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Accounting for Leverage in Intangible and Tangible Investments Across the Business Cycle

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Accounting for Leverage in Intangible and Tangible Investments Across the Business Cycle

Abstract
In this paper, I study the role of the leverage ratio and its impact on investing in tangible and intangible goods. The results confirm the hypotheses outlined in the introduction. Specifically, the results show that when accounting for differences in the leverage ratio between firms, investment is cyclical. However, when looking only at firms with low leverages, intangible investing becomes countercyclical. Moreover, during recessions, firms with lower leverages tend to invest more than firms with higher leverages. Finally, the results argue for the existence of financial frictions between investing in tangibles and intangibles.

Keywords
Business Cycles, Leverage, Financial Frictions

Cover Page Footnote
I would like to express my sincerest gratitude for all the help and support provided by my advisor, Stephen Terry. This paper would not have been possible without his commitment to both me and to this paper.

1. Introduction

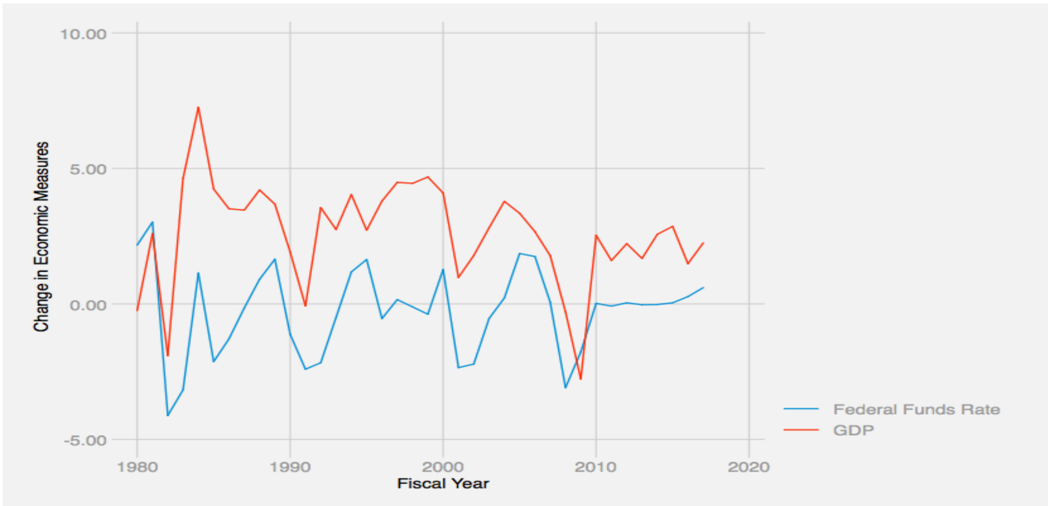
Firms generally have more disposable income when the economy is doing well. On the other hand, firms have less disposable income when the economy isn't doing well. This effect has a pronounced impact on how investment changes throughout the business cycle; this change, however, tends to be different for tangible and intangible investment. This paper examines the role of financial frictions and the leverage ratio in determining these heterogeneous changes in investment decisions.

During economic contractions, or recessions, there are two major types of theories as to how firms invest: cyclical and countercyclical. In a perfect credit market, investment is dictated by the opportunity cost approach, a counter cyclical theory of investing, which states that firms will know that the economy will eventually get better. Thus, firms will be inclined to invest more during a recession when prices are lower, allowing them to collect large profits once the economy has improved. However, when credit constraints get too tight, this investment channel becomes cyclical. Firms facing tight credit constraints in a recession will have less money for non essential transactions, such as investing, and could instead choose to save that money or spend it elsewhere[1].

The graph below shows the percent change data for both the Gross Domestic Product (GDP) and the Federal Funds Rate. While the level of the GDP percent change is often higher or more positive than the level of the Federal Funds Rate change, the differences are still highly correlated. The rate of change for both functions is often quite similar; when one function is increasing or decreasing, the other function is likely doing the same. This correlation occurs when the Federal Reserve adjusts the Federal Funds Rate to either create or reduce growth in the economy. When the economy is in a recession, the Fed tries to create growth by setting a low federal funds rate and vice versa.

[1] See Aghion, Philippe, et al. (2010)

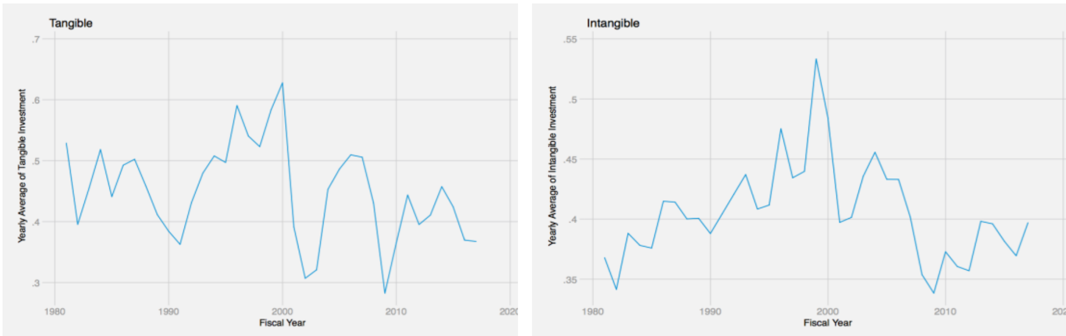
Figure 1: GDP and Federal Funds Rate Growth Graphs



Notes: The data is from the St. Louis FRED Database. The data was compiled and graphed using Stata. GDP data outlined is in percentage change units and the Federal Funds Rate Data is just change.

