# The relationship between capital structure and product market competition in US listed firms


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# ABSTRACT

This study measures the effect of competition on leverage using unbalanced panel data from 4,957 US listed firms within 8 industries. To address the issues associated with concentration indexes, we contribute to the literature by using a new measure of competition – the Boone indicator which is based on efficiency. Initially results indicate a positive (negative) effect of competition (concentration) on leverage. Due to the distorting effect of the recent financial crisis, the sample was split into two sub-periods. From this it was determined that competition has a significant negative effect on capital structure when measured with the BI which is a theoretically robust proxy for competition. Accounting for non-linearity does not produce any significant results.

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# 1. INTRODUCTION

The theory of capital structure gained global attention with the introduction of the Modigliani and Miller model (Modigliani & Miller, 1958, 1963) which states that firm value and capital structure are independent of one another in a perfect capital market. Under this assumption firms cannot strengthen their competitive position via strategically determining leverage. This implication that debt and equity are equal alternatives for one another formed the basis of modern thinking on capital structure and has led to alternative theories in which the irrelevance of capital structure is rejected when the assumption of perfect capital markets is relaxed (Pandey, 2002). Although it has been a significant subject for financial economists, there is still no definitive overarching explanation of corporate debt policy. The prevalent alternative explanations include: predation models (Bolton & Scharfstein, 1990), limited liability models (Brander & Lewis, 1986) and investment effect models (Myers, 1977) which will be explored in detail below.

This paper analyzes the interaction between capital structure and product market behavior (competition) by empirically modelling the determinants of leverage. We use a new measure of competition: the Boone (Boone, Griffith & Harrison, 2005) Indicator (BI). To the best of our knowledge, this has not been used as a measure of competition for US listed firms. Given that traditional theory has been challenged and studies recognize that financial leverage has an impact on product market behavior, it is important to correctly identify the nature of this relationship. This is of practical significance because a firm can strategically alter a rival's behavior. The Boone Indicator is a relatively new proxy that resolves several problems that are often encountered in studies focusing on capital structure and product market competition. So, our efforts will provide results that utilize a more accurate indicator of competition.

There are various studies that explore the link between capital structure and market structure such as Titman (1984), Brander & Lewis (1986), Maksimovic (1988), Bolton & Scharfstein (1990) and Showalter (1999). The results indicate that by varying debt in a strategic way, a firm can shift a rival's strategy in a way that benefits the firm, thus enhancing their product market position. At a certain point the benefits of strategic debt equal the costs associated with an increase in leverage, and an equilibrium is reached. The theory is consistent in that firms select capital structure based on these various costs and benefits of debt and equity respectively.

A theory of predation is presented by Bolton & Scharfstein (1990) which is similar to the long-purse theory. The idea is that higher levels of debt help mitigate managerial agency problems however, the optimal debt ratio to achieve this inadvertently maximizes a rival's opportunity to prey. A highly-

levered firm is susceptible to predatory action by a firm with lower leverage or "deep pockets," for example, a firm may drop prices (Bertrand competition) or increase output (Cournot competition) in order to drive rivals out of the market. Therefore, there is a trade-off between mitigating incentive problems and dissuading predation by competitors. Based on the predation model the relationship between leverage and competitive position is negative.

Choice of financial structure can affect output markets and future competitive position in what Brander and Lewis (1986) refer to as the 'limited liability effect of debt financing.' Essentially, changes in the debt ratio affect the distribution of returns between debt and equity holders which alters the strategy favored by equity holders. Since creditors have preference when a firm is in receivership, equity holders are only concerned about returns during periods of profitability and when leverage increases shareholders are motivated to adopt riskier output strategies (Mitani, 2014). Consequently, when a firm increases debt it is signaling a more aggressive future strategy. The relationship described here demonstrates a firm's anticipation of the effect of their capital structure on output markets, as such, product market conditions shape financing decisions. In contrast to the predation model, limited liability effect incentivizes firms to increase debt levels.

The asset substitution effect describes a situation in which a firm exchanges low-risk assets for high-risk assets, thus shifting value from debt-holders to shareholders. In the investment effect models, debt causes underinvestment due to the agency problem / asset substitution effect where a firm will not invest in low-risk assets (Kovenock & Phillips, 1997; Myers, 1984, 1977). Due to asymmetric information, the pecking order hypothesis was developed which states that internal financing is cheaper than both debt and equity financing. These models also support a negative relationship between leverage and competition.

The empirical papers often present ambiguous or inconsistent results regarding the nature of the relationship between capital structure and a firm's market share which demonstrates the need for further investigation. Some results indicate a positive relationship between debt and market structure and others support a negative relationship, however, older studies consistently predict a linear relationship. Pandey (2002) was the first to suggest that the relationship between capital structure and market power may be nonlinear. His research was based on data from Malaysian firms using Tobin's Q as a proxy for market power. Guney, Li & Fairchild (2011) build on this research also suggesting a nonlinear relationship between capital structure and product market competition in Chinese listed firms using Tobin's Q. Consequently, we will also test for both a linear and nonlinear relationship in the US.

Studies on this topic typically measure market structure using one of the following: Tobin's Q, the Herfindahl-Hirschman index (HHI) or the Lerner index (LI). We employ the Boone indicator (BI) (Boone, Griffith & Harrison, 2005) to address some of the issues associated with the concentration indexes found in previous studies. For example, we do not know what causes a high level of market concentration; it could be that inefficient firms exit as competition intensifies (Fosu, 2013). In this case, concentration isn't necessarily the best predictor of the degree of competition. Alternatively, the BI measures how sensitive a firm's market share is compared to their inefficiency in the market (Boone, Griffith & Harrison, 2005). This is derived from the expectation that firms will be more acutely penalized through loss of market share for being inefficient when it's a more competitive product market. Hence, the BI is not affected by restructuring within product markets as the alternative indexes are. In addition to the BI, we will use the Herfindahl-Hirschman index which is based on concentration to examine the consistency of the results. We hope that by using a new measure of competition we can contribute to the literature and shed some light on the nature of the relationship between capital structure and competition.

The paper is organized as follows. Chapter 2 reviews the existing literature and covers key works on capital structure and market structure. Guided by the preceding review, Chapter 3 presents the conceptual framework and more specifically, the hypotheses regarding the effect of market competition on capital structure. Chapter 4 outlines the methodology and a description of the data which is followed by the results and discussion of the statistical analysis in Chapter 5. The paper concludes with a summary.

# 2. LITERATURE REVIEW

This chapter analyzes the previous empirical studies on firm capital structure relative to their market share as well as the theoretical literature on agency costs, asset substitution, bankruptcy and tax shield. This is then linked backed to competition and the implications on our research and how we developed our model. It forms the basis of understanding on the topic and leads to our conceptual framework.

## 2.1 Background

Though many studies analyze the relationship between capital structure and market structure, different conclusions are often made due to the utilization of different competition variables as well as the level of development of the studied country. For example, as a developed country, capital structure in the United States is often defined using long term debt and more developing countries use short term debt (Rajan & Zingales 1995). Pandey (2002) demonstrates how the tax shield, different agency costs and financial distresses lead to a non-linear relationship between capital structure and market structure. Using the Lerner index, Krishnaswamy, Mangla and Rathinasamy (1992) find a positive relationship between debt and market structure. As such, we will also use a concentration index to determine whether our results are consistent with previous studies. On the other hand, Chevalier (1993) finds a negative relationship straying from pecking order and asymmetric information theories.

## 2.2 Agency Costs

In order to maximize profits for the benefit of shareholders, the agency costs theory suggests high levels of borrowing (Pandey, 2002). Problems are evident within agency relationships[1] due to the information asymmetries. Jensen and Meckling (1976) analyze the two variations of agency costs. One type of agency cost comes into effect from the shareholder-manager conflict which causes agency costs of managerial discretion; when there is an information advantage for one party, moral hazard is created[2]. To protect against this, firms must monitor management which translates to more firm costs. Aggarwal & Kyaw (Aggarwal & Kyaw, 2010) suggest that the shareholder-manager problem fails to acknowledge that

[1] We define an agency relationship as one where a person / party appoints an 'agent' to perform duties on their behalf and consequently shift decision making power to the agent.

[2] A moral hazard occurs when one party has an information advantage, and uses this at the expense of the lesser informer party.

the agency costs of managerial discretion take place between firms in imperfectly competitive markets. A firm will place positive weight on their own performance and alternatively, negative weight on industry performance. The negative sensitivity to industry performance suggests that the manager will receive higher compensation if they provide higher returns relative to the industry. This creates an incentive to lower the industry returns. Jensen and Meckling (1976) suggest that by increasing leverage, this type of agency cost can be avoided and firm performance can be improve. The second type of agency cost that they identify is the shareholder-creditor conflict, or rather, the agency costs of debt. While shareholders will prefer higher leverage and higher payouts, debt-holders will prefer lower leverage and lower payouts. Consequently, the agency cost theory predicts a positive relationship between leverage and competition.

