Business Cycles, Nature of Firms' Assets, and Financing Decisions

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Abstract

As more advanced economies are being transformed into knowledge-based economies, intangible capital has become a fundamental input for the future competitiveness and growth of these economies and the firms that operate in them. Despite the economic importance of intangible assets, the prevailing opinion among managers and scholars is that intangible assets cannot support debt as tangible assets do. However, recent trends show the opposite, and an increasing proportion of secured syndicated loans in the U.S. include intangible assets as loan collateral. In fact, using data on U.S. firms from 1980 to 2021, this dissertation finds a statistically significant positive relationship between a firm-level measure of intangible assets and financial leverage. Another interesting question is: How does the relationship of tangible and intangible assets with leverage behave across the business cycle? Using data on the three most recent business cycles (2001-2006; 2007-2019; 2020-2021), in most cases, intangible assets enter the standard leverage regression with a higher coefficient during expansion periods than in contraction periods. For tangible assets, the opposite trend is found. These results suggest that firms with more intangible assets find it more difficult to issue debt during contraction periods. In addition, the results might also imply that the relationship between asset tangibility and financial leverage is stronger during contraction periods which is consistent with the literature.

Key Words: Knowledge-based Economy, Intangible Assets, Tangible Assets, Business Cycles, Contraction Period, Expansion Period, Financial Leverage.

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Resumo

Enquanto as economias mais desenvolvidas se vão tornando "economias do conhecimento", os ativos intangíveis tornaram-se um input fundamental à competitividade e crescimento futuros destas economias e das empresas que nelas operam. Apesar da elevada importância económica dos ativos intangíveis, a opinião predominante entre gestores e estudiosos é de que este tipo de ativos não é capaz de auxiliar o acesso ao crédito como os ativos tangíveis. No entanto, as tendências recentes mostram o contrário, uma proporção crescente de empréstimos sindicalizados nos EUA incluem os ativos intangíveis como garantia de empréstimo. De facto, utilizando dados de empresas americanas entre 1980 e 2021, esta dissertação encontra uma relação positiva e estatisticamente significativa entre uma medida ativos intangíveis ao nível da empresa e a alavancagem financeira. Outra pergunta que pode ser colocada é: De que forma a relação dos ativos tangíveis e intangíveis com o nível de alavancagem se desenvolve ao longo do ciclo económico? Utilizando a informação dos três ciclos económicos mais recentes (2001-2006; 2007-2019; 2020-2021), na maioria dos casos, os ativos intangíveis entram na regressão com um coeficiente mais elevado durante os períodos de expansão do que nos períodos de contração, relativamente aos ativos tangíveis verifica-se a tendência oposta. Estes resultados sugerem que as empresas com mais ativos intangíveis poderão ter mais dificuldade em emitir dívida durante os períodos de contração. Adicionalmente, os resultados podem também implicar que a relação entre tangibilidade dos ativos e alavancagem financeira é mais forte durante períodos de contração, o que é consistente com a literatura.

Palavras-Chave: Economia Baseada no Conhecimento, Ativos Intangíveis, Ativos Tangíveis, Ciclo Económico, Período de Contração, Período de Expansão, Alavancagem Financeira.

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List of Abbreviations

GDP – Gross Domestic Product

IPO – Initial Public Offering

OLS – Ordinary Least Squares

P&T – Peters and Taylor (2017)

PP&E – Property, Plant, and Equipment

PPI – Producer Price Index

R&D – Research and Development

NBER – National Bureau of Economic Research

SG&A – Selling, General, and Administrative Expenses

SIC – Standard Industrial Classification

U.S. – United States of America

1. Introduction

"The four largest companies today by market value do not need any net tangible assets…We have become an asset-light economy." Warren Buffet (2018)

Since the introduction of the modern capital theory of Modigliani and Miller (1958), many economists have been devoted to understanding capital structure decisions. Research has primarily focused on the determinants of capital structure decisions (Harris and Raviv 1991; Rajan and Zingales 1995; Frank and Goyal 2003; Flannery and Rangan 2006; Frank and Goyal 2009). Asset tangibility has been found to be one of the most important determinants of capital structure decisions (Frank and Goyal 2003). However, little is known about the impact of business cycles and capital structure decisions and even less on the role of asset tangibility through the cycle. Economic intuition suggests that the business cycle stage should be an important determinant of default risk, affecting the financing policy. Indeed, the most important determinants of capital structure may vary in the different phases of the business cycle. For example, during recessions, asset prices may drop, which influences debt capacity, which in turn influences firms' capital structure decisions.

Furthermore, capital market conditions covary with macroeconomic conditions. As a result, recessions might generate supply effects on the optimal capital structure. Therefore, analyzing the impact of the different business cycle phases on financial leverage may generate interesting insights about firms' financing decisions.

As more advanced economies are being transformed more and more into knowledge-based economies, intangible capital, as the primary determinant of innovation, has become vital for the future competitiveness and growth of these economies. However, the existence of market imperfections, such as information asymmetries and transaction costs, can limit the amount of debt firms are allowed to use (debt capacity)[1], which can lead to an inefficient level of innovation. Almeida and Campello (2007) find that investment-cash flow sensitivities are increasing in the tangibility of financially constrained firms. Their results strongly suggest that financing frictions affect investment decisions; this is an important conclusion given the importance of intangible capital for economic growth.

[1] Myers and Pogue (1974) define debt capacity as the point at which the probability that the firm will "get into trouble" reaches an unacceptable level. The authors define trouble as a situation is which the book value of the firm's liabilities is higher than the real value of its assets.

The relationship between intangible assets and economic performance is well reported in the economic growth literature. It has been consistently found that R&D has a significant and positive effect on output growth (Solow 1957; Griliches 1979; 1988; Coe and Helpman 1995).

Researchers have long recognized that asset tangibility is an important determinant of a firm's ability to access external finance (Almeida and Campello 2007). In this line, the fundamental shift in corporate asset composition from tangible to intangible assets in recent decades raises a challenge: How are firms from knowledge-based economies being financed? This dissertation attempts to answer this question by adding a new factor: the influence of business cycles.

The current study addresses two questions. Firstly, it aims to analyze the nature and significance of the relationship between intangible assets and financial leverage in the entire period of analysis (1980-2021). Do intangible assets significant relationship with leverage? If yes, is that relationship significantly positive? Reasons for a negative relationship between leverage and intangible assets would be its low redeployability, higher information asymmetry, and uncertain liquidation value intrinsic to intangible assets, making intangible assets less suitable as loan collateral.

Secondly, this dissertation aims to analyze changes in the relationship between tangible and intangible assets and financial leverage across two phases of business cycles: contraction periods and expansion periods. The existing literature documents an increase in the use of intangible assets as loan collateral over time (Loumioti 2012a). As such, it may be interesting to analyze differences within the different phases of the same business cycle and differences across different business cycles.

Regarding differences between the relationship of tangible and intangible assets in contraction and expansion periods, it is expected that banks may be stricter with the type of collateral demanded during contraction periods. Thus, firms that rely more on intangibles may have lower access to external debt and, therefore, issue less debt. What is going to be analyzed in this study is if the business cycle has any influence on the relationship of intangible and tangible capital with leverage. If a difference is found, it can indicate that lenders' perception of intangible assets as loan collateral changes through the business cycle. Furthermore, as credit markets are using more intangible assets in the form of loan collateral, asset tangibility might lose some of its significance and importance when predicting leverage ratios across time. The rationale behind this prediction is that intangible capital is becoming more and more important in

alleviating financing frictions and enhancing debt capacity, substituting, to some extent, the tangible assets in this role.

Intangible capital plays a crucial role in economic growth, and the lack of pledgeability of this type of asset can result in inefficient levels of investment and economic growth. This dissertation contributes to the study of the impact of different business cycle stages on corporate financing decisions. More precisely, it studies a possible change in capital structure of firms from the knowledge-based economy during the different stages of the business cycle.

The remainder of this thesis is organized as follows: Section 2 presents an overview of the literature addressing the impact of firms' asset nature and macroeconomic conditions on capital structure decisions. Section 3 addresses the variable construction and describes the methodology and hypothesis of this dissertation. Section 4 describes the data used and provides a detailed descriptive analysis. Section 5 focuses on the hypothesis, presenting and analyzing the results. Section 6 includes the robustness tests of the model used. Section 7 presents the main limitations of the model used and possible future research. Finally, Section 8 concludes the dissertation with a discussion of the main results.

2. Literature Review

Over the past few decades, the proportion of corporate assets that consists of intangible assets has been increasing significantly in knowledge-based economies. Literature regarding this rise in intangible capital has mushroomed in academic journals and press from various areas, including the economics of innovation, macroeconomics, and industrial organization, documenting the dramatic shift in the composition of investments and capital formation towards intangible capital. In the aggregate, the upward trend in the investment in intangibles by U.S. firms is observed since the 1980s (C. Corrado, Hulten, and Sichel 2009; C. A. Corrado and Hulten 2010).

Furthermore, researchers have documented an increase in corporate cash holdings in the last few decades. This increase in corporate cash holdings coincides with the dramatic decline in asset tangibility. Several researchers have analyzed the link between the rise in intangible capital and the secular upward trend in corporate cash holdings. From 1980 to 2004, the average cash to assets ratio for U.S. industrial firms increased by 129% (Bates, Kahle, and Stulz 2009). Falato et al. (2020), using data from U.S. corporations over the 1970 and 2010 period, shows

that the rise in intangible assets can account for about 3/4 of the upward trend in the average corporate cash ratios.

It is important to note that the study of the relationship between internal finance and R&D expenditures did not start recently. Since Schumpeter, economists have argued that internal finance is a key determinant of R&D expenditures. One of Schumpeter's (1942) arguments in defense of monopoly is that it can provide the internal resources that firms need to finance innovation. For example, Kamien and Schwartz (1978) argue that one of the leading characteristics associated with R&D is the necessity of it to be financed internally.

According to the existing literature, asset tangibility is an important determinant of corporate capital structure decisions. Moreover, asset tangibility helps explain why some firms have little or no debt ("low leverage puzzle"). Researchers have found that low leverage firms are largely firms with relatively low asset tangibility (Rampini and Viswanathan 2013).