The following graphs show the changes in the yearly averages for tangible and intangible investing.

Figure 2: Investment Graphs



Notes: Data is from Compustat annual and the graph was created using Stata. Tangible investing was calculated and normalized by dividing capital expenditures by the previous years net property plant and equipment. Intangible investing was calculated and normalized by dividing SG&A by the previous years assets. The data was trimmed by using values that were in the 0.5 to 99.5 percentile range for each measure to exclude any outliers.

When looking at the graphs of tangible and intangible investments over the years, it appears to be procyclical to changes in the economy[2]. Yet, this is without taking a firm's ability to borrow money and the leverage ratio into consideration. This distinction is particularly important when accounting for an inherent difference between tangible and intangible investments -- the inability to acquire collateral. For example, if investors give money to a firm for an advertising campaign, an intangible investment, they don’t gain anything if the company fails. On the other hand, if they give money for a tangible investment like a new factory, the investor will at least get the factory if the company fails. Thus, investors are more inclined to to invest in tangible goods. This process is further exacerbated during recessions when people are more conservative with their money and collateral becomes a higher priority for investors.

We theorize that for those who choose to continue to invest, the leverage ratio, the proportion of debts to assets, gives investors insight into a firm’s financials and likeliness to succeed. The leverage ratio, in the models, shows how much money a firm has borrowed in relation to its total assets. Thus, during recessions, firms with lower leverage ratios should actually be able to borrow more for investments when investors are fiscally conservative and are looking for

[2] See Appendix A

safer investments. Due to an inability to acquire collateral, we theorize that the leverage ratio will have more of an impact on investment decision for intangible investing when compared to tangible.

We examine this connection between leverage and investment for four different types of investment: tangible, intangible, research and development, and advertising. The latter two are specific types of intangible investment. These four investment types are run through three different types of measures of the economy: GDP, Federal Funds Rate, and Industry Output. These three measures are endogenous, which means other variables could impact them and thus bias the study. For example, suppose a firm has an innovative product idea. In order to act on this idea, they will start borrowing and investing more, which leads to a higher leverage ratio. Essentially, they ignore a firm's investment opportunities which skews the models. For that reason, two more models were used. The first, the monetary policy shock (also referred to as the Federal Funds Rate shock) looks at shocks in the federal funds rate futures. The second, the policy news shocks, looks at the shocks in multiple futures. Using the shock data doesn't run into this same issue. Imagine there are two companies that have the exact same idea. For whatever reason, Firm A borrowed a lot of money a few years back and thus has a high leverage, while Firm B has been very conservative with their borrowing and has a very low leverage. The shock data doesn't have any endogeneity bias because firms will respond to the shock accordingly without any other variables interfering. Using these models allows us to see who ends up investing more money without the bias from the previous measures. Of course, theoretically, Firm B should invest more than Firm A.

Given all this information, the hypotheses can be summarized as follows:

1. Firms with lower leverages will invest more than firms with higher leverages during a recession.
2. Firms with low leverages will invest counter cyclically in intangibles, while firms with higher leverages will invest cyclically.
3. There are financial friction present regarding tangible and intangible investing when accounting for leverage.

Related Literature:

This paper relies heavily on the work completed in Ottonello & Winberry (2018), which shows that firms with low leverage are more responsive to monetary policy shocks. Specifically, that investment and shocks are inversely correlated, such that firms with low leverages invest more in capital stock than firms with higher leverages during a recession. This paper expands on this aspect by looking at different types of investment.

Regarding actual intangible investments, Lopez-Garcila et al. (2012) shows that with little to no credit constraints, a firm's R&D investments tend to be countercyclical. However, at a certain point when credit constraints become too tight, R&D investments will actually be cyclical. Although this variable is not leverage, leverage and credit constraints tend to be highly correlated. Both high credit constraints and leverage ratios mean that a firm will generally invest less and be more cautious while the opposite is true for the low end of the variables. In fact, a high leverage can be a type of credit constraint in and of itself, because investors are less likely to give credit to a firm that has a lot of debt. Aghion et al. (2005) show that this relationship is true for long term investment in general, which is what a significant portion of intangible investing is.

The shock data was obtained using values calculated in Nakamura & Steinsson (2018). They calculate the shocks to the federal funds rate futures and other futures that occur in the 30 minutes surrounding an announcement by the Federal Reserve regarding monetary policy.