Brander and Lewis (1986) provide a link to the firm financing of an investment. While debt holders are given priority over firm income, stockholders can only claim residual earnings. Consequently, investment behavior, given a high level of debt, incentivizes strategies producing high returns in good times and lower returns in bad times. This assumption that firms want to maximize shareholder wealth is also seen in Maksimovic (1988). Their paper also argues to increase leverage in order to reduce agency costs.

## 2.3 Asset Substitution

Shareholders often take on high levels of debt in order to finance risky projects. If the investment is profitable, both lenders and shareholders are compensated; however, if the project fails, only the lender incurs the loss. Jensen and Meckling (1976) identify asset substitution, the transfer of wealth from debt to equity holders through the substitution of riskier assets, in order to increase the value of equity. This often takes place as it is both costly and difficult for the debt holders to assess and monitor the risky projects. Myers (1977) uses asset substitution to model the determinants of corporate borrowing; a model that demonstrates under-investment is caused by debt.

The premise of the pecking order hypothesis is that financing comes from 3 sources: internal financing, debt and the issuance of new equity with the latter resulting in the most deadweight cost of information asymmetry (Myers, 1984). This theory is important further on in the study when we are modelling leverage and predicting the effect that certain variables in the empirical formula will have on leverage. For example, we would expect that a firm with high profitability will have access to internal financing and as such the pecking order hypothesis would predict a negative relationship between leverage and profitability. We will explore these relationships further in the methodology section.

Stulz (1990) demonstrates how efforts to alleviate overinvestment problems can in turn result in underinvestment due to managers' resource constraints from the shift of cash flow to debtholders. In summary, theories guided by asset substitution and the pecking order hypothesis predict a negative relationship between capital structure and market structure.

## 2.4 Bankruptcy

Bankruptcy costs have been used to explain how a firm determines its capital structure. A firm with a higher probability of bankruptcy will combat the problem with a lower debt ratio. Though a firm with more available equity is less prone to bankruptcy, firms with deep pockets have a competitive advantage (Brander & Lewis 1986). This is based on the long purse hypothesis where a firm chooses low leverage as a competitive strategy to push more highly levered firms out of its industry. In Titman (1984) it is shown that capital structure can instigate liquidation by shareholders when a firm is not bankrupt. Additionally, capital structure is a mechanism through which a firm can predispose itself to a particular liquidation policy which it deems optimal. By using capital structure to determine the future liquidation policy, the current terms of trade with customers, employees and suppliers are affected. Subsequently, an increase in debt is associated with an increase in risk of bankruptcy which adversely affects the aforementioned terms of trade with stakeholders.

Bankruptcy is a cost of debt financing that is pertinent when management are determining the debt ratio. Ideally, we would have liked to include bankruptcy costs in our model of leverage, but following the works of Negash (2001), this in itself is a separate topic for investigation and a limitation of our study.

## 2.5 Tax Shield

Mogliani and Miller (1963) justify a high debt level through the tax shield theory. Here, they argue that profitable firms borrow more in order to utilize the tax shelter. Deductions from interest costs maximize output which ultimately increases profitability. A positive relationship between profitability and market structure as well as between capital structure and market structure is concluded. DeAngelo and Masulis (1980) model optimal capital structure through the incorporation of taxes: corporate, personal and non-debt related tax shields. The model defends the argument that these tax credits and deductions are substitutes to the benefits of debt financing. So, less debt is seen in firm capital structure for firms with a higher non-debt tax shield relative to its expected cash flow. This paper comes to the conclusion

that every firm will have a unique level of optimal capital structure. We will include the tax shield in our model of capital structure and we predict a positive relationship to exist.

## 2.6 Leverage-Competition

Zingales (1998) addresses causality and how the lack of a structural model prohibits us from determining whether product market competition affects capital structure or if a firm's capital structure affects its standing against its competition The works of Brander & Lewis (1986), Maksimovic (1988), and Bolton & Scharfstein (1990) demonstrate how firms decide on their capital structure before engaging in product market competition. Given a level of debt, managers have to commit to their competitive strategy. We explore this potential reverse causality further on in the study.

## 2.7 Practical Implications

We have found an extensive array of literature which we have categorically organized into: agency costs, asset substitution, bankruptcy, the tax shield, and competition and we have discussed the effect each of these has on our model of capital structure. These are broad theories and should not be considered in isolation. Although there are strategic approaches taken by firms to optimize the tradeoff between debt and equity, the literature does not propose an operational formula that can measure this relationship (Negash, 2001). There are reasons for using debt that are hard to quantify for example, it can be a takeover defense (Israel, 1991) or a barrier to entry (Fulghieri & Nagarajan, 1996). Due to measurement difficulties these benefits, among others, are endogenous in the model and make this a difficult topic to investigate. In the following section we outline our hypothesis then begin developing our model.

# 3. CONCEPTUAL FRAMEWORK

In the previous chapter, we systematically reviewed the literature. We found conflicting evidence which we use to narrow down our hypotheses. We provide a brief explanation of the implications of results of the hypotheses.

## 3.1 Hypotheses

Studies have affirmed that there is a significant difference in leverage between industries in US listed firms (Guney, Li & Fairchild, 2011). Given the assumption that there is also a significant difference in product market competition between industries in US listed firms we are testing the following:

> Hypothesis 1: There is a significant relationship between leverage and product market competition across US listed firms.

As outlined in the introduction, a positive relationship between leverage and product market competition indicates the presence of limited liability effects and a negative relationship indicates the presence of predation and asset substitution effects. Because there are more theories suggesting a negative relationship, we test the following:

> Hypothesis 2: There is a negative relationship between leverage and product market competition across US listed firm.

Further, we will also explore a non-linear relationship between leverage and product market competition which is indicative of a combination of limited liability effects and predation effects (Fairchild, 2004). All the previous research on US firms suggests a linear relationship (Chevalier, 1993; Krishnaswamy, Mangla & Rathinasamy, 1992; Phillips, 1995). There are some recent studies suggesting a non-linear relationship albeit based on studies in the Asia-Pacific region (Guney, Li & Fairchild, 2011; Pandey, 2002). We wish to verify whether the previous US literature is still accurate:

> Hypothesis 3: There is a linear relationship between leverage and product market competition across US listed firms.

# 4. DATA AND METHODOLOGY

In the previous chapters the literature was reviewed and conceptual framework outlined, from which our hypotheses were derived. In order to test the relationships described, data on US listed firms has been obtained and our method to quantify the leverage-competition effects is outlined below.

## 4.1 Data and Empirical Model

This study uses unbalanced panel data for firms listed on the New York Stock Exchange between 2006 and 2016 obtained from Compustat North America. The last ten years are used in order to analyze the most recent trends between capital structure and product market behavior. To manage a reasonable amount of observations, for practical matters, yearly observations are used. The data is broken down into individual industries based on the Standard Industrial Classification (SIC) code: agriculture, mining, construction, manufacturing, transportation, wholesale trade, retail trade and services. Financial and other securities industries were excluded as they are seen to use leverage differently than other industries. By utilizing the four-digit SIC codes we assume that there is a "one-to-one correspondence." As Aggarwal (1999) points out, this is not always so as certain industries may include a mismeasurement due to aggregation, however, it is unlikely to bias our empirical results. The study excludes companies with missing data, no sales, or negative equity; we are left with a sample 38,767 observations and 4,957 firms.

Table 1: Panel Data Information

| Industry | Industry Code | Number of Observations | Number of Firms |
|---|---|---|---|
| Agriculture | A | 199 | 26 |
| Mining | Mi | 2492 | 396 |
| Construction | Co | 472 | 60 |
| Manufacturing | Ma | 17378 | 2212 |
| Transportation | T | 6264 | 709 |
| Wholesale Trade | W | 1494 | 181 |
| Retail Trade | R | 2569 | 301 |
| Services | S | 7899 | 1072 |
| | | 38767 | 4957 |

In our model, the dependent variable is leverage and is defined by total debt over total assets. The independent variables were selected based on the literature as listed in section 4.1 and include: profitability, size, growth, tangibility, uniqueness of assets and non-debt tax shield. We estimate capital structure as follows:

$$lev_{it} = \alpha + \lambda_t + \mu_i + \beta_1 prof_{it} + \beta_2 size_{it} + \beta_3 growth_{it} + \beta_4 tang_{it} + \beta_5 NDTS_{it} + \beta_6 UOA_{it} + \beta_7 X_{jt} + \beta_8 X_{jt}^2 + \beta_9 X_{jt}^3 + \varepsilon_{it} \quad (1)$$

where *i* denotes each individual firm, *t* denotes years, j denotes each industry, $\alpha$ denotes the intercept, $\lambda_t$ is a time dummy variable that controls for macroeconomic events, $\mu_i$ is the fixed effect for firms, $\beta$ denotes the estimated coefficients for the explanatory variables, X denotes the competition variable - linear, parabolic (X, $X^2$) or cubic (X, $X^2$, $X^3$) relationships are considered between leverage and product market competition and finally $\varepsilon_{it}$ is the error term.

