The Impact of Interest Rate Volatility on the Leverage Choices of S&P500 US-Listed Firms

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Abstract

This thesis examines how interest rate volatility affects the borrowing decisions of S&P500 listed companies. The study includes data from 205 S&P 500 companies from 2000 to 2023 in order to explore how interest rate volatility impacts capital structure decisions. By using panel data regression models, it analyzes both long-term and short- term interest rate changes, along with firm-specific factors, to understand leverage decisions during a 24-year period. The results show that interest rate volatility has a big impact on leverage, especially long-term, which discourages borrowing due to financial risks. Firm-specific factors like cash flow strength, size, and market-to-book ratios play a key role in shaping borrowing strategies. Industry-specific differences matter less overall, though Technology and Telecommunications firms are more likely to reduce leverage when faced with long-term volatility. This is probably because these sectors rely on intangible assets and have less predictable revenues. For most other industries, macroeconomic conditions and firm-level traits are more important. These findings give useful insights for financial managers to create flexible borrowing strategies and for policymakers to ensure stable borrowing conditions during periods of economic uncertainty.

Keywords: Interest Rate Volatility; Borrowing Decisions; Capital Structure; Leverage; Financial Risk; Macroeconomic Conditions; Crisis.

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Resumo

Esta tese analisa o impacto da volatilidade das taxas de juro nas decisões de endividamento de empesas nos Estados Unidos. O estudo inclui dados de 205 empresas do índice S&P 500 entre 2000 e 2023, e explora a forma como a volatilidade das taxas de juro influencia as decisões de estrutura de capital. Através de modelos de regressão linear com dados em painel, avaliam-se variações de taxas de juro de longo e curto prazo, juntamente com fatores específicos das empresas, para compreender as decisões de alavancagem em períodos económicos incertos. Os resultados mostram que a volatilidade das taxas de juro tem um impacto significativo nas decisoes de endividamento, especialmente em taxas de longo prazo, que desencorajam o endividamento devido aos riscos financeiros. Fatores como fluxos de caixa, tamanho da empresa e capitalizacao de mercado têm um papel importante na definição das estratégias de financiamento. Diferenças entre setores são, no geral, menos relevantes, embora os setores de Tecnologia e Telecomunicações reduzam mais a divida perante volatilidade de longo prazo, devido à dependência de ativos intangíveis e receitas imprevisíveis. Estas conclusões oferecem *insights* úteis para que os gestores criem estratégias de financiamento flexíveis e para *decision-makers* políticos para que criem condições estáveis de financiamento em períodos de incerteza económica.

Palavras-Chave: Volatilidade das Taxas de Juro; Decisões de Empréstimo; Estrutura de Capital; Endividamento; Riscos Financeiros; Condições Macroeconómicas; Crise. **Título:** O Impacto da Volatilidade das Taxas de Juro nas Escolhas de Endividamento das Empresas Cotadas no S&P500.
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1. Introduction

The decisions that firms make regarding their capital structure, meaning the adopted mix of debt and equity, are paramount for the process of risk management, and for achieving strategic objectives. Capital structure decisions are influenced by a range of firm-specific, industry dynamic, and macroeconomic parameters. Out of all the key variables at the macro level that might influence leverage choices, interest rate volatility directly affects the uncertainty in the costs of borrowing and consequently, the access to debt financing by firms. While capital structure theories like the Trade-Off Theory and the Pecking Order Theory provide a foundational framework from which to set grounded understanding of leverage behavior, much of the nuanced effects of short-term and long-term interest rate volatility across industries and economic cycles remain underexplored.

This paper discusses the extent to which shifts in long-term and short-term interest rate volatility impact the leverage decisions of S&P500 listed companies, with a special focus on interactions between uncertainty in the cost of borrowing, while controlling for firm characteristics, industry-specific factors, and macroeconomic shocks. The forces that might drive leverage choices in periods of economic stability and turbulence are investigated empirically by means of panel data for 205 firms in the S&P500 over the period from 2000 to 2023.

What is suggested by the estimated results is that there are heterogeneous responses to short- and long-term interest rate volatilities. In particular, the 10Y Treasury Yield, adopted as a proxy for long-term volatility, negatively affects the choice of leverage and thus shows how firms reduce their dependence on debt when presented with uncertain borrowing costs. On the other hand, short-term volatility proxied by Federal Funds Rate is positively related to leverage, suggesting that firms may opportunistically use short-term debt in order to endure volatile financing conditions. The divergence in these findings therefore suggests the need to distinguish between short-term and long-term interest rate volatility in studies of capital structure determination. In general, the analysis supports the idea that interest rate volatility impacts leverage decisions, whether it is positively or negatively.

As part of alternative model specifications, crisis dummies for the Dot-Com Bubble (2000-2002), the 2008 Financial Crisis (2007-2009), and the COVID-19 pandemic period (2020-2021) were included. The findings indicate that even though leverage is found to decline during these crises, reflecting cautious financing behavior of firms and/or constraints in access to credit, the negative relationship between leverage and long-term interest rate volatility remains intact.

The study also includes an approach that evaluates how different industries might play a role in leverage decisions. When interaction terms between industry dummies and the interest rate volatility measures are added to the model, the previously significant relationship between interest rate volatility and leverage becomes non-significant. These results show that the impact of interest rate volatility is overshadowed by other factors when we account for industry-specific dynamics.

This thesis contributes to the literature on corporate financial behavior by integrating the impact of macroeconomic factors, firm-specific variables, and industry-level heterogeneity on leverage decisions. The findings can provide some useful implications for financial managers in optimizing their capital structure in response to interest rate volatility and to policymakers who want to gauge the broader economic implications of interest rate policies. The results, set against both theoretical frameworks and real-life decision-making, provide a good basis for further research into the dynamic relationship between macroeconomic volatility and corporate finance.

2. Literature Review

Over the years, much research has been done to understand how firms choose their preferred capital structure. According to Myers (2001), capital structure refers to the combination of different financial sources through which companies finance their investments. It is about an optimal mix between debt, equity, and internal financing, which can help a firm to give support to its investments. This balance between debt and equity has a very significant role in defining the value of a firm. To better understand the driving factors for these capital structure decisions, it is worthwhile to begin by considering the foundational theories that were set out by Modigliani and Miller (1958) and whose findings laid the bedrock for modern capital structure models.

2.1. Modigliani and Miller

Modigliani and Miller’s (1958) paper on capital structure argues that a firm’s financing choices do not influence its value as long as we assume that the market is perfect. Perfect markets have no transaction costs, taxes, bankruptcy costs, agency costs, or information asymmetry. Miller

(1977) added to this by adding personal taxes to the previous considerations. He concluded that although debt financing is appealing due to the tax deductibility of interest expenses, this advantage is counterbalanced by the fact that equity financing receives more favorable tax treatment. For example, dividends and capital gains from equity may be taxed at lower rates than the interest income from debt.

2.2. The Trade-Off Theory

Building on Modigliani and Miller’s capital structure irrelevance theory, the Trade-Off Theory suggests that companies try to find the right balance between the advantages and disadvantages of taking on debt. Kraus and Litzenberger (1973) built the fundamentals for this theory, suggesting that the optimal level of leverage results from weighting the tax advantages of debt against the risk of bankruptcy. Adding to this, DeAngelo and Masulis (1980) presented the idea of corporate tax shield substitutes, which refers to tax benefits similar to those gained through debt. This concept further explores the existence of an optimal leverage point when the market is in equilibrium.

Agency costs are also a key consideration in the Trade-Off Theory, as discussed by Stulz (1990) and Morellec (2003). They highlighted that conflicts between managers and shareholders can significantly influence a company's capital structure decisions. Morellec elaborated further, noting that such conflicts often lead high-growth firms to maintain lower levels of debt. He also emphasized the importance of managerial discretion, as leadership decisions regarding capital structure can vary widely. Stulz emphasized two main risks that come with managerial discretion: the risk of overspending when management takes on too many projects, and the risk of underspending when they argue there aren't enough resources for promising opportunities. Because both debt and equity address one issue while complicating the other, finding the right balance becomes essential for shaping a firm’s capital structure.