2. Data Description

The Variables

Measures of the Economy:

To determine the effects of a change in the leverage ratio, a models was run for each of the five different economy measures: Gross Domestic Product, Federal

Funds Rate, Industry Output, Federal Funds Rate Shocks, and Policy News Shocks. The GDP and Industry Output variables are growth rates measured in percentage change points, while the Federal Funds Rate variable corresponds to the change. The GDP and Federal Funds Rate data was taken from the databases of the St. Louis Federal Reserve Economic Data (St. Louis FRED) and the industry output data was taken from the Bureau of Economic Analysis (BEA). The GDP and Industry Output values are growth rates rather than measures of level, so it is not skewed and thus, does not need to be logged. The industries for the industry output data were determined by the firm's North American Industry Classification System (NAICS) code[3]. The values for the Federal Funds Rate Shocks and the Policy News shocks were obtained from Nakamura (2018) and the time aggregation was done by summing up all the shocks in a given period, as was done in Wong (2015). A positive shock corresponds to lower interest rates, which means the expansionary policy is being used and is thus correlated with recessions.

[3] See Appendix B for specifics about classification

Table 1: Summary Statistics of Economy Measures

	GDP % Change	FFR Change	Industry Output % Change	FFR Shock	PNS Shocks
mean	6.461416	-.3548571	1.600575	-.1082817	-.0009557
median	5.949645	-.03	6.760336	-.0322377	.0429941
std	3.22188	1.634106	1.95	.2150766	.178694
min	-2.037206	-4.119999	-22.1	-.8558841	-.6396713
max	15.69019	3.02	20.2	.2072204	.1857514
Years:	1980-2016	1980-2016	1980-2016	1995-2013	1995-2013

Note: GDP and Federal Funds Rate data was taken from the St. Louis FRED Database. Industry Output data was taken from the BEA and was assigned to firms by NAICS codes. Shock data was acquired from Nakamura (2018) and the time aggregation was done by summing up all the shocks in a given period, as was done in Wong (2015)

Firm Level Variables:

All the firm level variables were acquired from compustat annual data, a panel dataset consisting of firm level data for all publicly listed firms. Having a panel dataset allowed the models to account for variation within each firm. Annual data was used rather than quarterly because the intangible investment data is more populated.

The firm level variables in this study were the different types of investment and the leverage ratio. For the following sentences, the letters in the parenthesis next to the variables are the corresponding variable names in compustat. The tangible investment variable was normalized by dividing capital expenditures (capxv) by the property, plants and equipment (ppent) from the year before. The intangible investment variable was normalized by dividing the Selling, General, and Administrative expenses (xsga) by the total assets (at) from the previous year. The Research and Development investment variable was normalized by dividing its own variable (xrd) by the total assets (at) from the previous year, as was advertising. These calculations make the investment types into percentage units.

The debt, which is in the numerator of the leverage ratio, was calculated by summing the total long term debt (dltt) and the debt in current liabilities (dlc). This, in turn, was divided by the total assets (at) to get the leverage ratio. The leverage in the models is lagged, because it is the leverage of the previous year which determines investing for the current year.

Firms with a negative value for total assets (at) and property, plants and equipment (ppent) were ignored in this study, as these firms skew the results by having negative leverages. Furthermore, the first three models used data for firms from 1980 until 2016, and the last two models used 1995 until 2013. The last model used data from 1995 to 2013 because that was the only data available. Data from other dates was not used. Furthermore, observations that were not within the 0.5 to 99.5 percentile range were excluded to prevent outliers from skewing the results.

The Models:

This paper uses 5 models -- 1 for each measure of the economy -- and is run for each of the investing types for a total of 20 regressions.

The simple model is as follows:

$$x_{it} = \beta_0 + f_i + g_t + \beta_1 l_{it-1} + \beta_2 l_{it-1} \Delta E_t + \varepsilon_{it}$$

Where x_{it} refers to the different types of investing, f_i is the firm fixed effect for firm i, g_t is the year fixed effect in year t, l_{it-1} is the leverage variable for firm i in the year prior to t, ΔE_t is the economy quantifier for year t, and ε_{it} is the residual.

The five economy quantifiers are GDP Percent Change, Federal Funds Rate Change, Industry Output Percent Change, Monetary Policy Shock, and Policy News Shock. Each model accounted for a different economy quantifier and was run for each of the different investment types: tangible investing, intangible investing, research and development, and advertising.

The coefficient of interest in this model is β_2, which shows the effect of changes in the economy on investing as a whole when accounting for leverage. The firm fixed effects captures the variations that occur within each firm, such as the individual investment strategies that each firm has. The year fixed effects accounts for variations that occur within each fiscal year.

For all subsequent paneled tables, Panel A corresponds with GDP Percent Change, Panel B corresponds with Federal Funds Rate Change, Panel C corresponds with Industry Output Percent Change, Panel D corresponds with Monetary Policy Shock, and Panel E corresponds with Policy News Shock. Because the different investment types are the dependent variables and they are in percentage units, the coefficients will represent a percentage change in that investment type.