Firms with more intangible assets tend to issue less debt, financing its investments with internal or external equity and retained earnings instead (Brown, Fazzari, and Petersen 2009; Bates, Kahle, and Stulz 2009; Falato et al. 2020). Among the possible explanations for this behavior offered by the literature intangible, assets may require less upfront cash, lowering the need for external funding (Döttling and Perotti 2017; Sun and Xiaolan 2019). This explanation derives from observing how intangible capital depends on the commitment of skilled human capital. Employees have limited commitment to the firm, meaning they can leave the firm with a portion of the intangible capital when they perceive a better opportunity outside. To ensure the retention of human capital, firms reward employees with deferred compensation, and as a result, firms' demand for external funds drops. The key insight is that firms finance intangible capital by delaying wage payments in the form of future claims.

Another explanation for the preference of internal funds in the financing decisions of firms that have a higher proportion of intangible assets is intangible assets' low collateral value, which emphasizes firms' financing frictions (Rampini and Viswanathan 2013; Falato et al. 2020). Indeed, intangible capital has a lower redeployability, higher information asymmetry, and higher uncertainty towards liquidation value, making it less suitable as loan collateral (Harris and Raviv 1991; Frank and Goyal 2008; Parsons and Titman 2009). Intangible assets are more difficult to value, when they are sold, as they usually do not have the same value for all potential bidders. In addition, intangible assets may also embody the human capital who created it, meaning that when creditors try to sell this type of asset in the market, they may only be able

to recoup a tiny fraction of its original value. Some intangible assets, such as patents, can be pledged as collateral. In recent years, much work on the potential of intangible assets as collateral has been carried out (Loumioti 2012; Mann 2018; Hochberg, Serrano, and Ziedonis 2018; Lim, Macias, and Moeller 2020).

The Collateral Channel

The use of collateral is present in corporate borrowing all over the world. Existent literature offers two explanations for the use of collateral in financing contracts: an attempt to compensate for *ex ante* asymmetric information or as a method of reducing *ex post* incentive problems (Berger, Scott Frame, and Ioannidou 2011). Regarding the first explanation, researchers argue that collateral arises from *ex ante* information gaps between lenders and borrowers that can produce an equilibrium characterized by adverse selection and credit restrictions. Within this line of thought, Chan and Thakor (1987) argue that lending against collateral helps mitigate some informational problems such as adverse selection and moral hazard. Regarding the second explanation, researchers argue that collateral is a critical component of an optimal debt contract by invoking *ex post* frictions, which can include: moral hazard concerns (Boot, Thakor, and Udell 1991); difficulties in enforcing repayment, or other contract specificities (Banerjee and Newman 1993); and costly state verification (Gale and Hellwig 1985; Boyd and Smith 1993).

Furthermore, recent literature highlights the importance of asset redeployability (which partially overlaps with asset tangibility) as a key driver of the collateral channel (Hall 2012; Campello and Giambona 2013; Norden and van Kampen 2013). Campello and Giambona (2013) examine the different components of tangible assets and detect that the redeployable component drives the leverage ratios observed. According to Ivashina, Laeven, and Moral-Benito (2020) the core characteristics of collateral are its liquidation value, pledgeability, and durability.

A sizable body of literature suggests that the "collateral channel" connects asset markets and the real economy (Fisher 1933). The rationale is that collateral plays a dual role in the economy: as production assets and as collateral for loans. Thus, a large decline in asset markets affects the collateral value of the assets and reduces firms' debt capacity; lower debt capacity, in turn, results in reduced investment and output (Bernanke and Gertler 1986; Kiyotaki and Moore 1997; Gan 2007).

Macroeconomic Conditions and Capital Structure Decisions

At least since Fisher (1933), many economists started viewing financial factors as important elements of business cycle fluctuations (Carlstrom and Fuerst 1997). Disturbances in the macroeconomic or the financial markets have a significant and persistent impact on firms' financing and investment decisions, affecting the real economy (Hackbarth, Miao, and Morellec 2006; Jermann and Quadrini 2012).

The dramatic collapse of the markets for securitized credit products in the second half of 2007 and its impact on economic growth proved how disruptions in financial markets can have severe macroeconomic consequences. Furthermore, this dramatic recession sparked substantial interest in the relationship between macroeconomic conditions and corporate capital structure decisions. Despite the effort, from the theoretical perspective, the relationship between business cycles and financial leverage is still ambiguous.

Hackbarth, Miao, and Morellec (2006) find that for their base parameters, in a standard economic environment with risk-neutral agents and a constant risk free-rate, the value-maximizing leverage ratio is higher during a contraction period than in an expansion period. Therefore, the authors' model predicts countercyclicality in leverage ratios. In the same line of thought, Levy and Hennessy (2007) developed a computable general equilibrium model that analyzes the interplay between managers' personal portfolio choices and the firm's external debt policy. This model also predicts a countercyclical dynamic in leverage. In their model, managers must hold a high percentage of the firm's equity to advert agency conflicts. Thus, during recessions, firms substitute debt for equity to maintain managerial equity shares. In contrast, during expansions, risk-sharing improves, and the managerial wealth increase, which facilitates the substitution of equity for debt.

Bhamra, Kuehn, and Strebulaev (2010) developed a general market equilibrium model of capital structure choice in which agents are risk-averse and recessions are periods of increased marginal utilities and slower expected cash-flow growth. Moreover, in this model, the risk-free rate moves procyclicality. In this context, the model predicts a procyclical market leverage dynamic. Furthermore, Bhamra, Kuehn, and Strebulaev's model assumes a countercyclical loss in case of default, implying that firms use more debt during booms than during recessions (Chen 2010).

It is possible to state that none of the models presented can determine the dynamics of the leverage ratio in a closed-form.

Furthermore, the literature also provides a cross-sectional analysis of the impact of macroeconomic conditions on firms' capital structure decisions. For example, Korajczyk and Levy (2003) develop a model of target capital structure as a function of macroeconomic conditions and firm-specific variables. By splitting firms by their probability of facing financing constraints, the authors find that leverage is countercyclical for the relative unconstraint firms but procyclical for the relatively constrained firms.

Covas and Den Haan (2012) show that large public firms substitute debt- and equity financing over the business cycle. In contrast, small firms' financing policy is procyclical for debt and equity. In other words, in expansion periods small firms increase external debt whereas, in contraction periods, total external debt is reduced.

Campello and Giambona (2013) argue that the redeployability-leverage relationship should strengthen during periods of credit contractions. Their argument is related to the hypothesis of this dissertation. Their results suggest that asset redeployability facilitates borrowing for firms that are likely to be credit constrained (small, unrated, and low payout firms) during periods of credit tightening.

The diverse theoretical predictions and the lack of empirical evidence on the relationship between business cycles and financing decisions is a motivator for the topic of this dissertation, that analysis how the nature and significance of particular determinants of capital structure evolve over the business cycle.

Intangible Assets

This empirical study contributes to a growing body of literature on the role of intangible assets in the collateral channel and in alleviating financing frictions for firms from knowledge-based economies. Recently, many researchers have been studying the usage of intangible assets as loan collateral. Loumioti (2012) examines the role of intangible assets in reducing financing frictions in credit markets. Using a sample of secured syndicated loans for the period 1996-2005, the paper shows that 21% of secured syndicated loans have been collateralized by intangible assets. Lim, Macias, and Moeller (2020) show empirically that identifiable intangible assets have a robust relationship with financial leverage. Their results suggest that, despite not being recognized in firms' financial statements and financial filings, identifiable intangible assets support debt similarly to the way tangible assets do. Mann (2018) shows that the pledgeability of patents for debt financing has become more common since the 2000s, which

contributes to financing innovation. This paper also shows that after court decisions that strengthen creditor rights to patents in bankruptcy, patenting firms raise more debt and spend more on R&D.

3. Variables Construction and Methodology

3.1. The Leverage Variable

Before addressing the research question, it is necessary to define leverage. According to Welch (2011), there is no universally used measure of leverage.

Measures of leverage can differ according to whether the market- or book-value of leverage is used. On the one hand, according to Myers (1977), debt is better supported by assets in place than by its growth opportunities, and as a result, managers focus more on the book value of leverage. Moreover, given that financial markets are constantly fluctuating, managers are said to believe that market values of leverage are unreliable as guidance for their corporate financing policy. On the other hand, Welch (2004) argues that the book value of equity is mainly a "plug number" to balance the left-hand and the right-hand side of the balance sheet. Thus, according to the author, book values are not a relevant number from the manager's perspective. Furthermore, the book measure reflects what has taken place; it is backward-looking. Conversely, market measures are generally assumed as forward-looking. Considering the insights from the literature, this dissertation will look at both the book value of leverage and the market value of leverage.

Furthermore, leverage measures also differ according to whether total debt or only long-term debt is included. Studies on the relationship between leverage and asset structure often opt for the broadest definition: the ratio of total debt to total assets (Giambona and Schwienbacher 2008; Sibilkov 2009; Campello and Giambona 2013). This dissertation will follow the literature and use the ratio of total debt to total assets. However, this measure has its limitations. Some authors argue that this measure fails to feature the fact that there are some assets that are offset by specific nondebt liabilities (Rajan and Zingales 1995). For example, an increase in the gross amount of trade credit is reflected in a reduction of this measure of leverage.

Considering the existing literature, in every estimation performed, two measures of leverage are going to be used.

- Market Leverage: the ratio of total debt (COMPUSTAT's items dltt + dlc) to market-value of total assets (or $at - ceq + (csho * prcc\_f)$);

- Book Leverage: the ratio of total debt to book-value of total assets (at).

3.2. Intangible Assets

Research on intangible capital faces the significant difficulty of measuring corporate intangible assets. Under the current accounting rules, internally generated intangible assets are treated as expenses (i.e., reported in R&D expenditures, Advertising Expenditures, SG&A, etc.) instead of being booked as assets. Conversely, intangible assets that are acquired can be booked as assets and are included in the "intangibles" in Compustat [2]. However, Peters and Taylor (2017) estimate that only 19% of firms' intangible capital is purchased externally. Hence, most intangible assets are absent from firms' balance sheets.

This dissertation follows Peters and Taylor (2017) to measure the replacement cost of intangible capital[3]. Thus, for the purpose of this dissertation, the measure of intangible capital (Intangible Assets) defined for each firm-year is going to be the sum (divided by book assets) of externally purchased and internally created intangible capital.