When it comes to interest rates impact on leverage, the Trade-Off Theory is particularly relevant. Firms might adjust debt levels as a reaction to volatile interest rates to avoid the financial risk associated with a possible rising of borrowing costs. When interest rates are higher, companies may prefer lower debt levels to reduce the risk of financial distress, while lower interest rates could encourage borrowing more to benefit from the tax advantages.

2.3. The Pecking Order Theory

Contrary to the previous model, the Pecking Order Theory presented by Myers (1984) proposes that firms do not seek a single optimal capital structure. Instead, they prioritize internal financing over debt and only resort to the issuance of equity as a last option. This theory predicts a hierarchy in financial choices in which firms prefer to use internally generated funds first, then debt and equity only when necessary. From an outsider's perspective, equity is seen as a riskier option compared to debt due to issues like adverse selection. However, for company insiders, retained earnings are viewed as the most attractive form of financing. According to Myers (2001), issuing debt reduces information asymmetry by counteracting the information advantage that corporate managers naturally have.

The Pecking Order Theory defends that firms generally prefer debt to equity due to lower perceived risks and costs. However, interest rate volatility might disrupt this suggested order. When borrowing costs are more volatile, firms may hesitate to issue debt, fearing the higher likelihood of financial distress. Therefore, interest rate fluctuations could significantly influence a firm's decision to act contrary to the traditional pecking order, especially if facing volatile financial markets.

2.4. The Determinants of Capital Structure

The theories previously discussed offer some general guidelines on how firms tend to make financing decisions. However, real-world conditions often force companies to deviate from these models. Capital structure decisions are highly sensitive to external economic factors, particularly during times of uncertainty, like financial crises (Graham et al., 2014). The 2008 global financial crisis and the COVID-19 pandemic are good examples that illustrate how companies adjust debt levels in response to economic disruptions. The analysis of these two events further contributed to support the idea that firms' reliance on debt over equity shifts as the risks and uncertainty of the economic environment change (Demirgüç-Kunt et al., 2015).

Research shows that companies tend to decrease their leverage during periods of crisis. For example, Graham et al. (2014) observed in their studies that firms reduce their debt level in uncertain times due to fewer investment opportunities. Similarly, Campello et al. (2010) found that companies tend to avoid the use of external funds during economic downturns mainly because of the higher costs of borrowing.

D'Amato (2019) explored the financing choices of Italian small and medium-sized enterprises (SMEs) during the 2008 financial crisis, providing more insights into how economic conditions might influence capital structure decisions. He found out that these firms significantly cut down on debt financing, especially short-term loans. D'Amato's research highlights the higher volatility of short-term debt compared to long-term debt, further contributing to supporting the idea that companies adjust their financing strategies in response to shifting credit conditions.

The patterns studied by D'Amato (2019) are not exclusive to smaller businesses. Larger firms in countries like the UK, France, and Germany also adjusted their leverage during and after the 2008 crisis. Iqbal and Kume (2014) noted that companies with lower-than-average leverage before the crisis gradually increased their debt levels during the crisis, while firms with higher leverage experienced a sharp reduction in debt following the crisis. This might indicate that firms adjust their capital structures based on prevailing market conditions and their financial standing before the downturn.

2.5. The Role of Interest Rates

Unlike the sudden disruptions witnessed during crises, interest rates shift gradually but can still significantly influence how firms approach borrowing. Understanding how companies adjust leverage in response to volatile interest rates can help us have a more complete view on how macroeconomic factors can shape financing decisions. Bhamra et al. (2009) highlight how macroeconomic conditions, like earnings and consumption growth, influence firms' leverage decisions, a reasoning that can be used to help understand how interest rate volatility might impact firms' capital structure.

Firms are often strategic in their timing of debt issuance, especially when borrowing costs are favorable. Research by Campello et al. (2010) shows that managers not only time equity markets but also tend to issue debt when interest rates are lower, using market conditions to guide financing decisions. Barry et al. (2008) further support this debt market timing behavior and found that companies are more likely to issue debt when interest rates are below historical averages, even excluding refinancing. This suggests that firms strategically issue new debt to take advantage of lower interest rates, reducing their interest payments.

The authors also concluded that the extent to which firms engage in debt market timing varies. Firms with high leverage and less financial flexibility are typically less responsive to interest rate changes. Opposingly, larger and more profitable firms are in a better position to be able to time the market and benefit from favorable borrowing conditions.

These aforementioned findings suggest that interest rate volatility can have a crucial role in leverage decisions, with firms adjusting their capital structures in response to changing borrowing costs.

2.5.1. Differences Across Industries

The impact of interest rate volatility on leverage decisions diverges across industries. Capital-intensive industries are more sensitive to changes in borrowing costs, given that their long-term investment plans heavily rely on external financing sources. For these firms, higher interest rates can significantly increase the cost of capital, resulting in the reduction of leverage financing to avoid financial distress. Conversely, technology firms, which typically have lower debt levels, are less vulnerable to fluctuations in interest rates (Graham & Harvey, 2001). These industry-specific differences highlight the importance of considering sectoral variations when assessing how interest rate changes impact capital structure decisions.

Ferri and Jones (1979) were among the first to establish a relationship between debt levels and industry classification. Bradley et al. (1984) provided strong evidence that firms within the same industry tend to exhibit similar leverage ratios, reflecting common characteristics such as asset types and business risks.

2.6. Gaps in the Literature

While there is a lot of research on how companies adjust their capital structures during financial crises, there is still a noticeable gap when it comes to studying how firms react to interest rates. Most studies focus on events like the 2008 financial crisis or the COVID-19 pandemic, which highlight economic downturns or credit market disruptions, but these do not deeply develop the role that interest rates play. Yet, interest rates are a crucial macroeconomic factor as they directly influence borrowing costs and, consequently, firms' leverage decisions. This thesis aims to fill this gap, offering some insights into how U.S. companies adapt their capital structure considering interest rates, a particularly important topic in today's uncertain financial environment.

3. Methodology

This section outlines the methodology employed to examine the impact of interest rates on the leverage of S&P500 listed companies, both generally and across industries. The analysis focuses on testing the hypothesis:

H1: Interest rate volatility affects S&P500 US-listed firms' leverage decisions.

To ensure robust and relevant insights, the data collection, cleaning, and analysis methods were carefully selected and grounded in prior literature.

3.1. Data Sources

The dataset that is used in this study includes yearly financial data for firms listed in the S&P500 index from January 2000 to December 2023, retrieved from DataStream. A list of all S&P500 constituents during the considered period was extracted, and then, some data cleaning procedures were applied to improve the relevancy of the sample for this analysis. Firms that were delisted during the considered period were removed, leaving a final sample of 205 companies. This approach ensures consistency in the dataset by focusing only on firms that were continuously part of the S&P500 index throughout the 24-year period. The decision to focus on S&P500 firms was driven by the fact that it includes the largest and most influential companies in the U.S., meaning that they are a great reflection of how big corporations operate and perform. Also, these firms provide reliable and detailed financial information since they follow strict reporting rules, making data easier to access and consistent with reality. Finally, the S&P500 constituents are well-known to investors, analysts, and policymakers, making the findings of the research more relevant and useful to a wide audience.

The dataset includes critical financial variables such as Total Debt, Total Assets, EBIT, Cash Flows to Sales, Market-to-Book Ratio, Total Shareholders' Equity, Market Capitalization, and Current Ratio. These independent variables were chosen based on their high usage in various studies of capital structure and leverage decisions, this way ensuring that this analysis captures some of the key determinants of corporate leverage.

To control for the potential influence of industry characteristics in leverage choices, industry classification information for each firm was obtained from DataStream using the Industry Classification Benchmark (ICB). Financial firms were excluded from the sample, following established practices in the literature. As highlighted by Fama and French (1992), financial services firms exhibit unique capital structures characterized by significantly higher leverage norms, which are influenced by regulatory requirements and their reliance on debt-based funding. Additionally, their heightened sensitivity to macroeconomic factors, such as interest rates, differs fundamentally from non-financial firms, potentially biasing the analysis if included. Excluding financial firms ensures the comparability of results across non-financial sectors and strengthens the focus on understanding leverage dynamics within this subset of firms.