3. Analysis of the Data

Impact of Leverage on Investment During Recessions:

In the models, the interaction variable between the leverage and economy quantifier describes the relationship between changes in the economy and investment spending for a constant level of leverage. For the first three models, a negative value for the economy variable corresponds to a recession. As stated earlier, we expect that firms with lower leverages would invest more during recession than firms with higher leverages. For this to be true, the coefficient would have to be positive. The data for the first three models outlined in the previous section is as follows:

Table 2: Summary Data for Models 1-3

Panel A: GDP Growth	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
Leverage	1.208***	5.498***	0.300***	0.300***
	(0.29100)	(0.24500)	(0.02930)	(0.05310)
Leverage x GDP % Change	-0.114**	0.340***	0.0473***	0.0251**
	(0.05440)	(0.05520)	(0.00628)	(0.01050)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	247,039	226,869	100,333	84,042
Firms	25,972	25,276	11,149	12,125
Years	1980-2016	1980-2016	1980-2016	1980-2016

Panel B: Federal Funds Rate Change	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
Leverage	0.641*	6.818**	0.397*	0.417***
	(0.37400)	(2.73900)	(0.22000)	(0.09970)
Leverage x FFR Change	0.01970	-0.47000	0.01610	0.00726
	(0.26400)	(0.38900)	(0.14600)	(0.03380)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	246,811	226,640	100,188	83,945
Firms	25,970	25,274	11,148	12,125
Years	1980-2016	1980-2016	1980-2016	1980-2016

Panel C: Industry Output Growth	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
Leverage	0.396***	8.775***	0.560***	0.375***
	(0.11400)	(0.12700)	(0.02980)	(0.02580)
Leverage x Industry Output % Change	0.111***	-0.505***	0.0387***	0.0177***
	(0.03100)	(0.02210)	(0.00340)	(0.00611)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	244,505	224,490	99,620	83,060
Firms	24,908	24,296	10,880	11,698
Years	1980-2016	1980-2016	1980-2016	1980-2016

Note: The standard errors are present in parentheses with the following: *** p<0.01, ** p<0.05, * p<0.1 This table shows the clustered standard errors, where the clustering is done by the gvkey, or the firm's identification code. All variables in the regression are normalized as outlined in the data description section. The GDP and Federal Funds Rate data were acquired from the St. Louis FRED Database, and the Industry Output was acquired from the Bureau of Economic Analysis (BEA). The regressions run also included time and firm dummy's which are not presented in this table. Each coefficient can be interpreted as how much investment will change on a percentage scale. For example, a coefficient value of 1 corresponds to a 1% increase in investment while a coefficient value of -2 corresponds to a 2% decrease for a 1 unit increase in the independent variable.

The data presented by these first three models is conflicting. In the first model, the coefficient of the interaction variable for tangible investments is negative while it is positive in the other two models. The opposite is true for intangible investing; the coefficient of the interaction variable of intangible investing is positive for the first model, but is negative in the other two. None of the interaction variable coefficients in the second model are significant, but the same coefficients are significant in the other models. This inherent difference in the interaction variables is most likely due to the the endogeneity bias, which is why the last two models were run.

In these models, a positive value for the shock corresponds to expansionary policy and recessions, which means that a negative value for the coefficient of the interaction variable is consistent with the hypothesis. The data for the two shock models is as follows:

Table 3: Summary Data for Models 4-5

	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
Panel D: Monetary Policy Shock				
Leverage	1.061***	3.588***	0.368***	0.545***
	(0.11400)	(0.08940)	(0.03210)	(0.03250)
Leverage x FFR Shock	-2.320**	-13.36***	-2.911***	-0.0463
	(0.95000)	(0.78100)	(0.44500)	(0.12600)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	132,907	125,685	57,201	45,052
Firms	18,364	18,075	8,037	7,413
Years	1995-2013	1995-2013	1995-2013	1995-2013
Panel E: Policy News Shock				
	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
Leverage	1.346***	4.011***	0.418***	0.551***
	(0.14500)	(0.08690)	(0.03890)	(0.03110)
Leverage x PNS Shock	-3.488***	-4.323***	-0.650*	-0.203
	(1.11100)	(0.97200)	(0.38400)	(0.14600)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	132,907	125,685	57,201	45,052
Firms	18,355	18,059	8,032	7,411
Years	1995-2013	1995-2013	1995-2013	1995-2013

Note: The standard errors are present in parentheses with the following: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ This table shows the clustered standard errors, where the clustering is done by the gvkey, or the firm's identification code. All variables in the regression are normalized as outlined in the data description section. The Monetary Policy and Policy News Shock data was acquired from Nakamura (2018) and the time aggregation was done by summing up all the shocks in a given period, as was done in Wong (2015). The regressions run also included time and firm dummy's which are not presented in this table. Each coefficient can be interpreted as how much investment will change on a percentage scale. For example, a coefficient value of 1 corresponds to a 1% increase in investment while a coefficient value of -2 corresponds to a 2% decrease for a 1 unit increase in the independent variable.

