Financial Market Frictions In The 21st Century - How Mandatory Pension Contributions Impact Investment Decisions and Cost of Capital

Maria Maia Mendes

Dissertation written under the supervision of Professor Ricardo Reis

Dissertation submitted in partial fulfilment of requirements for the International MSc in Finance, at the Universidade Católica Portuguesa, January 2024.

Abstract

Title: Financial Market Frictions In The 21st Century - How Mandatory Pension Contributions Impact Investment Decisions and Cost of Capital

Author: Maria Maia Mendes

This dissertation investigates the influence of mandatory pension contributions on U.S. companies' Weighted Average Cost of Capital (WACC) and Capital Expenditures (CapEx). Motivated by demographic shifts, a pivotal regulatory change in 2006, known as the "Pension Protection Act 2006" (PPA 2006), aimed to address the aging U.S. population, requiring companies with pension plans to enhance their funding status. The research hypotheses expected mandatory pension contributions to positively impact WACC and negatively impact CapEx.

Utilizing a sample of S&P 500-listed companies reporting pension funds, spanning 1991 to 2022, the study navigates four major economic crises – the 2008/2009 financial crisis followed by the European debt crisis, the COVID-19 crisis and the current crisis arising from the conflict between Russia and Ukraine. This temporal breadth provides a robust foundation for understanding how mandatory pension contributions impact financial decisions across diverse economic landscapes.

Main findings support the expectation that mandatory pension contributions negatively impact CapEx. This effect was reinforced after the regulatory change in 2006, indicating a heightened sensitivity of companies to investment decisions post-legislation. However, when examining the influence of mandatory pension contributions on WACC, the results reveal a counterintuitive negative coefficient, suggesting a complex interplay influenced by the regulatory changes of 2006. To validate these findings, several robustness checks were conducted.

Keywords: PPA 2006, Mandatory Pension Contributions, Pension Plans Funded Status

Resumo

Título: Fricções dos Mercados Financeiros no Século XXI - O Impacto das Contribuições Obrigatórias para as Pensões nas Decisões de Investimento e no Custo de Capital

Autor: Maria Maia Mendes

Esta dissertação investiga a influência das contribuições obrigatórias para pensões no Custo Médio Ponderado de Capital (CMPC) e nas Despesas de Capital (CapEx) das empresas nos Estados Unidos. Motivada por mudanças demográficas, uma alteração regulatória em 2006, conhecida como "Lei de Proteção de Pensões 2006" (PPA 2006), visava lidar com o envelhecimento da população dos Estados Unidos, exigindo que as empresas com planos de pensões reforçassem o seu estado de financiamento. As hipóteses de pesquisa esperavam que as contribuições obrigatórias para pensões tivessem um impacto positivo no CMPC e um impacto negativo no CapEx.

Utilizando uma amostra de empresas listadas no S&P500 que reportaram fundos de pensões, considerando o período de 1991 a 2022, o estudo percorre três crises económicas significativas – a crise financeira de 2008/2009 seguida pela crise da dívida europeia, a crise da COVID-19 e a atual crise decorrente do conflito entre a Rússia e a Ucrânia. Esta amplitude temporal proporciona uma base robusta para compreender como as contribuições obrigatórias para pensões impactam as decisões financeiras em diferentes contextos económicos.

Os resultados corroboram a expectativa de que as contribuições obrigatórias para pensões impactam negativamente o CapEx. Este efeito foi reforçado após a alteração regulatória de 2006, indicando uma maior sensibilidade das empresas às decisões de investimento pós-legislação. No entanto, ao examinar a influência das contribuições obrigatórias para pensões no CMPC, os resultados revelam um coeficiente negativo e contraintuitivo, sugerindo uma interação complexa influenciada pelas mudanças regulatórias de 2006. Para validar estes resultados, foram realizadas várias verificações de robustez.

Palavras-chave: PPA 2006, Contribuições Obrigatórias para Pensões, Estatuto de Financiamento dos Fundos de Pensões

Table of Contents

List Of Tables

List Of Abbreviations

WACC – Weighted Average Cost of Capital

CapEx – Capital Expenditures

PPA 2006 – Pension Protection Act of 2006

t – t-stat

PBO – Projected Benefit Obligation

FVPA – Fair Value of Pension Assets

AOCI – Accumulated Other Comprehensive Income

Preface

Mais um capítulo cumprido. Agora que acaba, não podia estar mais orgulhosa do que consegui conquistar.

A todos os que fizeram parte desta aventura, especialmente aos meus pais, que sempre me motivaram a querer fazer mais e a fazê-lo melhor, e à minha irmã, que me apoia incondicionalmente mesmo quando a ambição me leva para voos mais longínquos, espero ter-vos feito orgulhosos.

Uma palavra de agradecimento especialmente aos meus avós, aos que ainda cá estão, e aos que me acompanharam durante toda a jornada desde lá de cima, se não fossem eles estou segura que dificilmente estaria aqui.

Ainda que agora seja quase Mestre, continuo a concordar com Sócrates quando dizia "Eu só sei que nada sei" e é tão bom ainda haver tanto para descobrir, para saber e aprender.

"A imaginação é mais importante que o conhecimento. O conhecimento é limitado. A imaginação envolve o mundo." Albert Einstein

1 Introduction

Examining the impact of mandatory pension contributions on corporate decision-making is crucial in today's financial landscape. Regulatory changes, especially those regarding pension contributions, play a pivotal role in shaping the strategies of companies, influencing economic outcomes. Understanding these dynamics is essential for policymakers, regulators, and businesses as it provides insights into the consequences of such changes and aids in developing effective regulatory frameworks.

The Pension Protection Act of 2006 marked a significant turning point in the way companies look at pension plans. This legislative shift, responding to the challenges posed by an aging U.S. population, compelled companies with pension plans to reassess their financial strategies. The study focuses on the years surrounding this regulatory change, aiming to uncover how companies adapted to this new financial landscape and navigated constant regulatory adjustments. It also utilizes a constant sample selection in which only firms with pension plans both before and after the regulatory shift were considered. This technique allows to perform a more robust comparison and interpretation of results.

The research hypotheses revolve around the core impact of mandatory pension contributions on corporate financial decisions. Increased contributions are expected to limit funds available for investment, leading to a decrease in CapEx. Simultaneously, higher contributions may signal an underfunded status, potentially elevating perceived risk and, consequently, raising the WACC. These hypotheses form the foundation of the study, shedding light on the intricate relationship between financial obligations and strategic decisions in the face of mandatory pension contributions.

The layout of this research starts with a comprehensive exploration of the topic's relevance [2]. Subsequently, an extensive literature review [3] was developed, providing a nuanced understanding of existing knowledge. This literature review informed the formulation of precise research hypotheses [4], shaping the direction of empirical inquiry. The subsequent section delves into the intricacies of data and methodology [5], detailing an overview of the research sample and sources [5.1], a discussion of the dependent and independent variables [5.2], and the method [5.3] of analysis used in this research. The empirical journey unfolds in data analysis and results [6], encompassing descriptive statistics [6.1] and delving into the nuances of empirical results [6.2], addressing factors like multicollinearity [6.2.1], the impact of

mandatory pension contributions on WACC [6.2.2], and on CapEx [6.2.3]. Robustness checks [6.3] were systematically conducted to ensure the validity of the findings. Further, I delve into the interpretation of my key findings [7.1], offering insights into the empirical outcomes, and theoretical implications [7.2], setting the stage for a discussion on limitations and further research [8]. Finally, a conclusion is presented [9], providing a comprehensive overview of the research journey.

2 Relevance Of The Topic

In the 21st century, the study of financial market frictions and their impact on corporate cost of capital and investment decisions holds significant importance for several reasons. First, it has profound economic implications, as these decisions play a pivotal role in determining a company's ability to expand, generate employment opportunities, and contribute to overall economic growth. Consequently, understanding these financial dynamics is essential for fostering economic prosperity.

Regulatory changes in mandatory pension contributions can significantly influence firms' financial strategies. By delving into the implications of these changes, this research serves as an important resource for policymakers and regulators, offering insights into the potential consequences of their decisions and aiding in the creation of more effective regulatory frameworks.

Furthermore, effective risk management is increasingly vital in today's business landscape. Analyzing how pension contributions affect corporate cost of capital can provide valuable insights for firms to manage their financial risks and make informed decisions, ultimately enhancing their competitive edge. This research offers a chance to explore best practices and strategies for optimizing financial decisions in the presence of mandatory pension contributions.