Externally purchased intangible capital is measured as intangible capital from the balance sheet (Compustat item *intan*), which is set to zero when missing[4]. Additionally, internally created intangible capital is measured by the sum of two components: Knowledge Capital and Organizational Capital (Peters and Taylor 2017; Sun and Xiaolan 2019)[5] .

[2] However, the "intangibles" variable of Compustat also includes Goodwill and excess cost or premium of acquisition.

[3] This measure of intangible capital used has the benefit of being easily computed for a full Compustat sample. Furthermore, this measure is highly correlated with other measures used in the literature, such as the measure from Falato et al. (2020). However, the measure has its limitations as Lim, Macias, and Moeller (2020) point out that this measure is an indirect measure of intangible assets, as it does not distinguish past expenses that had successful outcomes from past expenses that had unsuccessful outcomes. Furthermore, the measure from Peters and Taylor (2017) cannot distinguish between identifiable and unidentifiable intangible assets. Lim, Macias, and Moeller (2020) argue that this distinction is more important than the distinction between tangible and intangible assets.

[4] Peters and Taylor (2017) do not exclude Goodwill in their primary analysis due to its inseparability. However, in the robustness tests, the authors try to exclude Goodwill from their measure and conclude that the results are almost unchanged.

[5] Falato et al. (2020) use a similar measure of intangible capital, which includes an extra component: Informational capital. However, the authors find that the results are little changed when this component is excluded. Furthermore, the relationship between intangible capital's measure in Falato et al. (2020) and the measure used in Peters and Taylor (2017) is 0.98.

Predicting the nature of the relationship between intangible assets and leverage is not straightforward. Evidence provided by the literature on the relationship between intangible assets and leverage is ambiguous. Earlier work on the topic argues that intangible assets are negatively correlated with leverage. However, recent work has been showing that intangible assets might have a role in alleviating financing frictions and report a significant increase in the use of intangibles as loan collateral. One of the main goals of this dissertation is to analyze the nature and significance of the relationship between these two variables. The remaining of this subsection will briefly describe the method used to estimate the two components of internally generated intangible capital: Knowledge Capital and Organization Capital.

Knowledge Capital

The knowledge capital, also known as intellectual capital, is a type of intangible capital made up of knowledge, relationships, learned techniques, and procedures. The stock of a firm's knowledge capital is estimated by accumulating R&D expenditures using a standard perpetual inventory method:

$$G_{i,t} = (1 - \delta_{R\&D})G_{i,t-1} + R\&D_t\,,$$

where $G_{i,t}$ is the end-of-period stock of knowledge capital, $\delta_{R\&D}$ is the depreciation rate, and $R\&D_{i,t}$ is the real expenditures on R&D during the year. The depreciation rate, $\delta_{R\&D}$, is going to be assumed as 15% (Falato et al. 2020)[6]. Annual R&D expenditures is measured using the Compustat variable *xrd*. Following the literature, R&D is set to zero when missing (see more details in Peters and Taylor (2017)).

The major challenge in applying the perpetual inventory method is to find the stock of knowledge capital of the first Compustat record, $G_{i,o}$, which is estimated using data on firm i's founding year, R&D spending on firm i's first Compustat record, and average pre-IPO R&D growth rates[7]. The major assumption of this measure is that pre-IPO R&D grows at the average rate across pre-IPO Compustat records. Furthermore, it is assumed that firms are founded with no capital. The period of analysis only starts in 1980. However, this dissertation requires Compustat data from 1955, the first year of Compustat, to compute the stock of capital.

[6] Peters and Taylor (2017) use BEA'S industry-specific R&D depreciation rates. However, the authors conclude that their results would be virtually unchanged when they set $\delta_{R\&D}$ to 10%, 15%, or 20% for all industries. Falato et al. (2020) also assumes $\delta_{R\&D} = 15\%$.

[7] For additional details see Appendix B of Peters and Taylor (2017).

Organization Capital

According to Evenson and Westphal (1995, p. 2237), organization capital is the knowledge that combines human resources with physical capital into systems that produce and deliver higher-value products. Examples of organization capital are a firm's culture, business practices, and incentive and compensation systems.

Following Peters and Taylor (2017), organization capital is measured by accumulating a stock of past SG&A spending using the perpetual inventory method. The rationale behind this measure is that at least part of SG&A represents firms' investment in organization capital through spending on personnel training, payments to strategy consultants, and marketing technologies. For this research, it is assumed that only 30% of SG&A spending constitutes investment in organization capital (Hulten and Hao 2008; Eisfeldt and Papanikolaou 2014; Zhang 2013). Furthermore, the depreciation rate is assumed at 20% (Lev and Radhakrishnan 2005; Eisfeldt and Papanikolaou 2013; Falato et al. 2020).

Additional actions must be taken when measuring SG&A from Compustat data. Despite almost all firms reporting SG&A and R&D separately. Compustat almost always adds SG&A and R&D together in the item *xsga* (labeled as "Selling, General and Administrative Expense"). As a result, it is mandatory to subtract *xrd* from *xsga* to isolate the SG&A that companies report[8]. Furthermore, when a firm purchases external R&D on products that have not been sold yet, this R&D is expensed as in-process R&D is not reported on the firm's balance sheet. Compustat adds to *xsga* only the part of R&D that does not represent the in-process R&D. As a result, to compute the organization capital, one must include the Compustat's item *rdip* (in-process R&D Expense), which Compustat codes as negative. Thus, following Peters and Taylor (2017) SG&A is measured as Compustat variable *xsga* minus *xrd* minus *rdip*.

The method to estimate the initial stock of organization capital is similar to the method used for knowledge capital[9].

[8] For additional details, see Appendix B of Peters and Taylor (2017).
[9] For additional details, see Appendix B of Peters and Taylor (2017).

3.3. Determinants of Capital Structure

3.3.1. Tangible Assets

Tangible assets are also a variable of interest in the current research. The importance of this variable as a determinant of the corporate asset structure is well established in the literature (Frank and Goyal 2009; Campello and Giambona 2013). Thus, this dissertation will include the variable Tangible Assets, defined as Net Property, Plant, and Equipment (Compustat item *ppent*) (Leary and Roberts 2010) divided by book assets, in the empirical estimations.

Tangible assets typically preserve better the value in case of default than intangible assets, hence increasing creditors' recovery rate - reducing the expected costs of financial distress. In addition, asset tangibility makes it more difficult for shareholders to substitute high-risk assets for low-risk assets- reducing agency costs associated with debt. In sum, firms with a higher proportion of tangible assets have lower expected costs of financial distress and fewer agency problems related to debt. Using this rationale, Frank and Goyal (2008), using the static Trade-off Theory and Agency Theory, predict a positive relationship between asset tangibility and financial leverage. However, the Pecking Order Theory makes opposite predictions (Harris and Raviv 1991). Tangible assets are associated with lower information asymmetry, and, as a result, equity issuances are less costly. Thus, asset tangibility should be negatively related to financial leverage. Frank and Goyal (2008) argue that this ambiguity comes from the fact that asset tangibility can be viewed as a proxy for different economic forces.

Despite the theoretical ambiguity, literature provides evidence that firms with more tangible assets tend to issue more debt (Rampini and Viswanathan 2013). Thus, it is expected that the variable Tangible Assets enters the leverage regression with a positive coefficient.

3.3.2. Control Variables

Literature on corporate leverage reports several factors which are claimed to have some influence on corporate capital structure decisions. To answer the research question, the model of leverage is going to be controlled by a list of these previously claimed determinants of financial leverage[10]. The list of control variables includes the following, variables: Size, Profitability, Growth Opportunities, and Earnings Volatility.

[10] The literature followed in the variable selection process includes Titman and Wessels (1988), Rajan and Zingales (1995), Frank and Goyal (2003), Korajczyk and Levy (2003), Frank and Goyal (2009), Flannery and Rangan (2006) and Lemmon, Roberts, and Zender (2008).

Firm Size (Size):

Several authors have suggested that firm size might be an important driver of the leverage ratio (Frank and Goyal 2009). Thus, capital structure studies often control for the effect of firm size (Giambona and Schwienbacher 2008; Campello and Giambona 2013).

Following the literature, the current dissertation is going to include a variable Size, measured as the natural logarithm of the market value of total assets (adjusted by the Producer Price Index (PPI) of 2020), in the model.

The literature offers evidence suggesting that direct bankruptcy costs represent a higher proportion of a firm's value as that value decreases (Warner 1977; Ang, Chua, and Mcconnell 1982). Furthermore, size is related to the cost of issuing debt and equity. More precisely, Smith (1977) finds evidence that suggests that small firms pay much more to issue long-term debt. Also, larger firms tend to be more diversified and have more stable cash flows. Rajan and Zingales (1995) argue that size could be an inverse proxy for the probability of bankruptcy.

Cross-sectionally, it has been consistently found that, in the U.S., large firms tend to have higher leverage ratios than small firms (Kurshev and Strebulaev 2015). Thus, the variable Size is expected to be positively correlated to leverage.

Profitability (Profitability):

Studies on the relationship between capital structure and asset structure often control for the effect of firms' profit on leverage (Mann 2018; Falato et al. 2020; Lim, Macias, and Moeller 2020). In this thesis, a variable Profitability is going to be included in the model. This variable is determined by the ratio of income before interest, taxes, depreciation, and amortization to the book value of total assets.

The expectation regarding the relationship between a firm's profitability and leverage is ambiguous. As Flannery and Rangan (2006, p.476) claim, "A firm with higher earnings per asset dollar could prefer to operate with either lower or higher leverage ."

On the one hand, profitable firms face lower expected costs of financial distress and can benefit more from interest tax shield. As a result, from the perspective of tax and bankruptcy costs, profitable firms have more debt. Moreover, from the agency costs perspective, profitable firms will also issue more debt (Jensen 1986).

On the other hand, Myers (1993) states, “The most telling evidence against the static Trade-off Theory is the strong inverse correlation between profitability and leverage.” In a dynamic Trade-off model, leverage and profitability can seem to be negatively related in the data due to the various frictions. One plausible reason for a negative relationship between profitability and leverage is if firms with market power prefer to keep their leverage at low levels to prevent the entrance of new players in their line of business (see, for example, Bolton and Scharfstein 1990).