As a measure of competition, the Boone Indicator and the Herfindahl-Hirschman Index are used. Tobin's Q was considered as it can be seen in many other empirical papers however, it is a more appropriate measure of future growth opportunities rather than competition (Demsetz & Lehn, 1985).

## 4.2 Competition Variables

### 4.2.1 The Boone Indicator (BI)

The Boone Indicator introduces a new way to measure competition that encompasses the intuition that firms in a competitive market are punished for inefficiency. BI measures competition amidst firms based on relative profit. The elasticity for an industry is estimated by profit over marginal costs or rather the increase in profits due to a 1% increase in efficiency (Boone, Griffith & Harrison, 2004). Given that a competitive market will punish firms intensely for being inefficient, an increase in marginal costs will have a more detrimental effect on variable profit.

A simple model is used to theoretically explain why the price-cost margin is not a robust measure of industry competition. Boone (2005) establishes the theory by first creating a model that looks at the demand curve for firm *i*:

$$p(x_i, x_{-i}) = a - bx_i - d\sum_{j \neq i} x_j$$

where

a: a measure of the size of the market

b: a measure of the market elasticity of demand

$c_i$: constant marginal costs

d: a measure of consumer's differentiation in products in a market as close substitutes

n: number of firms

Firm *i* will choose output $x_i$ for:

$$\max_{x \geq 0}\{(a - bx - d\sum_{j \neq i} x_j)x - c_i x\}$$

The Cournot output for firm *I*:

$$x(c_i, c_{-i}, n) = \frac{\left(\frac{2b}{d} - 1\right)a - \left(\frac{2b}{d} + n - 1\right)c_i + \sum_{j=1}^{n} c_j}{(2b + d(n-1))(\frac{2b}{d} - 1)}$$

where:

$c_i$ are average variable costs defined by $\frac{variable\ costs_i}{revenue_{\ i}}$

and profits are defined by:

$$\pi_i = (b + \lambda d)x(c_i, c_{-i}, n)^2$$

where firm *i* enters if $\pi_i \geq f$

By reducing entry barriers (f), competition can be increased and the firm takes on a more aggressive stance.

(Boone, Griffith & Harrison, 2004)

Based on Fosu (2013), firm elasticity (the Boone Indicator) is estimated by $\beta$ given:

$$\pi_{it} = \alpha + \beta_t \ln(C_{ij}) + \varepsilon_{it} \quad (2)$$

Where $\pi$ is profit, measured as sales revenue less cost of goods sold (COGS) divided by total assets. ln(C) is the natural log of marginal costs measured by COGS divided by sales revenue. The firm is *i* and the industry is *j*. The absolute value of $\beta$ measures competition, therefore a higher absolute value of the coefficients indicates a higher level of industry competition. We separated the data into the eight industries and ran a regression for each year in our sample period resulting in 80 estimates of competition. The average of these for each industry can be seen in Table 4.

In the results for the Boone Indicator we expect to either find that high efficiency firms compete more fiercely or that high levels of competition push out inefficient firms and increases productivity (Boone, Griffith & Harrison, 2004).

### 4.2.2 Herfindahl-Hirschman Index (HHI)

Since the vast majority of previous empirical studies use a concentration index, HHI is utilized to see if we get consistent results. HHI is a proxy for the level of market concentration (which is said to be the inverse of competition) for a given industry. The higher the HHI, the higher the level of concentration in an industry and in turn, the industry consists of a less competitive market.

Given that HHI is based on the Cournot model, an increase in competition is seen to raise the HHI. Following the method utilized in Guney, Li & Fairchild (2011), HHI is defined as:

$$HHI_{jt} = \sum_{i=1}^{Nj} \left(\frac{x_{ijt}}{\sum_{i=1}^{nj} x_{ijt}}\right)^2 \quad (3)$$

Where $HHI_j$ is the index for industry *j* at time *t*. $X_i$ denotes the sales conducted by firm *i*. As with the BI, there is one measure of competition per year within each industry and the average value can be found in Table 4.

## 4.3 Independent Variables

Amongst the various empirical studies on capital structure, the determinants are seen to vary by country given the level of economic development. Rajan and Zingales (1995) compare the capital structure of firms in the United States to the capital structure seen in various countries and find firm leverage to be quite similar across the G-7 countries.

Table 2: Definition of Variables

| **Variables:** | **Abbreviation** | **Definition** |
|---|---|---|
| **Dependent Variable** | | |
| Leverage | lev | Debt/Total Assets |
| | | |
| **Independent Variables** | | |
| Profitability | prof | Operating Profit/ Total Assets |
| Size | size | ln(Total Assets) |
| Growth | growth | $Sales_t$-$Sales_{t-1}$/$Sales_{t-1}$ |
| Tangibility | tang | PP&E/Total Assets |
| Uniqueness of Assets | UOA | Operating Expenses/Total Sales |
| Non-debt tax shield | NDTS | Depreciation/Total Assets |

### 4.3.1 Profitability

Profitability (prof) heavily influences capital structure and can be defined through the return on assets. This is calculated as operating profit over total assets. The more profitable a firm is the more the firm can shield itself from taxes and therefore can take on more debt. However, pecking order theory predicts a negative relationship between profitability and leverage as described in section 2.2. As such, the relationship is unclear.

### 4.3.2 Size

Firm size (size) is defined as the natural log of total assets. Many studies, including Rajan and Zingales (1995), show both a significant and positive relationship between the size of a firm and its debt ratio.

### 4.3.3 Growth

Sales growth (growth) is calculated as the difference between the sales of firm *i* at time *t* less a one period lag divided by the said lag. This variable is indicative of expectations of future profit and will provide flexibility for future investments creating a positive correlation between the debt ratio and growth.

### 4.3.4 Tangibility

Tangibility (tang) is calculated as the ratio of plant, property & equipment over total assets and has a significant impact on a firm's borrowing capacity (Booth, Aivazian & Demirguc-kunt, 2001; Campello, 2003). Jensen & Meckling (1976) demonstrate how tangible assets provide lenders security in times of financial distress by acting as collateral; this is supported by the trade-off hypothesis. The shareholder-lender conflict holds its share of moral hazard whereby the information advantage held by one party is exploited at the expense of the lesser informed party. This conflict is protected by "collateral" of tangible assets. From this, firms that have more tangible assets are seen to have a higher level of debt. The positive relationship between tangibility and total debt is empirically supported by Rajan & Zingales (1995).

### 4.3.5 Uniqueness of Assets

The uniqueness of assets (UOA) is calculated as the ratio of operating expenses to total sales. The binding effect of a uniqueness of assets is suggested in Titman and Wessels (1988) study. Limitations that

the firm and its affiliates face results in a high cost of liquidation and consequently, firms have a lower debt ratio. So, uniqueness of assets is expected to be negatively associated to the debt ratio.

### 4.3.6 Non-Debt Tax Shield

The non-debt tax shield (NDTS) is calculated as the ratio of depreciation to total assets. Firms with high non-debt tax shields often have less debt. A firm can decrease the amount of corporate taxes owed by using depreciation deductions and corporate tax credits (DeAngelo, and Masulis, 1980).

## 4.4 Endogeneity Issues

In general, endogeneity occurs in a regression when the independent variable and the error term are correlated. This produces biased and inconsistent coefficient estimates from which no reliable conclusions can be drawn (Roberts et al., 2011). There are three sources of endogeneity – omitted variables, simultaneity and measurement error and we discuss the implications of each below.

### 4.4.1 Omitted Variables and Measurement Error

Omitted variable bias is the result of leaving important variables out of a model and consequently over or under estimating the effect of one or more of the other factors. Often, we want to measure a particular attribute but have no way to do so or there are multiple proxies that can be used; the researcher must choose variables that are most appropriate which biases interpretation. Since some factors are not being represented as an explanatory variable, they appear in the error term, $\varepsilon$. If the omitted variable is correlated with the explanatory variable, then inferences from the regression are unreliable (Roberts et al., 2011).

It is reasonable to assume that there will be omitted variable bias with regards to leverage because there are dimensions of the model which are hard to quantify. For example, frictions such as information asymmetry have an impact on capital structure but are extremely difficult to observe, particularly to an external researcher. We are also aware from the literature review that bankruptcy costs are taken into consideration when determining leverage but it is complicated to model this and reliant on firm specific probability of default (Negash, 2001).