The results presented in these last two models are consistent. The interaction variables are negative for the different types of investment, indicating that there is a negative correlation between investment and leverage for a constant, positive shock. Thus, as leverage increases, investment decreases. This agrees with the hypothesis that during a recession, a firm with a higher leverage will see a greater decrease in investment than a firm with a low leverage. The following table shows how the interaction variable and investment change for different percentiles of leverage:

Table 4: Changes in Investment at Different Levels of Leverage

Panel D: Monetary Policy Shocks

Leverage Percentile	Leverage Level	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
25th Percentile	0.0435962	-0.101143184	-0.582445232	-0.126908538	-0.002018504
50th Percentile	0.2087623	-0.484328536	-2.789064328	-0.607707055	-0.009665694
75th Percentile	0.400307	-0.92871224	-5.34810152	-1.165293677	-0.018534214

Panel E: Policy News Shocks

Leverage Percentile	Leverage Level	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
25th Percentile	0.0435962	-0.152063546	-0.188466373	-0.02833753	-0.008850029
50th Percentile	0.2087623	-0.728162902	-0.902479423	-0.135695495	-0.042378747
75th Percentile	0.400307	-1.396270816	-1.730527161	-0.26019955	-0.081262321

Note: Shock data was acquired from Nakamura (2018) and the time aggregation was done by summing up all the shocks in a given period, as was done in Wong (2015). These values were computed using the data from the regressions run to create Table 3. Each value can be interpreted as how much investment will change on a percentage scale. For example, a value of 1 corresponds to a 1% increase in investment while a value of -2 corresponds to a 2% decrease for a 1 unit increase in the independent variable.

This table shows that as the level of leverage increases, the coefficient of the interaction variable decreases. This indicates that firms with higher leverages will invest less than firms with lower leverages.

The differences in significance between advertising and the other investment types, however, may be attributed to a lack of data, rather than an absolute proof that advertising doesn't share this relationship. There is significantly less advertising data than the other types of investment, which can be seen in Table 3. With more data points for advertising, the results might have been significant.

The data regarding tangible investment agrees with the results published in Ottonello & Winberry (2018), despite using annual data. Notice, however, that the coefficients are larger for intangible investment than it is for tangible investment, despite the mean of tangible investment being similar in magnitude to intangible when ignoring outliers[4]. This indicates that the leverage ratio is more important

[4] See Appendix B

when investing in intangible investment, and thus also argues for the existence of financial frictions between tangible and intangible investments.

Cyclicality:

The data also argues that investment is cyclical when taking leverage into account. The following table demonstrates this relationship:

Table 5: Cyclicality

Panel D: Monetary Policy Shocks					
		(1)	(2)	(3)	(4)
Economic Strength	Shock Level	Tangible Investment	Intangible Investment	R&D Investment	Advertising Investment
Boom	-0.1	1.293	4.924	0.6591	0.54963
Recession	0.1	0.829	2.252	0.0769	0.54037
Panel E: Policy News Shocks					
		(1)	(2)	(3)	(4)
Economic Strength	Shock Level	Tangible Investment	Intangible Investment	R&D Investment	Advertising Investment
Boom	-0.1	1.6948	4.4433	0.483	0.5713
Recession	0.1	0.9972	3.5787	0.353	0.5307

Note: Shock data was acquired from Nakamura (2018) and the time aggregation was done by summing up all the shocks in a given period, as was done in Wong (2015). These values were computed using the data from the regressions run to create Table 3 and plugging a leverage value of 1 and the shock level from the table. Each value can be interpreted as how much investment will change on a percentage scale. For example, a value of 1 corresponds to a 1% increase in investment while a value of -2 corresponds to a 2% decrease for a 1 unit increase in the independent variable.

For all the investment types, notice that the coefficient is less during a recession than during boom, which indicates that investing is cyclical.

This shouldn't be the case; both Aghion et al. (2005) and Lopez-Garcila et al. (2012) show that when accounting for credit constraints, firm investing is counter cyclical. Because credit constraints and the leverage ratio are highly correlated, it would seem that the cyclicality in this paper should be countercyclical.

To see if the results in each paper can show consistent results, the models were rerun, but only included firms with low leverages. The following table contains the data for observations that are within the 1-25 percentile range:

Table 6: Summary Data for Low Leveraged Firms

Panel D: Monetary Policy Shock

	(1)	(2)	(3)	(4)
	Tangible Investment	Intangible Investment	R&D Investment	Advertising Investment
Leverage	12.14***	107.7***	27.13***	10.52***
	(4.66300)	(4.44700)	(2.15700)	(1.48700)
Leverage x FFR Shock	-17.66	172.9***	5.711	-4.056
	(13.31000)	(26.28000)	(10.34000)	(6.64700)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	12,455	11,735	7,477	4,444
Firms	4,879	4,716	2,837	1,873
Years	1995-2013	1995-2013	1995-2013	1995-2013

Panel E: Policy News Shock

	(1)	(2)	(3)	(4)
	Tangible Investment	Intangible Investment	R&D Investment	Advertising Investment
Leverage	15.26***	80.42***	25.94***	10.77***
	(3.99500)	(3.23500)	(1.60100)	(1.36600)
Leverage x PNS Shock	-4.747	275.7***	33.65***	3.487
	(15.68000)	(29.34000)	(12.25000)	(7.66900)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	12,455	11,735	7,477	4,444
Firms	4,879	4,716	2,837	1,873
Years	1995-2013	1995-2013	1995-2013	1995-2013

