% level. The behavior of the control variables varies slightly, but not very significantly. Similar to the 1970-1989 sample set, the effect of leverage on investment and employee growth is not economically important; a company with half the mean leverage is predicted to have about 3% higher gross investment than a firm with average leverage. In contrast, the effect of leverage on capital expenditures is economically significant; a firm with half the average leverage would have about 34% higher capital

expenditures growth than a company with average leverage. In addition, a firm with half the mean leverage is predicted to have about 12% higher employee growth, which is moderately economically important. Overall, the effect of leverage on company performance is greater in magnitude than in the extended dataset, and the signs have remained the same. Therefore, it cannot be concluded that there is a structural break in the data due to the great recession. It is also of note that the general effect of leverage (signs of leverage coefficients) on company performance measures persists across all three sample periods, even through disruptive macroeconomic environments.

VIII. Conclusion

This study sets out to address the key research question of if and how leverage affects company performance. Using a dataset that covers large public companies from 1970 to 2017, it is found that leverage, defined as the ratio of total debt to book value of assets, has a consistent negative impact on growth-oriented measures such as investment, capital expenditures growth, and employee growth. By contrast, I find no such negative effect of leverage on return on equity—if anything, point estimates incorporating more recent data indicate that the opposite is true. This result is largely consistent with prior literature: empirical studies have shown that leverage has a negative relationship with growth measures (Aivazan et al. 2005) (Cai & Zhang 2001) (Lin & Chang 2011). Yet, this effect stands in contrast with the Modigliani Miller theorem (1958), as Modigliani and Miller would suggest that firm performance is not affected by its debt levels.

It is worth noting how this study lines up with that of Lang, Ofek, and Stulz (1996). As a validation, I tested and was largely able to replicate their result using a dataset (covering 1970-

1987) similar to the one used by Lang et al. When applying the same methodology to the extended dataset (covering 1970-2017), the negative impact of leverage on firm performance measured by growth variables continues to hold. The magnitudes of the relationships between leverage and company growth measures vary somewhat over time, but the overall effects remain the same. This is significant, as the dataset used in this study covers several time periods of disruptive and even unprecedented economic situations (such as the dotcom boom and bust from 1996 to 2001, the financial crisis in 2008-2009, and quantitative easing between 2008 and 2014). This study shows that the negative relation between leverage and company growth, which are firm-level measurements, holds true regardless of significant variations in exogenous economic conditions.

It is also useful to look deeper into the growth-based performance measures. Lang et al. presented the negative effect of leverage on company growth and explained this relationship by positing that higher leverage hinders companies' ability to allocate financing to growth investment because of the liquidity effect (1996). Among the three growth measures studied in this research, capital expenditures growth is most impacted negatively by leverage. In other words, when a company is highly leveraged, its capital expenditures are less likely to increase. In addition, despite the relatively small negative coefficient, leverage is strongly tied to investment (as exemplified by a high R^2 value). Such relationships show that financing decisions on target leverage may have an impact on management's operational decisions. As argued by Lang et al. (1996), in extreme cases, this negative effect can result in debt overhang or a debt burden large enough to stop a company from raising funds for operational activities altogether.

Perhaps more interestingly, this study highlights the importance of adopting appropriate measures when examining company performance. The results of this research show contrasting

effects of leverage on company growth versus return on equity. When an observer (e.g. an investor or researcher) asks a seemingly straightforward question of "what is the impact of a firm's leverage on its performance," the answer can be complicated, because it depends on how performance is measured. Moreover, when company executives make strategic decisions about capital structure, they are more likely to examine common metrics of company performance such as return on equity than operations-oriented growth variables, in which case leverage does not seem to impact firm performance at all.

This study provides several important implications for researchers, industry practitioners, and policymakers. First, since the results show that leverage affects company growth but not return on equity, a key metric that influences valuation, investors should be less inclined to worry about a company's leverage when evaluating potential returns. (Note that, however, other debt-related investment issues such as liquidly or credit risks are not addressed in the current study.) Second, given the large negative impact of leverage on investment, capital expenditures, and employee growth, it is advisable that companies in the growth stage (e.g. start-ups) should carefully monitor and manage debt loads. Lastly, this study sheds light on incentive problems when considering macroeconomic policies related to leverage. Overall employment and investment growth are desirable; therefore, policymakers would like to see companies reduce their leverage according to the results of this analysis. However, at the firm level, leverage may be less of a concern in management's decision-making process because capital structure may not affect key performance metrics such as ROE. Such a misalignment implies policymakers cannot rely on management incentives to achieve the macroeconomic goals. Instead, if policymakers want to increase employment and investment, they must find ways to incentivize managers to choose lower levels of leverage beyond natural free-market incentives. Such considerations

might be the reason behind recent tax reform programs that seek to minimize interest rate deductibility and discourage high leverage levels (Rapoport 2018).

