How do firms' capital structure decisions vary between monetary easing and tightening, and what drives these differences in response to interest rate changes

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Contents:

Abstract

How do firms' capital structure decisions vary between monetary easing and tightening, and what drives these differences in response to interest rate changes

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This dissertation investigates variations in corporate capital structure decisions during periods of monetary easing and tightening and analyses the factors reflecting these changes in response to interest rate changes. Using a comprehensive dataset covering all available US firms from 2000 to 2022, this dissertation employs Fixed Effects (FE), Pooled Ordinary Least Squares (POLS), and Random Effects (RE) models to investigate the impact of monetary policy changes on firms` capital structure, more specifically, debt to equity ratios.

The results shows that a Risk-Free rate increase significantly influences the leverage of firms, leading to the leverage decrease. Conversely, the Spread rate shows a positive correlation with debt to equity. This counterintuitive finding suggests that firms might expect the further growth of interest rate and increases the level of debt to guarantee the lower rates.

Additionally, the paper analyses the impact of specific factors such as industry classification, firm size, profitability, volatility, and other related financial metrics in making capital structure decisions, showing statistically significant, varying impacts on leverage.

This dissertation enhances the practical and theoretical understanding of how macroeconomic policies reflect corporate capital structure strategies, giving additional insights for investors, financial managers, and policymakers.

Keywords: *Interest Rates, Capital Structure, Industry, Debt Market Timing*

Sumário

Como as decisões de estrutura de capital das empresas variam entre flexibilização e aperto monetário, e o que impulsiona essas diferenças em resposta às mudanças nas taxas de juros

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Esta dissertação investiga variações nas decisões sobre a estrutura de capital das empresas durante períodos de flexibilização e aperto monetário e analisa os fatores que refletem essas mudanças em resposta a alterações nas taxas de juro. Usando um conjunto de dados abrangente que cobre todas as empresas americanas disponíveis de 2000 a 2022, a dissertação emprega modelos de efeitos fixos, modelos de OLS agrupados (*pooled*) e de efeitos aleatórios para investigar o impacto das mudanças na política monetária na estrutura de capital das empresas, mais especificamente, nos rácios dívida/capital.

Os resultados mostram que o aumento da taxa de juro sem risco reflete significativamente a alavancagem das empresas, levando à diminuição da alavancagem. Por outro lado, o *spread* apresenta uma correlação positiva com a dívida em relação ao capital próprio. Esta conclusão contraintuitiva sugere que as empresas podem esperar um maior crescimento da taxa de juro e aumentar o nível de endividamento para garantir taxas mais baixas.

Além disso, o artigo analisa o impacto de fatores específicos, como classificação do setor, dimensão da empresa, rendibilidade, volatilidade e outras métricas financeiras na tomada de decisões sobre estrutura de capital, mostrando impactos estatisticamente significativos e variados na alavancagem.

Esta dissertação melhora a compreensão prática e teórica de como as políticas macroeconómicas refletem as estratégias de estrutura de capital empresarial, fornecendo conhecimentos adicionais para investidores, gestores financeiros e decisores políticos.

Palavras-chave: *Taxas de juros, Estrutura de capital, Indústria, Timing do mercado de dívida*

1. Introduction

Capital structure decision is very relevant in corporate finance, that is showing a firm`s value and the level of risk that a firm is taking in terms of leverage proportion on total assets. Before starting to make any analyses, it is crucial to look on Modigliani and Miller (1958). Proposition I, named as the capital structure “irrelevance proposition”, which talks about the value of the firm. It says that the value of the firm is unaffected by the capital structure, and therefore the capital structure is irrelevant. By irrelevance it doesn’t mean we don’t need to understand the capital structure, rather it means that it doesn’t matter by how much percentage you finance your assets in whatever mix of debt and equity, it is not going to affect the value of the firm. Although their proposition gives a theoretical knowledge, the practical implications of these decisions are being reflected by a variety of dynamic factors such as monetary policy.

There are many authors that proposed theories to explain firm`s capital structure decisions and different financial metrics were analyzed to define and predict the optimal capital structure. The most well-known theories are *Pecking Order Theory, Trade-off Theory, Agency Cost Theory and Market Timing Theory*. The financial metrics that were used in these theories for trying to find why some firms use more leverage than others are: Profitability, Firm Size, Tangibility, Growth Forecasts, Non-Debt Tax Shield, Stock Returns.

Interest rate changes, being a main part of the monetary policy, take a crucial role in shaping economic environments, affecting corporate investment and leverage decisions. One of the studies mentioning how monetary policy can influence credit conditions and corporate financial policies is proposed by Bernanke, Gertler, and Gilchrist (1999). The other proposes on interest rate changes reflecting capital structure during monetary easing and tightening are provided by Korajczyk & Levy (2003); Graham & Harvey (2001).

Although there are some studies on capital structure and monetary policy relationship, gaps remain in defining clean view on how companies adjust their financial structures in response to various monetary changes – especially during interest rates increasing compared to decreasing. Moreover, influence of these adjustments over different industries, reflected by financial metrics like the industry specific cost of debt and profitability are being neglected and not fully studied Frank & Goyal (2009). To fill this gap, I added industry related analysis in my dissertation.

The goal of this dissertation is to extend both empirical and theoretical understanding of capital structure management during monetary policy easing and tightening. It aims to provide insights for investors, financial managers, and policymakers on capital structure optimizing in a changing economic environment.

Moreover, looking back to the literature, studies about market timing have connections with equity market timing. It means that, when the equity is assessed "cheap", firms are willing to raise equity for their investment financing. It is reasonable to think if firms will only rely on equity for their decision making when it will be time in the market where both equity and debt is "cheap". As the capital structure rely on equity and debt, we can propose that making financial decisions potentially can be defined by the current conditions of the whole market, but not only by equity market.

This dissertation uses an extensive dataset of financial metrics to analyse the dynamics of capital structure changes under varying monetary conditions. The dependent variable being Debt to Equity (D/E) ratio, is used for firms` leverage calculations, whereas independent variables include Volatility, Firm Size (Natural Log of Total Assets), Profitability (EBIT/Total Assets), Tangibility, Non-Debt Tax Shield (NDTS), Growth (Market Value/Book Value), Stock Returns, Net Debt/EBITDA metrics are used to conduct this study. In addition risk-free data being Market Yield on U.S. Treasury Securities at 30-Year Constant Maturity, as well as industry specific cost of debt data was used. For the data collection process, Wharton Research Data Services (WRDS), more precisely CRSP/Compustat Fundamentals Annual data was used. Data spanning from 2000 to 2022 with entire database of US companies, which includes a comprehensive panel of 81.479 firm year observation and 6611 across 11 GIC sectors.

After running Fixed Effects (FE), Pooled Ordinary Lease Squares (POLS), and Random Effects (RE) models in STATA software, the results show a negative impact of Risk-Free rate on the capital structure, which is consistent with most papers on capital structure. In addition to risk free rates, which is common to all firms, the Spread variable was added to reach specification on interest rate and it is calculated by cost of debt minus risk-free rate. The spread rate shows negative statistical significancy. Industry analyses, generally show a negative influence, but also include sectors with positive impact on the capital structure.

For a better and detailed presentation of these findings, following this introduction dissertation is divided into the following parts: Chapter 2 reviews the literature on capital structure theories starting with the background theories, continuing discussions about influence of monetary policy on corporate financing. Chapter 3 outlines the statement of research/project methodology, and limitations/constraints with explanations of the econometric models used for analysis. Chapter 4 presents the empirical results and the estimation of models as well as different diagnostic tests providing a deeper analysis on how firms respond to monetary changes. Lastly, Chapter 5 concludes with a summary of the research contributions, identifies the dissertation`s limitations, and suggests potential improvements for the future research.

2. Literature review

2.1 Background on capital structure theory

The background of capital structure theory provides a thorough analysis of publications that have influenced our perception of how firms fund their financials. The basis was laid by Modigliani and Miller's (1958) claim that capital structure has no bearing on a firm's value in a perfect market condition. This was further complicated by taking tax effects into account, which gave rise to the trade-off theory, that advises businesses to weigh the advantages of debt tax shields against the risks of possible financial difficulties. Looking to the other papers, Taggart (1981) gave propositions at how different interest rates could affect the debt-equity decision. He suggests that real-world conditions, like as interest rates, might lead to departures from the principle. Pecking order theory states that because of knowledge asymmetry, firms prefer internal financing over external debt and equity. Myers (1984) is one of the first who presented this idea.