Growth Opportunities (Growth):

A number of models of corporate leverage control for the effect of firms' growth opportunities in leverage (Loumioti 2012a; Giambona and Schwienbacher 2008; Campello and Giambona 2013). This dissertation determines firms' growth (Growth) as the ratio of the market value of total assets to the book value of total assets.

Firms with higher growth opportunities might have less debt to avoid greater agency problems that can result in underinvestment, which affects both the firm value and the shareholders' wealth (Myers 1977). Moreover, Agency Theory predicts that firms with higher growth opportunities should have less debt. The existence of debt creates the need for more discipline, which can be harmful to firms that are expected to make more profitable investments (Frank and Goyal 2003). Furthermore, according to Titman and Wessels (1988), growth opportunities are capitalized assets that add value to the firm, but that cannot be collateralized and do not generate taxable income, and for these reasons, there should be a negative relationship between debt and growth opportunities. Thus, the variable Growth is expected to enter the regression with a negative sign.

Earnings Volatility (Earnings Volatility):

Several models of corporate leverage include a variable related to earnings volatility (Giambona and Schwienbacher 2008; Campello and Giambona 2013). In this dissertation, the variable Earnings Volatility, measured as the ratio of the standard deviation of income before interest, taxes, depreciation, and amortization to total book assets, computed from four-year windows of consecutive firm observations, is going to be included to control for the effect of earnings volatility on leverage.

Cash flow volatility may increase the expected cost of financial distress. Thus, the Trade-off Theory predicts that firms with higher cash flow volatility issue less debt. Additionally, cash flow volatility reduces the probability that the benefits from tax shields are fully explored. Therefore, Earnings Volatility is expected to enter the model with a negative coefficient.

The following Table 1 summarizes the expected effect of the control variables of the model according to the literature. An overview of the definitions of all the variables can be found in Appendix 1.

Table 1: Overview of Explanatory Variables

Variable	Expected Effect on Leverage
Tangible Assets	+
Firm Size	+
Profitability	+/-
Growth Opportunities	-
Earnings Volatility	-

3.4. Methodology

In this section it is going to be presented the methodology used in this dissertation. This dissertation aims to answer two main questions:

- Do Intangible Assets influence corporate financing decisions? If yes, what is the nature of that influence?

- How does the relationship between Intangible Assets and Leverage change across the different stages of the business cycle? How does the relationship between Tangible Assets and Leverage change across the different stages of the business cycle?

In order to answer these questions, the following panel leverage regression model is going to be used:

$$Leverage_{i,t} = \alpha + \beta \begin{matrix} Tangible \\ Assets \end{matrix}_{i,t} + \omega \begin{matrix} Intangible \\ Assets \end{matrix}_{i,t} + \gamma X_{i,t} + \sum_i Firm_i + \sum_t Year_t + \varepsilon_{i,t},$$

where the index *i* denotes a firm, t denotes a year, α is a constant, X is a matrix containing the control variables just described (size, profitability, etc.). Firm and Year absorb firm- and time specific effects, respectively. Despite the dependent variable being truncated at zero, with

12.04% of firms in the sample of analysis having no leverage, the model applied uses an Ordinary Least Squares (OLS) regression without deleting observations with zero leverage.[11]

Intangible Assets and Leverage

The literature provides several reasons why intangible assets could have no relationship or even a negative relationship with financial leverage[12]. Firstly, intangible assets have a low collateral value (low redeployability, higher valuation risk, and higher information asymmetry). Secondly, traditionally lenders find intangible assets riskier than tangible assets, which is related to the first point. Thirdly, when firms have enough tangible assets, they will not need to use intangible assets to support debt.

Yet, in recent years an increasing number of intangible assets started to be used as loan collateral (Loumioti 2012a). Furthermore, Larkin (2013) demonstrates that a positive consumer attitude towards a firm's products alleviates financing frictions and provides additional net debt capacity. She argues that brand perception affects financing policy by reducing overall firm riskiness. Good consumer valuations translate into lower future cash flow volatility and higher credit ratings for potentially volatile firms. Furthermore, Lim, Macias, and Moeller (2020) point to another reason why intangible assets should support debt. The authors argue that intangible assets reliably generate cash flows that can support debt and, as so, should lead to lower interest rates and, all else equal, higher levels of debt.

As previously described, expectations towards the nature of the relationship between intangible assets and leverage are ambiguous. Thus, this dissertation aims to examine whether intangible assets have a role in firms' financing decision process or not. And if, indeed, intangible assets have a role in the decision process what the nature of that role is.

Hypothesis: Does the coefficient of the variable Intangible Assets is significantly different from zero? What is the sign of the coefficient of the variable Intangible Assets?

Significance of Tangible and Intangible Assets across the Business Cycle

Jiménez, Salas, and Saurina (2006) show that macroeconomic conditions, such as the business cycle, have an important role in determining the terms of a credit contract. According to

[11] Following (Lim, Macias, and Moeller 2020).
[12] For more details, see Section 2.

Azariadis (2018), unsecured firm credit moves cyclically, while secured credit moves countercyclically. In other words, secured credit increases during recessions. This conclusion might be an indication of the importance of collateral during recessions.

Recent studies show that the use of intangible assets in the form of loan collateral is increasing. However, this practice is still widely associated with high-risk credit. As a result, during periods of contraction, financing frictions increase, and creditors might be less willing to accept intangible assets as loan collateral. Regarding the tangible assets, it is expected the opposite. As creditors increase collateral demands, tangible assets will be even more important in determining debt capacity and leverage during periods of contraction.

Hypothesis: During periods of expansion (contraction), it is easier (more difficult) for firms to use intangible assets as loan collateral. In the same business cycle, during the expansion period, the coefficient of Tangible Assets (Intangible Assets) is going to be higher (lower) than during recessions.

4. Sample Selection and Descriptive Statistics

4.1. Sample Selection

This research is based on a sample of active and inactive firms from Compustat with main operations in the US. Following the literature, the raw sample includes all firms except regulated utilities (SIC codes 4900-4999), financial firms (6000-6900), and firms categorized as public service, international affairs, or non-operating establishments (9000+). This selection rule aims to avoid capital structures driven by heavy regulation (Leary and Roberts 2010; Campello and Giambona 2013; Peters and Taylor 2017).

Furthermore, observations, where firms' net sales or total assets are less than $1M, were excluded. This selection rule eliminates very small firms from the sample, usually more vulnerable to capital market imperfections (Gertler and Gilchrist 1994). Furthermore, observations where firms experience an increase in size of more than 100% were also dropped from the sample. These large jumps in size are typically indicative of mergers, reorganizations, and other major corporate events. After applying all the selection rules, the final sample amounts to 14,666 firms.

The period of analysis includes the years between 1980 and 2021, although earlier data is used to estimate firms' intangible capital. The sample starts in 1980 because it was around this year that the Digital Revolution began, and intangible assets started to fill more space in corporate balance sheets.

Business Cycles

As described in Section 1, the period of analysis is going to be divided into smaller periods according to the Business Cycle Dating Procedure of National Bureau of Economic Research (NBER). According to this procedure, business cycles are dated according to the peaks and troughs of the economic activity.

Business cycle is the term used to describe the fluctuations in aggregate economic activities over time. A single business cycle is composed of 4 stages: expansion, peak, contraction (recession), and trough. However, for the purpose of this dissertation, the period of analysis is going to be discriminated only by two of the stages: Expansion periods and Contraction periods.

Table 2 describes the contraction and expansion periods considered according to NBER. As it can be observed in Table 2, the economy tends to experience longer periods of expansion than periods of contraction.

Table 2: Business Cycles: Contraction and Expansion Periods (1980-2021)

This table contains all the contraction periods and expansion periods that occurred between 1980-202, according to the NBER Business Cycle Dating Procedure.

Contraction Periods	Expansion Periods
1980 - 1982[13]	1983-1989
1990 - 1991	1992-2000
2001	2002-2006
2007-2009	2010-2019
2020	2021

[13] NBER considers the 1980-1982 recession as two separate recessions (one lasting for the first half of 1980 and the other form July 1981 to November 1981). However, for the purposes of the current dissertation these two recessions are going to be analyzed in the same period.

4.2. Descriptive Statistics

In this section, is going to be presented the descriptive statistics of all the variables of the empirical estimations for the entire period of analysis, 1980-2021, and separately for the subsamples of contraction and expansion periods.

Descriptive Statistics (1980-2021)

Table 3 presents the summary statistics of the variables used in the model for the period of analysis. The sampling and variable construction used in this dissertation are very similar to those used in capital structure studies. However, the period of analysis of this dissertation is more extensive than most other studies.

In the sample used in this study, it is found an average Market Leverage of 0.213 and an average Book Leverage of 0.287. These values are not very far from the values of studies of capital structure decisions[14].

Furthermore, by looking at the two main variables of interest of the current study, one can highlight that the sample used has an average proportion of tangible assets of 0.290, whereas the average proportion of intangibles assets is about 0.715. This means that, in the sample used, on average, firms invest more in intangible assets than in tangible assets. This value is higher relative to the average proportion of intangible assets in similar studies. Recent studies estimate that the contribution of intangible capital to overall corporate capital stocks to be around one-half (Eisfeldt and Papanikolaou 2014; Belo et al. 2019).

Moreover, regarding the standard deviation, Intangible Assets present a higher standard deviation than Tangible Assets, 0.234 and 1.105, respectively[15]. The standard deviation measures how dispersed the data is relative to the mean. The higher standard deviation of Intangible Assets indicates the higher dispersion of this variable in the dataset used. This is consistent with the fact that intangible assets have been on rapid growth in the past decades. Nakamura (2003) reports that intangible assets as a proportion of U.S. GDP more than doubled

[14] Campello and Giambona (2013), for example, report average market and book leverage, respectively, 0.202 and 0.256.

[15] Lim, Macias, and Moeller (2020) report a standard deviation of 0.435 and 1.322 for the Proportion of Tangible Assets and Proportion of Intangible Assets (using the P&T measure), respectively. However, their sample consists of 469 non-financial U.S. public firms that were acquired by U.S. acquires between 2002 and 2014.

in the last 40 years, increasing from 4.40 percent to 10.00 percent. Furthermore, the literature provides evidence of the dispersion of investment in intangible assets across industries which also contributes to the higher standard deviation of this variable[16].