As the global population ages, the sustainability of pension plans and the financial security of individuals are of paramount concern. Thus, understanding how pension contributions impact corporate finance is instrumental in ensuring the long-term viability of pension programs.

Lastly, this research addresses contemporary issues, aligning with the evolving dynamics of the 21st century business environment. As such, it is not only academically significant but also highly relevant to the practical realities faced by businesses today.

3 Literature Review

3.1 Pension Protection Act of 2006

The initial part of this literature review aims to clarify the pivot regulatory change that happened in 2006 in the U.S. market and expose some of the previous research that was conducted to investigate its impact.

The Pension Protection Act of 2006 was designed to enhance the funded status of corporate defined benefit pension plans by addressing the disparity between plan assets and pension obligations. This regulatory change was mainly driven by the US's increasingly elderly population, and authors such as Campbell, Dhaliwal, and Schwartz (2010) believe that it was also partly prompted by the growing underfunded status of pension plans in the US market (Appendix 1).

The legislation establishes a more direct relationship between a company's pension plans' funded status and its required pension contributions. Enacted in 2008, the law incorporates transition provisions to facilitate a smooth transition from existing regulations, affording companies sufficient time for preparation to start accelerating their pension contributions. The PPA 2006 requires firms to fully fund their pension plans in seven years. Previously, firms were allowed thirty years to fund 90% of their pension plans. Consequently, this legislative initiative gradually diminishes a company's reliance on the pension plan as a funding source over time (Moody’s 2006).

Campbell, Dhaliwal, and Schwartz (2010) examined the repercussions of the PPA 2006 on equity valuation within pension firms. The research discerned substantial adverse effects on market values of these firms in the lead-up to PPA 2006's adoption. Moreover, the authors identified factors that amplified these valuation effects. Firms laden with larger unfunded pension liabilities and greater capital expenditure requirements bore more substantial negative impacts. Conversely, firms with higher marginal tax rates saw positive outcomes.

Notably, a differential equity valuation effect was absent among firms classified as 'at risk' under the PPA 2006. However, variations surfaced when firms were categorized based on their pension underfunding relative to the market value of equity.

Furthermore, this study revealed a significant number of pension freezes during the sample period. These pension freeze firms exhibited distinctive characteristics, being more

underfunded, having higher investment requirements, lower growth opportunities, lower credit ratings, and lower profitability compared to non-freeze firms.

Besides Campbell, Dhaliwal, and Schwartz (2010), Moody's (2006) also examines the implications of the Pension Protection Act of 2006, focusing on its aim to improve the funded status of corporate defined benefit pension plans. The authors defend that the legislation may establish a direct link between a company's pension plan funded status and mandatory contributions. Well-funded plans witness minimal changes, while under-funded plans face substantial contribution increases, and "at-risk" plans (less than 65% funded) may experience significant rises in contributions. The study suggests potential corporate responses, including strategic cash flow allocations, and adjustments to investment portfolios, as companies adapt to the evolving regulatory landscape.

The paper underscores the legislation's impact on corporate behavior, anticipating shifts such as freezing or exiting defined benefit plans. Moody's (2006) emphasizes the significance of the delayed effective date and transition provisions, providing companies time to prepare for potential heightened funding requirements. Lastly, the research discusses Moody's analytical approach, treating pension liabilities as "debt-like" and considering the impact on credit profiles when companies borrow to meet increased pension contributions.

3.2 Pension Plans and Their Impact on Financial Markets

The second part of the literature review gives a brief overview of the most relevant research that has been done regarding the impact of pension plans on financial markets.

Campbell, Dhaliwal, and Schwartz (2012) investigate the relationship between a firm's WACC and its internal financial resources until 2007, using mandatory pension contributions as a proxy for such resources. The research builds upon Rauh's (2006) observation of a negative association between mandatory pension contributions and capital expenditures, assuming that increased pension contributions lead to foregone investment. In contrast, the authors found that the impact of increased mandatory pension contributions on the cost of capital is contingent on a firm's external financing constraints. Specifically, the study reveals that the cost of capital rises in response to heightened mandatory pension contributions, but this effect is more pronounced for firms facing greater external financing constraints.

The findings of Campbell, Dhaliwal, and Schwartz (2012) contribute to the broader understanding of real economic activity, particularly corporate investment. By demonstrating

that financial constraints play a crucial role in influencing the relationship between mandatory pension contributions and the cost of capital, the study aligns with the conclusions drawn by Rauh (2006) and Almeida and Campello (2007). The research emphasizes the interconnectedness of internal financial decisions, external financing constraints, and the overall cost of capital for firms.

In a different investigation by Acharya, Almeida, and Campello (2007), corporate financial policies were scrutinized. The study offered theoretical underpinnings that emphasized the role of cash and debt in the context of financing frictions. It highlighted that financially constrained firms employed cash to hedge future investments against potential income shortfalls, concluding that reducing current debt was a more effective strategy to bolster investments in states of future high cash flows.

Empirical validation corroborated the theoretical framework, revealing a distinct link between hedging needs and financial policies. Constrained firms with high hedging requirements directed excess cash flows into cash holdings, while constrained firms with lower hedging needs allocated surplus cash flows to reduce outstanding debt.

Moreover, unconstrained firms exhibited systematic preferences for utilizing excess cash flows to reduce debt. This discovery pointed to additional considerations influencing financial decision-making, such as the yield on cash relative to borrowing costs and management's diversion of free cash flows.

Rauh (2006) explores the connection between corporate investment and internal financial resources. The research identified a clear dependence of corporate investment on mandatory contributions to defined benefit pension plans, irrespective of correlations between pension funding status and unobserved investment opportunities. It was found that capital expenditures exhibited a decline when firms were obliged to make required contributions to defined benefit pension plans, particularly affecting those with financing constraints.

Furthermore, this study highlighted the nonlinearities in the relationship between required pension contributions and investment, providing valuable insights into the impact of these contributions on corporate spending.

Additionally, the research explored the implications of these findings for borrowing and corporate governance. It raised significant questions about the effects of shifts in internal

financial resources on stock prices, particularly concerning various levels of corporate governance and agency issues.

Almeida, Campello, and Weisbach (2004) focus on modeling a firm's demand for liquidity and proposing a novel empirical test to assess the impact of financial constraints on corporate policies. The study introduced the concept of the “cash flow sensitivity of cash”, concluding that constrained firms would exhibit a positive cash flow sensitivity of cash, indicating a propensity to save cash out of cash flows, while unconstrained firms would not have systematic relationships between cash savings and cash flows. The empirical analysis provided robust support for the theoretical framework, validating the relationship between financial constraints and corporate liquidity management.

Furthermore, the research suggested that cash holding patterns should vary over the business cycle, with financially constrained firms expected to increase their propensity to retain cash after negative macroeconomic shocks.

The impact of financing constraints on corporate investment may be influenced by asset tangibility, as Almeida, and Campello (2007) studied. They introduced the concept of a credit multiplier, suggesting that “pledgeable” assets enabled firms to access more borrowing, subsequently facilitating further investment in these assets. This credit multiplier served as a key element for identifying the influence of financing frictions on corporate investment decisions.

The theoretical framework posited that investment-cash flow sensitivities should increase as the tangibility of a firm's assets (a proxy for pledgeability), particularly when firms faced financial constraints. Empirical analysis strongly supported this theoretical prediction, highlighting the importance of asset tangibility.

Additionally, the study presented an innovative approach to identify the link between financing frictions and real investment, avoiding issues stemming from unobservable variation in investment opportunities. These findings offer a reliable method for future researchers to explore the impact of financial constraints on investment and other financial variables.

Fazzari, Hubbard, and Petersen (1987) presented an alternative perspective on investment models. The study introduced the concept of a "financing hierarchy" arising from capital market imperfections. This challenged traditional models that relied on centralized securities markets.

The research suggested that certain firms may lack sufficient access to external capital markets, rendering them unable to respond effectively to changes in the cost of capital, asset prices, or tax-based investment incentives. Consequently, the availability of internal finance became crucial in influencing investment behavior.

The study also explored the notion of "excess sensitivity" of investment to cash flow, particularly for firms facing external finance constraints, highlighting that investment may exhibit a heightened sensitivity to internal finance availability.

In conclusion, these studies collectively offer a comprehensive understanding of corporate financial policies, regulatory impacts, and the intricate dynamics of financing constraints. This body of research provides valuable insights in the field of corporate finance and financial distress, opening the way for further exploration and a deeper understanding of the complex world of corporate finance.