There were other influential hypotheses that developed after Modigliani and Miller (1958) capital structure irrelevance principle, which will be discussed in a more detail in the next sections.

2.1.1 Trade-off Theory

The Trade-off Theory of capital structure, being one of the main theories in corporate finance, propose that businesses balance advantages of equity and debt and the cost to define their optimal capital structure. This theory suggests that companies make efforts to optimize the tax benefits of debt financing, in general the tax deductions of debt interest payments against bankruptcy costs and other expecting financial distress.

This theory starts its history back to 1968, in the paper of Modigliani and Miller. In proposed by these authors irrelevance theory, suggests that in a perfect capital market (market without bankruptcy costs, taxes and asymmetric information), the value of a company is not changed by its capital structure. However, they updated their theory later by adding the influence of corporate taxes, proposing that tax shield could reflect the firm value Modigliani and Miller (1963). This update gave a starting point for development of the trade off theory, which proposes that there is indeed an optimal capital structure where the marginal benefit of debt increases is equals to the marginal cost of financial distress (Kraus and Litzenberger, 1973). Over the decades, other authors also support this theory by doing empirical tests. DeAngelo and Masulis (1980) enriched trade off theory by considering non-debt tax shields, which decreased the benefits of debt`s tax shield, thus reflecting optimal capital structure decisions. These findings were supported later by Titman and Wessels (1988), by proposing the influence of different firm specific metrics, such as growth opportunities, non-debt tax shields on the capital structure. Later, personal taxes also added to the trade-off theory (Miller, 1977), to counteract the corporate tax advantage of debt. This update proposed more complicated view on how taxes can reflect the capital structure decision, considering both personal and corporate taxation levels.

More recent studies were proposed on changing the definitions by testing trade off theory, adding more sophisticated metrics of corporate finance, such as firm specific variables and different economic market conditions. Fama and French (2002) presented that financial metrics such as market-to-book ratios and profitability have significant influence on capital structure, mentioning that more profitable companies with low tangible assets have lower levels of debt.

However, there are critics of trade off theory, mentioning that it does not give a full explanation of capital structure management behaviors, in a way that many companies keeps low levels of debt despite significant tax shields and volatility in capital structure which the static trade off theory do not forecast (Myers, 2001). These critiques ended up with dynamic trade-off models development, which tries to incorporate adjustments over time in response to changing market conditions (Flannery and Rangan, 2006)

2.1.2 Pecking Order Theory

The Pecking Order Theory of capital structure in corporate finance is a fundamental theory that explains how firms choose their source of financing. This theory proposed by Stewart Myers (1984), suggests that firms use internal financing (retained earnings) first for financing, in a second place prefer debt and equity as a last option. Pecking order theory contrasts with the trade off theory, which that firms are balancing the benefits and costs of equity and debt to choose the optimal capital structure. Myers and Majluf (1984) presented this theory in their work, mentioning information asymmetry as a main driver behind this behavior. They proposed that firms managers, have the insights and more clear detailed information as well as desires and future growth opportunities of their company compared to any other external investors. With this, managers might prefer debt over equity when internal funds are not enough, as adding equity possible might undervalue the firm, especially when investors issuing equity is taking as a signal that firm is overvalued.

There are other authors who tested the implications of the Pecking Order Theory. For instance, Shyam-Sunder and Myers (1999) presented empirical support by proposing that the financing preferences of firms are consistent with the predictions of theory. Their further analyses show that firms prefer internal financing over external and debt over equity when external financing is required. Additionally, research also extended on how different market conditions and firm`s financial metrics such as asset tangibility and profitability influence the pecking order behavior. Profitable firms with more tangible assets, are less expected to issue equity (Frank and Goyal 2003), which is consistent with the theory`s predictions.

Like the other theories, it also has many arguing and criticizing points. The biggest limitation is its proposition that firms do not target an optimal capital structure, which is against of many empirical analyses and theoretical frameworks, proposing that firms over time balance debt and equity targets. Besides that, the theory does not explain clearly why firms often issue equity even when have sufficient internal funds or available debt options.

If we look to a more recent studies, we can observe that the Pecking Order Theory is keeping its relevancy, especially in debates on financing constraints and the influence of market conditions on the financing options. As an example, during the financial crisis of 2007-2008, many firms switched back to the internal financing as interest rates hiked on credit markets, which is consistent with the predictions of theory. Moreover, the theory has been extended to explain financing options in various organizations, including startups and small businesses, that usually deals with higher costs of external financing and high information asymmetries.

2.1.3 Market Timing Theory

The Market Timing Theory in corporate finance is a financial theory that explains how firms` decisions on capital structure are highly related by their attempts to time the equity market, capitalizing on available gaps when market conditions are suitable. This theory analyzed and discussed by Baker and Wurgler (2002). They proposed that the capital structure decisions of firms are mainly the result of historical tries to time the equity market. As per theory, firms issue equity when their market valuations are high and conversely when low - buys back the equity, leading to changes in debt levels that reflect historical market conditions rather that a desired debt to equity ratio. This process propose that capital structure is the overall outcome of the recent market timing possibilities and the firm`s reaction to these options.

The empirical confirmation for the Market Timing Theory is discovered by the long-term consequences of equity issuance and repurchase determination done by companies. Baker and Wurgler (2002) presented that firms` current capital structure is highly reflected by past market conditions. These authors proposed that firms which issued equity during increased valuation had substantially lower debt level in the long time period, than firms that don`t, suggesting that capital structure decisions have constant impact and are reflected by tries to take advantage of stock price`s wrong valuation.

Following the initial papers, several authors have enlarged the market timing theory in a different contexts and found its implications in a broader way. Hovakimian, Opler, and Titman (2001) analyzed if firms optimize their capital structures to reach target levels after market timing tries. Their findings suggest that despite the reflection of market timing on a capital structure decisions in the short term, firms over time are tend to go back to recent target ratios of leverage, showing a mix of traditional trade off and market timing theories considerations.

If we look to cons of market timing theory, many argue that it does not consider the role of long term strategic planning in capital structure decision and overvalue opportunities of firms. Moreover, there are some authors that found the reflection of the market timing on a capital structure are not resistant as initially proposed, mentioning that other keys like firm specific characteristics and macroeconomic factors also have crucial roles.

It is appropriate to mention that Market Timing Theory keeps its relevance in explanation of behavioral and corporate finance, specifically in understanding how market conditions and psychological factors reflect financial managers decisions. This is especially relevant in a volatile market where a desire to issue equity during economy prosperity and repurchase during periods of economy shrink is strong.

2.1.4 Agency Cost Theory

The Agency Costs Theory of capital structure is a relevant concept in financial economics that investigates the contradiction of interests among shareholders with management and shareholders with debt holders. This proposition is described in a broader framework of agency costs theory, which was developed and presented most accurately by Jensen and Meckling (1976) in their work.

One of the main points of this theory in the context of capital structure is the agency costs of debt, that appears in a result of actions debt holders might take to save them from expropriation by shareholder, which could end up with higher interest rate requirements or restrictive sanctions.

Myers (1977) further expanded these concepts in the context of the agency costs related with equity. This paper discusses the agency costs of external equity and how they can lead to insufficient investment issues, especially when there is presence of risky debt.

Modern appliance of the Agency Costs Theory frequently focus on how various management structures can reduce agency problems. Shleifer and Vishny (1997) in their paper discuss how effective management structures can align interests between shareholders and managers, thus decreasing agency costs and reflecting capital structure decisions.

Critiques around Agency Costs Theory focus on its predictions about behavior and trickiness of quantifying agency costs. Many argue that the theory, predicts basic behavior models that do not constantly meet with real world complexities. As mentioned before, the empirical assessment of agency costs is complicated, which can make it hard to test the theory`s predictions carefully.

2.2 Interest Rate Environment and Capital Structure Decisions

The issue of capital structure sensitivity to interest rate fluctuations has been well studied in the literature, illustrating how companies modify their leverage in reaction to changing interest rates. For instance, Barclay and Smith (1995) provide insights into how interest rate environments affect firms` leverage decisions. Furthermore, Guedes and Opler (1996) provide empirical evidence on enterprises' strategic reactions to interest rate changes by analysing the effect of interest rate levels on the decision between short-term and long-term loans. All this research improves our knowledge of the intricate connection between corporate capital structure and interest rates.