Free cash flow from operating activities is a measure we wanted to include since it increases a firms borrowing capacity, from this perspective the relationship would be positive. On the other hand, the pecking order hypothesis suggests that internally generated funds should be the first source of financing

and this would suggest a negative relationship between leverage and free cash flow. Consequently, the impact is unclear. To ascertain free cash flow from operating activities, manual adjustments to the reported financial data are required and due to the magnitude of observations in our sample this was not practically plausible to do.

These are just a few examples of potential omitted variables in our model. Another source of endogeneity is measurement error which is the result of any discrepancy between a proxy used for a variable that is hard to quantify and the true variable (Roberts et al., 2011). In this study, it is quite likely that there is measurement error with regards to the competition proxies. According to Roberts et al. (2011) panel data can offer a solution to the heterogeneity present in empirical finance and fixed effects remedy the endogeneity problem caused by omitted variables and measurement error. According to Lemmon, Roberts & Zender (2008) fixed effects make an important difference to estimated parameters of leverage equations. This study utilizes fixed effects and runs the redundant fixed effects (likelihood ratio) test to confirm that they are necessary.

### 4.4.2 Simultaneity

Simultaneity bias occurs when the dependent variable and one of the explanatory variables are determined in equilibrium and consequently it can be said that the dependent variable causes the explanatory variable and vice versa (Roberts et al., 2011). Much of the theory on capital structure and product market position suggests there may be reverse causality in our model (Zingales, 1998) - it is unclear whether leverage is determined based on competition, or whether competition defines leverage. To address potential reverse causality between leverage and competition, we can lag competition:

$$lev_{it} = \alpha + \lambda_t + \mu_i + \beta_1 prof_{it} + \beta_2 size_{it} + \beta_3 growth_{it} + \beta_4 tang_{it} + \beta_5 NDTS_{it} + \beta_6 UOA_{it} + \beta_7 X_{jt-1} + \beta_8 X_{jt-1}^2 + \beta_9 X_{jt-1}^3 + \varepsilon_{it} \quad (4)$$

We explore these results in the next section.

# 5. RESULTS AND DISCUSSION

In this chapter, the empirical results obtained from EViews are discussed as well as the econometric techniques employed. We outline the descriptive statistics, correlation analysis, regression findings and discuss the implications with regards to the hypotheses.

## 5.1 Descriptive Statistics

Table 3 includes the descriptive statistics for the overall sample and shows that leverage, on average, is approximately 26%; this coincides with Rajan and Zingales (1995) who find that firms in developed countries are not highly levered. As demonstrated in Table 1, the sample was also broken into eight industries. Table 4 includes the mean by industry and demonstrates the difference of product market competition between industries. After comparing the overall sample to each industry individually, we can see that Agriculture takes on less leverage on average at only 15% and Services, at 33%, has the highest leverage. It is interesting to see how the inventory based industries are most hindered by taking on additional debt but it can be expected as they are more likely to have a high value-at-risk.

Now observing the measures of competition, the average Boone indicator for the overall sample is 0.19. The highest BI is observed in the construction industry at 0.86. This suggests that the product market competition in this industry is much higher than for the overall market. In turn, HHI, which measures market concentration, shows that Agriculture has the highest concentration level (0.38) and the lowest debt to equity ratio. The high level of concentration found with HHI translates into Agriculture having the least amount of competition.

Our conceptual framework built a hypothesis around the assumption that there is a difference in capital structure and product market competition across industries and as such we want to test whether there is a relationship. Table 4 shows the difference across industries for leverage, BI, and HHI.

Table 3: Descriptive Statistics

| | Mean | Median | Maximum | Minimum | Std. Dev. | Probability | Observations |
|---|---|---|---|---|---|---|---|
| LEV | 0.2606 | 0.1430 | 102.6531 | 0.0000 | 1.1429 | 0.0000 | 38767 |
| PROF | -0.7872 | -0.4525 | 1.2592 | -289.8148 | 2.6209 | 0.0000 | 38767 |
| SIZE | 6.3469 | 6.5455 | 13.0101 | -5.5215 | 2.6536 | 0.0000 | 38767 |
| GROWTH | 0.3511 | 0.0522 | 3184.0000 | -0.9976 | 18.1472 | 0.0000 | 34193 |
| TANG | 0.2953 | 0.2001 | 1.0000 | 0.0000 | 0.2638 | 0.0000 | 38767 |
| NDTS | 0.0458 | 0.0357 | 6.1713 | 0.0000 | 0.0665 | 0.0000 | 38767 |
| UOA | 1.4584 | 0.8775 | 2767.6670 | 0.0481 | 16.3565 | 0.0000 | 38767 |
| BI | 0.1855 | 0.1890 | 1.9984 | -0.0946 | 0.1117 | 0.0000 | 38767 |
| HHI | 0.0229 | 0.0115 | 0.4218 | 0.0084 | 0.0319 | 0.0000 | 38767 |

Table 4: Mean by Industry

| | LEV | PROF | SIZE | GROWTH | TANG | NDTS | UOA | BI | HHI |
|---|---|---|---|---|---|---|---|---|---|
| A | 0.1458 | -0.4735 | 5.4478 | 0.5102 | 0.4043 | 0.0324 | 2.1135 | 0.0822 | 0.3815 |
| Co | 0.2798 | -1.1878 | 0.1875 | 6.7181 | 0.1216 | 0.0276 | 1.0285 | 0.8563 | 0.0731 |
| Ma | 0.2429 | -0.8115 | 0.1699 | 6.0047 | 0.2081 | 0.0401 | 1.8172 | 0.2166 | 0.0104 |
| Mi | 0.2695 | -0.3528 | 1.0495 | 6.8565 | 0.6644 | 0.0791 | 1.8186 | 0.0323 | 0.0482 |
| R | 0.2448 | -1.2723 | 1.4700 | 6.6829 | 0.3430 | 0.0499 | 0.9342 | 0.0654 | 0.0654 |
| S | 0.3259 | -0.7707 | 0.3116 | 5.5537 | 0.1741 | 0.0492 | 1.3101 | 0.1805 | 0.0199 |
| T | 0.2420 | -0.4013 | 0.2023 | 7.9702 | 0.5629 | 0.0488 | 0.8389 | 0.1484 | 0.0109 |
| W | 0.2207 | -2.0145 | 0.2232 | 6.2902 | 0.1715 | 0.0251 | 1.0166 | 0.2705 | 0.0555 |

## 5.2 Correlation

Table 5 presents a correlation matrix for the variables used in the study. There are significant correlations between leverage and the independent variables. Interestingly, both profitability and size are negatively correlated with leverage. The BI &HHI have a correlation of -0.0081 suggesting that they're almost independently determined. As such, we find that one cannot be used as a robustness check for the other, they are simply two measures of competition and concentration respectively.

Table 5: Correlation Matrix

| | LEV | PROF | SIZE | GROWTH | TANG | NDTS | UOA | BI | HHI |
|---|---|---|---|---|---|---|---|---|---|
| LEV | 1.0000 | | | | | | | | |
| PROF | -0.1933*** | 1.0000 | | | | | | | |
| SIZE | -0.0862*** | 0.2120*** | 1.0000 | | | | | | |
| GROWTH | 0.0119** | -0.0090* | -0.0213*** | 1.0000 | | | | | |
| TANG | 0.0262*** | 0.0807*** | 0.2839*** | 0.0094* | 1.0000 | | | | |
| NDTS | 0.1388*** | -0.3451*** | -0.0992*** | 0.0159** | 0.1916*** | 1.0000 | | | |
| UOA | 0.0558*** | -0.0887*** | -0.1092*** | 0.0016*** | -0.0284*** | 0.0358*** | 1.0000 | | |
| BI | -0.0013 | -0.0548*** | -0.0773*** | -0.0100* | -0.2930*** | -0.1010*** | 0.0027 | 1.0000 | |
| HHI | -0.0053 | -0.0413*** | -0.0070 | 0.0085 | 0.0771*** | 0.0136** | -0.0081 | -0.0932*** | 1.0000 |

This table presents the correlation between the variables in the model. The variables are as defined in Table 2 and explained in section 4. The sample is from 2007-2016 and comprises US listed firms. BI and HHI are alternative measures of competition and do not enter the same regression simultaneously.

* Significant at 10%

** Significant at 5%

*** Significant at 1%

## 5.3 Regression Findings

### 5.3.1 Leverage-Competition Relationship

In order to test the effect of competition on leverage, this study uses ordinary least squares (OLS) regression. In Table 6 we can see the results of estimating the Eq. 1 regression using data for the overall sample from 2007 - 2016. Models 1 and 2 are linear and non-linear models, respectively, that use the BI to measure competition. Models 3 and 4 are linear and non-linear models that use HHI as a proxy for concentration (seen as the inverse of competition). The results of the Breusch-Pagan-Godfrey test indicate very significant heteroscedasticity with a p-value of 0.0000 so White's (1980) heteroscedasticity-robust-standard errors are used to control for this (Petersen, 2009). We estimate the equations using panel fixed effects (FE) models in the period and cross-section dimension. The Hausman (1978) specification test is employed to confirm the suitability of FE against the random effects model. Further, we perform the redundant fixed effects test and obtain a p-value of 0.0000 for cross-section, period, and cross-section/period combined indicating that FE is required in both dimensions.