To assess the impact of interest rates on leverage, this study incorporates measures of interest rate volatility for both long-term and short-term rates. The 10-Year Treasury Yield, a 10Y Treasury Yield backed by the U.S. Government, is included as a proxy for long-term interest rates. As a widely recognized economic benchmark influencing borrowing costs across markets (Baldridge, 2023), it serves as the primary independent variable in the baseline analysis. Interest rate volatility for the 10-Year Treasury Yield is measured by computing its annual standard deviation using monthly data retrieved from the Federal Reserve Economic Data (FRED) database. Using this methodology allows to capture the fluctuations in long-term interest rates, providing a representation of the risks firms face when relying on debt financing.

The Federal Funds Rate, which represents the overnight interest rate at which banks lend to each other, is included in the analysis as an alternative measure of interest rates in model variations. Changes in the Federal Funds Rate directly influence short-term borrowing costs for financial instruments and corporate credit (Economy at a Glance - Policy Rate, n.d.). Like the 10-Year Treasury Yield, the annual standard deviation of the Federal Funds Rate was computed using monthly data from FRED, capturing short-term interest rate volatility and providing a complementary perspective on the impact of borrowing costs on leverage decisions.

By combining firm-level financial data, industry classifications, and macroeconomic indicators, the dataset enables a comprehensive examination of how interest rates and other factors influence leverage decisions among S&P500 listed companies across industries and during periods of economic stability and disruption. This rigorous approach ensures the relevance and reliability of the data for addressing the research objectives.

3.2. Definition of Variables

3.2.1. Dependent Variable | Leverage

There are various ways to define leverage ratio among the diverse literature. In this analysis, the leverage formula will be the same as used by Ferri and Jones (1979), which is total debt over total assets. The authors argue that the use of this ratio was adopted for “conceptual simplicity” and due to the variables’ ability to reflect a firm’s reliance on borrowed funds.

$$Leverage_{i,t} = Total\ Debt_{i,t} \div Book\ Value\ of\ Total\ Assets_{i,t}$$[1]

3.2.2. Independent Variables | Interest Rate Volatility

Interest rate volatility in this study is measured using the annual standard deviation of the 10-Year Treasury Yield, which is a key benchmark often considered risk-free because it is backed by the US Government. This rate is widely seen as an important indicator for borrowing costs in financial markets (Baldridge, 2023). By including it as the main measure of long-term interest rate volatility, the analysis focuses on how shifts in this rate influence companies' decisions about long-term debt. This measure will be referred to as SD_10YTY.

To capture short-term interest rate volatility, the study also looks at the Federal Funds Rate. The Federal Funds Rate is the overnight rate that banks charge each other for loans, and it directly affects short-term borrowing costs for businesses (Economy at a Glance - Policy Rate, n.d.). Adding the Federal Funds Rate as a secondary measure helps the study explore how short-term changes in borrowing costs might influence firms' more immediate financial strategies. This measure will be referred to as SD_FFR.

For both the 10-Year Treasury Yield and the Federal Funds Rate, volatility is calculated in the same way, using the annual standard deviation of monthly data. This keeps the approach consistent and makes it easier to compare how firms react to changes in short-term versus long-term interest rates.

3.2.3. Control Variable | Cash Flow Efficiency

Cash flow efficiency in this analysis will be measured as operating cash flows over sales. It reflects a firm's ability to generate cash from its core operating activities relative to its revenue. Rujoub et al. (1995) highlight the importance of measuring the change in the value of cash flow components as a critical practice in determining a firm's future success. Including it as a control variable will allow controlling for the impact of internal liquidity creation on leverage decisions and will isolate the effect of interest rate volatility.

$$Cash\ Flow\ to\ Sales_{i,t} = Operating\ Cash\ Flows_{i,t} \div Total\ Sales_{i,t}$$

3.2.4. Control Variable | Growth Prospects

[1] Firm *i* and year *t*

The market-to-book ratio is calculated as the market value of equity over the book value of equity. Penman (1996) argues in his research that the market-to-book ratio is the appropriate indicator of earnings growth because it reflects future profitability. A higher ratio indicates that the market values the firm more than the value in the balance sheet. Controlling for this ratio helps to capture the influence of growth potential on a firm's leverage decisions.

$$Market - to - Book_{i,t} = Market\ Value\ of\ Equity_{i,t} \div Book\ Value\ of\ Equity_{i,t}$$

3.2.5. Control Variable | Size

As a measure of firm size, this study will consider the natural logarithm of total assets as was used by Ferri and Jones (1979). By including a firm size as a control variable, the analysis will consider the influence of size-related factors on leverage decisions.

$$Size_{i,t} = Log(Total\ Assets)_{i,t}$$

3.2.6. Control Variable | Liquidity

Lemke (1970) mentions in his paper that various studies in the US report the current ratio as crucial in determining a firm's creditworthiness and that the same ratio may also help determine internal allocation of capital resources. Therefore, the measure for liquidity in this analysis will be the current ratio which is calculated as a firm's current assets over its current liabilities. It reflects the ability to meet short-term obligations using short-term assets. Including this variable as a control helps to account for the impact of a firm's short-term financial health on leverage decisions.

$$Current\ Ratio_{i,t} = Current\ Assets_{i,t} \div Current\ Liabilities_{i,t}$$

3.2.7. Control Variable | Crisis

The Crisis variable is a binary dummy variable that equals 1 during defined economic crisis periods and 0 otherwise. Crisis periods are identified as the Dot-Com Bubble (2000–2002), the Global Financial Crisis (2007–2009), and the COVID-19 pandemic (2020–2021). This variable is included in the model variations to enhance robustness by capturing potential differences in the determinants of firm leverage during periods of economic turmoil compared to normal conditions.

3.3. Model Specifications

The statistical model employed for this analysis examines the impact of long-term interest rates on S&P500 firms' leverage decisions, using panel data with time-varying firm characteristics. The dependent variable in all models is $Leverage_{i,t}$ and the independent variable is the standard deviation of the 10-Year Treasury Yield ($SD\_10YTY_{i,t}$). To control for firm-specific factors that influence leverage, the following explanatory variables are included: $Cash\ Flow\ to\ Sales_{i,t}$, $Market-to-Book_{i,t}$, $Size_{i,t}$, and $Current\ Ratio_{i,t}$.

The baseline model is specified as:

$$(1)\quad Leverage_{i,t} = \beta_1 + \beta_2 SD\_10YTY_{i,t} + \beta_3 Cash\ Flow\ to\ Sales_{i,t} + \beta_4 Market-to-Book_{i,t} + \beta_5 Size_{i,t} + \beta_6 Current\ Ratio_{i,t} + \mu_{i,t}$$

Where β_1 is the intercept term, β_2 captures the effect of interest rates on leverage, and $\mu_{i,t}$ represents the error term.

To ensure robustness and account for unobserved heterogeneity across industries, the analysis incorporates industry fixed effects accompanied by interaction terms between industry dummies and the interest rate measure. By introducing industry dummies (D1-D10) and interaction terms (D1*10Y to D10*10Y) the model controls for industry-specific characteristics that may influence leverage. The interaction model is specified as:

$$(2)\quad Leverage_{i,t} = \beta_1 + \beta_2 SD\_10YTY_{i,t} + \beta_3 Cash\ Flow\ to\ Sales_{i,t} + \beta_4 Market-to-Book_{i,t} + \beta_5 Size_{i,t} + \beta_6 Current\ Ratio_{i,t} + \sum_{1}^{10} \delta D_k + \gamma_1 D1*10Y + \gamma_2 D2*10Y + \gamma_3 D3*10Y + \gamma_4 D4*10Y + \gamma_5 D5*10Y + \gamma_6 D6*10Y + \gamma_7 D7*10Y + \gamma_8 D8*10Y + \gamma_9 D9*10Y + \gamma_{10} D10*10Y + \mu_{i,t}$$

Where, δ_k (for k = 1, ..., 10), represents the indutsry dummies that refer to indutsry fixed-effects and γ_k (for k = 1, ..., 10) represents the interaction terms for each of the 10 industries, with definitions provided in the Appendix, being Industry 7 (Real Estate) ommited due to multicollinearity. The inclusion of industry fixed effects and industry interaction terms ensures that the observed relationship between interest rates and leverage remains robust after accounting for structural differences across sectors, such as variations in asset tangibility or revenue stability.