Research by Flannery and Rangan (2006) analyses how companies adjust their capital structures over time, in accordance to changes in the financial landscape. Additionally, Faulkender and Petersen (2006), emphasise the significance of monetary policy in capital structure choices by providing information on how the present interest rate environment affects companies' decisions to issue debt. These studies provide a foundation for investigating the intricate relationships that exist between interest rate and firms` financial strategy.

2.3 Capital structure adjustments during monetary easing and tightening

Empirical studies have provided insightful information on how businesses modify their capital structures throughout monetary easing cycles. Research on how monetary policy affects corporate borrowing done by Bernanke, Gertler, and Gilchrist (1999) suggests that lower interest rates encourage businesses to borrow more money. Frank and Goyal (2009) provides analysis of the patterns where interest rate, which is one of the macroeconomic factors reflects capital structure. It also provides insights about firm`s leverage determination during monetary policy changes. All the mentioned papers improve our knowledge of the dynamic relationship that exists between firms` financing behaviour and monetary policy.

The practice of companies adjusting their capital structure by lowering debt during monetary tightening is supported by empirical data. Faulkender and Petersen (2006), for instance, look at how businesses change their debt levels in response to increasing interest rates. According to the findings, they often show a propensity to deleverage in order to lower interest expenses and the risk of financial distress. Furthermore, cross-industry research, such as a 2007 study by Almeida and Campello demonstrates that capital-intensive companies are more inclined to lower their debt during tightening cycles. Concluding relevant study results, it is being clear that firms make their adjustments related to shifting macroeconomic conditions.

2.4 Methods used for analysing how interest rates changes affect capital structure.

To analyse how interest rate fluctuations are reflecting capital structure, researchers use methodological approaches relating on theoretical background and empirical data from well trusted economics/finance papers and sources.

Quantitative models offer sophisticated tools for analysing the effects of interest rate changes on firm leverage over time. Examples of these models are dynamic panel data models, as demonstrated in studies by Faulkender and Petersen (2006), and structural equation modelling, as shown by Fama and French (2002).

To determine the causal linkages between interest rates and capital structure choices, empirical approaches are often used. These methods include regression analysis and event study procedures. Techniques for exploring relations between interest rate fluctuations and capital structure financing decisions made by firms, are well studied in Rajan and Zingales (1995) and Frank and Goyal (2009) papers. For these analytical approaches well known databases like Compustat and CRSP were used to gather comprehensive financial data. Procedures for sample selection, as covered by Faulkender and Petersen (2006), guarantee the research sample's reliability and representativeness. Variable definitions are created to precisely capture important components including leverage, interest rates, and other firm`s financing related metrics.

3. Methodology

3.1 Regression Models

To analyze the impact of monetary easing or tightening on the capital structure, in response to changes of interest rate, the study consists of three main econometric models:

1. *Pooled Ordinary Least Squares (POLS):* This regression model assumes that coefficients are the same for all firms. Regressors are nonstochastic, errors are not correlated with explanatory variables, so covariance in zero. This assumption is mandatory to be sure that our parameter estimates are unbiased and consistent. Error term is independently and identically distributed above the mean of zero with a constant variance condition of homoscedasticity.
2. *Fixed Effects (FE):* Conversely, second model explicitly account for the effect firm heterogeneity by allowing different intercepts, one for each firm in the pooled data. It does this with the use of dummy variables. Differences in intercepts capture the unique characteristics of each firm of the sample dataset. If we find that significant difference occur in these intercepts after running regression, we are going to conclude that heterogeneity exist and are not homogeneous. In this case fixed effect estimation would be considered more suitable than POLS.
3. *Random Effects (RE):* is also called error components model. It incorporates firm heterogeneity, within the error term, rather than being specified as a dummy variable, while allowing for a common intercept. Unlike in Firm Fixed Model, where each firm has its own fixed intercept value, in Random Effects model the common intercept is the average of all the firms` intercepts.

The applicability of the model is examined with Hausman tests by comparing the Firm fixed and Random effects models F-test results is used to compare with the POLS model. The Breusch-Pagan and White tests are used to determine whether heteroscedasticity is present, while the Wooldridge test is used to verify whether autocorrelation exists in panel dataset.

The main regressions were estimated using overall firm`s data, all sectors combined. Additionally, the research was extended by dividing the data by the 11 GIC industry sectors, using dummy variables. It gave possibility to extend the analysis on how those sectors influence to overall model and provided insights on how different sectors reacts to interest rate easing or tightening.

3.2 Data collection

For the data collection process, I used Wharton Research Data Services (WRDS), more precisely CRSP/Compustat Fundamentals Annual data. As a year span I took 2000-2022 with entire database of US companies, which includes a comprehensive panel of 81.479 firm year observations.

Additionally, for risk free rate I used data from FRED (Federal Reserve Bank of St.Louis) web site, specifically the Market Yield on U.S. Treasury Securities at 30-Year Constant Maturity was used.

As we are informed about that in a real world, not all the companies have the same cost of debt. To add industry cost of debt variable, Interest and related expenses over Total debt ratio was used from Compustat. At the final dataset there was around 34% of data missing for this ratio. To fill the missing gaps, it was decided to extract industry cost of debt data from Damodaran web site for the corresponding years and industry categories.

After the collection of data from different sources, I merged and matched them in Excel for the data processing. As part of the cleaning process, first I deleted all companies that had zero debt, also empty data for total assets, as they are out of my research question and analyses. For the next step I eliminated companies that have less than 5 years of data in a row. After, I defined and calculated relevant variables/ratios such as Profitability, D/E, Lsize, Volatility, Growth, Stock return, Tangibility, NDTS (non-debt tax shield) and others. More details about those calculations are given in a variable description part below. Lastly, I winsorized these variables at the 1^{st} and 99^{th} percentile to clean the data from extreme outliers. After passing all the required processing, data was exported to STATA for the further analyses and running the regression model. The software gave possibility for running multiple statistical tests and comprehensive analyses for the desired research question.

3.3 Variables description

PROF – Profitability. There are different ways to measure profitability ratios in the existing literature. EBITDA over Book Value of Total assets was the option chosen in the work of Rajan and Zingales (1995). While Titman and Wessels (1988) in their study used Operating Income over Total Sales and Operating Income over Total Assets. In our case this ratio is calculated as Earnings before interest and tax (EBIT) divided by total assets, which indicates the operational efficiency of the firms.

PROF = EBIT / TOTAL ASSETS

Debt to Equity Ratio (D/E) - The primary focus ratio of analysis for this research, which is taken as the dependent variable reflecting firms' capital structures, representing the firm`s financial leverage and calculated as total debt over total equity.

NDTS – Non-debt tax shield, known in the literature as ratio that corresponds to the effect of the tax shield, provided by investment tax credit and depreciations. For representing NDTS in this study, it will be used Depreciations over Total Assets.

NDTS = DEPRECIATIONS/TOTAL ASSETS

VOL – Volatility. Looking back to the Titman and Wessels (1988) paper, we can see that for volatility measurement of the company it`s been used the standard deviation of the percentage changed in the operating income. For the purpose of our research, I used method provided by Brandley et al. (1984), where volatility is calculated by standard deviation of return on assets of EBIT/Total Assets. Additionally, as EBIT is not reflecting the capital structure, the standard deviation of this ratio will be used in last five years of each year to have more reliable and consistent values.

$$VOL_{i,t} = STD\ DEV\ (EBIT/TOTAL\ ASSETS)_{i,t-(t-5)}$$

Size – For representing the companies` size, it will be used natural logarithm of total assets, the same way that was also used by Murray Z.Frank and Goyal (2009) and Ferri and Jones (1979). The other approach that I found in the literature was by Rajan and Zingales (1995) and Ferrid and Jones (1979), where companies` size is calculated by using natural logarithm of net sales.

LSIZE = Log (TOTAL ASSETS)

TANG – Tangibility. There are plenty options to measure tangibility of the firms in the literature. Fixed Assets over Total Assets is one of the methods used by Rajan and Zingales (1995). More recent approach is used by Murray Z. Frank and Goyal (2009), by calculating ratio of R&D expenses over Total Sales. All of them should leave us with the approximately same results, but because of limitations in WRDS database, I decided to utilize Titman and Wessels (1988) approach. So, for the tangibility variable is calculated by the ratio of Intangible assets over Total Assets.