Table 3: Summary Statistics (1980-2021)

This table reports the summary statistics for the main variables in the thesis' empirical estimation. All the data is firm-level data over the sample period 1980-2021. The sample includes all firms except regulated utilities, financial firms, and firms categorized as public service, international affairs, or non-operating establishments. Variable definitions are described in Appendix 1.

Period: 1980 - 2021								
	Mean	Median	Std. Dev.	p25	p75	Max	Min	Obs.
Market Leverage	.213	.156	0.209	.032	.334	.996	0	151655
Book Leverage	.287	.226	0.470	.059	.397	56.345	0	151655
Tangible Assets	.290	.226	0.234	.102	.420	1	0	151655
Intangible Assets	.715	.507	1.105	.243	.837	87.395	0	151655
Size	6.028	5.965	2.273	4.345	7.606	14.791	-3.081	151655
Profitability	.058	.109	0.285	.034	.169	4.156	-12.615	151655
Growth	1.883	1.349	2.310	1.011	2.032	341.382	.012	151655
Earnings Volatility	.084	.042	0.193	.023	.081	13.042	0	151655

Moreover, to further characterize the data before estimating the model, Table 4 presents the pairwise correlation between the different variables present in the regression. Regarding Tangible Assets, this variable has a weak positive correlation with both measures of Leverage.

Furthermore, the variable Intangible Assets has a negative correlation with Market Leverage but a positive correlation with Book Leverage. However, both Market and Book Leverage have little correlation with Intangible Assets. Finally, regarding the correlation between Tangible Assets and Intangible Assets, these two variables have a negative correlation.

[16] According to Lim, Macias, and Moeller (2020), the Healthcare Industry reports an average investment in intangible assets as a percentage of a firm's purchase price of 40.50 percent, while the Utilities Industry reports an average investment in intangible assets as a percentage of firm's purchase price of, only, 1 percent.

Table 4: Correlation Matrix (1980-2021)

This table contains the correlations between the main variables in the thesis' empirical estimations. Variable definitions are described in Appendix 1.

Period: 1980-2021								
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Market Leverage	1.000							
(2) Book Leverage	0.510	1.000						
(3) Tangible Assets	0.315	0.125	1.000					
(4) Intangible Assets	-0.139	0.115	-0.271	1.000				
(5) Size	-0.030	0.007	0.122	-0.212	1.000			
(6) Profitability	0.023	-0.209	0.147	-0.496	0.254	1.000		
(7) Growth	-0.238	0.216	-0.132	0.257	0.094	-0.254	1.000	
(8) Earnings Volatility	-0.051	0.173	-0.075	0.525	-0.237	-0.498	0.226	1.000

Descriptive Statics by Business Cycle Stage

What differentiates this work from related literature is its discrimination between contraction and expansion periods. Thus, it is important to look at the summary statistics of the variables for the different subsamples. Table 5 presents the summary statistics of the variables used for each subsample. Starting with the dependent variables of the model, the average of the variable Book Leverage is higher during the contraction periods than during the expansion periods of the same business cycle; this is true in all business cycles[17]. It is not possible to find a pattern regarding Market Leverage.

Turning to the independent variables of the model, the average of Tangible Assets is relatively higher in contraction periods when compared with the expansion period that comes afterward. This can be related to the impact of macroeconomic conditions on corporate investment decisions.

Regarding Intangible Assets it is not possible to find a pattern, as expected due to the substantial increase of this type of asset during the period of analysis. For the first two business cycles, the

[17] This is consistent with the models of Hackbarth, Miao, and Morellec (2006) and Levy and Hennessy (2007) presented in Section 2.

average proportion of intangible assets was lower in the contraction period than in the proceeding expansion period. For example, for the contraction period 1990-1991, the average proportion of intangible assets is 0.587, on the subsequent expansion periods, the average proportion of intangible assets is 0.649.

For the last three contractions, one can observe the opposite, i.e., the average proportion of intangible assets is higher during the contraction period than during the proceeding expansion period. This might indicate that firms tend to invest more in intangible assets during periods of contraction. However, Malik, Ali, and Khalid (2014) find that investment in intangible capital is pro-cyclical. Furthermore, it is important to highlight the substantial increase in the average proportion of intangible assets in the earlier period compared with the later period, from 0.435 and 0.640, respectively. Lastly, the average proportion of intangible assets registers its maximum in the contraction period of 2001.

Table 5: Summary Statistics by Business Cycle Stage

This table reports the summary statistics for the main variables in the thesis' empirical estimation. All the data is firm-level data. Variable definitions are described in Appendix 1. The period of analysis is divided by business cycle and business cycle stage according to the NBER Business Cycle Dating Procedure. **Panel A** shows the descriptive statistics for the Contraction Period: 1980-1982: and the Expansion Period: 1983-1989; **Panel B** shows the descriptive statistics for the Contraction Period: 1990-1991; and the Expansion Period:1992-2000; **Panel C** shows the descriptive statistics for the Contraction Period: 2001; and the Expansion Period:2002-2006; **Panel D** shows the descriptive statistics for the Contraction Period: 2007-2009; and the Expansion Period: 2010-2019; **Panel E** shows the descriptive statistics for the Contraction Period: 2020; and the Expansion Period: 2021.

Panel A: Contraction 1980 - 1982 & Expansion: 1983 - 1989						
Variables	**Contraction: 1980-1982**			**Expansion: 1983-1989**		
	Mean	St. Dev.	Obs.	Mean	St. Dev.	Obs.
Market Leverage	0.287	0.213	10936	0.256	0.211	25536
Book Leverage	0.289	0.250	10936	0.302	0.318	25536
Tangible Assets	0.364	0.219	10936	0.344	0.225	25536
Intangible Assets	0.435	0.827	10936	0.482	0.762	25536
Size	5.127	2.084	10936	5.367	2.112	25536
Profitability	0.130	0.134	10936	0.094	0.185	25536
Growth	1.253	0.961	10936	1.480	1.172	25536
Earnings Volatility	0.058	0.083	10936	0.076	0.126	25536

(Continued on the next pages)

(Continued)

Panel B: Contraction 1990 - 1991 & Expansion: 1992 - 2000

Variables	Contraction: 1990-1991			Expansion: 1992-2000		
	Mean	St. Dev.	Obs.	Mean	St. Dev.	Obs.
Market Leverage	0.268	0.231	7696	0.209	0.207	40493
Book Leverage	0.316	0.455	7696	0.276	0.367	40493
Tangible Assets	0.330	0.231	7696	0.300	0.230	40493
Intangible Assets	0.587	0.745	7696	0.649	0.887	40493
Size	5.347	2.237	7696	5.832	2.159	40493
Profitability	0.090	0.185	7696	0.064	0.270	40493
Growth	1.574	1.578	7696	1.965	2.263	40493
Earnings Volatility	0.077	0.127	7696	0.083	0.165	40493

Panel C: Contraction: 2001 & Expansion: 2002 - 2006

Variables	Contraction: 2001			Expansion: 2002-2006		
	Mean	St. Dev.	Obs.	Mean	St. Dev.	Obs.
Market Leverage	0.206	0.221	4655	0.173	0.202	20406
Book Leverage	0.281	0.476	4655	0.259	0.392	20406
Tangible Assets	0.267	0.227	4655	0.244	0.225	20406
Intangible Assets	0.850	1.226	4655	0.901	1.309	20406
Size	5.993	2.190	4655	6.324	2.160	20406
Profitability	-0.019	0.435	4655	0.036	0.304	20406
Growth	1.914	1.904	4655	2.066	2.084	20406
Earnings Volatility	0.124	0.287	4655	0.105	0.290	20406

Panel D: Contraction: 2007 - 2009 & Expansion: 2010 - 2019

Variables	Contraction: 2007-2009			Expansion: 2010- 2019		
	Mean	St. Dev.	Obs.	Mean	St. Dev.	Obs.
Market Leverage	0.186	0.208	10356	0.180	0.193	28635
Book Leverage	0.274	0.729	10356	0.298	0.665	28635
Tangible Assets	0.242	0.233	10356	0.248	0.242	28635
Intangible Assets	0.934	1.465	10356	0.917	1.391	28635
Size	6.429	2.203	10356	6.923	2.309	28635
Profitability	0.022	0.369	10356	0.026	0.345	28635
Growth	1.876	2.314	10356	2.214	3.156	28635
Earnings Volatility	0.086	0.217	10356	0.081	0.209	28635

Panel E: Contraction: 2020 & Expansion: 2021

Variables	Contraction: 2020			Expansion: 2021		
	Mean	St. Dev.	Obs.	Mean	St. Dev.	Obs.
Market Leverage	0.205	0.191	2567	0.164	0.158	375
Book Leverage	0.362	0.551	2567	0.282	0.225	375
Tangible Assets	0.253	0.233	2567	0.225	0.194	375
Intangible Assets	0.802	0.926	2567	0.640	0.482	375
Size	7.453	2.355	2567	7.611	2.501	375
Profitability	-0.010	0.300	2567	0.085	0.162	375
Growth	2.915	5.349	2567	2.580	2.247	375
Earnings Volatility	0.077	0.167	2567	0.049	0.076	375

5. Empirical Analysis and Results

This section presents the main results of this study. As described in the previous sections, this study addresses two questions. Therefore, this section is going to be structured as follows: Firstly, it is going to be analyzed the standard leverage regression for the entire period of analysis (1980-2021), which will allow the comparison of this model with other standard leverage models in the literature. Secondly, it is going to be examined the same standard leverage regression across the contraction and expansion stages of each business cycle that occurred in the period of analysis. There are five business cycles in the period of analysis, which imply five contraction periods and five expansion periods. Furthermore, for each expansion/contraction period, two regressions will be performed, one for Market Leverage and one for Book Leverage. Therefore, for the second part of this section, twenty regressions will be performed.

Standard Leverage Regression (1980-2021)

Aiming to fulfill the first goal of this dissertation, the standard leverage regression is going to be estimated two times, one for Market Leverage and one for Book Leverage, for the period between 1980-2021. The estimations also include year dummies. The results are reported in Table 6.