3.4. Model Variations for Robustness

To test the robustness of the findings, two key variations of the base model are introduced:

- The SD_FFR is used as an alternative proxy for interest rates, differing from the SD_10YTY on the fact that this measure is short-term. The structure of the model and the explanatory variables remain unchanged, allowing a clear assessment of how the choice of interest rate measure affects the relationship between borrowing costs and leverage. Industry fixed effects are also included in the models using the same structure, ensuring that robustness is tested across different interest rate measures.

(3) $$Leverage_{i,t} = \beta_1 + \beta_2 SD\_FFR_{i,t} + \beta_3 Cash\ Flow\ to\ Sales_{i,t} + \beta_4 Market - to - Book_{i,t} + \beta_5 Size_{i,t} + \beta_6 Current\ Ratio_{i,t} + \mu_{i,t}$$

(4) $$Leverage_{i,t} = \beta_1 + \beta_2 SD\_FFR_{i,t} + \beta_3 Cash\ Flow\ to\ Sales_{i,t} + \beta_4 Market - to - Book_{i,t} + \beta_5 Size_{i,t} + \beta_6 Current\ Ratio_{i,t} + \sum_{1}^{10} \delta D_k + \gamma_1 D1 * 10Y + \gamma_2 D2 * 10Y + \gamma_3 D3 * 10Y + \gamma_4 D4 * 10Y + \gamma_5 D5 * 10Y + \gamma_6 D6 * 10Y + \gamma_7 D7 * 10Y + \gamma_8 D8 * 10Y + \gamma_9 D9 * 10Y + \gamma_{10} D10 * 10Y + \mu_{i,t}$$

- A dummy variable for economic crisis periods is added to the model to examine whether the relationship between interest rates, leverage, and other explanatory variables differs during periods of financial disruption. The crisis dummy captures periods of heightened economic uncertainty, specifically the Dot-Com Bubble (2000–2002), the 2008 Financial Crisis (2007–2009), and the COVID-19 pandemic (2020–2021). This variation provides additional insights into how macroeconomic disruptions, such as financial crises, interact with interest rates and firm characteristics to influence leverage decisions.

(5) $$Leverage_{i,t} = \beta_1 + \beta_2 SD\_10YTY_{i,t} + \beta_3 Crisis + \beta_4 Cash\ Flow\ to\ Sales_{i,t} + \beta_5 Market - to - Book_{i,t} + \beta_6 Size_{i,t} + \beta_7 Current\ Ratio_{i,t} + \mu_{i,t}$$

And with industry fixed-effects plus industry * interest rate interaction terms:

(6) $$Leverage_{i,t} = \beta_1 + \beta_2 SD\_10YTY_{i,t} + \beta_3 Crisis + \beta_4 Cash\ Flow\ to\ Sales_{i,t}$$

$$+ \beta_5 Market - to - Book_{i,t} + \beta_6 Size_{i,t} + \beta_7 Current\ Ratio_{i,t}$$

$$+ \sum_{1}^{10} \delta D_k + \gamma_1 D1 * 10Y + \gamma_2 D2 * 10Y + \gamma_3 D3 * 10Y$$

$$+ \gamma_4 D4 * 10Y + \gamma_5 D5 * 10Y + \gamma_6 D6 * 10Y + \gamma_7 D7 * 10Y$$

$$+ \gamma_8 D8 * 10Y + \gamma_9 D9 * 10Y + \gamma_{10} D10 * 10Y + \mu_{i,t}$$

3.5. Descriptive Statistics

Table 1 presents descriptive statistics for all financial metrics included in the model, displaying mean, standard deviation, minimum and maximum, skewness, and kurtosis for a sample dataset with 34 440 observations.

Table 1*- Descriptive Statistics Before Winsorizing. Leverage, Cash Flows to Sales, SD_10YTY and SD_FFR values are in percentage format where Mean for Leverage reads 0.299 or 29.9%. Market-to-Book and Current Ratio are expressed as a ratio. Size is a natural logarithm.*

Variables	Mean	Median	Std. Dev.	Min	Max
Leverage	0.299	0.283	0.171	0.000	2.560
CashFlowsSales	0.170	0.144	0.118	-2.655	0.916
MarkettoBook	3.740	2.730	52.249	-1481.45	1513.530
Size	7.250	7.252	0.525	5.576	8.902
CurrentRatio	1.536	1.320	0.874	0.180	9.590
SD_10YTY	0.195	0.199	0.061	0.094	0.348
SD_FFR	0.091	0.065	0.082	0.010	0.302

The results in Table 1 show significant differences between the minimum and maximum values. For instance, the Market-to-Book ratio ranges from -1481.45 to 1513.53, while Cash Flows to Sales spans from -2.655 to 0.916. These extreme values suggest the presence of outliers, which can distort the analysis and reduce its reliability. To address this, winsorization was applied at the 1st and 99th percentiles, effectively removing the most extreme top and bottom 1% of values. This approach reduces the influence of outliers while retaining the core structure of the data, ensuring the results are more reliable.

Table 2*- Descriptive Statistics After Winsorizing at 1%. Leverage, Cash Flows to Sales, SD_10YTY and SD_FFR values are in percentage format where Mean for Leverage reads 0.299 or 29.9%. Market-to-Book and Current Ratio are expressed as a ratio. Size is a natural logarithm.*

Variables	Mean	Median	Std. Dev.	Min	Max
Leverage	0.299	0.283	0.171	0.000	2.560
CashFlowsSales	0.168	0.144	0.097	0.000	0.372
MarkettoBook	3.824	2.730	3.348	0.000	13.890
Size	7.250	7.252	0.525	5.576	8.902
CurrentRatio	1.536	1.320	0.874	0.180	9.590
SD_10YTY	0.195	0.199	0.061	0.094	0.348
SD_FFR	0.091	0.091	0.082	0.010	0.302

The SD_10YTY and SD_FFR are relatively stable with means of 19.5% and 9.1%, respectively, and with standard deviations of 6.1% and 8.2%. Both distributions are close to being symmetric, with only a slight positive skewness and modest kurtosis values. This low variability suggests a consistent interest rate environment during the analyzed period.

Leverage and Current Ratio have more variability and heavier tails, as suggested by the higher skewness and kurtosis values. Leverage has a mean of 29.9%, with a standard deviation of 17.1%, being right-skewed (2.5) with a kurtosis of 26.6. The Current Ratio has a mean of 1.5, a standard deviation of 0.9, and is rightly skewed (skewness of 2.3 and kurtosis of 12.4). The characteristics of these variables suggest that while most firms maintain moderate levels of debt and liquidity, a group of them takes significantly higher leverage or holds larger liquidity reserves. The existence of these outliers can be an indicator of firms having distinct levels of risk tolerance or financial strategies.

Contrarily, Cash Flows to Sales and Size show more balanced distributions. Cash Flows to Sales has a mean of 16.8% with a standard deviation of 9.7%, and Size has a mean of 7.3 with a low standard deviation of 0.5. Both variables have nearly normal distributions as indicated by the low skewness and kurtosis values.

The Market-to-Book Ratio has a mean of 3.8 and a standard deviation of 3.3. The right skew (1.8) and moderate kurtosis (5.5) indicate that while many firms have market-to-book ratios that are close to the average value, some of them present significantly higher valuations which might be indicative of growth-oriented strategies of firms with high market expectations.

Overall, applying winsorization helped to smooth out extreme values, creating a dataset with distributions that are closer to normal and more suitable for regression analysis.