Note: The standard errors are present in parentheses with the following: *** p<0.01, ** p<0.05, * p<0.1 This table shows the clustered standard errors, where the clustering is done by the gvkey, or the firm's identification code. All variables in the regression are normalized as outlined in the data description section. The Monetary Policy and Policy News Shock data was acquired from Nakamura (2018) and the time aggregation was done by summing up all the shocks in a given period, as was done in Wong (2015). The regressions run also included time and firm dummy's which are not presented in this table. Each coefficient can be interpreted as how much investment will change on a percentage scale. For example, a coefficient value of 1 corresponds to a 1% increase in investment while a coefficient value of -2 corresponds to a 2% decrease for a 1 unit increase in the independent variable. Observations above the 25th percentile and below the first were ignored. The former is to ensure that only low leveraged firms were observed and the latter is to ensure no outliers.

These coefficients, when looking at different shock values, present the following results:

Table 7: Cyclicality for Low Leveraged Firms

Panel D: Monetary Policy Shocks

		(1)	(2)	(3)	(4)
Economic Strength	Shock Level	Tangible Investment	Intangible Investment	R&D Investment	Advertising Investment
Boom	-0.1	13.906	90.41	26.5589	10.9256
Recession	0.1	10.374	124.99	27.7011	10.1144

Panel E: Policy News Shocks

		(1)	(2)	(3)	(4)
Economic Strength	Shock Level	Tangible Investment	Intangible Investment	R&D Investment	Advertising Investment
Boom	-0.1	15.7347	52.85	22.575	10.4213
Recession	0.1	14.7853	107.99	29.305	11.1187

Note: The standard errors are present in parentheses with the following: *** p<0.01, ** p<0.05, * p<0.1 This table shows the clustered standard errors, where the clustering is done by the gvkey, or the firm's identification code. All variables in the regression are normalized as outlined in the data description section. The Monetary Policy and Policy News Shock data was acquired from Nakamura (2018) and the time aggregation was done by summing up all the shocks in a given period, as was done in Wong (2015). The regressions run also included time and firm dummy's which are not presented in this table. Each coefficient can be interpreted as how much investment will change on a percentage scale. For example, a coefficient value of 1 corresponds to a 1% increase in investment while a coefficient value of -2 corresponds to a 2% decrease for a 1 unit increase in the independent variable. Observations above the 25th percentile and below the first were ignored. The former is to ensure that only low leveraged firms were observed and the latter is to ensure no outliers.

Notice, that in Panel E and Panel D, intangible investing and R&D are both counter cyclical because the value invested is larger during a recession. This agrees with the other papers that have shown the following: firms with lower credit constraints do countercyclical investing, but when credit constraints get too tight, investing actually becomes cyclical. The data agrees with previous literature because low leverages and low credit constraints are highly correlated. Tangible investing is most likely cyclical even when looking at low leverages because more of it is short term whereas intangible investing tends to be more long term.

4. Conclusion

In this paper, I looked to see if the cyclicality of investing changes when accounting for the leverage ratio. In addition, I was trying to display the existence of financial frictions between tangible and intangible investing. Finally, this paper looked to see how investing was impacted for different levels of the leverage ratio.

The data from the last models without endogeneity bias show that when accounting for leverage in general, investing is cyclical. When looking only at firms with low leverages, however, intangible investing becomes countercyclical, which agrees with previous literature. Furthermore, the coefficient for tangible investments, while negative like that of intangible investments, is smaller, indicating the existence of financial frictions. During a recession, all the investment types see a larger decrease in firms with higher leverages than firms with lower leverages.

While the research conducted confirmed all the stated hypotheses in this paper, for better and more conclusive evidence, a larger sample size would be necessary, especially for R&D and Advertising data. Moreover, compustat only contains data on publicly listed firms, which can lead to altered results. Public companies respond to different incentives than private firms, as they have to appease their investors. In order to see how leverage is truly connected to investing and the business cycle, data from both private and public companies is necessary.

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Appendix A: Models Without Leverage

The following regressions were run to see the behavior without leverage:

$$x_{it} = \beta_0 + f_i + g_t + \beta_1 \Delta E_t + \epsilon_{it}$$

Where x_{it} refers to the different types of investing, f_i is the firm fixed effect for firm i, g_t is the year fixed effect in year t, ΔE_t is the economy quantifier for year t, and ε_{it} is the residual. The four different invest types are tangible investing, intangible investing, research and development, and advertising. The five economy quantifiers are GDP Percent Change, Federal Funds Rate Change, Industry Output Percent Change, Monetary Policy Shock, and Policy News Shock.