4 Research Hypotheses

(H1) - A higher level of mandatory pension contributions will be associated with an increase in the cost of capital, indicating that companies facing financial constraints allocate excess cash flows into pension funds, leading to higher financing costs.

Linked to the broader exploration of financial market frictions and their consequences, hypothesis (H1) delves into the relationship between mandatory pension contributions and the cost of capital. When a company makes higher pension contributions, it may suggest that the company's pension plan is underfunded, this means, the assets in the pension plan may not be sufficient to cover the promised pension benefits. To bridge this funding gap, the company contributes more money to the pension fund. The increased contributions can be seen as a financial burden on the company, leading to higher costs. Consequently, this additional financial burden is reflected in the overall cost of capital for the company, contributing to a positive relationship between Mandatory Pension Contributions and WACC. The increase in the cost of capital becomes a consequential outcome, influencing the financial risk profile of companies. This hypothesis contributes to a deeper understanding of how mandatory pension contributions, as a financial variable, can have a direct impact on a company's financing costs.

(H2) – A higher level of mandatory pension contributions will be associated with lower investment levels, indicating that companies facing financial constraints allocate excess cash flows into pension funds rather than investment.

Considering the contemporary business environment, where financial decisions have far-reaching implications for economic growth, the hypothesis (H2) addresses a critical aspect of corporate financial strategy. When a company faces high pension contributions, it may indicate that the company's pension plan is underfunded. This implies that a significant portion of the company's financial resources is allocated to cover pension obligations, leaving fewer funds available for capital investment in the form of CapEx. In essence, higher pension contributions create a financial constraint on the company, diverting resources away from potential capital projects. Therefore, the negative impact on CapEx can be attributed to the burden on financial resources caused by elevated pension contributions, limiting the company's ability to invest in capital expenditures. By focusing on this relationship, the research contributes to a nuanced comprehension of how financial decisions, driven by mandatory pension contributions, impact

investment dynamics, ultimately influencing a company's growth trajectory and its broader economic contributions.

(H3) – The PPA 2006 regulatory change in the US Market about mandatory pension contributions changed how they impact companies' cost of capital.

(H4) – The PPA 2006 regulatory change in the US Market about mandatory pension contributions changed how they impact companies' investment decisions.

The hypotheses (H3) and (H4) suggest that the introduction of the PPA 2006 has brought about changes in how mandatory pension contributions impact companies' financial dynamics. For H3, the expectation is that the regulatory framework has changed the conventional relationship between pension contributions and the cost of capital, introducing new considerations for businesses. Regarding H4, the hypothesis anticipates a transformation in how companies make investment decisions, attributing this shift to the regulatory changes implemented by PPA 2006. These hypotheses collectively underscore the significance of regulatory shifts in reshaping the financial implications of mandatory pension contributions on both cost of capital and investment choices for companies in the US market.

5 Data and Methodology

5.1 Data Sources

This research draws its primary dataset from the comprehensive Compustat IQ, a database that contains accounting numbers for US listed firms. Specifically, financial metrics were obtained from the Fundamentals Annual dataset, and for pension-related information, the study turned to the Pensions Annual reports within the Compustat database. Credit rating data was sourced from the Ratings reports and, to incorporate credit ratings into the regression, a scale ranging from 1 to 21 was made based on the credit rating categories (Table 1). Additionally, selected indicators such as Market Value (MV) of equity, Earnings Per Share (EPS), Dividends Per Share, and others were took from Refinitiv Eikon Datastream, enriching the dataset's depth.

The temporal scope of the study spans an expansive 32-year period, from 1991 to 2022, considering critical moments such as the post-2008 financial crisis, the unprecedented challenges raised by the global pandemic in 2020, and even the geopolitical implications of the Ukraine conflict in 2022. This extended timeframe provides a robust foundation for understanding the dynamics of the variables under scrutiny across diverse economic landscapes.

The selection of companies for analysis involved a meticulous process. Initial screening was based on a 2019 report of the S&P 500, identifying companies reporting pension-related information. To justify the choice of the S&P 500 for this study, an in-depth analysis was carried out to assess the suitability of alternative indices, such as the Nasdaq 100. Initially considered for its prominence in the technology sector, Nasdaq 100 was eventually dropped due to the prevalence of tech start-ups, as many of these companies tend to employ alternative mechanisms to traditional pension funds, such as offering stock options, which makes them less representative of conventional pension plans. Recognizing the importance of a comprehensive and diversified data set, the S&P 500 has emerged as a more appropriate index, covering a broader range of sectors and companies.

Further analysis within this subset pinpointed companies that entered the S&P 500 index before January 1st 1991, and remained part of the index until December 31st 2022. This rigorous process resulted in a final sample of 97 companies. Subsequent data cleaning procedures, using both VBA and Python as support tools in data treatment, and considering the inconsistency in reporting specific accounting items, led to a refined sample of 86 companies, ensuring data

integrity over the entire 32-year span. To ensure that the sample was relevant enough to reflect the reality of companies that have pension funds in the US market, as it only includes around 20% of the companies that belong to the SP500, further investigation was conducted to assess the weight of these companies in SP500 total market capitalization, concluding that, considering the entire 32 - year time span, these companies account for around 46% of the index's market capitalization.

Credit Rating	Score
AAA	21
AA+	20
AA	19
AA-	18
A+	17
A	16
A-	15
BBB+	14
BBB	13
BBB-	12
BB+	11
BB	10
BB-	9
B+	8
B	7
B-	6
CCC+	5
CCC	4
CCC-	3
CC	2
D	1

Table 1 - Credit Ratings and Attributed Scores

5.2 Variables

The following section will discuss the variables that were used in this study more in detail. First, there is an overview of the two dependent variables, WACC and CapEx. Subsequently, a discussion of the independent variables of interest. Finally, the control variables used to capture a better understanding of the dynamics at play are presented.

All variables are trimmed at 10% and 90% to avoid the influence of outliers on statistical inference. Variables definitions are as follows:

Weighted Average Cost of Capital	Estimate according to Modigliani & Miller (1966) Cost of Debt * Debt / (Debt + Equity) plus Cost of Equity * Equity / (Debt + Equity)
Capital Expenditures	Capital Expenditures reported by Refinitiv Eikon at the end of year t
Cost of Debt	Interest Expenses * (1 – Tax Rate (35%)), all divided by Total Debt
Cost of Equity	Dividends per Share divided by Current Market Price, plus Dividend Growth Rate
Debt to Equity Ratio	Total Debt divided by Total Equity, reported by Compustat IQ at the end of year t – 1
Mandatory Pension Contributions Moody's (2006)	Estimate according to Moody's (2006) - If Projected Benefit Obligation (PBO) is smaller than the Fair Value of Pension Plan Assets (FVPA), then equals zero; if PBO > FVPA then equals the Service Cost plus Accumulated Benefit Obligation less Fair Value of Pension Plan Assets divided by 30 if year < 2008, and by 7 if not, all divided by Total firm Assets as of year t – 1
Mandatory Pension Contributions Rauh (2006)	Estimate according to Rauh (2006) – If Projected Benefit Obligation (PBO) is smaller than the Fair Value of Pension Plan Assets (FVPA), then equals zero; if PBO > FVPA then equals the Pension Expense (Service Cost + Interest Cost + Other Periodic Cost Components – Expected Return on Plan Assets) divided by Total firm Assets as of year t – 1
Pension Plan Funded Status	Fair Value of Pension Plan Assets minus the Projected Benefit Obligation all divided by the Market Value of Equity as of year t – 1
Return on Assets	Income before extraordinary items divided by Total Assets at the end of year t − 1
Credit Rating	Moody's Credit Rating in year t converted to a numerical equivalent, where 1 is assigned to bonds with an AAA rating and 21 is assigned to bonds with a D rating

Volatility Index	Annual volatility based on CBOE Volatility Index
Market Beta	Covariance (Stock Return , Market Return) all divided by Market Variance based on Refinitiv Eikon data at the end if year t
Market Value of Equity	Logarithm of Market Value of Equity reported by Refinitiv Eikon at the end of year t − 1
Dividend Payout Ratio	Dividends per Share divided by Earnings Per Share reported by Refinitiv Eikon as of year t – 1
Earnings Per Share	Earnings Per Share reported by Refinitiv Eikon as of year t – 1
Free Cash Flow	Operating Cash Flow Less CapEx reported by Refinitiv Eikon as of year t – 1
PPA 2006	Dummy Variable, equals 1 if the year is above 2007; and 0 if the year is 2007 or less
Interaction Term	Mandatory Pension Contributions * PPA 2006 Dummy

Table 2 - Dependent and Independent Variables

The dependent variables used in the two regressions are the WACC and CapEx. WACC, determined by Modigliani & Miller's (1966) model, accounts for the total cost of capital, including debt and equity components. The analysis refrains from logarithmic transformation to maintain clarity and directly assess the impact of pension contributions on the WACC.