TANG = INTANGIBLE ASSETS/TOTAL ASSETS

Growth – Going back to the Titman and Wessels (1988) study, we can observe three different approaches for calculating company`s growth. R&D over Total Sales; CAPEX over Total Assets and Total Assets` change in percentage. Market to Book ratio is another definition for growth variable that was used in Rajan and Zingales (1995) study, which was replicated later by Adam and Goyal (2008). For this paper I also use the same approach as it`s more appropriate way for companies` growth determination.

GROWTH = MARKET VALUE/BOOK VALUE

Net Debt/EBITDA – This is a common financial metric used to represent a firm`s leverage and its ability to pay off debt using core operational earnings before interest, taxes, depreciation and amortization. This ratio is calculated by the amount of net debt (total debt – cash and cash equivalents) over Earnings before interest, taxes, depreciation and amortization. Lower ratio hypotetically shows that firm can pay off its debt faster relating to current earnings, showing lower risk of default. While higher ratio shows that company is using more leverage than potentially can afford, which potentially increasing the risk profile.

SR – Stock Return. This variable if ones of the other fundamental metric to assess the performance of the firm in the capital market, representing percentage change in the price of a stock over a specific period. For the research purposes of this paper, I used difference of one year.

$$STOCK\ RETURN = STOCK\ CLOSING\ PRICE_{t-1} / STOCK\ CLOSING\ PRICE_{t}$$

Interest Rates - For interest rates definition, it will be used two types of interest rates. First is risk free rate which is common to all firms. As risk free rate, it will be used the interest rates of the long-term yield on U.S. Treasury Securities at 30-year Constant Maturity. It presents a benchmark for assessing returns on investments with various risk profiles, as it is known that U.S Treasury Securities are virtually risk-free.

Second, in order to reach some specification on interest rates (as defined before, all firms could have different cost of debt), it will be used cost of debt data from Compustat. As there was 34% missing values, it was decided to use industry cost of debt data from Damodaran web site for the corresponding years and industry categories to fill the missing values. After having cost of debt for specific industries, we subtract Risk Free Rate to get a **Spread** variable value. It reflects the risk premium that investors have to bear, as you get additional risk of lending. In other words, it indicates the credit risk of the specific industries.

SPREAD = COST OF DEBT – RISK-FREE RATE

GIC sector – This is the variable that is used for categorizing firms based in the Global Industry Classification Standard (GICS), developed by Standard & Poor`s. Aiming help in categorizing companies into sectors and industries, this data divides the economy in 11 sectors such as Communication Services, Consumer Discretionary, Consumer Staples, Healthcare, Industrials, Financials, Real Estate, and others.

3.4 Descriptive Statistics:

Table 1 shows descriptive statistics for chosen financial metrics, providing results for the mean, median, standard deviation, minimum and maximum values, skewness, and kurtosis for a sample dataset of 81479 observations.

Table 1 Descriptive Statistics of the Variables after applying winsorizing technique at 1% to the data. These values are in percentage format, where the Median for Profitability can be 0.045 or 4.5%, except LSize variable which is natural logarithm of firms` size.

Variables	Obs	Mean	Median	St.Dev	Min	Max	Skew	Kurt
Risk-free	81479	0.038	0.039	0.011	0.016	0.059	-0.114	1.867
Debt/Equity	81479	0.159	0.146	0.113	0.001	0.467	0.563	2.597
Spread	81479	0.038	0.016	0.100	-0.033	0.773	5.533	34.637
Profitability	81479	0.009	0.045	0.195	-1.036	0.309	-3.056	14.656
Non-debt tax shield	81479	0.037	0.031	0.033	0	0.172	1.535	6.044
Volatility	81479	0.071	0.042	0.088	0.003	0.524	2.832	12.529
Lsize	81479	7.053	7.051	2.218	2.231	12.71	0.095	2.748
Tangibility	81479	0.155	0.056	0.198	0	0.766	1.357	3.874
Growth	81479	2.421	1.585	4.924	-16.45	31.162	2.329	18.739
Net Debt/EBITDA	81479	1.231	0.67	5.434	-23.438	28.064	0.605	14.09
Stock return	81479	0.151	0.032	0.742	-0.847	4.486	3.126	16.971

Risk-free rate has a tight distribution around its mean (3.8%) and median (3.9%), with a low standard deviation (1.1%), showing low dispersion, while skewness is negative (-1.1%) which means that distribution is left side tailed. Debt/Equity ratios shows higher variability with a standard deviation of 1.5%. Positively skewed distribution concludes that part of firms has higher leverage ratios, but the big proportion of data remains closer to median. Spread variable has the highest kurtosis (34.637), showing a peaked distribution with heavy tails. Profitability shows a negative skewness (-3.056) with a minimum and maximum range from -1.036 to 0.309, suggesting that while most observants remain moderately profitable, a large proportion of firms shows substantial losses, reflecting the overall distribution’s symmetry. Lsize, which is the natural logarithm of firms` size is showing remarkable stable results, looking to mean of 7.053 and median of 7.051 and normal distribution as kurtosis is 2.748. Firms with high stock returns, tangibility and growth, in contrary to extreme values, may use assets more efficiently or considered as a growth oriented in the market, reflecting financial and investment decisions.

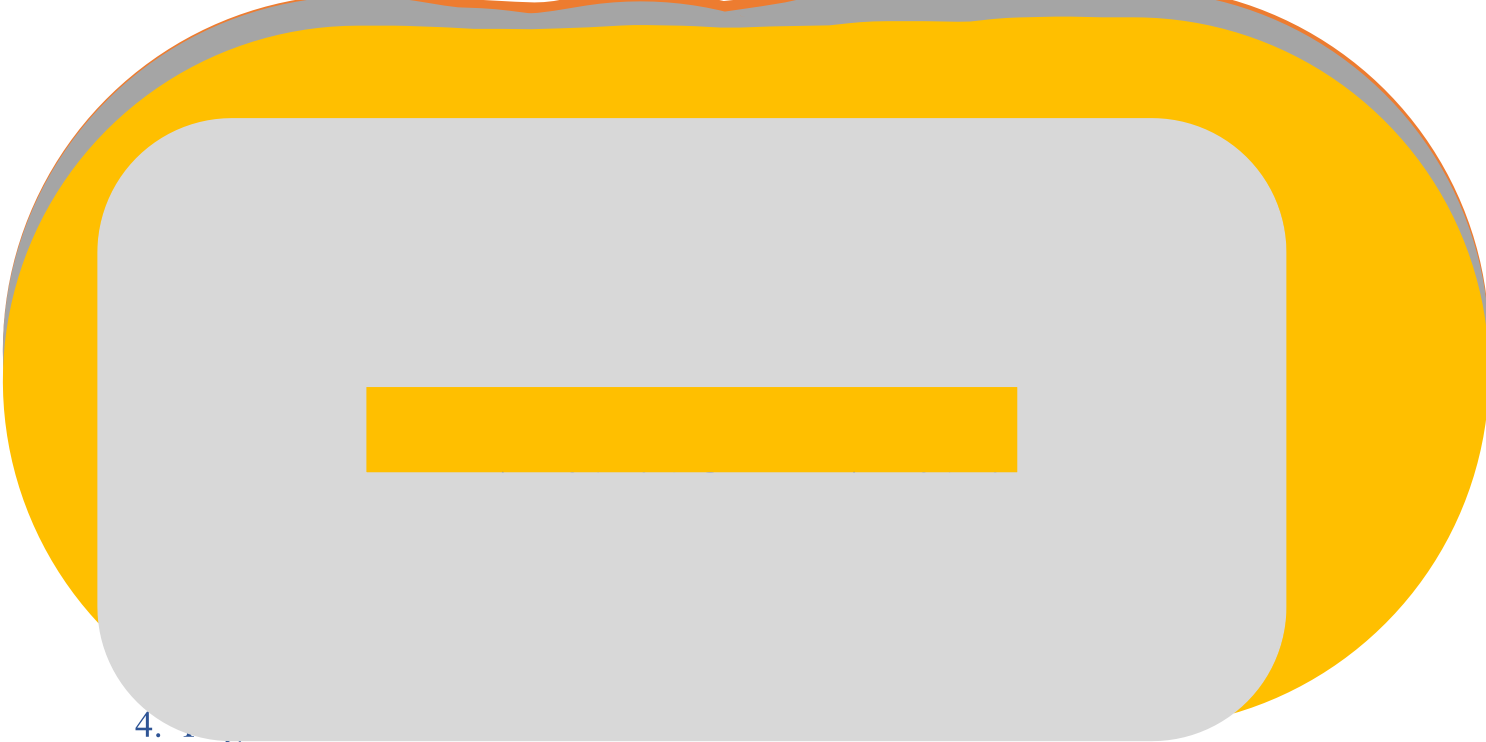
Table 2 indicates descriptive statistics of debt ratio by industry and the respective industry category by each dummy.