Table A1: Summary Data for Models 1-3

Panel A: GDP Growth

	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
Leverage	7.572***	2.124***	0.748***	0.514***
	(0.71600)	(0.36500)	(0.22100)	(0.06090)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	247,039	226,869	100,333	84,042
Firms	25,972	25,276	11,149	12,125
Years	1980-2016	1980-2016	1980-2016	1980-2016

Panel B: Federal Funds Rate Change

	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
Leverage	22.11***	6.395***	3.784***	1.484***
	(0.63500)	(0.34100)	(0.25200)	(0.06100)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	246,811	226,640	100,188	83,945
Firms	25,970	25,274	11,148	12,125
Years	1980-2016	1980-2016	1980-2016	1980-2016

Panel C: Industry Output Growth

	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
Leverage	0.441***	0.0473	0.105***	0.0279***
	(0.05890)	(0.03430)	(0.03940)	(0.00787)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	244,505	224,490	99,620	83,060
Firms	24,908	24,296	10,880	11,698
Years	1980-2016	1980-2016	1980-2016	1980-2016

Note: The standard errors are present in parentheses with the following: *** p<0.01, ** p<0.05, * p<0.1 This table shows the clustered standard errors, where the clustering is done by the gvkey, or the firm's identification code. All variables in the regression are normalized as outlined in the data description section. The GDP and Federal Funds Rate data were acquired from the St. Louis FRED Database, and the Industry Output was acquired from the Bureau of Economic Analysis (BEA). The regressions run also included time and firm dummy's which are not presented in this table. Each coefficient can be interpreted as how much investment will change on a percentage scale. For example, a coefficient value of 1 corresponds to a 1% increase in investment while a coefficient value of -2 corresponds to a 2% decrease for a 1 unit increase in the independent variable.

The data presented in this model shows the correlation between investment and economic measures when not taking leverage into account. The coefficients for each of the investment types in all the models are positive, which indicates that investing is cyclical. Thus, this data is saying when the economy increases, so does investing and vice versa. The variables which measure economic strength here, however, potentially face endogeneity bias, which is why the following two models are run:

Table A2: Summary Data for Models 4-5

Panel D: Monetary Policy Shock

	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
Leverage	-150.7***	-107.6***	-38.62***	-15.27***
	(5.22300)	(3.45600)	(2.28200)	(0.69500)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	116,812	107,735	53,150	40,310
Firms	17,480	16,154	7,623	6,933
Years	1995-2013	1995-2013	1995-2013	1995-2013

Panel E: Policy News Shock

	(1) Tangible Investment	(2) Intangible Investment	(3) R&D Investment	(4) Advertising Investment
Leverage	-197.1***	-140.7***	-50.52***	-19.98***
	(6.83300)	(4.52000)	(2.98500)	(0.90900)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	116,812	107,735	53,150	40,310
Firms	17,480	16,154	7,623	6,933
Years	1995-2013	1995-2013	1995-2013	1995-2013

Note: The standard errors are present in parentheses with the following: *** p<0.01, ** p<0.05, * p<0.1 This table shows the clustered standard errors, where the clustering is done by the gvkey, or the firm's identification code. All variables in the regression are normalized as outlined in the data description section. The GDP and Federal Funds Rate data were acquired from the St. Louis FRED Database, and the Industry Output was acquired from the Bureau of Economic Analysis (BEA). The regressions run also included time and firm dummy's which are not presented in this table. Each coefficient can be interpreted as how much investment will change on a percentage scale. For example, a coefficient value of 1 corresponds to a 1% increase in investment while a coefficient value of -2 corresponds to a 2% decrease for a 1 unit increase in the independent variable for a 1 unit increase in the independent variable. To exclude outliers, this model excludes values for investing outside the 10-90th percentile range.

The data presented in this table agrees with the conclusions from the previous table. For the shock values, a negative shock value corresponds to an economic boom, which leads to the opposite signs between the tables. Therefore, the negative coefficients here indicate that investing is cyclical.

It may seem like the coefficients for the economic quantifier are too large; for example, a 1 unit increase in the PNS shock would decrease tangible investment by 197%. Of course, this isn't possible because investment would then become negative. However, because the PNS shock has a maximum value of .1857514 and the FFR shock has a maximum value of .2072204, the values are significantly below 100, making it plausible.

Appendix B: Variable Summary

Calculations:

The calculations presented below are using the variable names provided by compustat.

Leverage = (dltt+dlc)/at
Tangible Investment = capxv/l.ppent
Intangible Investment = xsga/l.at
R&D = xrd/l.at
Advertising = xad/l.at

Summary:

Table B1: Summary Statistics of Model Variables

	Leverage	Tangible Investment	Intangible Investment	R&D	Advertising
mean	.3287075	45.72674	.4096417	.1399219	.0507688
median	.2556242	21.71297	.2504729	.0335306	.0136443
std	.3720434	90.66892	.6192981	.3603204	.1538803
min	1.75e-06	.0002335	.0053627	0	0
max	4.862596	1358.589	8.205387	5.669101	2.887392

Note: All data is calculated from variables in Compustat. Values presented above represent the data for the 0.5 to 99.5 percentile range.

GDP data was calculated using the percentage change data from the St. Louis FRED Database.

Federal Funds Rate data was calculated using the level change data from the St. Louis FRED Database.