Table 3*- Descriptive Statistics of Leverage across industry dummies.*

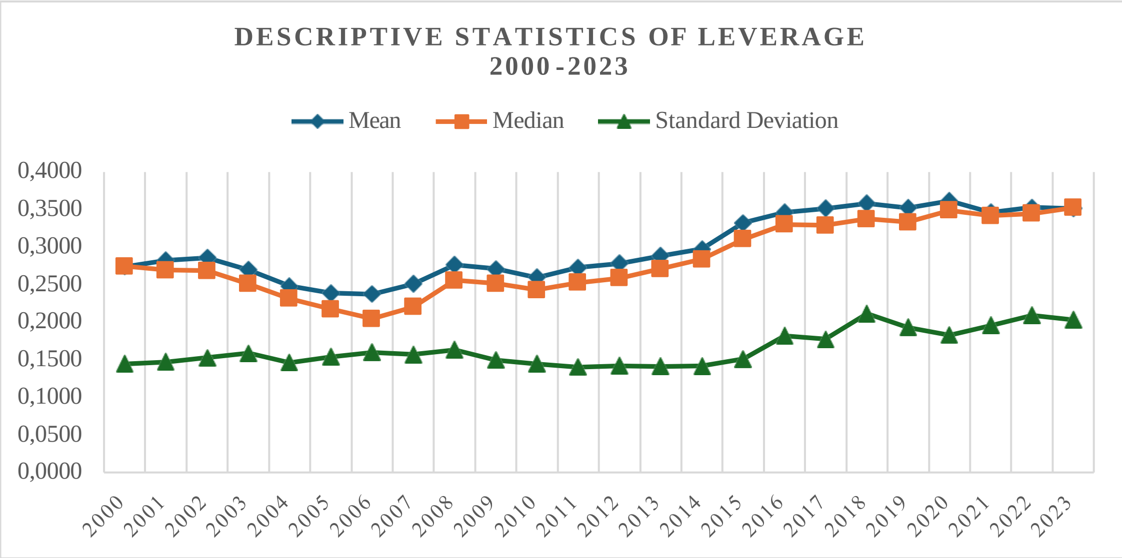
Industry	Dummy	Obs	Weight (%)	Mean (%)	Std. Dev. (%)
Basic Materials	D1	336	6.83	28.00	9.80
Consumer Discretionary	D2	1032	20.98	30.50	23.30
Consumer Staples	D3	504	10.24	34.20	14.80
Energy	D4	360	7.32	25.40	13.30
Healthcare	D5	384	7.80	29.50	16.80
Industrials	D6	1104	22.44	30.50	15.50
Real Estate	D7	24	0.49	36.10	4.90
Technology	D8	504	10.24	18.90	15.20
Utilities	D9	144	2.93	30.60	14.00
Telecommunications	D10	528	10.73	38.40	8.30

The Industrial sector has the highest representation, accounting for 22.44% of the dataset, followed by Consumer Discretionary (20.89%) and Utilities (10.73%). On the other hand, Real Estate accounts for only 0.49% of the sample, which may limit the possibility of generalizing the analysis' insights for this industry.

Utilities and Real Estate show the highest average leverage ratios at 38.4% and 36.1%, respectively. This suggests that firms in these sectors tend to rely more heavily on debt financing. This is consistent with their capital-intensive nature. Technology has the lowest mean leverage at 18.9%, indicating a lower reliance on debt that reflects the sector's preference for equity financing and growth-focused strategies likely due to the high intangibility of its assets.

Consumer Discretionary has the highest standard deviation in leverage (23.3%), which suggests significant variability within the industry. This could reflect the diverse nature of the sector, which includes both high-debt and low-debt firms. In contrast, Real Estate, Utilities, and Basic Materials have relatively lower standard deviations (4.9%, 8.3%, and 9.80%, respectively), suggesting that firms within these sectors tend to have more consistent leverage ratios, possibly because of more standardized financing practices.

Graph 1- *Evolution of Mean, Median, and Standard Deviation of Leverage from 2000-2023.*



Graph 1 shows that Leverage levels among the firms in the sample have stayed relatively steady over the past two decades, with a slight upward trend in both the average and typical Leverage (mean and median, respectively). This gradual increase suggests that firms have generally become slightly more confident in taking on debt. This is particularly noticeable after the 2008 financial crisis, possibly related to the economic recovery and historically low interest rates that might have made borrowing more attractive. An interesting detail is the fact that the gap between the mean and median is consistent over the years, corroborating the fact that a group of firms consistently holds much higher levels of debt than the rest. At the same time, the stability of the standard deviation line suggests that, even with some firms carrying higher debt over the years, the overall spread of leverage across companies has not changed much.

4. Estimation of Results

4.1. Estimation of the General Regression Model

Table 4- *Estimation of the Regression Model of Equation [1]: This table presents the results of panel regressions analyzing the relationship between the SD_10YTY, firm-level variables, and Leverage. Each model includes the Cash Flows to Sales, Market-to-Book, Size, and the Current Ratio as explanatory variables. Standard errors are reported in parentheses, and significance levels are indicated by ***(1%), **(5%), and *(10%).*

	(1)	(2)	(3)
SD_10YTY	-0.120***		-0.127***
	(0.0405)		(0.0392)
Cash Flows/Sales		0.143***	0.142***
		(0.0293)	(0.0292)
Market-to-Book		0.004***	0.003***
		(0.0009)	(0.0009)
Size		-0.019***	-0.020 ***
		(0.0066)	(0.0066)
Current Ratio		-0.058***	-0.058***
		(0.0034)	(0.0033)
Constant	0.323***	0.488***	0.522***
	(0.00829)	(0.0499)	(0.0518)
N	4920	4920	4920
Adjusted R^2	0.002	0.089	0.091
F-Statistic (p-value)	8.865 (0.0029)	111.6 (0.0000)	93.70 (0.0000)

Table 4 presents regression results examining the impact of the SD_10YTY on firm leverage, alongside firm-specific control variables. The results show that the SD_10YTY consistently has a negative and statistically significant coefficient across all models. This suggests that higher long-term interest rate volatility is associated with lower leverage, possibly due to firms having concerns about the uncertainty in future borrowing costs. The increased volatility raises the risk of financial distress, pushing firms to adopt more conservative capital structures and reduce their reliance on debt. This behavior aligns with the Trade-Off Theory (Kraus and

Litzenberger, 1973), which explains the balance firms seek between the tax benefits of debt and the costs of potential financial distress.

Regarding the firm-specific variables, Cash Flows to Sales shows a positive and significant coefficient, which suggests that firms with stronger cash flows tend to use more debt. This might be because stronger cash flows improve a firm's creditworthiness, allowing for easier access to more favorable debt financing options. Similarly, the Market-to-Book ratio is positively associated with leverage, showing that growth-oriented firms might strategically use debt to fund new investment opportunities.

On the other hand, Size and the Current Ratio are negatively associated with leverage. Larger firms, which generally have more stable cash flows and easier access to equity markets, are less dependent on debt financing, likely due to the fact that the cash flows are sufficient to support the financing activities, lowering the need to rely on debt. On the exact same line of thought, firms with higher liquidity, as indicated by their Current Ratio, tend to rely on internal financing rather than external debt, reflecting a more cautious and conservative financial strategy.

The explanatory power of the models improves as more variables are added, with the adjusted R^2 increasing from 0.002 to 0.091. Although the adjusted R^2 remains relatively low, the highly significant F-statistics confirm that the models are meaningful overall in explaining variations in leverage.

Overall, the results in Table 4 show that higher long-term interest rate volatility is associated to a noticeable reduction in leverage, emphasizing how uncertainty around interest rates plays a key role in shaping corporate financing decisions. At the same time, firm-specific factors like cash flows, growth opportunities, size, and liquidity remain important determinants of leverage. These results support the hypothesis (H1) that interest rate conditions play a critical role in shaping firms' capital structure choices.