Similarly, the logarithm of Capital Expenditures reported by Refinitiv Eikon at the end of year t is a key dependent variable. It provides insights into the investment decisions and capital allocation strategies of the company. Capital Expenditures include various components, including the costs associated with expanding or maintaining productive capacity. The logarithmic transformation of CapEx aids in normalizing the data, ensuring a more robust examination of the factors influencing the company's investment behavior. This approach enables a comprehensive understanding of the complete financial landscape, allowing for a thorough assessment of how pension contributions impact investment decisions.

Mandatory Pension Contributions represent one of the most important independent variables. To compute this variable, two different approaches were considered - Rauh (2006) and Moody's (2006). The first approach led to better results, so the author decided to focus on that one when

analyzing the results. Despite that, results considering the second approach are presented in Appendix 2 and 3. To compute companies' Mandatory Pension Contributions, the author used firm's FVPA and PBO, considering that when FVPA is higher than PBO, then companies are overfunded, having no mandatory requirement to contribute to their pension plans - Mandatory Pension Contributions = 0. If FVPA is lower than PBO, than the pension plan status is underfunded, thus the firm is required to contribute.

The inclusion of the interaction term and the PPA 2006 dummy variable in the analyses holds significant implications for understanding the dynamics of the financial model. PPA 2006, or the Pension Protection Act of 2006, represents a pivotal regulatory change in the U.S. market, that started having practical implications only in the beginning of 2008, so the dummy equals 1 for 2008 until 2022, and 0 for 1991 until 2007. This legislative shift was a response to demographic challenges, particularly the aging population in the early 21st century. As the U.S. witnessed a growing elderly demographic, concerns arose regarding the security of pension plans. PPA 2006 demanded companies to enhance their pension plan funded status, reflecting a proactive approach to address potential vulnerabilities in pension systems. This regulation underscored the government's commitment to ensuring the financial well-being of retirees, considering that pension plans are not compulsory in the U.S.

The interaction term, which multiplies Mandatory Pension Contributions by the PPA 2006 dummy variable, is helpful in capturing the effects of the regulatory change. This interaction term allows to assess whether the impact of mandatory pension contributions on financial variables differs between the periods before and after the enactment of PPA 2006. If the interaction term is statistically significant, it suggests that the impact of Mandatory Pension Contributions on both WACC and CapEx is different before and after the regulatory change. It helps unravel the specific influence of the regulatory environment on the relationship between pension contributions and financial metrics.

Moreover, the emphasis on the pension plan funded status is essential. This variable serves as an indicator of a company's ability to meet its pension obligations. A well-funded pension plan not only reflects financial prudence but also enhances the company's credibility and attractiveness to investors. The funded status is a comprehensive measure, considering both the Fair Value of Pension Plan Assets and the Projected Benefit Obligation. By incorporating this variable, the analysis gains insight into the financial health and risk exposure associated with the company's pension plan.

To mitigate industry-specific influences, dummy variables were introduced. These variables serve to control heterogeneity across different industries, ensuring that observed effects are attributed to the variables of interest rather than industry-specific variations.

While these variables are focal points in the analyses, it is important to acknowledge the significance of other variables as well. Variables such as the Weighted Average Cost of Capital (when used as an independent variable on Regression 2), Market Beta, and Credit Rating serve as essential control variables, offering a holistic understanding of the financial landscape by considering broader market dynamics and creditworthiness.

Altman's Z-score also stands out as a relevant variable in the regression analysis, offering valuable insights into the impact of financial distress on the dynamics between both WACC and mandatory pension contributions, as well as CapEx and mandatory pension contributions. However, when Altman's Z-score was introduced into the regression models, an unexpected challenge emerged — the presence of heightened multicollinearity, resulting in a notable deterioration in the overall regression outcomes. Recognizing the need for a comprehensive solution, a meticulous examination was undertaken. The initial step involved systematically excluding individual ratios within the Z-score to identify those contributing to bias and suboptimal results. Although improvements were observed upon their removal, the modified approach led to a variable considerably distant from the original Altman Z-score, rendering it impractical for the intended analysis.

After further analysis, another workaround was explored, considering the incorporation of Accumulated Other Comprehensive Income (AOCI) into the Retained Earning / Income ratio, adding this item to the numerator. This was made considering that AOCI encapsulates unrealized gains and losses, as when companies observe changes in the Projected Benefit Obligation (PBO) related to their pension plans, they subsequently recognize these changes in AOCI, to acknowledge the potential impact of these future obligations on their financial health. Despite these efforts, the persistent issue of high multicollinearity persisted, prompting a decisive choice to exclude Altman's Z-score from the final regression models. This strategic decision aimed to ensure the reliability and interpretability of the analytical outcomes, safeguarding the integrity of the study's conclusions.

In conclusion, the paper incorporates a thoughtful selection of variables, emphasizing the pivotal role of PPA 2006 and the funded status in shaping the financial landscape. The interaction term enriches the analysis by capturing the regulatory impact, while control

variables contribute to a comprehensive assessment of the company's financial standing in a dynamic market environment.

5.3 Methodology

As previously mentioned, the approach used largely follows the methodology of Campbell, Dhaliwal and Schwartz (2012). To perform the OLS regressions, the paper uses Python. The analytical approach employed a panel data framework, using the 86 companies' annual data over the 32 years, incorporating both year and firm fixed effects. Year fixed effects capture overall time-specific variations, including trends and fluctuations affecting all firms uniformly. Simultaneously, firm fixed effects control for individual firm-specific characteristics that persist over time, enhancing the accuracy of variable assessments. The regressions were developed to analyze the veracity of each of the four research hypotheses stated above.

The regression models look as following:

Regression 1 - $\boldsymbol{Weighted\ Average\ Cost\ of\ Capital_{i,t}} = \beta_0 + \beta_1\ Mandatory\ Pension\ Contributions_{i,t} + \beta_2\ Pension\ Plan\ Funded\ Status_{i,t} + \beta_3\ Debt\text{-}to\text{-}Equity\ Ratio_{i,t} + \beta_4\ MV\ Equity_{i,t-1} + \beta_5\ Credit\ Rating_{i,t} + \beta_6\ ROA_{i,t-1} + \beta_7\ VIX_{i,t} + \beta_8\ Market\ Beta_{i,t} + \beta_9\ PPA\ 2006_{i,t} + \beta_{10}\ Interaction\ Term_{i,t} + \Sigma\beta_{i,t}\ Industry\ Dummies_{i,t} + \mathcal{E}_{i,t}$

The primary goal of estimating this model (Regression 1) is to examine the impact of Mandatory Pension Contributions on a firm's WACC while specifically addressing the influence of the regulatory change introduced by the PPA 2006. The inclusion of the PPA 2006 dummy variable and its Interaction Term with Mandatory Pension Contributions allows for a focused analysis of how the relationship between pension contributions and WACC may have been modified by regulatory shifts.

Regression 2 - $\boldsymbol{Capital\ Expenditures_{i,t}} = \beta_0 + \beta_1\ Mandatory\ Pension\ Contributions_{i,t} + \beta_2\ Pension\ Plan\ Funded\ Status_{i,t} + \beta_3\ EPS_{i,t-1} + \beta_4\ Dividend\ Payout\ Ratio_{i,t-1} + \beta_5\ FCF_{i,t-1} + \beta_6\ Credit\ Rating_{i,t} + \beta_7\ Wacc_{i,t} + \beta_8\ ROA_{i,t-1} + \beta_9\ PPA\ 2006_{i,t} + \beta_{10}\ Interaction\ Term_{i,t} + \Sigma\beta_{i,t}\ Industry\ Dummies_{i,t} + \mathcal{E}_{i,t}$

Regression 2 was developed with the primary goal of exploring the relationship between Mandatory Pension Contributions and firm's Capital Expenditures. In this model, the focus is to understand how Mandatory Pension Contributions influence Capital Expenditures while considering the potential impact of the Pension Protection Act of 2006.

The combination of these two regressions provides a comprehensive understanding of how pension contributions, influenced by regulatory changes, impact both the cost of capital and capital expenditure decisions. This dual regression approach offers a complete view, highlighting the multifaceted implications of pension-related dynamics on the financial landscape of companies. It underscores the importance of considering distinct financial metrics to derive more robust insights into the broader effects of pension contributions and regulatory changes on corporate finance decisions.