The industry output data was calculated using the data provided by the Bureau of Economic Analysis. The industries are as follows:

Agriculture, forestry, fishing, and hunting (NAICS Code 11)
Mining (NAICS Code 21)
Utilities (NAICS Code 22)
Construction (NAICS Code 23)
Manufacturing (NAICS Code 31, 32, 33)
Wholesale Trade (NAICS Code 42)
Retail Trade (NAICS Code 44, 45)
Transportation and Warehousing (NAICS Code 48, 49 (except 491))
Information (NAICS Code 51)
Finance, insurance, real estate, rental, and leasing (NAICS Code 52, 53)
Professional and Business Services (NAICS Code 54, 55, 56)
Educational services, health care, and social assistance (NAICS Code 6)
Arts, entertainment, recreation, accommodation, and food services (NAICS Code 7)
Other services, except Government (NAICS Code 81)

The Shock data was obtained using values calculated in Nakamura and Steinsson (2018).

Table B2: Summary Statistics of Economy Measures

	GDP % Change	FFR Change	Industry Output % Change	FFR Shock	PNS Shocks
mean	6.461416	-.3548571	1.600575	-.1082817	-.0009557
median	5.949645	-.03	6.760336	-.0322377	.0429941
std	3.22188	1.634106	1.95	.2150766	.178694
min	-2.037206	-4.119999	-22.1	-.8558841	-.6396713
max	15.69019	3.02	20.2	.2072204	.1857514
Years:	1980-2016	1980-2016	1980-2016	1995-2013	1995-2013

Note: GDP and Federal Funds Rate data was taken from the St. Louis FRED Database. Industry Output data was taken from the BEA and was assigned to firms by NAICS codes. Shock data was acquired from Nakamura (2018) and the time aggregation was done by summing up all the shocks in a given period, as was done in Wong (2015)

Appendix C: Comparison to Ottonello Winberry Models

We ran a similar model to the one done in Ottonello & Winberry (2018) to compare the results. Leverage, Intangible Investment, R&D, and Advertising were calculated as outlined in the data description section. The dependent variable used in their paper was the log of the change in the capital stock. The capital stock was calculated by setting the first value for a firm as the gross plant, property, and equipment (ppegt) and the following values were calculated using the change in net plant, property, and equipment (ppent). It is important to note, however, that the data used here is annual data while their paper used quarterly.

The following results were received:

Table C1: Ottonello Winberry Model Panel D: Monetary Policy Shock				
	Ottonello Winberry Model Δlogk	(1) Intangible Investment	(2) R&D Investment	(3) Advertising Investment
Leverage x FFR Shock	-0.253**	-159.8***	-78.15***	-13.19***
	(0.10700)	(11.66000)	(9.00500)	(1.91000)
Firm Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	82,136	70,269	38,325	24,755
Firms	5,970	5,379	3,120	2,586
Years	1995-2013	1995-2013	1995-2013	1995-2013

Note: The standard errors are present in parentheses with the following: *** p<0.01, ** p<0.05, * p<0.1 This table shows the clustered standard errors, where the clustering is done by the gvkey, or the firm's identification code. The Monetary Policy Shock data was acquired from Nakamura (2018) and the time aggregation was done by summing up all the shocks in a given period, as was done in Wong (2015). Outliers were omitted and the regressions run also included time sector and firm dummy's which are not presented in this table. The regression equation is as follows:

$$x_{it} = a_i + a_{st} + \beta l_{it-1} * \epsilon_t^m + \epsilon_{it}$$

Where x_{it} represents the investment (this is $\Delta logk$ for the Ottonello Model), $a_i$is the firm fixed effect, $a_{st}$is the time sector fixed effect, β is the coefficient of interest, $l_{it-1}$is the leverage of the previous year, $\epsilon_t^m$is the federal funds rate shock, and $\epsilon_{it}$is the residual.

The first column contains the regression results when using the $\Delta logk$ variable for tangible investment as was done in their paper. The coefficient of the interaction variable is negative here just as in the paper, but is less in magnitude (-0.79 in their paper vs -0.253 here). This is most likely due to 2 reasons: the first being this is annual data rather than quarterly so there must be some level of discrepancy, and the second is the scale of the Federal Funds Shocks is different due to different calculation equations. However, because it shows the same relationship, this is not of significant consequence. Therefore, despite using annual data, the general results are the same for tangible investment and can be used effectively in this paper.

Their model was then run for the different types of intangible investing; the investig types are defined the same as in the rest of the paper. Similar to the earlier models in this paper, there is a negative coefficient for the interaction variables. Notice, however, that the coefficient for advertising investment is significant, which was not the case in the earlier models. This indicates that advertising is cyclical, and also that firms with lower leverages will invest more than firms with higher leverages during times of recessions.

In order to stimulate as similar of a regression as possible to their paper, the following changes were made to the data:

1. Leverage was normalized using the z score equation so that leverage values would now represent standard deviations from the mean
2. Only observations that had investment within the 0.5 to 99.5th percentile range were included
3. No observations with a leverage greater than 10
4. No observation with a current assets to total assets ratio above 10 or less than -10
5. No observations with a sales growth rate of less than -1
6. No observations from firms with less than 10 years of data

If a single value of ppent was missing, a linear approximation using the ppent from the year before and after estimated it's value. However, if either the year before or year after value for ppent was also missing, there was no approximation and the observation was ignored.