Table 5*- Estimation of the Regression Model of Equation [2]: This table presents the results of panel regressions estimating the determinants of firm leverage, incorporating interaction terms between the SD_10YTY and industry dummy variables (D1×10Y to D10×10Y) to capture the heterogeneous effects of interest rates across industries. The dependent variable in all models is firm leverage, and the key explanatory variables include the SD_10YTY, Cash Flows to Sales, Market-to-Book, Size, and the Current Ratio. Standard errors are reported in parentheses, and significance levels are denoted by ***(1%), **(5%), and *(10%).*

	(1)	(2)	(3)
SD_10YTY	-0.0264		0.0839
	(0.143)		(0.211)
Cash Flows/Sales		0.195***	0.195***
		(0.0381)	(0.0382)
Market-to-Book		0.00411***	0.00411***
		(0.000983)	(0.000983)
Size		-0.0203***	-0.0203***
		(0.00639)	(0.00639)
Current Ratio		-0.0419***	-0.0419***
		(0.00347)	(0.00347)
D1 (Basic Mat)	-0.0679**	-0.0725***	-0.0561
	(0.0327)	(0.0206)	(0.0442)
D2 (Cons Disc)	-0.0339	-0.0605**	-0.0441
	(0.0377)	(0.0287)	(0.0489)
D3 (Cons Staples)	0.0192	-0.0288	-0.0123
	(0.0354)	(0.0232)	(0.0456)
D4 (Energy)	-0.0996***	-0.128***	-0.112**
	(0.0366)	(0.0260)	(0.0468)
D5 (Healthcare)	-0.0341	-0.0482	-0.0318
	(0.0403)	(0.0319)	(0.0505)
D6 (Industrials)	-0.0585*	-0.0822***	-0.0658
	(0.0322)	(0.0207)	(0.0444)
D8 (Technology)	-0.101***	-0.107***	-0.0908*
	(0.0359)	(0.0251)	(0.0465)
D9 (Telecommunications)	0.0207	-0.00932	0.00709
	(0.0454)	(0.0359)	(0.0530)
D10 (Utilities)	-0.00486	-0.0683***	-0.0519
	(0.0304)	(0.0191)	(0.0432)
D1 × 10Y	-0.0666	-0.116	-0.200
	(0.167)	(0.0808)	(0.226)
D2 × 10Y	-0.112	-0.114	-0.198
	(0.187)	(0.120)	(0.244)
D3 × 10Y	-0.195	-0.201**	-0.284
	(0.179)	(0.0945)	(0.232)
D4 × 10Y	-0.0363	-0.0632	-0.147
	(0.183)	(0.106)	(0.236)
D5 × 10Y	-0.164	-0.247*	-0.331
	(0.204)	(0.142)	(0.255)
D6 × 10Y	0.0121	-0.0160	-0.0999
	(0.163)	(0.0784)	(0.225)
D8 × 10Y	-0.365**	-0.385***	-0.469**
	(0.183)	(0.106)	(0.237)
D9 × 10Y	-0.385*	-0.471***	-0.555**
	(0.224)	(0.156)	(0.263)
D10 × 10Y	0.143	0.167***	0.0830
	(0.155)	(0.0600)	(0.219)
Constant	0.366***	0.556***	0.540***
	(0.0279)	(0.0503)	(0.0626)
N	4920	4920	4920
Adjusted R^2	0.084	0.134	0.133
F-Statistic	48.335	59.849	57.278
(p-value)	(0.0000)	(0.0000)	(0.0000)

Table 5 looks at how leverage decisions for S&P500 firms are influenced by long-term interest rate when combined with industry-specific effects using interaction terms (D1×10Y to D9×10Y). By adding these terms, the analysis can help us to examine if the impact of long-term interest rate volatility on leverage changes between industries, while still considering company-specific characteristics.

The results show that the overall effect of the SD_10YTY is no longer statistically significant. This is different from earlier models, where a negative and significant link supported H1. This change suggests that once it is accounted for differences between industries with the interaction terms, the relationship between long-term interest rate volatility and leverage becomes less clear. Nonetheless, two interaction terms show some interesting patterns. The coefficients for Technology (D8×10Y) and Telecommunications (D9×10Y) are negative and significant. This means firms in these industries reduce their leverage more than Real Estate (the reference category) when long-term interest rate volatility increases. This makes sense because Technology firms rely a lot on intangible assets, which cannot be used as collateral easily, so they are more cautious about borrowing when borrowing costs are uncertain. Telecommunications firms, which have unpredictable revenues and require big long-term investments, are also more careful about debt during volatile times.

For most other industries, the interaction terms are not significant. This means their sensitivity to long-term interest rate volatility is not that different from Real Estate. So, while Technology and Telecommunications stand out, most industries seem to handle borrowing uncertainty in a similar way. This consistency shows that things like firm-specific traits and macroeconomic factors are more important than industry differences when it comes to deciding leverage.

Firm-specific factors still follow the earlier patterns. Firms with stronger cash flows are more likely to borrow since their cash makes it easier to manage debt. On the other hand, bigger companies and those with higher liquidity (shown by the negative coefficients for Size and Current Ratio) tend to avoid borrowing and rely more on their own funds or equity. This just proves how important company-level traits are when deciding leverage.

Adding the interaction terms makes the model a bit better, as shown by a small bump in adjusted R^2. Even though the interaction terms are not significant for most industries, the results for Technology and Telecommunications show how these sectors are more vulnerable to economic uncertainty. This proves that industries with intangible assets and unstable revenues are extra cautious about borrowing when long-term interest rates are unpredictable.

To sum up, Table 5 shows that while long-term interest rate volatility seemed like a big factor in leverage decisions before, its effect weakens when it is accounted for industry-specific differences. The interaction terms for Technology and Telecommunications highlight how sensitive these industries are to economic uncertainty. These findings show that firm-specific traits and macroeconomic factors play the biggest roles in shaping leverage decisions, but they also show the unique challenges faced by some industries during times of borrowing uncertainty.

4.2. Robustness Analysis

The robustness analysis builds on the main results by testing different versions of the model. In Tables 6 and 7, the SD_10YTY is replaced with the SD_FFR to check if a different way of measuring interest rate volatility gives the same results. Tables 8 and 9 introduce a Crisis Dummy to see how major economic downturns affect leverage decisions. These tests are meant to confirm whether the interest rate volatility findings hold up under different conditions.

In Table 6, the SD_FFR replaces the SD_10YTY as the key variable. The results show a positive and significant relationship between the SD_FFR and leverage, which is the opposite of what was found with the SD_10YTY in earlier models. This shows that firms respond differently to short-term and long-term interest rate volatility. Long-term volatility seems to discourage borrowing because of uncertainty about future costs, while short-term volatility encourages borrowing, probably because it creates opportunities for more flexible financing. The other variables remain consistent: Cash Flows to Sales is still positively linked to leverage, while Size and Current Ratio are negatively linked, further enhancing the importance of firm specific characteristics in leverage decisions.

In Table 7, interaction terms between the SD_FFR and industry dummies are added to see if industries react differently to short-term volatility. The overall coefficient for the SD_FFR is no longer significant, meaning there is no clear effect across all industries. However, there are significant interaction terms for Consumer Discretionary, Energy, Industrials, and Utilities. This means these industries are more likely to increase leverage when short-term volatility rises, compared to Real Estate, which is the reference category. This behavior can be explained by industry-specific characteristics, such as capital intensity, the availability of tangible assets for collateral, and stable cash flows that make debt financing more accessible or necessary. For example, capital-intensive industries, such as utilities and real estate, may rely on leverage to fund essential investments, even during periods of higher interest rate volatility. Similarly, industries with predictable cash flows, such as healthcare, may be less sensitive to interest rate volatility and more willing to take on additional debt to finance growth or expansion regardless of the macroeconomic conditions. For the other industries, the interaction terms are not significant, so it is harder to say how they behave.

Table 8 adds a Crisis Dummy to look at the effects of major downturns like the Dot-Com Bubble, the 2008 Financial Crisis, and the COVID-19 pandemic. The SD_10YTY is still used as the measure of interest rate volatility. The results show that the SD_10YTY is still negative and significant, which supports the main conclusion that long-term volatility discourages leverage. This suggests that firms reduce borrowing during times of uncertainty, even during crises. However, the Crisis Dummy itself is not significant, so its direct effect on leverage is unclear. This could be due to the effects of crises already being captured by other variables, such as interest rate volatility, or firm characteristics. Once again, firm characteristics' coefficients stay consistent, reinforcing the reliability of its influence on leverage decisions.

In Table 9, both the Crisis Dummy and interaction terms between the SD_10YTY and industry dummies are included. This combines the effects of crises and industry-specific dynamics for a more detailed analysis. The interaction terms for Technology and Telecommunications are significant and negative, meaning firms in these industries reduce leverage more than others when faced with long-term volatility during crises. This is likely because these industries rely heavily on intangible assets and deal with revenue uncertainty, making borrowing riskier in tough times. For the other industries, the interaction terms are not significant, and their behavior during crises is unclear. The Crisis Dummy is also not significant in this model. Reasons as to why this model presents mostly non-significant results were explored in previous sections.