6 Data Analysis and Results

In the subsequent sections, the paper will delve into the descriptive statistics. Following this, empirical results derived from the research will be presented. In conclusion, some robustness checks were conducted to provide additional validation for the earlier findings.

6.1 Descriptive Statistics

In Table 3, the paper presents a comprehensive overview of the distribution of the sample. This table serves as a valuable reference for understanding the distributional characteristics and variations in the key financial variables under examination.

The table outlines essential statistics such as the mean, standard deviation, median, kurtosis, and skewness for each variable within the sample. Notably, WACC exhibits a mean of 0.08, suggesting a moderate average cost, while the substantial standard deviation of 0.19 indicates notable variability within the sample. Additionally, the skewness and kurtosis values provide insights into the distribution shape and the presence of outliers.

The mean of approximately 0 for the variable Mandatory Pension Contributions suggests that, on average, over the sample period, most companies may have an overfunded status in most years, as this condition allows them to have 0 contributions in those specific years. However, this finding may appear contradictory when compared with the variable Pension Plan Funded Status, which indicates that, on average, most companies across the years are underfunded. The discrepancy between these means highlights the dynamic nature of pension funding status within the sample. Moreover, the considerable standard deviation of the Pension Plan Funded Status indicates substantial variability, suggesting that the underfunded status is subject to fluctuations and can vary significantly from year to year. This variability underscores the importance of examining not just the mean, but also the dispersion of values, offering a more nuanced understanding of the diverse financial conditions companies navigate regarding their pension plans. Further analyses were conducted to understand how the sample is spread within the industry categories (Appendix 4).

	Mean	Std. Dev.	Median	Kurtosis	Skewness
WACC	0,08	0,19	0,06	695,91	21,00
Mandatory Pension Contributions	0,00	0,00	0,00	74,37	8,29
Pension Plan Funded Status	-0,01	0,11	-0,01	110,55	0,89
Debt To Equity Ratio	0,90	7,56	0,85	476,47	-17,68
Credit Rating	15,37	2,63	16,00	0,74	-0,17
MV Equity	4,25	0,55	4,24	-0,45	0,07
CBOE Volatility Index	19,56	5,90	17,67	-0,77	0,55
Return on Assets	0,07	0,05	0,06	5,18	-0,37
Market Beta	3,03	7,38	1,41	61,71	4,96
CapEx	5,90	0,62	5,92	5,23	-0,61
Earnings Per Share	2,43	3,01	1,83	21,58	1,21
Dividend Payout Ratio	0,48	2,92	0,44	1749,75	36,70
Free Cashflow	2041679	3964038	739545	11,78	2,79

Table 3 - Descriptive Statistics

6.2 Empirical Results

6.2.1 Multicollinearity

A correlation matrix was constructed to assess the relationships among independent variables and to identify potential multicollinearity, which can compromise the stability and reliability of regression coefficient estimates, jeopardizing result interpretation. Typically, correlation values above 0.7 or below -0.7 are considered indicative of high correlation. However, as outlined in Table 4 and 5, only the variables "Return on Assets" and "Credit Rating" exhibit moderate correlation in the context of the WACC regression. Additionally, in the CapEx regression, a moderate correlation is observed between "Free Cashflow" and "CapEx," given that capital expenditures are included in the Free Cashflow formula. Consequently, all the independent variables included in this matrix are deemed suitable for incorporation into multiple regression analyses.

To further scrutinize the potential for multicollinearity, Variance Inflation Factors (VIFs) were computed for all regressions using Python. VIF quantifies the extent to which multicollinearity inflates the variance of estimated regression coefficients. A VIF value of 1 indicates no correlation with other independent variables, while values between 1 and 5 suggest low to moderate correlation, possibly indicating multicollinearity. Values exceeding 5 imply high correlation (Jamal (2017)). In this study, the independent variables of interest in all regressions exhibited VIF values ranging from 1.03 to 1.9, indicating low to moderate correlation (Appendix 5 and 6).

	WACC	Mandatory Pension Contributions	Pension Plan Funded Status	Debt To Equity Ratio	Credit Rating	MV Equity	Volatility Index	Return on Assets	Market Beta
WACC	1,00	-0,08	0,02	-0,29	0,23	0,03	-0,11	0,30	0,13
Mandatory Pension Contributions		1,00	-0,40	-0,03	-0,07	0,02	0,04	0,08	0,06
Pension Plan Funded Status			1,00	-0,11	0,18	-0,20	-0,05	0,09	-0,01
Debt To Equity Ratio				1,00	-0,42	-0,02	0,05	-0,30	-0,10
Credit Rating					1,00	0,36	-0,03	0,54	0,10
MV Equity						1,00	0,12	0,22	0,07
Volatility Index							1,00	0,07	-0,04
Return on Assets								1,00	0,08
Market Beta									1,00

Table 4 - Correlation Matrix (1/2)

	CapEx	Mandatory Pension Contributions	Pension Plan Funded Status	Earnings Per Share	Dividend Payout Ratio	Free Cashflow	WACC	Credit Rating	Return on Assets
CapEx	1,00	-0,08	-0,07	0,24	0,05	0,37	-0,06	0,05	-0,24
Mandatory Pension Contributions		1,00	-0,31	-0,03	-0,03	-0,09	-0,04	-0,06	0,01
Pension Plan Funded Status			1,00	-0,17	0,05	-0,01	0,01	0,23	0,08
Earnings Per Share				1,00	-0,02	0,32	0,05	0,03	0,23
Dividend Payout Ratio					1,00	0,03	-0,21	0,02	-0,12
Free Cashflow						1,00	0,08	0,30	0,23
WACC							1,00	0,17	0,23
Credit Rating								1,00	0,44
Return on Assets									1,00

Table 5 - Correlation Matrix (2/2)

6.2.2 The Impact on WACC

Dependent Variable: WACC	R-squared:	0.439
Model: OLS	Adj. R-squared:	0.379
No. Observations: 1985	F-statistic:	7.727
	Coefficient	t - stat
Mandatory Pension Contributions	-0.0765***	-2.567
Pension Plan Funded Status	-0.1766***	-4.927
Debt To Equity Ratio	-0.3266***	-7.861
Credit Rating	0.0673	1.143
MV Equity	0.1955***	2.079
CBOE Volatility Index	-0.1463***	-5.789
Return on Assets	0.3071***	8.548
Market Beta	0.0094	0.352
Interaction Term	0.0614*	1.766
PPA 2006	-0.5589***	-2.947
Industry Dummies		
35 – Health Care	-2.4591***	-2.888
20 – Industrials	-1.5255**	-2.021
55 – Utilities	-1.4625**	-1.997
15 – Materials	-1.5115**	-2.001
30 – Consumer Staples	-1.7411**	-2.470
10 – Energy	-1.2876**	-2.123
50 – Communication Services	-1.0643	-1.619
25 – Consumer Discretionary	-1.1331***	-3.266
45 – Information Technology	-1.1331***	-3.266
Firm Fixed Effects	Yes	

Year Fixed Effects	Yes

*** significant at 1%, ** significant at 5%, and * significant at 10%. This regression considers Rauh (2006) proxy to compute Mandatory Pension Contributions.

Table 6 - Regression 1 Results (considering Rauh (2006))

It is essential to frame the regression analysis, the overall model, considering a dependent variable of WACC, exhibits an R-squared of 0.439, suggesting that the model explains 43.9% of the variance in WACC. The high adjusted R-squared value of 0.379 indicates robustness even after accounting for the number of variables. Out of 1985 observations, the F-statistic of 7.727 adds confidence to the overall model's significance.

The primary variable employed in this research is Mandatory Pension Contributions, computed as per Rauh (2006). The negative coefficient with a significant t-stat on Mandatory Pension Contributions rejects the null hypotheses, indicating that a higher level of mandatory pension contributions is associated with a decrease in WACC. This implies that companies which allocate more funds to pension contributions have lower financing costs, contradicting the previous literature (Moody's (2006); Campbell, Dhaliwal, and Schwartz (2012)) that argues companies required to increase their mandatory pension contributions are most likely the ones with underfunded pension plans, and consequently in most cases they may have to borrow money to fund their pension obligations. This reliance on borrowing can, in turn, elevate the perceived riskiness of these companies as borrowers. Consequently, lenders may charge them higher interest rates, effectively increasing the cost of debt for these companies. This increase in the cost of debt directly contributes to a higher WACC.