Appendix

Appendix A: Lang, Ofek & Stulz (1996) Results

	Investment	1-year employment growth	3-year employment growth	1-year capital expenditures growth	3-year capital expenditures growth
Leverage	-0.105	-0.066	-0.200	-0.480	-0.634
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cash Flow / TA	0.324	0.238	0.643	0.378	0.754
	(0.001)	(0.001)	(0.001)	(0.039)	(0.011)
Capital Expenditures / FA	0.105	0.023	-0.015	-0.368	-1.066
	(0.001)	(0.012)	(0.571)	(0.012)	(0.001)
Sales Growth	0.016	0.029	0.172	0.277	0.409
	(0.068)	(0.007)	(0.001)	(0.001)	(0.001)
Tobin's q	0.017	0.017	0.033	0.017	0.030
	(0.001)	(0.001)	(0.001)	(0.014)	(0.016)
Constant	0.002	-0.041	0.054	0.079	0.365
	(0.020)	(0.001)	(0.019)	(0.055)	(0.001)
Observations	6,791	6,777	5,478	6,795	5,480
R^2	0.148	0.060	0.094	0.087	0.120

p-values in parentheses

Source: Lang et al. (1996)

Appendix B: Regressions of Performance Measures on Leverage for 1970-1989 (including cash flow)

	Investment	Employee Growth	Capital Expenditures Growth	ROE
Leverage	-0.0247	-0.102	-0.193	0.102
	(0.158)	(0.183)	(0.365)	(0.680)
Cash Flow / TA	0.101	0.161	0.700	2.111
	(0.043)	(0.458)	(0.247)	(0.003)
Capital Expenditures / FA	0.567	0.252	-2.198	-1.301
	(0.000)	(0.300)	(0.001)	(0.091)
Sales Growth	-0.00449	-0.00811	0.495	0.443
	(0.768)	(0.903)	(0.007)	(0.036)
Tobin's q	0.00815	0.00971	0.0342	0.208
	(0.054)	(0.599)	(0.494)	(0.000)
Constant	0.0349	0.0176	0.226	-0.131
	(0.002)	(0.670)	(0.088)	(0.390)
Observations	282	281	277	279
R^2	0.3444	0.0170	0.0610	0.0912

p-values in parentheses

Appendix C: Regressions of Performance Measures on Leverage for 1970-2017 (including cash flow)

	Investment	Employee Growth	Capital Expenditures Growth	ROE
Leverage	-0.0220	-0.0719	-0.171	0.856
	(0.000)	(0.305)	(0.000)	(0.000)
Cash Flow / TA	0.0792	0.343	0.856	0.171
	(0.000)	(0.205)	(0.000)	(0.848)
Capital Expenditures / FA	0.584	0.286	-0.898	-1.119
	(0.000)	(0.199)	(0.000)	(0.128)
Sales Growth	0.00921	-0.0297	0.360	-0.0450
	(0.000)	(0.603)	(0.000)	(0.810)
Tobin's q	0.00600	0.00949	0.0240	0.124
	(0.000)	(0.455)	(0.001)	(0.003)
Constant	0.0322	0.00314	0.142	-0.123
	(0.000)	(0.988)	(0.535)	(0.862)
Observations	6047	5903	6048	6014
R^2	0.5209	0.0068	0.0524	0.0110

p-values in parentheses

Appendix D: Summary Statistics for 2008-2017 Post-Recession Dataset

	Observations	Mean	Std. Dev.	Min	Max
Leverage	3,263	.3483924	.798707	0	30.70588
Investment	2,798	.1413869	2.301274	0	98.125
Employee Growth	2,631	.0694465	1.417196	-.9666612	71.5
Capital Expenditures Growth	2,771	.1035365	.5594069	-1	14.31996
ROE	2,833	.1810434	1.88068	-33.73333	41.285
Cash Flow / TA	2,990	.0251577	.0581979	-.717551	.6093664
Capital Expenditures / FA	3,148	.0695425	.0837367	0	2.682089
Sales Growth	3,164	.093219	1.309635	-.8270082	70.0128
Tobin's Q	2,922	1.736307	16.17197	-.3163615	873.0306

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