In Table 6, the linear models show that there is a positive relationship between leverage and competition when measured by the BI and a significant negative relationship between leverage and concentration when measured by the HHI; the inverse results are intuitive. These relationships are in line with the limited liability model and consistent with the theory on agency cost. Next, we consider the non-linear models. When a model includes a non-linear component, the coefficients are not directly

interpretable. Instead, we are interested in the marginal effect - the slope of the regression with respect to the covariate, competition. Essentially, the marginal effect disseminates the rate at which leverage changes "at a given point in covariate space, with respect to one covariate dimension and holding all covariate values constant" (Leeper, 2017). This requires a partial derivative calculation of the leverage equation with respect to competition:

$$\widehat{Lev} = \beta_7 x + \beta_8 x^2 + \beta_9 x^3 \quad (5)$$

$$\frac{\partial Lev}{\partial x} = \beta_7 + 2\beta_8 x + 3\beta_9 x^2 \quad (6)$$

We can then substitute any value of X (the competition variable) into Eq. 6 and use the coefficient estimates from Table 6 to find the marginal effect. We select the mean values of the BI and the HHI from Table 3 which are 0.1855 and 0.0229 respectively and calculate the marginal effects to be -0.0507 and -5.6540. The non-linear models both predict a negative effect on average. In Appendix 1 we have plotted the marginal effect using constant intervals of competition to diagrammatically demonstrate how the effect changes as competition increases. We can see in Graph 1 that the marginal effect of the BI using a non-linear model is negative and convex. In Graph 2 the marginal effect of the HHI is negative for lower values of concentration, and as it increases the effect crosses the x-axis and becomes positive for very high levels of concentration.

We must now consider whether the non-linear model is significant. When estimating non-linear models we conduct a Wald test (Engle, 1984) which is used to test the joint significance of a subset of coefficients, namely the competition variables. The results of the test are in Table 6; there is not a jointly significant relationship when the BI is used, but the HHI is jointly significant at the 1% level. In summary, the results of the HHI are consistent with previous literature using concentration index's (Krishnaswamy, Mangla & Rathinasamy, 1992), predicting a positive (negative) relationship between competition (concentration).

However, having conducted these regressions for the overall sample we realized that we may not be able to draw reliable inferences from the data (although statistically sound) due to the macroeconomic event that took place within our sample period which we examine in the next section.

Table 6: Leverage and Competition in the US – Period & Firm Fixed Effects

| | **Boone Indicator** | | | | **Herfindahl-Hirschman Index** | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors |
| C | 0.6489*** | 0.1377 | 0.6647*** | 0.1383 | 0.6866*** | 0.1432 | 0.7908*** | 0.1604 |
| PROF | -0.0416 | 0.0395 | -0.0417 | 0.0395 | -0.0416 | 0.0395 | -0.0416 | 0.0394 |
| GROWTH | -0.0001 | 0.0008 | -0.0001 | 0.0008 | -0.0001 | 0.0008 | -0.0001 | 0.0008 |
| SIZE | -0.0939*** | 0.0223 | -0.0939*** | 0.0223 | -0.0944*** | 0.0224 | -0.0948*** | 0.0224 |
| TANG | 0.5055** | 0.2106 | 0.5079** | 0.2105 | 0.5036** | 0.2107 | 0.5053** | 0.2108 |
| NDTS | 0.3815 | 0.8313 | 0.3804 | 0.8313 | 0.3807 | 0.8314 | 0.3812 | 0.8311 |
| UOA | -0.0002 | 0.0042 | -0.0002 | 0.0042 | -0.0002 | 0.0042 | -0.0002 | 0.0042 |
| X | 0.0654 | 0.0864 | 0.0149 | 0.1407 | -0.9421** | 0.3804 | -9.6206*** | 3.0254 |
| $X^2$ | | | -0.2169 | 0.3132 | | | 91.2793*** | 31.4303 |
| $X^3$ | | | 0.1441 | 0.1514 | | | -136.06*** | 47.4124 |
| Wald | | | 0.7969 | | | | 4.4221*** | |
| Adj $R^2$ | 0.5641 | | 0.5642 | | 0.5641 | | 0.5642 | |

This table shows the estimation results for Eq. 1 with Lev as the dependent variable, see table 2 for list of independent variables, the BI is the beta coefficient from Eq. 2 multiplied by -1 so that higher values reflect higher competition, the HHI is determined from Eq. 3. The sample period is 2006 – 2016 using US listed firms. Model 1 and 3 are the linear regressions for the two competition indices, models 2 and 4 are the non-linear regressions. The regressions are run using period and cross-section fixed effects. Standard errors robust to heteroscedasticity (white diagonal) are shown. Wald tests the joint significance of the competition variables.

* Significant at 10%
** Significant at 5%
*** Significant at 1%

### 5.3.2 Leverage-Competition Relationship Pre/During and Post-Crisis

The 2008 global financial crisis (GFC) shocked the economy and severely affected the US capital market (Gokay, 2009). To explore the impact that it had on capital structure, we split the sample into two sub-periods: 2006 – 2011 which is pre/during the crisis (table 8) and 2012 – 2016 which is post-crisis (table 9). When we split the sample, none of the non-linear models are jointly significant per the Wald test indicating that the relationship is linear, in align with Hypothesis 3. Interestingly, the BI is significant and negative in the post-crisis linear model but not significant during the crisis. This can be interpreted in two ways: 1. The BI does not work in periods of financial distress because it is calculated using financial data which is distorted during a crisis 2. The BI does work but competition is not significant in determining leverage during periods of uncertainty. It is important to note that period and cross-section fixed effects were used which reduces variation in the explanatory variables and hence the probability of finding an effect, given that it exists. Therefore, the fact that the regression found a significant effect of competition as measured by the BI on leverage means that the relationship is very strong. The negative effect of

competition on leverage is consistent with the theoretical predation and asset substitution models and supports hypothesis 2.

Table 7: Leverage and Competition in the US – Sub Period 1

| | **Boone Indicator** | | | | **Herfindahl-Hirschman Index** | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors |
| C | 1.0975*** | 0.3875 | 1.0946*** | 0.3886 | 1.1445*** | 0.3993 | 1.3418*** | 0.4265 |
| PROF | -0.1158 | 0.0783 | -0.1158 | 0.0783 | -0.1162 | 0.0785 | -0.1163 | 0.0784 |
| GROWTH | -0.0019 | 0.0018 | -0.0020 | 0.0018 | -0.0020 | 0.0018 | -0.0020 | 0.0018 |
| SIZE | -0.1650*** | 0.0588 | -0.1650*** | 0.0588 | -0.1661*** | 0.0592 | -0.1643*** | 0.0589 |
| TANG | 0.1555 | 0.1340 | 0.1578 | 0.1334 | 0.1512 | 0.1341 | 0.1616 | 0.1315 |
| NDTS | -0.3773 | 0.3746 | -0.3779 | 0.3737 | -0.3731 | 0.3781 | -0.3755 | 0.3770 |
| UOA | 0.0083 | 0.0132 | 0.0083 | 0.0132 | 0.0083 | 0.0132 | 0.0083 | 0.0132 |
| X | 0.2612 | 0.2105 | 0.3940 | 0.2542 | 0.4897 | 1.6988 | -14.7803** | 7.5012 |
| $X^2$ | | | -0.6004 | 0.6427 | | | 140.0278 | 86.8890 |
| $X^3$ | | | 0.2617 | 0.2785 | | | -205.4946 | 131.0433 |
| Wald | | | 1.4449 | | | | 2.2240* | |
| Adj $R^2$ | 0.7663 | | 0.7664 | | 0.7657 | | 0.7659 | |

This table shows the estimation results for Eq. 1 with Lev as the dependent variable, see table 2 for list of independent variables, the BI is the beta coefficient from Eq. 2 multiplied by -1 so that higher values reflect higher competition, the HHI is determined from Eq. 3. The sample period is 2006 – 2011 using US listed firms. Model 1 and 3 are the linear regressions for the two competition indices, models 2 and 4 are the non-linear regressions. The regression is run using period and cross-section fixed effects. Standard errors robust to heteroscedasticity (white diagonal) are shown. Wald tests the joint significance of the competition variables.