It is important to start by noting that Tangible Assets and Intangible Assets enter both regressions with a positive, highly significant coefficient. This means that one can state with at least 95 percent confidence that the coefficient of the variable Intangible Assets is different from zero in the Book Leverage and Market Leverage regressions. With this, the first research question is answered. The positive relationship between intangible assets and leverage is consistent with the most recent literature that argues that intangible assets have a role in alleviating financing frictions. This result is consistent with the argument that intangible assets as any other type of asset should enhance the firms' access to external debt.

Turning to the control variables, all these variables attract the expected sign. Size enters the regressions with the expected positive sign (consistent with, Kurshev and Strebulaev 2015) , although not statistically significant. Profitability has a significant negative coefficient (consistent with Titman and Wessels 1988; Frank and Goyal 2003; Flannery and Rangan 2006).

Furthermore, the variable Growth enters the Market Leverage regression with a statistically significant negative sign which is consistent with the argument that firms with higher growth opportunities use less debt to avoid underinvestment (Myers 1977; Hart 1996). However, the variable Growth enters the Book Leverage regression with a positive sign, although not statistically significant. The positive sign in the variable Growth is consistent with the Pecking Order Theory, which predicts that firms with more investments – keeping profitability fixed- should accumulate more debt over time. Lastly, the coefficient on Earnings Volatility obtains the expected negative sign (Giambona and Schwienbacher 2008; Campello and Giambona 2013).

Table 6: Standard Leverage Regression (1980-2021)

This table presents the regression results for the OLS estimation with firm-fixed effects of the model presented in Section 3.4. for the sample period 1980-2021. Estimations also include year dummies. Refer to Appendix 1 for detailed variable definitions. The sample includes all firms except regulated utilities, financial firms, and firms categorized as public service, international affairs, or non-operating establishments. Standard errors reported in parentheses are based on heteroskedastic consistent errors for clustering across observations of a given firm.

Period: 1980- 2021		
Variables	Market Leverage	Book Leverage
Tangible Assets	0.182***	0.193***
	(0.0106)	(0.0296)
Intangible Assets	0.00347**	0.0393***
	(0.00142)	(0.0119)
Size	0.000554	0.0200**
	(0.00161)	(0.00846)
Profitability	-0.0765***	-0.234***
	(0.00419)	(0.0419)
Growth	-0.0137***	0.0167
	(0.00108)	(0.0111)
Earnings Volatility	-0.0123**	0.159***
	(0.00545)	(0.0421)
Constant	0.199***	0.0439
	(0.00922)	(0.0305)
Observations	151,655	151,655
R-squared	0.088	0.085
Number of Firms	14,666	14,666

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Standard Leverage Regression by Business Cycle Stage

After analyzing the results of the standard leverage regression for the entire dataset, it is time to move to the next step, which consists of analyzing the same regression in different stages of business cycles. Table 7 reports the results of the regressions for each stage of the different business cycles. The analysis will be focused on the two main explanatory variables: Tangible Assets and Intangible Assets.

Regarding the variable Tangible Assets, one can easily find a pattern. This variable enters all the twenty regressions with a positive coefficient. Furthermore, the coefficient of this variable is statistically significant with at least 95 percent of confidence for all the regressions, except for the Book Leverage regression of the expansion period between 1983-1989. Additionally, it is important to note that the coefficient for this variable during periods of contraction is higher than during periods of expansion. This is true for all the regressions except for the Market Leverage regression of the recession period 2007-2009. This may be evidence that tangible assets as loan collateral may be more important during contraction periods than in expansion periods. These results are consistent with the argument that Tangible Assets are an even more important determinant of leverage during credit tightening periods. It is not possible to identify a trend for the coefficient of Tangible Assets across time.

Regarding the Intangible Assets it is not possible to find a clear pattern in the different business cycles, so each period is going to be analyzed separately. To begin with, in the first business cycle (1980-1989), the variable Intangible Assets obtains a significant coefficient in just one of the regressions, the Market Leverage regression for the recession period (1980-1982), and this coefficient is negative. The negative coefficient of the variable Intangible Assets during this business cycle can be justified by the lack of valuation methods for intangible assets along with the poor legislation protecting creditors in the case of the use of intangibles as loan collateral at that time.

Furthermore, the second business cycle between 1990 and 2000 follows a similar pattern to the previous business cycle. However, in this business cycle there is one statistically significant negative coefficient for Intangible Assets in the Market Leverage regression for the expansion period.

Finally, the last three business cycles follow a similar pattern for the coefficient of Intangible Assets. In most cases, the coefficient of the variable Intangible Assets is higher during the expansion periods than during the contraction periods. However, in half of the cases, the coefficient obtained for this variable is not statistically significant. In some contraction periods, very few (e.g., 2007-2009), the coefficient of Intangible Assets takes a negative value. This does not happen in any expansion period of these three business cycles. This is consistent with the argument that creditors are more willing to accept intangible assets as loan collateral during expansion periods when there is more credit supply than during recession periods. However, not all the coefficients are statistically significant. Furthermore, it is important to consider the temporal distance between the different periods that are being analyzed.

It was empirically found that the use of intangible assets as loan collateral increased significantly in the past few decades. Loumioti (2012) points out several justifications for this new credit market trend. Firstly, intangible capital has a higher market liquidity and there are more sophisticated methods of valuing intangible assets than before. Secondly, there were some structural changes in the syndicated loan market that contributed to the use of intangible assets as loan collateral.

Table 7: Standard Leverage Regression by Business Cycle

This table presents the regression results for the OLS with firm-fixed effects of the model presented in Section 3.4. for the different business cycle stages. Estimations also include year dummies. Refer to Appendix 1 for detailed variable definitions. Standard errors reported in parentheses are based on heteroskedastic consistent errors for clustering across observations of a given firm. Firm- and year- fixed effects are not included when the period is too short (1990-1991; 2001; 2020; 2021). **Panel A** shows the regression results for the Contraction Period: 1980-1982: and the Expansion Period: 1983-1989; **Panel B** shows the regression results for the Contraction Period: 1990-1991; and the Expansion Period:1992-2000; **Panel C** shows the regression results for the Contraction Period: 2001; and the Expansion Period:2002-2006; **Panel** shows the regression results for the Contraction Period: 2007-2009; and the Expansion Period: 2010-2019; **Panel E** shows the regression results for the Contraction Period: 2020; and the Expansion Period: 2021.

Panel A: Business Cycle: 1980 - 1989				
Variables	**Market Leverage**		**Book Leverage**	
	1980-1982	1983-1989	1980-1982	1983-1989
Tangible Assets	0.303***	0.158***	0.255***	0.0237
	(0.0325)	(0.0250)	(0.0542)	(0.144)
Intangible Assets	-0.0173*	-0.00101	0.00257	-0.0169
	(0.00997)	(0.00221)	(0.00434)	(0.0159)
Size	-0.0170**	0.0184***	0.0368***	0.0331
	(0.00796)	(0.00537)	(0.0110)	(0.0225)
Profitability	-0.167***	-0.134***	-0.253***	-0.171***
	(0.0235)	(0.0151)	(0.0522)	(0.0629)
Growth	-0.0411***	-0.0342***	0.00111	0.0343
	(0.00540)	(0.00494)	(0.0104)	(0.0268)
Earnings Volatility	0.0249	0.00855	0.423***	0.491***
	(0.0471)	(0.0302)	(0.110)	(0.137)
Constant	0.353***	0.136***	0.0190	0.0106
	(0.0397)	(0.0263)	(0.0576)	(0.115)
Observations	10,936	25,536	10,936	25,536
R-squared	0.173	0.112	0.131	0.102
Number of Firms	4,104	5,804	4,104	5,804

(Continued on the next page)

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

(Continued)

Panel B: Business Cycle: 1990 - 2000

Variables	Market Leverage		Book Leverage	
	1990-1991[(A)]	1992-2000	1990-1991[(A)]	1992-2000
Tangible Assets	0.205***	0.163***	0.296***	0.208***
	(0.0134)	(0.0159)	(0.0606)	(0.0435)
Intangible Assets	-0.00682	-0.00782**	-0.00120	0.0145
	(0.00665)	(0.00305)	(0.0201)	(0.0103)
Size	0.000470	-0.00956***	0.00322	0.0272***
	(0.00139)	(0.00335)	(0.00641)	(0.00640)
Profitability	-0.161***	-0.0749***	-0.306***	-0.125***
	(0.0167)	(0.00748)	(0.0707)	(0.0325)
Growth	-0.0408***	-0.00862***	0.0393	0.00317
	(0.00558)	(0.00189)	(0.0457)	(0.00360)
Earnings Volatility	0.0257	-0.0335**	0.187	0.253***
	(0.0345)	(0.0157)	(0.114)	(0.0706)
Constant	0.278***	0.243***	0.153***	0.0228
	(0.0107)	(0.0179)	(0.0378)	(0.0367)
Observations	7,696	40,493	7,696	40,493
R-squared	0.136	0.091	0.207	0.077
Number of Firms	4,126	7,769	4,126	7,769

Panel C: Business Cycle: 2001 - 2006

Variables	Market Leverage		Book Leverage	
	2001[(A)]	2002-2006	2001[(A)]	2002-2006
Tangible Assets	0.288***	0.154***	0.374***	0.254***
	(0.0151)	(0.0249)	(0.0338)	(0.0659)
Intangible Assets	-0.00654	0.00138	-0.0795	0.0555***
	(0.00621)	(0.00239)	(0.0660)	(0.0174)
Size	0.00288*	-0.00545	0.0168**	0.00104
	(0.00154)	(0.00403)	(0.00816)	(0.0213)
Profitability	-0.0160	-0.0463***	-0.312	-0.165***
	(0.0202)	(0.00727)	(0.231)	(0.0475)
Growth	-0.0277***	-0.0111***	0.0247**	0.0315*
	(0.00263)	(0.00131)	(0.0105)	(0.0173)
Earnings Volatility	0.0100	-0.0169**	0.411**	0.00293
	(0.0227)	(0.00738)	(0.207)	(0.0368)
Constant	0.169***	0.217***	0.0432	0.0938
	(0.0106)	(0.0252)	(0.0356)	(0.103)
Observations	4,655	20,406	4,655	20,406
R-squared	0.166	0.087	0.198	0.107
Number of Firms	4,655	5,319	4,655	5,319

(Continued on the next page)

[(A)] These recessions are not controlled for year and firm fixed effect due to the short extension of the period.