Furthermore, the negative statistically significant coefficient of Pension Plan Funded Status corroborates the idea of the previous literature Rauh (2006) and Moody's (2006), as it shows that as companies decrease their funded status, becoming more underfunded, their cost of capital tends to increase, since they may be perceived as riskier by investors.

Companies seem to prioritize pension contributions over other uses of cash flow, impacting their overall cost of capital. This could be attributed to risk aversion or regulatory compliance. Further exploration could involve understanding how different industries respond to this phenomenon and whether the impact is consistent across diverse financial conditions.

The positive coefficient for the Interaction Term with a statistically significant t-stat suggests a noteworthy moderating effect on the relationship between Mandatory Pension Contributions

and the WACC following the regulatory change represented by PPA 2006. The regulatory change in 2006 seems to have influenced the dynamics of how companies incorporate pension contributions into their overall financial strategy. While the overall significance may not be the highest, the presence of this interaction term underscores the importance of exploring the nuanced interplay between external regulatory changes and internal financial decisions in future research. Investigating how the relationship varies in the context of the regulatory shift can provide valuable insights into the dynamics shaping financial outcomes.

In conclusion, the regression analysis provides robust support for hypotheses H3, and contradicts the H1, emphasizing the impact of mandatory pension contributions on the weighted average cost of capital and the influence of the PPA 2006 regulatory change.

6.2.3 The Impact on CapEx

Dependent Variable: CapEx	R-squared:	0.885
Model: OLS	Adj. R-squared:	0.878
No. Observations: 2349	F-statistic:	130.0
	Coefficient	t - stat
Mandatory Pension Contributions	-0.0212**	-2.114
Pension Plan Funded Status	0.0048*	1.694
Earnings Per Share	0.1256***	9.067
Dividend Payout Ratio	-0.0490***	-5.211
Free Cashflow	-0.0278**	-2.222
WACC	0.0215**	2.510
Credit Rating	0.1947***	12.662
Return on Assets	-0.1252***	-8.870
Interaction Term	0.0204*	1.791
PPA 2006	0.7561***	16.62

Industry Dummies		
35 – Health Care	-0.0379	-0.200
20 – Industrials	0.3000*	1.773
55 – Utilities	-0.7784***	-4.788
15 – Materials	-0.4779***	-2.857
30 – Consumer Staples	0.6157***	3.885
10 – Energy	0.8230***	6.003
50 – Communication Services	-0.7420***	-4.899
25 – Consumer Discretionary	0.2261***	2.784
45 – Information Technology	0.2261***	2.784
Firm Fixed Effects	Yes	
Year Fixed Effects	Yes	

*** significant at 1%, ** significant at 5%, and * significant at 10%. This regression considers Rauh (2006) proxy to compute Mandatory Pension Contributions.

Table 7 - Regression 2 Results (considering Rauh (2006))

The CapEx model exhibits an impressive R-squared of 0.885, suggesting that the model explains 88.5% of the variance in capital expenditures. The adjusted R-squared value of 0.878 shows the model's robustness, accounting for the number of variables. With 2349 observations, the F-statistic of 130.0 underscores the overall significance of the model.

The primary variable employed in this research is Mandatory Pension Contributions, computed as per Rauh (2006). The statistically significant negative coefficient in relation to mandatory pension contributions supports Hypothesis 2 (H2), indicating that companies, tend to allocate more funds to pension contributions at the expense of capital expenditures. This negative association implies that higher mandatory pension contributions are linked to reduced investment levels. The rationale behind H2 lies in the understanding that companies facing financial constraints are more likely to have underfunded pension plans, having to make increased contributions to meet future obligations (Rauh (2006); Campbell, Dhaliwal, and Schwartz (2012)).

The observed negative coefficient may suggest that, for financially stressed companies, there exists a strategic choice to prioritize pension funding over direct investments. This decision is

grounded in the notion that bolstering pension plans serves as a risk mitigation strategy for underfunded companies, addressing both present and future financial uncertainties. The negative coefficient thus highlights a clear trade-off where companies allocate excess cash flows to pension contributions as a way of strategically managing their financial obligations, particularly in the face of constraints.

Moreover, Pension Plan Funded Status seems to be significant at a 10% level, with a positive coefficient, confirming the results obtained by Rauh (2006). A positive relation between Pension Plan Funded Status and CapEx can be justified since as companies improve their funded status, they are required to contribute less for pensions, having more cash available to invest instead of using it to increase pension plan assets.

The interaction term's positive coefficient with a significant t-stat indicates a potential moderating effect on the relationship between mandatory pension contributions and CapEx. This suggests that the impact of Mandatory Pension Contributions on the WACC is different before and after the regulatory change represented by the PPA 2006. The positive sign of the coefficient implies that, following the regulatory change, there is an increased influence of Mandatory Pension Contributions on Capital Expenditures, implying a stronger association between pension obligations and investment decisions. The statistically significant interaction term underscores the importance of considering the regulatory context when assessing the financial dynamics between pension-related factors and capital expenditures, emphasizing the need for firms to adapt their investment strategies in response to changes in pension regulations.

In conclusion, the CapEx regression analysis supports both hypotheses H2 and H4, shedding light on the relationship between mandatory pension contributions, the PPA 2006 regulatory change, and capital expenditures.

6.3 Robustness Checks

Robustness checks play a crucial role in reinforcing the validity and reliability of empirical findings by examining whether the results hold across different subsamples or when controlling for specific characteristics. In this context, the conducted robustness checks involve three distinct regressions, each focusing on different firm-level characteristics: firm size, firm age, and firm debt level. These regressions aim to scrutinize the robustness of the relationships between Mandatory Pension Contributions and the WACC, in Regression 1, and CapEx, in Regression 2. To assess robustness, interaction terms were incorporated into each regression,

providing a nuanced understanding of how the relationships between pension contributions and financial metrics vary based on specific firm-level characteristics.

	Regression 1 - WACC			**Regression 2 - CapEx**		
	Firm Size	**Firm Age**	**Firm Debt Level**	**Firm Size**	**Firm Age**	**Firm Debt Level**
Mandatory Pension Contributions	-0,2098 (-0,489)	0,038 (0,513)	0,0126 (0,192)	-0,1935 (-1,822)*	0,037 (1,631)	-0,0512 (2,559)**
Firm Size	-0,1069 (-0,890)			0,8355 (38,829)***		
Size Interaction Term	0,1537 (0,357)			0,1971 (1,847)*		
Firm Age		-0,2811 (-2,823)***			-0,1194 (-5,279)***	
Age Interaction Term		-0,1222 (-1,659)*			-0,0618 (-2,687)***	
Firm Debt Level			-0,0125 (-0,231)			-0,1254 (-9,157)***
Firm Debt Level Interaction Term			-0,0792 (-1,169)			0,0467 (2,245)**

*** significant at 1%, ** significant at 5%, and * significant at 10%. This regression considers Rauh (2006) proxy to compute Mandatory Pension Contributions. T-stats are presented within parentheses.

Table 8 - Robustness Tests Results 1

The first regression considers firm size as a controlling factor. Notably, the coefficient of Mandatory Pension Contributions is statistically insignificant (-0.2098, t = -0.489) for WACC. Additionally, the interaction term with firm size also exhibits statistical insignificance (0.1537, t = 0.357), suggesting that the relationship between pension contributions and WACC remains consistent regardless of firm size. This robustness check emphasizes the consistent nature of the impact of pension contributions on WACC, highlighting that the lack of significance in the interaction term supports the stability of this relationship across different firm sizes. On the other hand, examining the CapEx regression, we find that the Mandatory Pension Contributions coefficient shows some statistical significance at a 10% level (-0.1935, t = -1.822), as well as the interaction term (0.1971, t = 1.847). However, it is crucial to note that this significance level is relatively low. Importantly, when considering the 5% and 1% levels, the results remain robust,

indicating that the relationship between pension contributions and CapEx is not strongly influenced by firm size, and any potential bias is only observed at the 10% significance level.

In the second regression, with a focus on firm age, the coefficient of Mandatory Pension Contributions becomes statistically insignificant (0.038, t = 0.513) for WACC. Furthermore, the interaction term with firm age also exhibits statistical insignificance, suggesting that the influence of pension contributions on WACC does not vary with the age of the firm. This robustness check reinforces the consistent nature of the impact of pension contributions on WACC, underscoring that the lack of significance in the interaction term supports the stability of this relationship across different firm ages. For the CapEx regression, the coefficients and t-stats are as follows: Mandatory Pension Contributions (0.037, t = 1.631) - insignificant at all levels, and the Interaction Term (-0.0618, t = -2.687) - significant at all levels. These results indicate that the relationship between pension contributions and CapEx is not robust and varies with firm age. Further research should be conducted to investigate this potential bias and gain a more comprehensive understanding of how firm age may influence the impact of pension contributions on CapEx.