* Significant at 10%

** Significant at 5%

*** Significant at 1%

Table 8: Leverage and Competition in the US – Sub Period 2

| | **Boone Indicator** | | | | **Herfindahl-Hirschman Index** | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors |
| C | 0.8533*** | 0.1707 | 0.8520*** | 0.1698 | 0.8418*** | 0.1722 | 0.9089*** | 0.1816 |
| PROF | -0.0149 | 0.0294 | -0.0149 | 0.0294 | -0.0149 | 0.0294 | -0.0148 | 0.0294 |
| GROWTH | -0.0004 | 0.0007 | -0.0004 | 0.0007 | -0.0004 | 0.0007 | -0.0004 | 0.0007 |
| SIZE | -0.1074*** | 0.0291 | -0.1075*** | 0.0291 | -0.1070*** | 0.0291 | -0.1072*** | 0.0291 |
| TANG | 0.3253 | 0.2309 | 0.3263 | 0.2310 | 0.3233 | 0.2310 | 0.3271 | 0.2311 |
| NDTS | 0.9643 | 1.0260 | 0.9646 | 1.0262 | 0.9663 | 1.0263 | 0.9709 | 1.0267 |
| UOA | -0.0075** | 0.0033 | -0.0075** | 0.0033 | -0.0075** | 0.0033 | -0.0075** | 0.0033 |
| X | -0.1195* | 0.0671 | -0.0552 | 0.2321 | -0.5574 | 0.4782 | -6.2442 | 3.8547 |
| $X^2$ | | | -0.3613 | 0.5528 | | | 57.7613 | 36.0923 |
| $X^3$ | | | 0.3855 | 0.3736 | | | -87.6710 | 54.8944 |
| | | | 1.7772 | | | | 0.8809 | |
| Adj $R^2$ | 0.6901 | | 0.6901 | | 0.6901 | | 0.6901 | |

This table shows the estimation results for Eq. 1 with Lev as the dependent variable, see table 2 for list of independent variables, the BI is the beta coefficient from Eq. 2 multiplied by -1 so that higher values reflect higher competition, the HHI is determined from Eq. 3. The sample period is 2012 – 2016 using US listed firms. Model 1 and 3 are the linear regressions for the two competition indices, models 2 and 4 are the non-linear regressions. The regression is run using period and cross-section fixed effects. Standard errors robust to heteroscedasticity (white diagonal) are shown. Wald tests the joint significance of the competition variables.

* Significant at 10%
** Significant at 5%
*** Significant at 1%

### 5.3.3 Leverage-Competition Reverse Causality

When formulating the main empirical model Eq. 1, we did not lag the competition variables because the data frequency is annual. If the observations were more frequent it is possible that a change in competition in one period would not have an effect on the debt ratio until the next period. However, due to the aforementioned a concern about potential reverse causality whereby leverage determines competition as discussed in the methodology, a solution to this is to lag the competition variables.

The results of estimating Eq. 4 can be found in Appendix 2. Although this is not the primary model used in this paper, we are including them for completeness. In these results only the HHI is significant in determining leverage in Table 10, model 2. This means that the relationship between the BI and leverage is not significant when lagging annual data.

## 5.4 Discussion

Following the results of the regressions, the implications will now be discussed in reference to the hypotheses. The purpose of this study is based on the notion that concentration is not necessarily an accurate reflection of inverse competition which is why we introduced a new measure, the BI. Using a measure of concentration as a proxy for competition is referred to as a structural approach whereas the non-structural approach ascertains competition directly from market behaviour. An issue with the structural approach is that high concentration does not automatically imply low competition. According to Demsetz & Lehn (1985) high concentration could easily be the result of substantial levels of efficiency or as Boone, Griffith & Harrison (2005) argue as a result of inefficient firms exiting the market when there is a hike in competition. From this perspective, the concentration level does not necessarily translate into a degree of competition. On the other hand, the BI captures the sensitivity of profits in relation to their inefficiency in the market. Thus, with this measure of sensitivity the BI is not skewed by inefficient firms exiting the market due to increased competition making it a more theoretically appealing measure.

With that being said, the significance of the models proxied by the HHI in the initial overall sample demonstrate a relationship between concentration and leverage (as seen in Table 6) but do not necessarily infer that a relationship exists between competition and leverage. Furthermore, due to the extreme financial turmoil experienced in the US within the 10-year sample period the results are unreliable.

In an effort to account for the macroeconomic circumstances, the regression is estimated using two sub-periods. We hope that sub-period 1 captured the vast majority of the volatility caused by the crisis and analysis of sub-period 2 more accurately reflects 'normal' economic conditions. Sub-period 2 yielded a significant negative relationship between leverage and competition measured by the linear BI model. We argue the implication of this finding with regards to the hypotheses:

1. There is a significant relationship between leverage and competition across US listed firms.
2. The relationship between leverage and competition in US listed firms is negative.
3. The relationship between leverage and competition in US listed firms is linear.

From a theoretical perspective, the findings of this paper support the predation model. As such if a firm is in a competitive industry and is trying to use high levels of debt, for example to curb the managerial agency problem or increase barriers to entry, they should be aware of their susceptibility to rivals with 'deep pockets.'

# 6. CONCLUSION

Using unbalanced panel data from 4,957 US listed firms, the effect of competition on leverage is investigated. We use a new measure of competition, the Boone Indicator, to overcome issues associated with using a concentration proxy as done in previous studies. The central idea of this study is to determine whether product market competition affects capital structure, and if so, what is the direction and nature of the relationship. Based on the literature, the limited liability model predicts a positive relationship whereas the predation and asset substitution models suggest a negative relationship.

In order to empirically model the determinants of capital structure this study uses data between 2006-2016 from eight different industries. Respective regressions were conducted using the BI and HHI as competition variables and as expected resulted in inverse results. With that said, the HHI was deemed to be a dissatisfactory variable given concentration as a proxy for competition can be distorted. To increase the reliability of the results found with the BI, the sample was split into two sub-periods. In doing so we accounted for the distortion to financial data caused by the 2008 financial crisis. Here, the sample "post crisis" showed a significant negative relationship between competition and capital structure. From this, our research supports the predation model and as such firms with a high debt to equity ratio are vulnerable to predatory tactics by rivals who have intentions of driving their competition out of the market.

Our study further supports the BI and negates the validity of the HHI as a proxy for competition, however, the study had limitations that need to be addressed. For one, it is difficult to quantify an operational formula to measure a relationship given there are numerous qualitative explanatory variables and factors, such as bankruptcy, which require complex models within themselves. The study also allows for future research built on the fact that the BI was not significant during the financial crisis. It is difficult to study leverage during an intense economic downturn since we do not know whether firms are making tactical changes to their capital structure or if their borrowing is constrained by financial institutions. As such, we suggest using the BI for additional time periods of relative normality to check and see if the relationship is still significant. Additional research could recreate a similar study using the BI but for different and or developing countries in order to assess whether competition is a determinant of leverage in alternative markets. Furthermore, it would be interesting to consider the relationship in reverse and create a model for competition with respect to leverage. From this angle it can be empirically ascertained whether firms have the ability to strategically alter debt and influence competitive position.

# REFERENCES


Aggarwal, R. & Kyaw, N. N. A. (2010). Capital Structure, Dividend Policy, and Multinationality: Theory versus Empirical Evidence, *International Review of Financial Analysis*, vol. 19, no. 2, pp.140–150.

Bolton, P. & Scharfstein, D. (1990). A Theory of Predation Based on Agency Problem in Financial Contracting, *American Economic Reivew*, vol. 80, no. 1, pp.93–106.

Boone, J., Griffith, R. & Harrison, R. (2004). Measuring Competition.

Boone, J., Griffith, R. & Harrison, R. (2005). Measuring Competition, *Advanced Institute of Management Research Paper No. 022*.

Booth, L., Aivazian, V. & Demirguc-kunt, A. (2001). American Finance Association Capital Structures in Developing Countries, *The Journal of Finance*, vol. 56, no. 1, pp.87–130.

Brander, J. & Lewis, T. (1986). Oligopoly and Financial Structure: The Limited Liability Effect, *American Economic Review*, vol. 76, no. 5, pp.956–970.

Campello, M. (2003). Capital Structure and Product Markets Interactions: Evidence from Business Cycles, *Journal of Financial Economics*, vol. 68, no. 3, pp.353–378.

Chevalier, B. J. A. (1993). American Economic Association Capital Structure and Product-Market Competition : Empirical Evidence from the Supermarket Industry, *The American Economic Review*, vol. 85, no. 3, pp.415–435.

DeAngelo, and Masulis. (1980). Optimal Capital Structure under Corporate and Personal Taxation, *Journal of Financial Economics*, vol. 8, no. 1, pp.3-29.

Demsetz, H. & Lehn, K. (1985). The Structure of Corporate Ownership: Causes and Consequences, *Journal of Political Economy*, vol. 93, no. 6, pp.1155–1177.

Engle, R. F. (1984). Hand Book of Econometrics, [e-book], Available Online: ftp://195.43.12.200/mysite6/adobo/021.pdf [Accessed 23 May 2017].