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

(Continued)

Panel D: Business Cycle: 2007 - 2019

Variables	Market Leverage		Book Leverage	
	2007-2009	2010-2019	2007-2009	2010-2019
Tangible Assets	0.183***	0.229***	0.372**	0.313***
	(0.0477)	(0.0231)	(0.147)	(0.0688)
Intangible Assets	-0.00549**	0.00155	0.0424	0.0359*
	(0.00273)	(0.00198)	(0.0284)	(0.0207)
Size	-0.0201***	-0.00392	0.0309	-0.00642
	(0.00776)	(0.00345)	(0.0249)	(0.0226)
Profitability	-0.0412***	-0.0583***	-0.158*	-0.320***
	(0.0119)	(0.00715)	(0.0933)	(0.0984)
Growth	-0.00204	-0.0120***	0.0245	0.0480***
	(0.00127)	(0.00115)	(0.0178)	(0.0184)
Earnings Volatility	-0.0331***	0.00256	0.0526	0.0742
	(0.00780)	(0.00829)	(0.0948)	(0.0959)
Constant	0.263***	0.148***	-0.128	0.0683
	(0.0570)	(0.0238)	(0.162)	(0.127)
Observations	10,356	28,635	10,356	28,635
R-squared	0.178	0.138	0.109	0.148
Number of Firms	3,949	4,607	3,949	4,607

Panel E: Business Cycle: 2020 - 2021

Variables	Market Leverage		Book Leverage	
	2020[(A)]	2021[(A)]	2020[(A)]	2021[(A)]
Tangible Assets	0.365***	0.236***	0.487***	0.377***
	(0.0207)	(0.0514)	(0.0613)	(0.0803)
Intangible Assets	0.0128***	0.0246	0.113***	0.0970***
	(0.00491)	(0.0162)	(0.0316)	(0.0262)
Size	0.00381**	0.00871**	0.0119	0.0259***
	(0.00163)	(0.00336)	(0.00741)	(0.00479)
Profitability	-0.0546***	0.0212	0.0353	0.0927
	(0.0181)	(0.0461)	(0.113)	(0.0638)
Growth	-0.00822***	-0.0283***	0.0209***	-0.00773
	(0.00287)	(0.00593)	(0.00627)	(0.00676)
Earnings Volatility	-0.0656**	0.00362	0.177	0.0658
	(0.0324)	(0.0768)	(0.244)	(0.138)
Constant	0.103***	0.100***	-0.0148	-0.0535
	(0.0155)	(0.0308)	(0.0585)	(0.0429)
Observations	2,567	375	2,567	375
R-squared	0.239	0.248	0.128	0.155
Number of Firms	2,567	375	2,567	375

[(A)] These recessions are not controlled for year- and firm-fixed effect due to the short extension of the period.

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Standard Leverage Regression for Two Periods

In order to better analyze the difference in behaviors across time, the period of analysis was further divided into two periods (1980-2000 and 2001-2021) and the two Standard Leverage Regressions were performed for these two periods. The results are presented in Appendix 2. What is most interesting to see is that Intangible Assets do not have a statistically significant coefficient during the first period (1980-2000). Intangible Assets enter the Market Leverage regression with a negative coefficient. However, for the second period (2001-2021), Intangible Assets enter both Market Leverage and Book Leverage, with a statistically significant positive coefficient. This difference across the two periods might be the result of the appearance of new legislations and the reorganization of credit markets that enhanced the use of intangible assets as loan collateral.

6. Robustness Tests

This section reports this thesis' results robustness across different empirical measures, and subsamples.

Robustness Tests: Fraction of SG&A

To construct the measure of Intangible Assets used in this study it was assumed that firms' annual investment on knowledge capital represents a proportion of SG&A. This proportion is fixed across time and firms and takes the value of λ = 30%. Therefore, an analysis was performed to see how the conclusions of this dissertation change when different values of λ ranging for 0% to 100%, are used. Appendix 3 shows that the main conclusions of this dissertation go through using different proportions of λ.

Robustness Tests: Alternate measures of Intangible Assets

In addition to varying the SG&A multiplier, other five variations of the measure of Intangible Assets will be considered. Firstly, variations of the depreciation rate of organization capital, $\delta_{SG\&A}$, will be tested. Secondly, variations of the depreciation rate of knowledge capital, $\delta_{SG\&A}$, will be tested. Lastly, all the balance sheet intangibles are going to be excluded from the measure of Intangible Assets- these intangibles include the Goodwill and is excluded in some measures from literature. The results are presented in Appendix 4. Despite the modest changes in some magnitudes, the main results still hold after all the variations made.

Robustness Testes: Different Subsamples

Finally, in last robustness test the sample is going to be divided only into business cycle stage - contraction periods and expansion periods, instead of considering each contraction and expansion episode separately. This robustness test will allow one to compare changes in conclusions when all the data of each business stage is aggregated into a single group, creating two samples: Contraction Periods sample and Expansion Periods sample. Appendix 5 reports the results of the market and book leverage regressions for these two samples. By looking at the Appendix 5, one can see that the behavior of the variable Tangible Assets is similar to the results of the main analysis. Thus, the coefficient of this variable is higher for the contraction table than for the expansion table.

Regarding the variable Intangible Assets, all the coefficients have a significance level of at least 5 percent. In the market leverage regression, the coefficient of this variable is higher for the Contraction Periods sample than for the Expansion Period Sample. However, for the book leverage regression, the opposite is found.

7. Limitations and Possible Future Research

As it would be expected, the current dissertation presents some limitations, leaving room for improvement that should be considered in future research. Some of the limitations were already presented in the previous sections. For example, the measure of intangible assets used has some limitations. To begin with, the measure includes Goodwill which could be contaminated by non-intangibles such as market premium for physical assets. Moreover, there are more sophisticated measures of intangible assets, such as the one used in Lim, Macias, and Moeller (2020). It would be interesting to study this paper's hypothesis with such measures.

Furthermore, it would be interesting to split firms from the sample according to their probability of facing financing frictions. Literature shows that asset tangibility becomes a more significant determinant of financial leverage for firms with a higher likelihood of facing financing frictions. Therefore, applying this distinction may produce interesting insights about the significance of intangible assets and business cycles.

Moreover, despite the evidence on the relationship between business cycles and corporate financing decisions, studying the relationship of financing decisions directly with changes in the credit markets might produce more robust results and interesting conclusions. For example, Campello and Giambona (2013) followed the two-step procedure used in Kashyap and Stein (2000) to study the role of asset tangibility (redeployability) in explaining capital structure decisions when credit conditions change. This dissertation used annual data which makes the definition of contraction periods and expansion periods less accurate and may influence the results.

Another limitation of the model used is that it does not consider that not all contraction/expansion periods are the same. The credit market does not react equally to all contraction periods. Also, the monetary policy used is not always the same. This, of course, will affect the reaction of lenders/borrowers during the business cycle.

8. Conclusion

The first goal of this dissertation was to examine the nature and extent of the relationship between intangible assets and financial leverage. Using a sample of 14,666 active and inactive firms with main operations in the U.S. between 1980 and 2021, this dissertation finds that intangible assets have a statistically significant positive relationship with both Book Leverage and Market Leverage. This result is consistent with the most recent literature on the topic that has shown an increase in the use of intangible assets in the form of loan collateral. This is an important conclusion given the importance of this type of asset for future growth and competitiveness of knowledge-based economies.

Secondly, this dissertation aims to analyze the impact of macroeconomic conditions on the nature and significance of two explanatory variables: Tangible Assets and Intangible Assets. The main premise is that asset tangibility is more important in facilitating financing frictions during periods when access to external debt is more constrained (contraction periods). This is consistent with Asea and Blomberg (1998), that find that there is a relationship between business cycles and lending standards; the authors find that the probability of collateralization increases during contraction periods. Conversely, intangible assets are still perceived as riskier than tangible assets. Thus during credit tightening periods, this type of asset may lose some of

its importance in enhancing debt capacity because creditors might be unwilling to accept them as loan collateral.

The results obtained in this study suggest that macroeconomic conditions have an impact on the relationship between tangible assets and financial leverage. The coefficient of the variable Tangible Assets tends to be higher during periods of contraction than during periods of eexpansion. This finding is consistent with Campello and Giambona (2013) that find that the relationship between firms' asset tangibility and leverage becomes stronger during recessions. Regarding the variable Intangible Assets, it is not easy to draw conclusions. It is possible to identify a trend for the last three business cycles. In most cases, the coefficient of Intangible Assets is lower during periods of recession when compared with the same coefficient during the proceeding expansion period.

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Appendix

Appendix 1: Variable Definition

The table presents the definition of the variables used in the study.

Variable	Description
Martet Leverage	Total Debt / Market-value of Total Assets
Book Leverage	Total Debt/ Book-value of Total Assets
Intangible Assets	P&T Intangible Assets/Total Assets
Tangible Assets	PP&E / Total Assets
Firm Size	Ln (Market Value of of Total Assets), computed for four-year windows
Profitability	EBITDA/ Book-Value of Total Assets
Growth Opportunities	Market-Value of Total Assets/ Book-Value of Total Assets
Earnings Volatility	St. Dev. (EBITDA/ Book-value of Total Assets)

Appendix 2: Standard Leverage Regression (1980-2000 & 2001-2021)

The results presented in the table are from Market Leverage Regression and Book Leverage Regression, for two different sample periods (1980-2000; 2001-2021). The R-Squared is from the OLS estimated that includes firm- and year- fixed effects. Standard errors reported in parentheses are based on heteroskedastic consistent errors for clustering across observations of a given firm.