Table 2 Descriptive Statistics of debt ratios across the industry dummies

GIC Sectors	**Dummy**	**Weight (%)**	**Mean (%)**	**Median (%)**	**SD (%)**
Communication Services	**D1**	4.51%	21.40%	21.60%	11.88%
Consumer Discretionary	**D2**	12.28%	18.86%	18.00%	11.49%
Consumer Staples	**D3**	4.49%	18.24%	18.80%	9.72%
Energy	**D4**	7.56%	21.04%	20.60%	10.81%
Financials	**D5**	19.83%	10.01%	6.40%	10.28%
Health Care	**D6**	13.44%	15.21%	13.30%	12.05%
Industrials	**D7**	14.32%	17.04%	16.70%	10.16%
Information Technology	**D8**	12.76%	12.28%	10.80%	9.77%
Materials	**D9**	6.12%	17.23%	17.10%	9.03%
Real Estate	**D10**	1.65%	26.87%	28.50%	11.95%
Utilities	**D11**	3.04%	22.14%	21.60%	6.60%

The result indicates that sectors belong to Communication Services, Energy, Real Estate and Utilities tends on average to have more percentage of debt compared to the other industry categories. The Debt/Equity standard deviation for Real Estates, Communication Services, Consumer Discretionary, Health Care is higher across the year and industries which means they are more dispersed over industry mean. Looking to the weight, we can observe that 5 out of 11 sectors like Consumer Discretionary, Financials, Health Care, Industrials and Information Technology in total consists 72.63% of the overall dataset.

The graph 1, show the mean descriptive statistic over the year 2000-2022. We can observe that all the results for mean, median and standard deviation are increasing till year 2008, while after 2008 there is decrease in the results. In 2014 these variables are touching previous values of 2008 followed by further growth.



4.

4.1.1 Estimation of the initial models

Table 3 provides the results of implementing three different regression models on the data used.

Table 3. Estimation of the results

VARIABLES	(Pooled OLS) D/E	(Fixed Effect) D/E	(Random Effect) D/E
Risk-Free	-0.524***	-0.244***	-0.241***
	(0.0331)	(0.0284)	(0.0276)
Spread	0.287***	0.0219	0.0336
	(0.0408)	(0.0305)	(0.0304)
Profitability	-0.00546**	-0.0667***	-0.0558***
	(0.00224)	(0.00231)	(0.00219)
Non-Debt tax shield	0.625***	0.287***	0.359***
	(0.0116)	(0.0145)	(0.0134)
Volatility	0.0445***	-0.00408	-0.00491
	(0.00509)	(0.00832)	(0.00700)
Lsize	0.00611***	0.00835***	0.00882***
	(0.000191)	(0.000329)	(0.000289)
Tangibility	0.0703***	0.0772***	0.0756***
	(0.00190)	(0.00249)	(0.00231)
Growth	-0.000343***	-0.000185***	-0.000217***
	(7.44e-05)	(5.82e-05)	(5.76e-05)
Net Debt/EBITDA	0.00603***	0.00228***	0.00255***
	(6.71e-05)	(5.15e-05)	(5.12e-05)
Stock return	-0.00181***	-0.00258***	-0.00252***
	(0.000495)	(0.000340)	(0.000340)
Constant	0.0885***	0.0855***	0.0810***
	(0.00227)	(0.00313)	(0.00294)
Observations	81,476	81,476	81,476
R-squared	0.170	0.079	
Number of ID		6,611	6,611

*Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1*

The initial regression models show the impact of chosen financial metrics on the Debt to Equity ratio using three methodologies, including Pooled Ordinary Least Squares (Pooled OLS), Fixed Effects, and Random Effects, using a dataset with 81.476 observations. The models analyse several variables, including risk-free rates, spread (cost of debt minus the risk free rate), firms` size, profitability, volatility, and other factors.

The risk-free rate consistently shows a negative coefficient across all three models, suggesting that when the risk-free rate increases, the leverage level (D/E ratio) generally decreases. This result is consistent with Modigliani and Millier`s (1958) theory under the assumption of no taxes. Increasing risk-free rates usually results in increase of the cost of debt, making less attractive taking debt in comparison to equity financing, thus decreasing the D/E ratio. This behaviour shows consistency with the monetary policy impacts behaviour context of Bernanke et al. (1999) paper. However, it is crucial to interpret coefficients of this regression within the context of each econometric model. First Pooled OLS Model is designed to define a broad, complex perspective across all firms, proposing a strong converse relationship between the firms` leverage and risk-free rate. Compared to other two models, it has larger coefficient of -0.524 showing a more explicit response across the entire sample. Fixed Effects Model focuses on variations within each firm over time. The coefficient of -0.244 shows that, when risk-free rate increases, there is consistent but less obvious trend to decrease the leverage. Random Effects Model like fixed effects, considers variations withing and across firms but assumes that some constant features can reflect all firms. The coefficient of -0.241 is close to fixed effect model, highlighting a consistent within firm and inter-firm decrease in leverage when risk free rates are increasing, but considering some unobserved effects which are common across firms.

Looking to the variable spread, which is chosen as a second metric for analysing interest rate, we can observe that it shows a positive impact on D/E ratio in the Pooled OLS model, suggesting that wider spreads between cost of debt and risk free rate are linked with increased leverage. This result can be explained by the trade-off theory of capital structure, which proposes that firms might increase leverage to take advantage of tax shields on debt interest, when the cost of debt is significantly higher than risk-free rate (Kraus and Litzenberger, 1973). Moreover the paper by Flannery and Rangan (2006) shows that firms adjust their capital structures according to changing market conditions, which could reflect the spread. Despite trade-off theory suggestions, it is also important to mention that a reverse causality exists. Firms that have more leverage could face higher risk spreads.

The profitability metric shows a negative coefficient with D/E, indicating that more profitable firms prefer to use less debt. This can be explained with the pecking order theory (Myers, 1984), which suggests that firms prefer internal financing instead of external debt when internal funds are sufficient. Firm size has a positive coefficient, suggesting that larger firms tend to use debt more. Larger firms have more diversified operations and relatively lower risk level, giving them possibilities in a debt market (Titman and Wessels, 1988). Volatility shows a positive coefficient in Polled OLS model, but not significant in Fixed Effect and Random Effect models. Non-Debt Tax Shield has a strong positive correlation on all three models. This is consistent with trade-off theory, which suggests that firms with higher non-debt tax shields (depreciation over total assets) might use more leverage as they can save more income from taxes (DeAngelo and Masulis, 1980). Assets are reducing the risk of lending being as collateral, which may encourage having more leverage (Myers, 1977). This is consistent with our results as tangibility shows positive correlation with D/E. Stock Return and Growth have negative statistical significancy on all three models.

4.2 Test for Model Selection

Table 4 show tests that are executed for defining the best suitable econometric model for the dataset, more specifically comparing Fixed and Random Effects over the OLS model as well as Hausman Test.

Table 4. Appropriate model defining tests

Test between FE-OLS	17.10 (0.000)
Test between RE-OLS	5.1e+35(0.000)
Hausman Test	2563.70(0.000)

Test between FE – OLS and RE – OLS

These tests compare the Fixed Effects and Random Effects models, against the Pooled OLS model. A significant test statistic (17.10 for Fixed Effect and 5.1e+35 for Random Effect) with p-values of 0, concludes that both RE and FE models shows significantly fits better to the data compared to Pooled OLS model.

Hausman test

Third test is Hausman Test that is to decide between RE and FE. A significant test statistic (2563.70 with p-value of 0) shows that using Fixed Effect model is more appropriate for this dataset, indicating that the unique errors of individual firms are correlated with the regressors, breaking one of the main assumptions of the Random Effects model.