Overall, the robustness analysis allows to infer that the previously observed relationship between interest rate volatility and leverage holds even when we change the model specifications, in models where industry interaction terms are not present which adds confidence to the results and further supports H1. When industry interaction terms are included in the model, the overall relationship becomes less clear as was observed in the correspondent section in the baseline analysis (Table 5). All in all, the robustness analysis partially supports H1, suggesting that interest rate volatility influences leverage choices among S&P500 firms, but this effect is contingent on the exclusion of industry-specific interactions and varies depending on the context of the analysis.

4. Conclusion

This thesis looks at how interest rate volatility affects the borrowing decisions of S&P500 listed companies, focusing on things like company characteristics, differences between industries, and economic crises. By using panel regression models, the study shows that interest rate volatility plays a role in how companies decide to use debt, while explaining the contingencies of this conclusion.

The results show that higher long-term interest rate volatility, measured by SD_10YTY, causes companies to borrow less. This matches the Trade-Off Theory, which explains that when borrowing costs are more uncertain, financial risks go up, and companies become less willing to rely on debt. This is especially true for S&P500 companies, which often depend on long-term debt and are more affected by changes in long-term rates.

Company-specific factors are proved to greatly influence borrowing decisions, with the results holding across all presented models. Companies with strong cash flows are more likely to take on debt because their financial stability helps them get better loan terms. On the other hand, larger companies and those with more liquidity usually avoid borrowing and prefer to use their own funds or equity. Companies focused on growth, shown by higher market-to-book ratios, tend to use debt more strategically to fund new investments.

To check if the results are solid, the study tested different models. Using the SD_FFR instead of the SD_10YTY showed that companies respond differently to short-term and long-term interest rate uncertainty. Long-term interest rate volatility discourages borrowing, likely because it increases uncertainty about future borrowing costs and raises the risk of financial distress. Consequently, firms respond by reducing long-term debt commitments, favoring financial stability and flexibility during the more volatile periods. On the contrary, short-term volatility shows to encourage borrowing, likely because it presents opportunities to secure favorable rates or meet immediate liquidity needs. Firms are more willing to take on short-term debt as its risks are perceived to be more manageable and aligned with opportunistic financial strategies. These contrasting effects enhance the importance of differentiating between short- and long-term interest rate volatility when analyzing leverage decisions. The study also found that during major economic crises, like the Dot-Com Bubble, the 2008 Financial Crisis, and

COVID-19, borrowing tends to drop. Even so, the connection between long-term volatility and borrowing stayed the same.

A result that holds in all 3 model variations is the fact that the analysis shows little differences between industries when it comes to how sensitive firms are to long-term and short-term interest rate volatility. This suggests that the effects of interest rate volatility on leverage decisions are driven more by firm-specific characteristics, rather than industry specifications.

These results have some useful takeaways. For financial managers, it suggests that companies should stay flexible with their debt strategies, borrowing more for the long-term during stable times and avoiding long-term debt when volatility is high. Managers in certain industries could adjust their strategies too, for example, Technology firms might focus on equity, while Utilities could look into spreading out debt to manage risks. Tools like hedging or staggered debt maturities could also help companies handle interest rate changes.

For policymakers, the results show the importance of keeping borrowing conditions stable by reducing interest rate volatility, especially during economic crises. This could encourage more investment and support financial stability. Policymakers might also consider offering help to industries that depend on debt when volatility is high.

That said, there are a few limits to the study. First, it only looks at S&P500 companies, which are big and well-established, so the results might not apply to smaller firms or companies in emerging markets. For example, the focus on S&P500 listed companies excludes insights into smaller firms or emerging markets, where interest rate effects may differ significantly. Second, using industry categories and broad measures of interest rate volatility might miss some important details about specific firms or sectors. For instance, the exclusion of financial firms, while necessary due to their regulatory constraints, limits the generalizability of the findings to other highly leveraged sectors. Finally, while the study looks at 24 years of data, it does not predict future changes in financial markets or unexpected events.

Even with these limits, the thesis helps to explain how interest rate volatility, company-specific factors, and industry differences shape borrowing decisions. The results give helpful advice to financial managers dealing with borrowing risks and to policymakers trying to understand how interest rates affect corporate debt. Overall, the thesis shows that interest rate volatility is a key factor in borrowing decisions for S&P500 listed companies, while company factors also play a big role. The results are consistent across different tests and situations, giving a strong foundation for future research on how macroeconomic uncertainty affects corporate finance.

5. Appendix

***Table 10** – Correlation Matrix between Independent Variables*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cash Flows/Sales (1)	1,000	-	-	-	-	-	-
Market-to-Book (2)	0,072	1,000	-	-	-	-	-
Size (3)	0,302	-0,055	1,000	-	-	-	-
Current Ratio (4)	0,070	-0,024	-0,254	1,000	-	-	-
10Y-Treasury Yield (5)	-0,047	-0,073	-0,063	-0,024	1,000	-	-
Federal Funds Rate (6)	-0,005	0,033	-0,002	-0,060	0,544	1,000	-
Crisis Dummy (7)	-0,051	-0,007	-0,085	-0,024	-0,2574	0,4618	1,000

***Table 11** – Industry Dummies Detailed Description*

Basic Materials (D1)	Companies involved in the discovery, development, and processing of raw materials, including metals, minerals, chemicals, and forestry products.
Consumer Discretionary (D2)	Businesses that produce goods and services not deemed essential, such as automobiles, entertainment, and luxury items, where demand tends to increase as consumer income rises.
Consumer Staples (D3)	Firms providing essential products that consumers regularly purchase, including food, beverages, household items, and personal care products, which typically exhibit steady demand regardless of economic conditions.
Energy (D4)	Enterprises engaged in the exploration, production, and distribution of energy resources, including oil, gas, coal, and renewable energy sources.
Healthcare (D5)	Organizations offering medical services, manufacturing medical equipment or drugs, and providing healthcare-related support services.
Industrials (D6)	Companies involved in manufacturing and distributing capital goods, providing commercial services, and supplying transportation services.
Real Estate (D7)	Businesses engaged in the development, management, and operation of properties, including residential, commercial, and industrial real estate.
Technology (D8)	Firms focused on the development and distribution of technology products or services, including software, hardware, and IT services.
Utilities (D9)	Companies that provide essential public services, such as electricity, water, natural gas, and sewage services.
Telecommunications (D10)	Enterprises that provide communication services, including fixed-line and wireless telephony, data transmission, and internet services.

Table 6*- Estimation of the Regression Model of Equation [3]: This table presents the results of panel regressions analyzing the relationship between the SD_FFR, firm-level variables, and Leverage. Each model includes the Cash Flows to Sales, Market-to-Book, Size, and the Current Ratio as explanatory variables. Standard errors are reported in parentheses, and significance levels are indicated by ***(1%), **(5%), and *(10%).*

	(1)	**(2)**	**(3)**
Federal Funds Rate	0.0949^{***}		0.0538^{*}
	(0.0305)		(0.0291)
Cash Flows/Sales		0.143^{***}	0.143^{***}
		(0.0293)	(0.0293)
Market-to-Book		0.00355^{***}	0.00351^{***}
		(0.000852)	(0.000853)
Size		-0.0189^{***}	-0.0187^{***}
		(0.00657)	(0.00657)
Current Ratio		-0.0581^{***}	-0.0577^{***}
		(0.00335)	(0.00334)
Constant	0.291^{***}	0.488^{***}	0.481^{***}
	(0.00354)	(0.0499)	(0.0497)
N	4920	4920	4920
Adjusted R^2	0.002	0.089	0.090
F-Statistic (p-value)	9.701 (0.0019)	111.533 (0.0000)	89.328 (0.0000)

Table 7*- Estimation of the Regression Model of Equation [4]: This table presents the results of panel regressions estimating the determinants of firm leverage, incorporating interaction terms between the SD_FFR and industry dummy variables (D1*FFR to D10×FFR) to capture the heterogeneous effects of interest rates across industries. The dependent variable in all models is firm leverage, and the key explanatory variables include Cash Flows to Sales, Market-to-Book, Size, and the Current Ratio. Standard errors are reported in parentheses, and significance levels are denoted by ***(1%), **(5%), and *(10%).*