Variables	**Market Leverage**		**Book Leverage**	
	1980-2000	2001-2021	1980-2000	2001-2021
Tangible Assets	0.201***	0.188***	0.194***	0.226***
	(0.0126)	(0.0159)	(0.0418)	(0.0488)
Intangible Assets	-0.00226	0.00306**	0.00120	0.0503***
	(0.00140)	(0.00145)	(0.0109)	(0.0156)
Size	-0.00235	-0.00257	0.0146	0.0276
	(0.00252)	(0.00210)	(0.0113)	(0.0220)
Profitability	-0.114***	-0.0516***	-0.166***	-0.259***
	(0.00674)	(0.00503)	(0.0263)	(0.0689)
Q	-0.0153***	-0.0103***	0.0180	0.0139
	(0.00227)	(0.000986)	(0.0136)	(0.0213)
Earnings Volatility	-0.0305**	-0.00607	0.348***	0.0845*
	(0.0123)	(0.00592)	(0.0634)	(0.0491)
Constant	0.235***	0.171***	0.0853**	-0.0512
	(0.0118)	(0.0138)	(0.0418)	(0.102)
Observations	84,661	66,994	84,661	66,994
R-squared	0.097	0.100	0.068	0.091
Number of Firms	11,065	7,875	11,065	7,875

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Appendix 3: Robustness Test – SG&A Multiplier

The results presented in table are from Market Leverage Regression (Panel A) and Book Leverage Regression (Panel B). The R-Squared is from the OLS estimated that includes firm- and year- fixed effects. The SG&A Multiplier is the fraction of SG&A assumed to be investment in Knowledge Capital. The main analysis follows the literature as used the 0.3 Multiplier.

Panel A: Dependent Variable - Market Leverage

Multiplier	Tangible Assets	Intangible Assets	Size	Profitability	Growth	Earnings Volatility	Constant	R-squared
0	0.182	0.008	0.001	-0.075	-0.014	-0.014	0.198	0.089
	(0.011)	(0.002)	0.002	(0.004)	(0.001)	(0.005)	(0.009)	
0.10	0.182	0.006	0.001	-0.075	-0.014	-0.014	0.198	0.088
	(0.011)	(0.002)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
0.20	0.182	0.005	0.001	-0.076	-0.014	-0.013	0.198	0.088
	(0.011)	(0.002)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
0.30*	**0.182**	**0.003**	**0.001**	**-0.076**	**-0.014**	**-0.012**	**0.199**	**0.088**
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
0.40	0.181	0.002	0.000	-0.077	-0.014	-0.011	0.200	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
0.50	0.181	0.002	0.000	-0.078	-0.014	-0.010	0.201	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
0.60	0.181	0.001	0.000	-0.078	-0.014	-0.008	0.202	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
0.70	0.181	0.000	0.000	-0.079	-0.014	-0.007	0.203	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
0.80	0.181	0.000	0.000	-0.079	-0.013	-0.006	0.204	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
0.90	0.181	0.000	0.000	-0.079	-0.013	-0.006	0.205	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
1.00	0.181	0.000	-0.001	-0.080	-0.013	-0.005	0.206	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	

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Panel B: Dependent Variable- Book Leverage

Multiplier	Tangible Assets	Intangible Assets	Size	Profitability	Growth	Earnings Volatility	Constant	R-squared
0	0.192	0.029	0.013	-0.250	0.018	0.202	0.087	0.081
	(0.030)	(0.010)	(0.008)	(0.042)	(0.011)	(0.041)	(0.024)	
0.10	0.193	0.035	0.015	-0.243	0.018	0.185	0.072	0.083
	(0.030)	(0.011)	(0.008)	(0.042)	(0.011)	(0.041)	(0.026)	
0.20	0.193	0.039	0.018	-0.238	0.017	0.171	0.057	0.084
	(0.030)	(0.012)	(0.008)	(0.042)	(0.011)	(0.042)	(0.028)	
0.30*	**0.193**	**0.039**	**0.020**	**-0.234**	**0.017**	**0.159**	**0.044**	**0.085**
	(0.030)	(0.012	(0.008)	(0.042)	(0.011)	(0.042)	(0.030)	
0.40	0.192	0.039	0.022	-0.231	0.016	0.150	0.034	0.086
	(0.030)	(0.012)	(0.009)	(0.042)	(0.011)	(0.043)	(0.033)	
0.50	0.192	0.037	0.023	-0.230	0.016	0.144	0.026	0.087
	(0.029)	(0.011)	(0.009)	(0.042)	(0.011)	(0.043)	(0.034)	
0.60	0.191	0.035	0.024	-0.229	0.016	0.139	0.020	0.088
	(0.029)	(0.011)	(0.009)	(0.042)	(0.011)	(0.044)	(0.036)	
0.70	0.191	0.033	0.025	-0.229	0.016	0.136	0.016	0.088
	(0.029)	(0.010)	(0.009)	(0.042)	(0.011)	(0.044)	(0.037)	
0.80	0.190	0.031	0.025	-0.229	0.016	0.134	0.013	0.088
	(0.029)	(0.010)	(0.009)	(0.042)	(0.011)	(0.044)	(0.038)	
0.90	0.190	0.029	0.026	-0.229	0.016	0.133	0.011	0.088
	(0.029)	(0.009)	(0.009)	(0.042)	(0.011)	(0.044)	(0.038)	
1.00	0.190	0.027	0.026	-0.229	0.015	0.132	0.010	0.089
	(0.029)	(0.008)	(0.009)	(0.042)	(0.011)	(0.044)	(0.038)	

Appendix 4: Robustness Test – Alternate Measures of Intangible Capital

The results presented in the table are from Market Leverage Regression (Panel A) and Book Leverage Regression (Panel B). The R-Squared is from the OLS estimated that includes firm- and year- fixed effects. The first row presents the results from Table 6 with the main measure of intangible assets. Rows 2-6 show results using alternate measures of intangible assets. Rows 2 and 3 use alternate values for the depreciation rate of organization capital ($\delta_{SG\&A}$). Rows 4 and 5 use alternate values for the depreciation rate of knowledge capital ($\delta_{R\&D}$). Row 6 excludes all balance sheets intangibles.

Panel A: Dependent Variable - Market Leverage

Specification	Tangible Assets	Intangible Assets	Size	Profitability	Growth	Earnings Volatility	Constant	R-squared
1. Main Results (Table 6)	0.182	0.003	0.001	-0.076	-0.014	-0.012	0.199	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
2. $\delta_{SG\&A} = 10\%$	0.182	0.003	0.001	-0.077	-0.014	-0.012	0.199	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
3. $\delta_{SG\&A} = 20\%$	0.182	0.004	0.001	-0.076	-0.014	-0.013	0.199	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
4. $\delta_{R\&D} = 10\%$	0.182	0.003	0.001	-0.077	-0.014	-0.012	0.199	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
5. $\delta_{R\&D} = 20\%$	0.182	0.004	0.001	-0.076	-0.014	-0.012	0.199	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	
6. Exclude Balance Sheets intangibles	0.181	-0.001	-0.001	-0.080	-0.013	-0.003	0.207	0.088
	(0.011)	(0.001)	(0.002)	(0.004)	(0.001)	(0.005)	(0.009)	

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Panel B: Dependent Variable- Book Leverage

Specification	Tangible Assets	Intangible Assets	Size	Profitability	Growth	Earnings Volatility	Constant	R-squared
1. Main Results (Table 6)	0.193 (0.011)	0.039 (0.001)	0.020 (0.002)	-0.234 (0.004)	0.017 (0.001)	0.159 (0.005)	0.044 (0.009)	0.085
2. $\delta_{SG\&A} = 10\%$	0.193 (0.011)	0.039 (0.001)	0.021 (0.002)	-0.234 (0.004)	0.017 (0.001)	0.156 (0.005)	0.041 (0.009)	0.086
3. $\delta_{SG\&A} = 20\%$	0.193 (0.011)	0.039 (0.001)	0.019 (0.002)	-0.235 (0.004)	0.017 (0.001)	0.162 (0.005)	0.047 (0.009)	0.085
4. $\delta_{R\&D} = 10\%$	0.192 (0.011)	0.037 (0.001)	0.020 (0.002)	-0.235 (0.004)	0.017 (0.001)	0.161 (0.005)	0.046 (0.009)	0.085
5. $\delta_{R\&D} = 20\%$	0.193 (0.011)	0.042 (0.001)	0.020 (0.002)	-0.233 (0.004)	0.017 (0.001)	0.157 (0.005)	0.042 (0.009)	0.086
6. Exclude Balance Sheets intangibles	0.184 (0.011)	0.035 (0.001)	0.020 (0.002)	-0.239 (0.004)	0.017 (0.001)	0.166 (0.005)	0.050 (0.009)	0.084

Appendix 5: Robustness Tests- Different Subsamples

The results presented in the table are from Market Leverage Regression and Book Leverage Regression. The R-Squared is from the OLS estimated that includes firm- and year- fixed effects. The Contraction Period consists of the results obtained using all firm-year observations for the years in which the economy was in contraction: 1980-1982; 1990-1991; 2001; 2007-2009; 2020. The Expansion Period includes the results obtained using all firm-year observations for the years in which the economy was in expansion: 1983-1989; 1992-2000; 2001-2006; 2010-2019; 2021.

Variables	**Market Leverage**		**Book Leverage**	
	Contraction Periods	Expansion Periods	Contraction Periods	Expansion Periods
Tangible Assets	0.185***	0.171***	0.230***	0.187***
	(0.0172)	(0.0111)	(0.0319)	(0.0320)
Intangible Assets	0.00545**	0.00366**	0.0362**	0.0392***
	(0.00216)	(0.00179)	(0.0142)	(0.0135)
Size	0.000378	0.00180	0.00342	0.0141**
	(0.00259)	(0.00174)	(0.00953)	(0.00624)
Profitability	-0.0882***	-0.0767***	-0.193***	-0.234***
	(0.00971)	(0.00459)	(0.0427)	(0.0467)
Growth	-0.0168***	-0.0135***	0.0379**	0.0256***
	(0.00256)	(0.00121)	(0.0150)	(0.00740)
Earnings Volatility	-0.0418***	-0.00973	0.0296	0.155***
	(0.0115)	(0.00661)	(0.0631)	(0.0454)
Constant	0.216***	0.145***	0.106***	0.0217
	(0.0136)	(0.00985)	(0.0364)	(0.0287)
Observations	36,210	115,445	36,210	115,445
R-squared	0.086	0.085	0.097	0.101
Number of Firms	11,201	13,535	11,201	13,535

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1