The results of these tests shows that Fixed Effects model is preferred over Random Effects and Pooled OLS models for our dataset. According to statistically significant results, it accounts more efficiently for firm variations and heterogeneity, which are not captured by the other two models, enhancing the validity and reliability of analysing dataset.

4.3 Test of Heteroscedasticity

Table 5 represents the results of three diagnostic tests to define heteroscedasticity, model specification errors and decide whether Fixed Effect is more appropriate than Random Effect.

Table 5. Test of Heteroscedasticity for Pooled OLS, Fixed and Random Effects models

Test	Pooled OLS model	Fixed effect model	Random effect model
Breusch-Pagan Test	328.19 (0.0000)	-	-
White Test	23963.56 (1.000)	-	-
Chi-test		5.1e+35 (0.000)	12.21 (0.0000)

The Breusch-Pagan test is being used for checking heteroscedasticity – the condition where the variance of the error terms differs across residuals. The test statistic is 328.19, while p-value is 0, which confirms the heteroscedasticity in the Pooled OLS. The White test shows unexpectedly high p-value of 1 and test statistic of 23963.56. The results of Chi-test shows that both Fixed and Random Effect models are more preferred over Pooled OLS. Hausman test result from previous analysis concludes that Fixed Effect model should be preferred over other two models, because of its ability to handle correlated individual effects.

4.4 Test for autocorrelation

The Wooldridge test for autocorrelation in panel data presented below, specifically is being used for the first-order autocorrelation test. The null hypothesis (H0) proposes that there is no first-order autocorrelation.

$$F(1, 1) = 71.912 \quad \textit{(F-statistic value)}$$

$$Prob > F = 0.0000 \quad \textit{(P-value)}$$

Autocorrelation is also violation of OLS assumption that error terms are not related. The above results show that null hypothesis is do not accepted as p-value is less than 0.05 and there is an issue of autocorrelation in the model.

4.1.2 Heteroscedasticity adjusted estimation of the models

Table 6. Estimation of the results

VARIABLES	(POLS) D/E	(FE) D/E	(RE) D/E
Risk-Free	-0.202***	-0.114**	-0.203***
	(0.0250)	(0.0573)	(0.0251)
Spread	-0.0248	-0.103***	-0.0247
	(0.0283)	(0.0239)	(0.0284)
Profitability	-0.0303***	-0.0698***	-0.0303***
	(0.00238)	(0.00641)	(0.00324)
Non-Debt Tax Shield	0.220***	0.218***	0.220***
	(0.00945)	(0.0403)	(0.0151)
Volatility	0.00574	-0.00302	0.00576
	(0.00460)	(0.0359)	(0.00742)
Lsize	0.00250***	0.00770***	0.00250***
	(0.000134)	(0.00122)	(0.000264)
Tangibility	0.0339***	0.0702***	0.0339***
	(0.00134)	(0.00721)	(0.00230)
Growth	-0.000108	-0.000120	-0.000108
	(7.63e-05)	(0.000120)	(0.000101)
Net Debt/EBITDA	0.00242***	0.00200***	0.00242***
	(7.29e-05)	(0.000120)	(0.000122)
Stock Return	-0.00731***	-0.00459***	-0.00731***
	(0.000440)	(0.000415)	(0.000433)
L.de	0.727***	0.356***	0.727***
	(0.00356)	(0.0124)	(0.00858)
Constant	0.0200***	0.0349***	0.0200***
	(0.00165)	(0.0106)	(0.00261)
Observations	74,867	74,865	74,865
R-squared	0.626	0.206	
Number of ID		6,476	6,476

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

Table 6 represents estimation of the regression adjusted the heteroscedasticity problem, so that the results are robust now. Additionally, the autocorrelation problem is also solved by including lag of dependent variable (L.de), which helps to capture of the dynamic aspects of financial decisions, providing a more accurate presentation of leverage behaviour. The coefficients are also differed from first model in table 5, because there is a problem of autocorrelation, beside heteroscedasticity. As a result, number of observations and unique firms are dropped from 81476 and 6611 to 74865 and 6476 respectively. After the adjustments Spread variable lost its significancy in POLS but became statistically significant with negative sign on Fixed Effects model. Risk-free rate is still negatively correlated with Debt-to-Equity, showing 5% statistical significancy in Fixed Effects instead of 1% in initial model. Tangibility and Profitability holds their statistical significance and direction on both models, showing their consistent impact of the D/E ratio. Volatility keeps statistical insignificancy in Fixed and

Random Effects model, while in Pooled OLS, it also became insignificant. Growth showing statistical insignificancy across all models after the adjustments.

4.5 Corporate Leverage Analysis using Pooled OLS Model: Examining the Impact of Spread, Risk-Free, and Interest Rates

Table 7. Estimation of the regression

Variables	(Spread only) D/E	(Risk-free only) D/E	(Interest rates only) D/E	(Interest rates not included) D/E	(Full Model) D/E
Spread	1.017***		1.041***		0.287***
	-0.0424		-0.0423		-0.0408
Risk-free		-0.771***	-0.793***		-0.524***
		-0.0348	-0.0347		-0.0331
Profitability				-0.00953***	-0.00546**
				-0.00223	-0.00224
Lsize				0.00664***	0.00611***
				-0.000187	-0.000191
Growth				-0.000269***	-0.000343***
				-7.44E-05	-7.44E-05
Tangibility				0.0751***	0.0703***
				-0.00188	-0.0019
Non-Debt Tax Shield				0.621***	0.625***
				-0.0114	-0.0116
Volatility				0.0556***	0.0445***
				-0.00505	-0.00509
Net Debt/EBITDA				0.00608***	0.00603***
				-6.72E-05	-6.71E-05
Stock return				-0.00191***	-0.00181***
				-0.000494	-0.000495
Constant	0.144***	0.188***	0.174***	0.0648***	0.0885***
	-0.000724	-0.00138	-0.00149	-0.00166	-0.00227
Observations	81,479	81,479	81,479	81,479	81,479
R-squared	0.007	0.006	0.007	0.167	0.17

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Table 7 shows a series of regression analysis meaning the impact of different factors on the Debt-to-Equity ratio across different models, giving a detailed explanation of how individual and combined factors influence leverage. These models include variables to isolate the effects of Spread and Risk-free rates, a combination of both (named as "Interest rates only") and "Full model" which includes all the variables. According to the results, all analyzed independent variables are statistically significant at 1% level, except Profitability with 5%. The correlation matrix of the variables used can be found in Table 2 of the Attachments part of the thesis.

First model labeled “Spread only” shows a significant positive impact of Spread on Debt-to-Equity ratio. The second “Risk-Free only” model is statistically significant negative relationship between Debt-to-Equity and risk-free rate, proposing that higher risk-free rates result in decreasing leverage level. These results are consistent with the work of Flannery and Rangan (2006), who analyzed the sensitivity of capital structure to interest rate changes, suggesting that individual interest rate components can uniquely affect corporate leverage decisions. “Interest rates not included” model checks the robustness of other variables\` influence on Debt-to-Equity excluding the market conditions influence, focusing on firm specific and operational factors. Looking to the “Interest rates only model”, we can conclude that both factors keep their sign and significance from the previous individual models, confirming the robustness of their influence when consider combined. Finally, “Full model” show expected signs and maintain statistical significance, confirming variables\` individual effect to leverage decisions.

4.6 Estimation of the model with industry dummies

Referring to the literature review, we can conclude that industry sector analysis have a significant impact on a corporate financing decisions. Industries differing widely in their asset structure, capital intensity and growth opportunities, all of which can reflect the leverage (Rajan and Zingales 1995). For instance, firms that rely more on assets or have consistent cast flows tend to use more leverage because of the lower risk of financial distress costs and having an option to provide tangible assets as collateral. Following these theories, industry related analysis was added to the dissertation.

Table 8 represents the results of regression, including the dummy variables of industries. First column shows the results by excluding independent Spread variable, then results where Risk Free rate is not considering. The next model represents results, where both Spread and Risk Free excluded from model and labeled as “Without interest rate”. Finally, it shows Full model, where all the independent variables are included to the model.

Table 8. Estimation of the regression with industry dummies using Fixed Effects model.