Fairchild, R. J. (2004). Potential Product Market Competition, Financial Structure, and Actual Competitive Intensity, *SSRN Electronic Journal*.

Fosu, S. (2013). Capital Structure, Product Market Competition and Firm Performance: Evidence from South Africa, *The Quarterly Review of Economics and Finance*, vol. 53, no. 2, pp.140–151.

Fulghieri, P. & Nagarajan, S. (1996). On the Strategic Role of High Leverage in Entry Deterrence, *Journal of Banking & Finance*, vol. 20, no. 1, pp.1–23.

Gokay, B. (2009). The 2008 World Economic Crisis: Global Shifts and Faultlines, *Centre for Research on Globalization*, Available Online: http://www.globalresearch.ca/the-2008-world-economic-crisis-global-shifts-and-faultlines/12283 [Accessed 1 May 2017].

Guney, Y., Li, L. & Fairchild, R. (2011). The Relationship between Product Market Competition and Capital Structure in Chinese Listed Firms, *International Review of Financial Analysis*, vol. 20, pp.41–51.

Hausman, J. (1978). Specification Tests in Econometrics, *Econometrica*, vol. 46, no. 6, pp.1251–1271.

Israel, R. (1991). Capital Structure and the Market for Corporate Control: The Defensive Role of Debt Financing, *The Journal of Finance*, vol. 46, no. 4, pp.1391–1409.

Jensen, M. C. & Meckling, W. H. (1976). Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure, *Journal of Financial Economics*, vol. 3, no. 4, pp.305–360.

Kovenock, D. & Phillips, G. (1997). Capital structure and product-market behavior: An examination of plant exit and investment decisions, *Review of Financial Studies*, vol. 10, no. 3, pp.767–803.

Krishnaswamy, C. ., Mangla, I. & Rathinasamy, R. . (1992). An Empirical Analysis of the Relationship between Financial Structure and Market Structure, *Journal of Financial and Strategic Decisions*, vol. 5, no. 3, pp.75–88.

Leeper, T. J. (2017). Interpreting Regression Results Using Average Marginal Effects with R's Margins, [e-

journal], Available Online: https://cran.r-project.org/web/packages/margins/vignettes/TechnicalDetails.pdf [Accessed 23 May 2017].
Lemmon, M., Roberts, M. & Zender, J. (2008). Back to the Beginning: Persistence and the Cross-Section of Corporate Capital Structure, *The Journal of Finance*, vol. 63, no. 4, pp.1575–1608.
Maksimovic, V. (1988). Capital Structure in Repeated Oligopolies, *RAND Journal of Economics*, vol. 19, no. 3, pp.389–407.
Mitani, H. (2014). Capital Structure and Competitive Position in Product Market, *International Review of Economics & Finance*, vol. 29, pp.358–371.
Modigliani, F. & Miller, M. (1963). Corporate Income Taxes and the Cost of Capital: A Correction, *The American Economic Association*, vol. 53, no. 3, pp.433–443.
Myers, S. (1984). The Capital Structure Puzzle, *The Journal of Finance*, vol. 39, no. 3, pp.575–592.
Myers, S. C. (1977). Determinants of Corporate Borrowing, *Journal of Financial Economics*, vol. 5, no. 2, pp.147–175.
Negash, M. (2001). Debt, Tax Shield and Bankruptcy Costs : Some Evidence from JSE, *Investment Analysts Journal*, vol. 30, no. 54, pp.33-44.
Pandey, I. M. (2002). Capital Structure, Profitability and Market Structure : Evidence from Malaysia, *Asia Pacific Journal of Economics and Business, vol. 8, no.2, pp.78–91.*
Petersen, M. A. (2009). Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches, *Review of Financial Studies*, vol. 22, no. 1, pp.435–480.
Phillips, G. M. (1995). Increased Debt and Industry Product Markets an Empirical Analysis, *Journal of Financial Economics*, vol. 37, no. 2, pp.189–238.
Rajan, R. G. & Zingales, L. (1995). What Do We Know about Capital Structure? Some Evidence from International Data, *The Journal of Finance*, vol. 50, no. 5, pp.1421–1460.
Roberts, M. R., Whited, T. M., Bowen, D., Frank, M., Gormley, T., Luo, M., Mackinlay, A., Schnabl, P., Singleton, K., Wessels, R., Zhao, S. & Zhu, H. (2011). Endogeneity in Empirical Corporate Finance *, [e-journal], Available Online: http://ssrn.com/abstract=1748604 [Accessed 22 May 2017].
Showalter, D. (1999). Strategic Debt: Evidence in Manufacturing, *International Journal of Industrial Organization*, vol. 17, no. 3, pp.319–333.
Stulz, R. (1990). Managerial Discretion and Optimal Financing Policies, *Journal of Financial Economics*, vol. 26, no. 1, pp.3–27.
Titman, S. (1984). THE EFFECT OF CAPITAL STRUCTURE ON A FIRM'S LIQUIDATION DECISION, *Journal of Financial Economics*, vol. 13, no. 1, pp.137–151.
Titman, S. & Wessels, R. (1988). The Determinants of Capital Structure Choice, *The Journal of Finance*, vol. 48, no. 1, pp.158–171.
Zingales, L. (1998). Survival of the Fittest or the Fattest? Exit and Financing in the Trucking Industry, *Journal of Finance*.

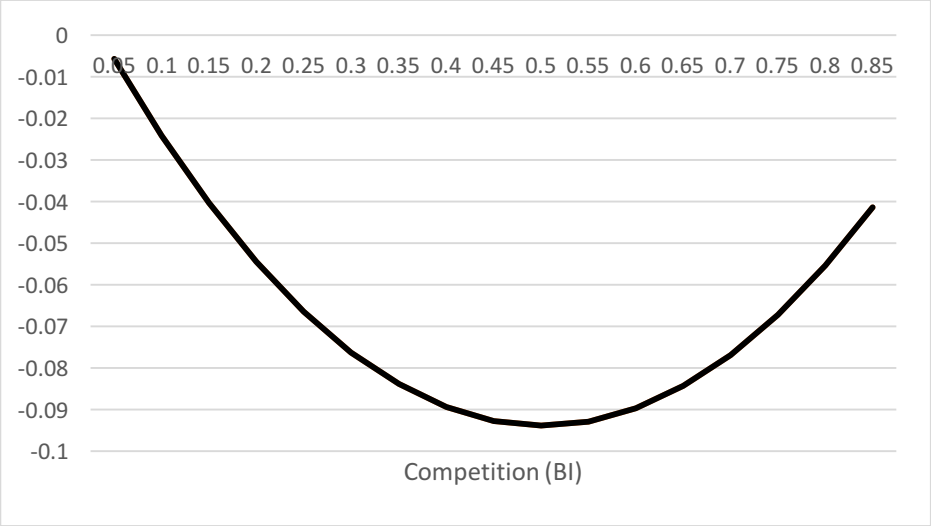
# APPENDIX

## Appendix 1 - Marginal Effect of Competition on Leverage

Table 9: The Marginal Effect of Competition on Leverage, Using Sample Values of the BI

| x | Marginal Effect[3] |
|---|---|
| 0.05 | -0.00570925 |
| 0.1 | -0.024157 |
| 0.15 | -0.04044325 |
| 0.2 | -0.054568 |
| 0.25 | -0.06653125 |
| 0.3 | -0.076333 |
| 0.35 | -0.08397325 |
| 0.4 | -0.089452 |
| 0.45 | -0.09276925 |
| 0.5 | -0.093925 |
| 0.55 | -0.09291925 |
| 0.6 | -0.089752 |
| 0.65 | -0.08442325 |
| 0.7 | -0.076933 |
| 0.75 | -0.06728125 |
| 0.8 | -0.055468 |
| 0.85 | -0.04149325 |