The third regression, examining firm debt level, reveals a statistically insignificant coefficient for Mandatory Pension Contributions (0,0126, t = 0,192) when predicting WACC. The interaction term with firm debt level also shows insignificance, emphasizing that the relationship between pension contributions and WACC is not influenced by debt level. On the other hand, when looking at the CapEx regression, the Mandatory Pension Contributions coefficient shows statistical significancy (0,0512, t = 2,559), as well as the interaction term (0,0467, t = 2,245). These results suggest that the relationship between pension contributions and CapEx may be influenced by firms' debt levels, and further research should be conducted to dive deep into this potential bias.

	Regression 1 - WACC	**Regression 2 - CapEx**
Mandatory Pension Contributions	-0,1111 (-2,653)***	0,0367 (2,884)***
35 – Health Care	-2,1816 (-2,565)**	-0,0277 (-0,147)
Interaction Term	1,07E-14 (3,211)***	-0,0085 (-0,658)
20 – Industrials	-1,4208 (-1,898)*	0,199 (1,179)

Interaction Term	-2,41E-14 (-2,280)**	0,0469 (3,894)***
55 – Utilities	-1,3965 (-1,927)*	-0,8082 (-4,977)***
Interaction Term	4,61E-15 (2,216)**	-5,81E-15 (1,265)
15 – Materials	-1,405 (-1,888)*	-0,4408 (-2,692)***
Interaction Term	-6,20E-16 (-0,189)	-0,0523 (-3,878)***
30 – Consumer Staples	-1,7384 (-2,498)**	0,5324 (3,326)***
Interaction Term	3,49E-15 (1,951)*	-8,78E-15 (-1,607)
10 – Energy	-1,0116 (-1,675)*	0,8134 (5,907)***
Interaction Term	-2,45E-14 (-2,291)**	8,75E-15 (5,352)***
50 – Communication Services	-0,6453 (-0,977)	-0,6375 (-4,145)***
Interaction Term	-2,23E-14 (-2,720)***	3,13E-15 (0,981)
25 – Consumer Discretionary	-0,9982 (-2,877)***	0,3957 (4,817)***
Interaction Term	-1,49E-14 (-2,802)***	2,60E-15 (3,843)***
45 – Information Technology	-0,9982 (-2,877)***	0,3957 (4,817)***
Interaction Term	-1,64E-14 (-2,217)**	7,37E-16 (0,395)

*** significant at 1%, ** significant at 5%, and * significant at 10%. This regression considers Rauh (2006) proxy to compute Mandatory Pension Contributions. T-stats are presented within parentheses.

Table 9 - Robustness Tests Results 2

In the presented robustness checks, the analysis extends its examination to various economic sectors based on the GICS classification. Regression 1, focusing on the WACC, reveals that the coefficient for Mandatory Pension Contributions is statistically significant and negative (-0.1111, t = -2.653) overall, indicating a consistent impact across sectors. However, important

differences appear when looking at individual sectors. For instance, the interaction term for the Materials sector shows a significant negative coefficient. This suggests that, most companies in the sector are overfunded, reducing the need for additional contributions, or that companies in this sector are less likely to offer pension plans. This sector-specific impact on pension contributions prompts a closer look at its implications for the WACC. Further research is needed to explore these sector-specific dynamics, as this insight indicates that the interplay of pension contributions and WACC varies across industries.

In Regression 2, focusing on the relationship between pension contributions and CapEx, significant results emerge across different industry sectors, which may justify the change in the sign of Mandatory Pension Contributions, it is positive and statistically significant (0,0367, t = 2,884). The coefficients associated with interaction terms are found to be statistically significant in almost all sectors, suggesting that the impact of pension contributions on CapEx is influenced by industry-specific dynamics. This sectoral variation in the relationship underscores the need for further research to explore and understand the nuanced interplay between pension contributions and financial metrics within each industry. The observed significance of interaction terms implies that a comprehensive analysis of sector-specific factors is essential for a more nuanced understanding of how pension contributions influence CapEx across diverse industry landscapes.

7 Main Findings

7.1 Key Findings

After concluding all the research, deriving results from rigorous regressions, and validating them through robustness checks, it is possible to highlight the key findings of this study.

In contrast to what was expected, the results showed a significant negative impact of mandatory pension contributions on WACC. The unexpected finding of a significant negative impact of mandatory pension contributions on WACC prompts an exploration of potential rationales. One plausible explanation could be that increased pension contributions signal a commitment to reinforce pension plan funding, which might be viewed positively by investors. If stakeholders interpret higher pension contributions as a strategy to ensure financial stability and meet future pension obligations, it could enhance investor confidence, leading to a reduction in the perceived risk associated with the company. Consequently, a lower perceived risk may contribute to a decrease in the company's WACC. This unexpected inverse relationship could underscore the complex interplay between financial decisions, investor perceptions, and the cost of capital, revealing that a proactive approach to pension funding may have favorable implications for the overall cost of capital.

As expected, the results showed a significant negative impact of mandatory pension contributions on CapEx. Companies that increase their mandatory pension contributions are directing their excess cashflow toward pension plan assets, instead of using it for investment. This redirection of funds toward pension plans contributes to a detrimental influence on CapEx. Furthermore, following the change introduced by the PPA 2006, companies were required to improve the funded status of pension plans, subsequently increasing mandatory pension contributions. This change in regulatory requirements played a key role in defining the impact of mandatory contributions to pension plans on CapEx. The increased obligation to make contributions to the pension fund consequently led to a more pronounced negative impact on CapEx, indicating an increased influence of the mandatory contributions on companies' CapEx after the regulatory change, underlining its critical role.

These findings contribute to the understanding of how financial decisions, especially those related to pension contributions, influence a company's overall cost of capital and its financial decisions. Understanding these dynamics is crucial for both practitioners and policymakers seeking to optimize financial decision-making in a dynamic regulatory environment.

7.2 Theoretical Implications

The findings from the WACC regression analysis yield noteworthy implications for existing literature. Contrary to the assertions of Moody's (2006) and Campbell, Dhaliwal, and Schwartz (2012), the negative coefficient associated with Mandatory Pension Contributions challenges the conventional belief that increased mandatory contributions lead to higher financing costs. This unexpected result suggests that companies allocating more funds to pension contributions experience a decrease in their WACC, signaling potential future research to explore the nuanced dynamics between pension contributions and overall financing costs. Moreover, in the context of pension plan funded status, the negative coefficient aligns with the theoretical underpinnings of Rauh (2006) and Moody's (2006). The result suggests that as companies become more underfunded, their perceived riskiness increases, leading to a corresponding rise in their cost of capital. This reaffirms the notion that pension plan funded status serves as a critical determinant of a company's financial risk profile in the U.S. market.

Furthermore, in the CapEx regression, the negative coefficient associated with Mandatory Pension Contributions indicates that when companies are required to prioritize pension contributions tend to jeopardize capital expenditures. This finding aligns with the perspectives of Rauh (2006) and Campbell, Dhaliwal, and Schwartz (2012). Additionally, the positive coefficient linked to Pension Plan Funded Status underscores the potential trade-off between improving funded status and allocating more resources to capital expenditures. This result aligns with Rauh's (2006) argument that as companies enhance their funded status, they have greater flexibility to invest in operational activities rather than directing excess cash flows to pension obligations.

The positive coefficient for the Interaction Term in both regressions suggests a meaningful moderating effect on the relationship between Mandatory Pension Contributions and WACC, and also between Mandatory Pension Contributions and CapEx, following the regulatory change introduced by PPA 2006. These findings corroborate the theoretical perspectives of Moody's (2006) and Campbell, Dhaliwal, and Schwartz (2010), emphasizing the relevance of considering the regulatory context in understanding the dynamics between pension-related factors and financial decisions. The significance of the interaction term underscores the necessity for firms to adapt their financial strategies in response to changes in pension regulations.

In summary, the study contributes to the existing literature by challenging certain established notions regarding the relationship between mandatory pension contributions, pension plan funded status, and financial outcomes for companies. The unexpected findings invite further exploration and understanding of the complex interactions within corporate finance and pension management.