Variables	(Without Spread)	(Without Risk Free)	(Without interest rate)	(Full model)
Risk-Free	-0.486***			-0.487***
	-0.033			-0.0331
Spread		-0.0167		0.00545
		-0.0453		-0.0453
Profitability	-0.0362***	-0.0405***	-0.0404***	-0.0362***
	-0.00236	-0.00235	-0.00234	-0.00236
Lsize	0.00617***	0.00674***	0.00674***	0.00617***
	-0.000198	-0.000195	-0.000195	-0.000199
Growth	-0.000479***	-0.000421***	-0.000421***	-0.000479***
	-7.45E-05	-7.45E-05	-7.45E-05	-7.45E-05
Tangibility	0.0828***	0.0855***	0.0855***	0.0828***
	-0.00206	-0.00206	-0.00206	-0.00206
Non-Debt Tax Shield	0.372***	0.351***	0.351***	0.372***
	-0.0132	-0.0132	-0.0132	-0.0132
Volatility	-0.0113**	-0.00577	-0.00577	-0.0113**
	-0.00534	-0.00533	-0.00533	-0.00534
D1 Communication Services	-0.0348***	-0.0338***	-0.0340***	-0.0348***
	-0.00276	-0.0028	-0.00276	-0.0028
D2 Consumer Discretionary	-0.0329***	-0.0322***	-0.0325***	-0.0329***
	-0.00236	-0.00244	-0.00236	-0.00243
D3 Consumer Staples	-0.0426***	-0.0421***	-0.0423***	-0.0426***
	-0.00272	-0.00279	-0.00273	-0.00279
D4 Energy	-0.0165***	-0.0149***	-0.0152***	-0.0165***
	-0.00254	-0.00261	-0.00255	-0.00261
D5 Financials	-0.107***	-0.107***	-0.107***	-0.107***
	-0.00226	-0.00226	-0.00226	-0.00226
D6 Healthcare	-0.0706***	-0.0698***	-0.0700***	-0.0707***
	-0.00242	-0.0025	-0.00243	-0.00249
D7 Industrials	-0.0542***	-0.0531***	-0.0533***	-0.0542***
	-0.00233	-0.00241	-0.00234	-0.00241
D8 Information Technology	-0.102***	-0.102***	-0.102***	-0.102***
	-0.00239	-0.00245	-0.00239	-0.00245
D9 Materials	-0.0502***	-0.0492***	-0.0494***	-0.0503***
	-0.00256	-0.00263	-0.00257	-0.00263
D10 Real Estate	0.0568***	0.0586***	0.0586***	0.0568***
	-0.00351	-0.00351	-0.00351	-0.00351
o.Utilites	-	-	-	-
Constant	0.172***	0.149***	0.149***	0.172***
	-0.00313	-0.00272	-0.00271	-0.00313
Observations	81,479	81,479	81,479	81,479
R-squared	0.175	0.173	0.173	0.175

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Based on the results, we can conclude that the idea to exclude the industry spread in the regression didn't show statistical significancy, comparing to the full model, as the first model include all variables including industry dummies and the variable "Spread" - which is indirectly a representation of the industry, and this could result a duplication of industry specification represented in the model. The results of the first and last models (without Spread and Full model) are slightly different in terms of statistical significance and coefficients.

The correlation matrix of the variables used can be found in Table 3 of Attachments part of the thesis.

Looking to the industry effects across models, it is clear that all the industry sectors are statistically significant. "Real Estate" industry shows a positive correlation, while 9 other industries have a negative correlation. The positive coefficients for "Real Estate" industry sector could be supported by the capital structure theories in Titman and Wessel`s (1988) work, which mentions the benefits of tangible assets in leveraging. Firms from this sector usually tend to have high levels of tangible assets, increasing cheaper secure borrowing. "Financials" and "Information Technology" sectors show the strongest negative influence on a leverage. This could be because of the higher regulatory capital requirements, especially on "Financials" sector.

In first two models, without spread and without risk-free rates, industry coefficients remain mainly unchanged in sign and significance. This means that capital structure of industries is not only defined by these macroeconomic metrics, but also by other specific industry characteristics. Finally, in the full model where all variables are considered, the significance and size of the coefficients for "Financials" and "Real Estate" sectors remain unchanged across all models, underlining the robustness of industry sector effects independent of other firm specific and macroeconomic factors.

4.7 Estimation of the model with multiplicate dummies

The main goal of next analysis is to find a specific reliance between external financial conditions (Risk Free rates) and internal industry characteristics in defining corporate structures. Adding interaction terms between Risk-Free rate and industry dummies provides a deeper analysis on how industry specific factors change the impact of macroeconomic conditions on leverage decisions. This approach is especially valuable in exploring whether some industries are more reflected by economic changes, which can influence strategic financial management and policy definition.

Accordingly, analysis in Table 9 shows the interaction effects between risk-free rates and industry classifications.

Table 9. Estimation of the regression with multiplicative dummies

Variables	**(Without Spread)**	**(Without Risk Free)**	**(Without interest rates)**	**(Full model)**
Spread		-0.0167		0.00545
		-0.0453		-0.0453
Risk-Free	-0.184***			-0.201***
	-0.0497			-0.0499
Profitability	-0.0322***	-0.0332***	-0.0334***	-0.0318***
	-0.00235	-0.00233	-0.00233	-0.00235
Lsize	0.00607***	0.00612***	0.00613***	0.00605***
	-0.000199	-0.000198	-0.000198	-0.000199
Growth	-0.000470***	-0.000454***	-0.000457***	-0.000468***
	-7.48E-05	-7.47E-05	-7.47E-05	-7.48E-05
Tangibility	0.0856***	0.0865***	0.0864***	0.0856***
	-0.00205	-0.00204	-0.00204	-0.00205
Non-Debt Tax Shield	0.442***	0.435***	0.436***	0.442***
	-0.0132	-0.0131	-0.0131	-0.0132
Volatility	0.00372	0.00369	0.00378	0.0036
	-0.00534	-0.00533	-0.00533	-0.00534
D1 Communication Services x RF	0.376***	0.273***	0.271***	0.388***
	-0.0588	-0.0516	-0.0516	-0.0588
D2 Consumer Discretionary x RF	0.298***	0.182***	0.191***	0.297***
	-0.0454	-0.0352	-0.0351	-0.0454
D3 Consumer Staples x RF	0.180***	0.0633	0.0729	0.180***
	-0.0568	-0.049	-0.0489	-0.0568
D4 Energy x RF	0.692***	0.585***	0.594***	0.692***
	-0.0516	-0.0442	-0.0442	-0.0516
D5 Financials x RF	-1.240***	-1.314***	-1.350***	-1.189***
	-0.0454	-0.0359	-0.0343	-0.0473
D6 Healthcare x RF	-0.533***	-0.652***	-0.642***	-0.533***
	-0.0475	-0.0374	-0.0373	-0.0475
D7 Industrials x RF	-0.133***	-0.248***	-0.239***	-0.134***
	-0.045	-0.035	-0.0349	-0.045
D8 Information Technology x RF	-1.325***	-1.440***	-1.433***	-1.323***
	-0.0457	-0.0353	-0.0353	-0.0457
D9 Real Estate x RF	2.751***	2.685***	2.649***	2.800***
	-0.0849	-0.081	-0.0803	-0.0859
D10 Utilites x RF	1.278***	1.212***	1.170***	1.334***
	-0.0647	-0.0591	-0.0578	-0.0664
Constant	0.107***	0.101***	0.103***	0.105***
	-0.00226	-0.00215	-0.00205	-0.00234
Observations	81,479	81,479	81,479	81,479
R-squared	0.164	0.164	0.164	0.164

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The structure of the regression remains the same with previous table, having which includes and excludes "Spread" and "Risk Free" and final model where all dependent variables are included.

The Risk-free rate shows a negative impact on the dependent variable, suggesting that higher rates result to decreased leverage, because of the increased cost of debt. Variable "Spread" in this model is statistically insignificant. In addition to “Spread”, only “Volatility” show insignificancy, while all other independent variables are statistically significant in this model. Significant industry interaction effects show different levels of sensitivity to the risk-free rate. For instance, the “Financials” and “Information technology” sectors show significant negative interaction, meaning that changes in risk-free rates have an explicit effect on the leverage of these sectors. Firms that belong to “Healthcare” and “Industrials” sectors also have a negative relation with the leverage. On the other hand, sectors like “Communication Services”, “Consumer Discretionary”, “Consumer Staples” the multiplicative dummy with Risk-free show varying positive responses, while “Energy”, “Real Estate”, “Utilities” have particularly strong positive interaction. It potentially could be explained by these sectors` dependency on financing for large-scale projects.