Figure 1: Marginal Effect of Competition (BI) on Leverage

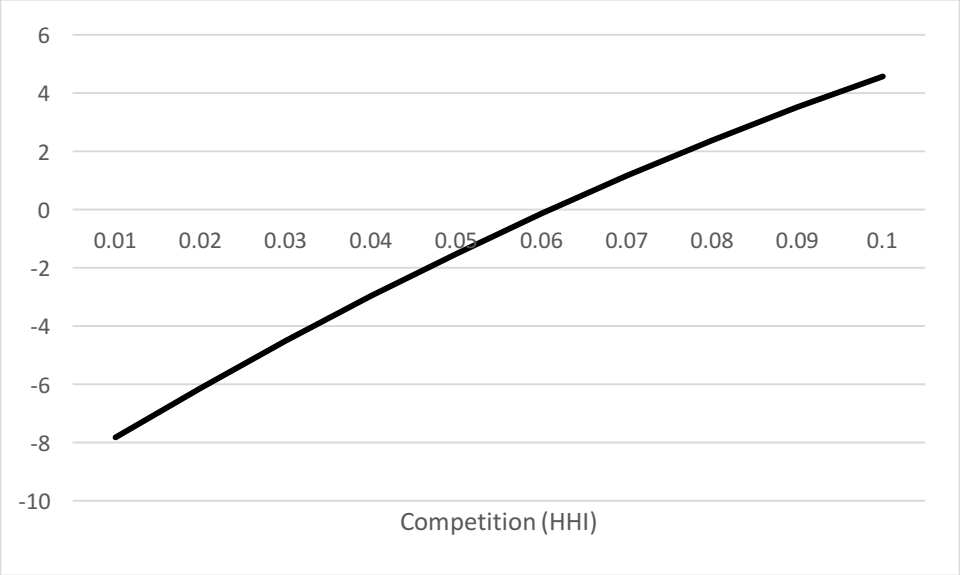



[3] Calculated from Eq. 6, using coefficient estimates from Table 6, Model 2

Table 10: The Marginal Effect of Competition on Leverage, Using Sample Values of the HHI

| x | Marginal Effect |
|---|---|
| 0.01 | -7.835832 |
| 0.02 | -6.1327 |
| 0.03 | -4.511204 |
| 0.04 | -2.971344 |
| 0.05 | -1.51312 |
| 0.06 | -0.136532 |
| 0.07 | 1.15842 |
| 0.08 | 2.371736 |
| 0.09 | 3.503416 |
| 0.1 | 4.55346 |

Figure 2: Marginal Effect of Competition (HHI) on Leverage



## Appendix 2 - Regression Results for Lagged Competition Variables

Table 11: Leverage and Competition in the US – Lagged Competition

| | **Boone Indicator** | | | | **Herfindahl-Hirschman Index** | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors |
| C | 0.6597*** | 0.1394 | 0.6597*** | 0.1403 | 0.7111*** | 0.1457 | 0.7737*** | 0.1606 |
| PROF | -0.0415 | 0.0395 | -0.0415 | 0.0395 | -0.0415 | 0.0395 | -0.0415 | 0.0395 |
| GROWTH | -0.0001 | 0.0008 | -0.0001 | 0.0008 | -0.0001 | 0.0008 | 0.0000 | 0.0008 |
| SIZE | -0.0964*** | 0.0228 | -0.0962*** | 0.0227 | -0.0973*** | 0.0228 | -0.0975*** | 0.0228 |
| TANG | 0.5173** | 0.2145 | 0.5173** | 0.2145 | 0.5128** | 0.2145 | 0.5148** | 0.2147 |
| NDTS | 0.3820 | 0.8360 | 0.3815 | 0.8361 | 0.3788 | 0.8358 | 0.3767 | 0.8364 |
| UOA | -0.0003 | 0.0042 | -0.0002 | 0.0042 | -0.0003 | 0.0042 | -0.0003 | 0.0042 |
| X | 0.0673 | 0.0575 | -0.0070 | 0.2329 | -1.2735*** | 0.3978 | -6.3478** | 2.8213 |
| $X^2$ | | | 0.3906 | 0.5165 | | | 52.0480* | 28.4409 |
| $X^3$ | | | -0.1881 | 0.2101 | | | -76.5972* | 42.6108 |
| Wald | | | 1.1267 | | | | 4.4465*** | |
| Adj $R^2$ | 0.5614 | | 0.5615 | | 0.5614 | | 0.5615 | |

This table shows the estimation results for Eq. 4 with Lev as the dependent variable, see table 2 for list of independent variables, the BI is the beta coefficient from Eq. 2 multiplied by -1 so that higher values reflect higher competition, the HHI is determined from Eq. 3. The sample period is 2007 – 2016 using US listed firms. Model 1 and 3 are the linear regressions for the two competition indices, models 2 and 4 are the non-linear regressions. The regressions are run using period and cross-section fixed effects. Standard errors robust to heteroscedasticity (white diagonal) are shown. Wald tests the joint significance of the competition variables.

* Significant at 10%

** Significant at 5%

*** Significant at 1%

Table 12: Leverage and Competition in the US – Lagged Competition (Sub Period 1)

| | **Boone Indicator** | | | | **Herfindahl-Hirschman Index** | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors |
| C | 1.2424*** | 0.4193 | 1.2854*** | 0.4222 | 1.2681*** | 0.4331 | 1.2103*** | 0.4357 |
| PROF | -0.1162 | 0.0816 | -0.1158 | 0.0815 | -0.1161 | 0.0816 | -0.1161 | 0.0816 |
| GROWTH | -0.0019 | 0.0017 | -0.0019 | 0.0018 | -0.0019 | 0.0017 | -0.0019 | 0.0017 |
| SIZE | -0.1794*** | 0.0631 | -0.1786*** | 0.0626 | -0.1798*** | 0.0633 | -0.1804*** | 0.0634 |
| TANG | 0.1467 | 0.1469 | 0.1491 | 0.1468 | 0.1457 | 0.1472 | 0.1416 | 0.1478 |
| NDTS | -0.3658 | 0.3812 | -0.3675 | 0.3786 | -0.3650 | 0.3813 | -0.3651 | 0.3811 |
| UOA | 0.0083 | 0.0134 | 0.0083 | 0.0134 | 0.0083 | 0.0134 | 0.0083 | 0.0134 |
| X | 0.0052 | 0.0855 | -0.5371 | 0.4371 | -0.8745 | 1.2759 | 3.7381 | 6.4038 |
| $X^2$ | | | 1.3986 | 1.2159 | | | -44.1093 | 64.2502 |
| $X^3$ | | | -0.5577 | 0.4909 | | | 67.2612 | 96.0017 |
| Wald | | | 1.7437 | | | | 0.4012 | |
| Adj $R^2$ | 0.7610 | | 0.7615 | | 0.7610 | | 0.0492 | |

This table shows the estimation results for Eq. 1 with Lev as the dependent variable, see table 2 for list of independent variables, the BI is the beta coefficient from Eq. 2 multiplied by -1 so that higher values reflect higher competition, the HHI is determined from Eq. 3. The sample period is 2007 – 2011 using US listed firms. Model 1 and 3 are the linear regressions for the two competition indices, models 2 and 4 are the non-linear regressions. The regression is run using period and cross-section fixed effects. Standard errors robust to heteroscedasticity (white diagonal) are shown. Wald tests the joint significance of the competition variables.

* Significant at 10%

** Significant at 5%

*** Significant at 1%

Table 13: Leverage and Competition in the US – Lagged Competition (Sub Period 2)

| | **Boone Indicator** | | | | **Herfindahl-Hirschman Index** | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors | Coefficient | Std Errors |
| C | 0.7961*** | 0.1623 | 0.7840*** | 0.1582 | 0.8402 | 0.1709 | 0.8700 | 0.1717 |
| PROF | -0.0150 | 0.0294 | -0.0150 | 0.0294 | -0.0149 | 0.0294 | -0.0149 | 0.0294 |
| GROWTH | -0.0004 | 0.0007 | -0.0004 | 0.0007 | -0.0003 | 0.0007 | -0.0003 | 0.0007 |
| SIZE | -0.1062*** | 0.0288 | -0.1062*** | 0.0287 | -0.1070 | 0.0291 | -0.1072 | 0.0290 |
| TANG | 0.3222 | 0.2310 | 0.3227 | 0.2307 | 0.3222 | 0.2311 | 0.3231 | 0.2310 |
| NDTS | 0.9658 | 1.0255 | 0.9664 | 1.0260 | 0.9637 | 1.0261 | 0.9627 | 1.0261 |
| UOA | -0.0075** | 0.0033 | -0.0075** | 0.0033 | -0.0075 | 0.0033 | -0.0075 | 0.0033 |
| X | 0.1584 | 0.1156 | 0.2087 | 0.3330 | -0.4422 | 0.4486 | -2.9477 | 3.4038 |
| $X^2$ | | | 0.1495 | 0.5758 | | | 27.0861 | 35.1916 |
| $X^3$ | | | -0.2699 | 0.3235 | | | -41.9674 | 55.3842 |
| Adjusted $R^2$ | 0.6901 | | 0.6901 | | 0.6901 | | 0.6900 | |

This table shows the estimation results for Eq. 4 with Lev as the dependent variable, see table 2 for list of independent variables, the BI is the beta coefficient from Eq. 2 multiplied by -1 so that higher values reflect higher competition, the HHI is determined from Eq. 3. The sample period is 2012 – 2016 using US listed firms. Model 1 and 3 are the linear regressions for the two competition indices, models 2 and 4 are the non-linear regressions. The regression is run using period and cross-section fixed effects. Standard errors robust to heteroscedasticity (white diagonal) are shown. Wald tests the joint significance of the competition variables.

* Significant at 10%

** Significant at 5%

*** Significant at 1%