	(1)	(2)	(3)
Federal Funds Rate	-0.123		-0.222
	(0.0861)		(0.160)
Cash Flows/Sales		0.194***	0.194***
		(0.0382)	(0.0382)
Market-to-Book		0.00435***	0.00435***
		(0.000973)	(0.000973)
Size		-0.0187***	-0.0187***
		(0.00638)	(0.00638)
Current Ratio		-0.0411***	-0.0411***
		(0.00347)	(0.00348)
D1	-0.0898***	-0.0912***	-0.111***
	(0.0147)	(0.0149)	(0.0193)
D2	-0.0782***	-0.0936***	-0.114***
	(0.0164)	(0.0167)	(0.0207)
D3	-0.0356**	-0.0711***	-0.0914***
	(0.0157)	(0.0156)	(0.0199)
D4	-0.137***	-0.158***	-0.178***
	(0.0166)	(0.0166)	(0.0207)
D5	-0.0803***	-0.0919***	-0.112***
	(0.0181)	(0.0182)	(0.0219)
D6	-0.0784***	-0.0935***	-0.114***
	(0.0144)	(0.0147)	(0.0192)
D7	-0.186***	-0.178***	-0.198***
	(0.0160)	(0.0162)	(0.0203)
D8	-0.0732***	-0.104***	-0.124***
	(0.0207)	(0.0209)	(0.0243)
D9	-0.0898***	-0.0912***	-0.111***
	(0.0147)	(0.0149)	(0.0193)
D1 × SD_FFR	0.0971	-0.0421	0.180
	(0.108)	(0.0606)	(0.171)
D2 × SD_FFR	0.245*	0.122	0.344*
	(0.128)	(0.0939)	(0.186)
D3 × SD_FFR	0.181	0.0299	0.252
	(0.118)	(0.0709)	(0.175)
D4 × SD_FFR	0.332**	0.188**	0.411**
	(0.131)	(0.0920)	(0.185)
D5 × SD_FFR	0.154	-0.0553	0.167
	(0.133)	(0.0969)	(0.187)
D6 × SD_FFR	0.244**	0.0904*	0.313*
	(0.102)	(0.0548)	(0.169)
D8 × SD_FFR	0.153	-0.0599	0.162
	(0.123)	(0.0848)	(0.181)
D9 × SD_FFR	0.204	0.0245	0.247
	(0.157)	(0.120)	(0.200)
D10 × SD_FFR	0.266***	0.136***	0.359**
	(0.0953)	(0.0418)	(0.165)
Constant	0.372***	0.542***	0.563***
	(0.0126)	(0.0502)	(0.0521)
N	4920	4920	4920
Adjusted R^2	0.082	0.131	0.131
F-Statistic	49.235	58.815	56.403
(p-value)	(0.0000)	(0.0000)	(0.0000)

Table 8*- Estimation of the Regression Model of Equation [5]: This table presents the results of panel regressions analyzing the relationship between the SD_10YTY, firm-level variables, and Leverage, while introducing a Dummy Variable for Crisis Years (= 1 if Crisis: = 0 otherwise). Each model includes the Cash Flows to Sales, Market-to-Book, Size, and the Current Ratio as explanatory variables. Standard errors are reported in parentheses, and significance levels are indicated by ***(1%), **(5%), and *(10%).*

	(1)	(2)	(3)
SD_10YTY	-0.127***		-0.112***
	(0.0392)		(0.0409)
Crisis		-0.0114**	-0.00774
		(0.00492)	(0.00513)
Cash Flows/Sales	0.142***	0.142***	0.142***
	(0.0292)	(0.0293)	(0.0292)
Market-to-Book	0.00338***	0.00353***	0.00338***
	(0.0009)	(0.000852)	(0.000857)
Size	-0.0199***	-0.0198***	-0.0204***
	(0.0066)	(0.00663)	(0.00665)
Current Ratio	-0.0584***	-0.0583***	-0.0586***
	(0.0033)	(0.00335)	(0.00334)
Constant	0.522***	0.499***	0.525***
	(0.0518)	(0.0507)	(0.0521)
N	4920	4920	4920
Adjusted R^2	0.091	0.090	0.091
F-Statistic (p-value)	93.703 (0.0000))	90.778 (0.0000)	78.615 (0.0000)

Table 9*- Estimation of the Regression Model of Equation [6]: This table presents the results of panel regressions estimating the determinants of firm leverage, incorporating industry dummy interaction variables (D1*10Y to D10*10Y), while introducing a Dummy Variable for Crisis Years (= 1 if Crisis: = 0 otherwise). The dependent variable in all models is firm leverage, and the key explanatory variables are the SD_10YTY, Cash Flows to Sales, Market-to-Book, Size,*

*and the Current Ratio. Standard errors are reported in parentheses, and significance levels are indicated by ***(1%), **(5%), and *(10%).*

	(1)	(2)	(3)	(4)
SD_10YTY	0.0839			0.0973
	(0.211)			(0.213)
Crisis		-0.00679		-0.00681
		(0.00500)		(0.00501)
Cash Flows/Sales	0.195***	0.194***	0.195***	0.194***
	(0.0382)	(0.0381)	(0.0381)	(0.0381)
Market-to-Book	0.00411***	0.00413***	0.00411***	0.00413***
	(0.000983)	(0.000981)	(0.000983)	(0.000981)
Size	-0.0203***	-0.0208***	-0.0203***	-0.0208***
	(0.00639)	(0.00643)	(0.00639)	(0.00644)
Current Ratio	-0.0419***	-0.0421***	-0.0419***	-0.0421***
	(0.00347)	(0.00347)	(0.00347)	(0.00347)
D1	-0.0561	-0.0752***	-0.0725***	-0.0561
	(0.0442)	(0.0207)	(0.0206)	(0.0444)
D2	-0.0441	-0.0633**	-0.0605**	-0.0443
	(0.0489)	(0.0289)	(0.0287)	(0.0490)
D3	-0.0123	-0.0315	-0.0288	-0.0125
	(0.0456)	(0.0233)	(0.0232)	(0.0458)
D4	-0.112**	-0.131***	-0.128***	-0.112**
	(0.0468)	(0.0260)	(0.0260)	(0.0469)
D5	-0.0318	-0.0507	-0.0482	-0.0317
	(0.0505)	(0.0319)	(0.0319)	(0.0506)
D6	-0.0658	-0.0849***	-0.0822***	-0.0659
	(0.0444)	(0.0208)	(0.0207)	(0.0445)
D7	-0.0908*	-0.110***	-0.107***	-0.0907*
	(0.0465)	(0.0252)	(0.0251)	(0.0466)
D8	0.00709	-0.0115	-0.00932	0.00753
	(0.0530)	(0.0359)	(0.0359)	(0.0531)
D9	-0.0519	-0.0707***	-0.0683***	-0.0517
	(0.0432)	(0.0192)	(0.0191)	(0.0433)
D1 × SD_10YTY	-0.200	-0.103	-0.116	-0.200
	(0.226)	(0.0811)	(0.0808)	(0.228)
D2 × SD_10YTY	-0.198	-0.100	-0.114	-0.197
	(0.244)	(0.122)	(0.120)	(0.245)
D3 × SD_10YTY	-0.284	-0.187**	-0.201**	-0.285
	(0.232)	(0.0948)	(0.0945)	(0.233)
D4 × SD_10YTY	-0.147	-0.0503	-0.0632	-0.148
	(0.236)	(0.106)	(0.106)	(0.237)
D5 × SD_10YTY	-0.331	-0.233	-0.247*	-0.331
	(0.255)	(0.142)	(0.142)	(0.256)
D6 × SD_10YTY	-0.0999	-0.00268	-0.0160	-0.0999
	(0.225)	(0.0789)	(0.0784)	(0.227)
D7 × SD_10YTY	-0.469**	-0.372***	-0.385***	-0.469**
	(0.237)	(0.107)	(0.106)	(0.238)
D8 × SD_10YTY	-0.555**	-0.458***	-0.471***	-0.555**
	(0.263)	(0.156)	(0.156)	(0.264)
D9 × SD_10YTY	0.0830	0.180***	0.167***	0.0828
	(0.219)	(0.0605)	(0.0600)	(0.220)
Constant	0.540***	0.562***	0.556***	0.543***
	(0.0626)	(0.0509)	(0.0503)	(0.0630)
N	4920	4920	4920	4920
Adjusted R^2	0.133	0.134	0.134	0.134
F-Statistic	57.278	57.304	59.849	54.950
(p-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

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