5. Conclusion

This dissertation analyzed how firms` capital structure decisions are reflected by monetary policy changes, specifically exploring this dynamic using both Risk-Free rates and “Spread”, which is being calculated as the difference between cost of debt and risk-free rate across 11 industries. The paper used a robust empirical approach, as well as incorporations of Trade-Off, Pecking Order, Agency costs and Market Timing theories to show a detailed analysis of capital structure dynamics under various economic conditions.

The analyses showed that Risk-Free rates have a negative impact on Debt-to-Equity, meaning that when risk free rates increase, the leverage of firms are decreasing. This result is consistent with Market Timing Theory, which proposes that higher rates increase debt costs, thus making less attractive the use of the leverage. However, “Spread” variable showed opposite results, suggesting that even during high interest rates, firms might increase use of debt, perhaps to keep in rates before expected further growth. This positive relationship, while being statistically significant, potentially could be caused by the inaccurate data. Around 34% of data for the cost of debt in Compustat was missing and in order to not exclude big portion of data from the analysis, it was decided to use Damadoran`s web site industry cost of debt data to fill the missing gaps, which could potentially lead to inappropriate results.

Adding multiplicative dummies to analyze interactions between industry classifications and risk-free rates also gave insights. The positive interaction of “Real Estate” sector shows the dependency of this sector on financing the long-term projects, indicating a strategic increase in leverage to finance ongoing and future activities before further hikes of interest rates. “Utility” sector also presented positive interaction effect, suggesting that firms in this sector may increase their leverage despite the rising interest rates, potentially due to the predictability of cash flows and regulation environment that provides stable revenue generation. On the other hand, “Information Technology” sector displays strongly negative interaction effect. This potentially could be because of the higher cost of debt for this industry, being riskier and having less tangible assets to provide as collateral.

The findings show that while traditional capital structure metrics like firms` size, profitability, tangibility are relevant, the addition of interest rate variables and industry interactions helps to understand better leverage dynamics. The study reveal that there is no single optimal theory that can accurately predict capital structure behavior under changing economic conditions.

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7. Attachments

Table 1. GIC 11 industry classification description

Dummy	GICS Sector	SIC Code Range	Description
D1	Communication Services	4800-4899	Telecommunications Services
D2	Consumer Discretionary	2300-2399, 2500-2599, 2700-2799, 3000-3199, 3600-3659, 3700-3799, 3900-3999	Automobiles, Home Builders, Apparel, Hotels, Restaurants
D3	Consumer Staples	0100-0999, 2000-2299, 2400-2499, 2640-2659, 2700-2749, 5000-5199	Food & Staples Retailing, Beverages, Tobacco, Food Products
D4	Energy	1200-1399, 2900-2999	Oil & Gas Exploration, Coal Mining, Refineries, Drilling
D5	Financials	6000-6799	Banks, Savings & Loans, Brokers, Asset Managers
D6	Health Care	8000-8099, 2830-2839, 3693-3693, 3840-3859	Health Care Providers, Biotechnology, Medical Equipment
D7	Industrials	1500-1799, 2000-3999 (Excluding ranges listed under other sectors)	Machinery, Construction, Defense, Aerospace, Engineering
D8	Information Technology	3570-3579, 3660-3692, 3694-3699, 3810-3839, 7370-7379	Computers, Semiconductors, Software, Hardware
D9	Materials	1000-1499, 2800-2899, 3200-3569	Chemicals, Construction Materials, Metals & Mining, Paper
D10	Real Estate	6500-6599	Real Estate Management & Development, REITs
D11	Utilities	4900-4949	Electric, Gas, Water Utilities

Table 2. Correlation matrix of financial metrics.

	Profitability	*D/E*	*Non-Debt Tax Shield*	*Volatility*	*Lsize*	*Tangibility*	*Growth*	*Net Debt/EBITDA*	*Stock return*	*Risk-free Rate*	*Spread*
Profitability	1	0.0318	-0.0843	-0.4907	0.4034	0.1416	-0.0047	0.0475	0.0366	0.0757	-0.0535
D/E	0.0318	1	0.1994	0.0103	0.1109	0.1775	-0.0124	0.3178	-0.0216	-0.0773	-0.0414
Non-Debt Tax Shield	-0.0843	0.1994	1	0.2297	-0.1548	0.1006	0.0001	0.0439	0.0025	0.0934	0.0183
Volatility	-0.4907	0.0103	0.2297	1	-0.4120	-0.1224	0.0644	-0.0403	0.0567	-0.0478	0.0539
Lsize	0.4034	0.1109	-0.1548	-0.4120	1	0.0847	-0.0384	0.0726	-0.0751	-0.1531	-0.0495
Tangibility	0.1416	0.1775	0.1006	-0.1224	0.0847	1	0.0601	0.0853	-0.0177	-0.0855	-0.0022
Growth	-0.0047	-0.0124	0.0001	0.0644	-0.0384	0.0601	1	-0.0192	0.1050	-0.0587	0.0099
Net Debt/EBITDA	0.0475	0.3178	0.0439	-0.0403	0.0726	0.0853	-0.0192	1	-0.0059	-0.0431	-0.0045
Stock return	0.0366	-0.0216	0.0025	0.0567	-0.0751	-0.0177	0.1050	-0.0059	1	-0.0203	0.0237
Risk-free Rate	0.0757	-0.0773	0.0934	-0.0478	-0.1531	-0.0855	-0.0587	-0.0431	-0.0203	1	0.0064
Spread	-0.0535	-0.0414	0.0183	0.0539	-0.0495	-0.0022	0.0099	-0.0045	0.0237	0.0064	1

Table 3. Correlation matrix of Risk-Free rate, Spread, and GIC Industry Dummies

	Risk-free Rate	***Spread***	***D1***	***D2***	***D3***	***D4***	***D5***	***D6***	***D7***	***D8***	***D9***	***D10***	***D11***
Risk-free Rate	1	0.0064	-0.0006	-0.0048	-0.0021	0.0437	0.0162	-0.0562	0.0032	0.0366	-0.0117	0.0093	-0.0253
Spread	0.0064	1	-0.0706	-0.0030	-0.0038	-0.0034	0.0006	0.0170	-0.0164	0.0190	0.0015	-0.0054	-0.0040
D1	-0.0006	-0.0706	1	-0.0606	-0.1404	-0.0250	-0.0486	-0.0654	-0.0514	-0.0660	-0.0078	-0.0528	-0.0375
D2	-0.0048	-0.0030	-0.0606	1	-0.1044	-0.0955	-0.0554	-0.1006	-0.1270	-0.0977	-0.0555	-0.0452	-0.0331
D3	-0.0021	-0.0038	-0.1404	-0.1044	1	-0.1529	-0.0886	-0.1611	-0.2033	-0.1563	-0.0889	-0.0723	-0.0529
D4	0.0437	-0.0034	-0.0250	-0.0955	-0.1529	1	-0.0811	-0.1475	-0.1861	-0.1431	-0.0813	-0.0662	-0.0485
D5	0.0162	0.0006	-0.0486	-0.0554	-0.0886	-0.0811	1	-0.0855	-0.1079	-0.0829	-0.0471	-0.0384	-0.0281
D6	-0.0562	0.0170	-0.0654	-0.1006	-0.1611	-0.1475	-0.0855	1	-0.1960	-0.1507	-0.0857	-0.0697	-0.0510
D7	0.0032	-0.0164	-0.0514	-0.1270	-0.2033	-0.1861	-0.1079	-0.1960	1	-0.1902	-0.1081	-0.0880	-0.0644
D8	0.0366	0.0190	-0.0660	-0.0977	-0.1563	-0.1431	-0.0829	-0.1507	-0.1902	1	-0.0831	-0.0677	-0.0495
D9	-0.0117	0.0015	-0.0078	-0.0555	-0.0889	-0.0813	-0.0471	-0.0857	-0.1081	-0.0831	1	-0.0385	-0.0281
D10	0.0093	-0.0054	-0.0528	-0.0452	-0.0723	-0.0662	-0.0384	-0.0697	-0.0880	-0.0677	-0.0385	1	-0.0229
D11	-0.0253	-0.0040	-0.0375	-0.0331	-0.0529	-0.0485	-0.0281	-0.0510	-0.0644	-0.0495	-0.0281	-0.0229	1