8 Limitations and Further Research

In the course of this research, certain limitations have emerged that are worse considering. Firstly, the choice to focus on S&P 500 companies, although a commonly employed practice, resulted in a reduced sample size due to the substantial number of firms within the index that do not maintain pension funds. This was particularly notable among start-ups, which can possibly be justified by the increasing trend of new companies to adopt alternative compensation strategies such as stock options over traditional pension plans. To ensure comparability with previous studies, the sample was further constrained to companies that remained in the index throughout the entire study period (1991 to 2022), resulting in a final sample size of 86 companies. While this selection criterion aimed to capture a diverse sample, the process of cleaning the dataset based on the criteria of having pension data and S&P 500 inclusion from 1991 to 2022 inadvertently resulted in a sample dominated by mature firms, which may introduce a bias towards well-established companies. Robustness checks indicated that age may indeed influence the results on Regression 2, emphasizing the importance of acknowledging potential limitations associated with sample selection.

Additionally, attempts to incorporate a Z-score variable for assessing financial distress status posed a challenge due to heightened multicollinearity issues. Despite exhaustive efforts to mitigate this concern, as described in section [5.3] Methodology, the inclusion of the Z-score variable adversely affected the regression's robustness. This limitation underscores the complexity of incorporating financial distress indicators into the analysis and prompts further exploration of alternative methodologies or variables to better capture the financial health of the companies under study.

The exploration of the impact of mandatory pension contributions on CEO compensation and operational management led to further challenges. Difficulty in obtaining comprehensive CEO salary data posed a limitation in extending the analysis to executive compensation, thereby having to signal this as potential future research. Investigating how companies structure executive compensation in relation to pension contributions, both pre and post PPA 2006, could yield valuable insights into evolving corporate strategies.

Moreover, in the pursuit of understanding the nuanced relationship between mandatory pension contributions, WACC, and Capital Expenditures, the inclusion of Credit Rating as a control variable aimed to address the potential influence of financial distress. A suggestion for further

research involves splitting the sample into investment-grade and non-investment-grade categories, enabling a more granular exploration of how financial health may interact with the examined relationships.

Finally, industry classification, size, and age emerged as influential factors in the robustness checks. While the relationship between mandatory pension contributions and WACC remained steadfast across characteristics as age or size, the influence of mandatory pension contributions on Capital Expenditures showed sensitivity to characteristics such as size and age, and both relations' results vary across industries. This finding underscores the need for a nuanced understanding of the interplay between both industry and company-specific attributes and the examined relationships. Future research to delve deeper into the contextual determinants of these dynamics should be assessed.

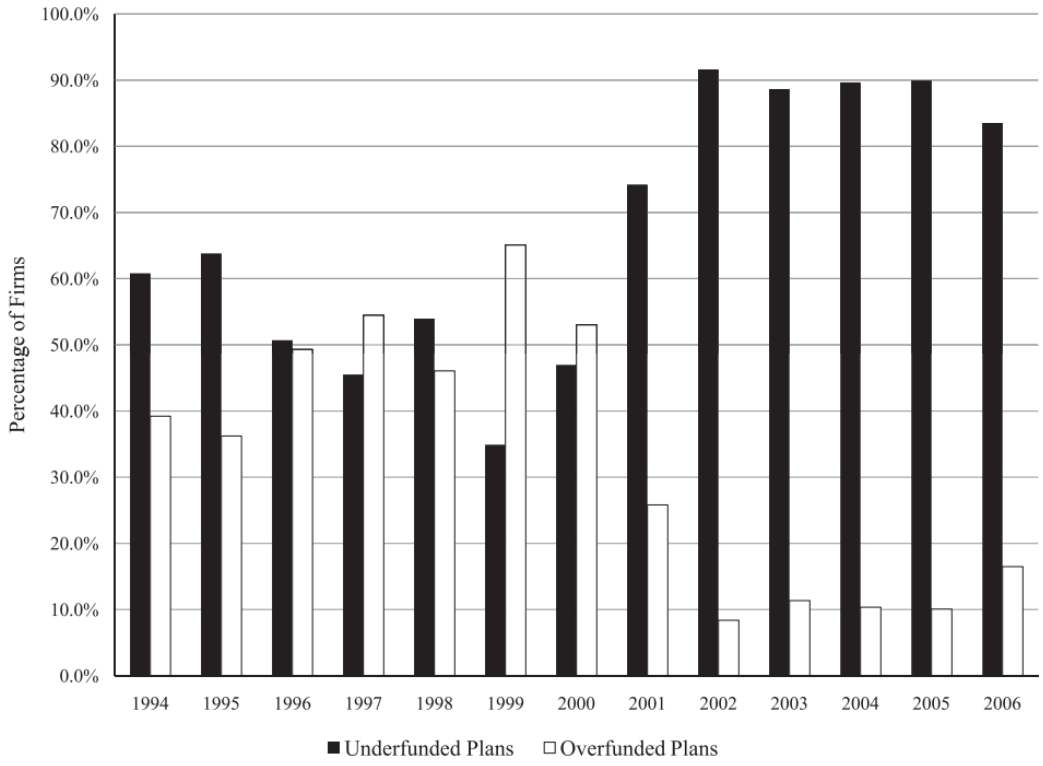
9 Conclusion

This research aims to understand the relationship between mandatory pension contributions, WACC and CapEx, with a specific focus on the impact of regulatory changes such as the Pension Protection Act of 2006, providing a better understanding of the dynamics that determine this.

Evidence found suggests that mandatory pension contributions significantly influence corporate financial strategies, and the PPA 2006 has a profound far-reaching impact. Most of the results obtained align with previous literature, and their validity is underscored through robustness checks. These checks not only strengthen the reliability of the findings but also signal potential paths for further research. Exploring the influence of firm characteristics such as size or age on the relationship between mandatory pension contributions and WACC and CapEx could deepen the understanding of these dynamics and their implications for corporate financial decision-making.

Finally, this research considers that mandatory contributions play a key role in shaping companies' financial decisions. The conclusions make it clear that these elements collectively shape the financial landscape and companies' strategies, particularly in response to regulatory developments as PPA 2006.

Appendices



Appendix 1 - Pension Plan Funded Status, Campbell, Dhaliwal, and Schwartz (2010)

Dependent Variable: WACC		R-squared:	0.405
Model: OLS		Adj. R-squared:	0.356
No. Observations: 1608		F-statistic:	8.229
		Coefficient	t - stat
Mandatory Pension Contributions		-0.0626*	-1.757
Pension Plan Funded Status		-0.1163***	-3.446
Firm Fixed Effects	Yes		
Year Fixed Effects	Yes		

*** significant at 1%, ** significant at 5%, and * significant at 10%. This regression considers Moody's (2006) proxy to compute Mandatory Pension Contributions.

Appendix 2 - Regression 1 Results (considering Moody's (2006))

Dependent Variable: CapEx		R-squared:	0.889
Model: OLS		Adj. R-squared:	0.883
No. Observations: 2414		F-statistic:	144.4
		Coefficient	t - stat
Mandatory Pension Contributions		-0.1100***	-9.093
Pension Plan Funded Status		-0.0226**	-2.114
Firm Fixed Effects	Yes		
Year Fixed Effects	Yes		

*** significant at 1%, ** significant at 5%, and * significant at 10%. This regression considers Moody's (2006) proxy to compute Mandatory Pension Contributions.

Appendix 3 - Regression 2 Results (considering Moody's (2006))

	Count	**Proportion**
20 – Industrials	448	0,159090909
55 – Utilities	288	0,102272727
15 – Materials	480	0,170454545
30 – Consumer Staples	224	0,079545455
10 – Energy	96	0,034090909
50 – Communication Services	160	0,056818182
25 – Consumer Discretionary	128	0,045454545
45 – Information Technology	128	0,045454545

Appendix 4 - Descriptive Statistics for Industry Data

	VIF
WACC	1,210290812
Mandatory Pension Contributions	1,268582596
Pension Plan Funded Status	1,367674149
Debt To Equity Ratio	1,32270853
Credit Rating	1,89080522
MV Equity	1,323681909
CBOE Volatility Index	1,048392495
Return on Assets	1,547341887
Market Beta	1,0338665

Appendix 5 - VIF Test Results for Regression 1

	VIF
CAPEX	1,433377
WACC (35%)	1,110708
Mandatory Pension Contributions	1,13514
Pension Plan Funded Status	1,227999
FCF (T-1)	1,42937
Credit Rating	1,450157
EPS (T-1)	1,281265
Return on Assets (T-1)	1,650872
Dividend Payout Ratio (T-1)	1,069132

Appendix 6 - VIF Test Results for Regression 2

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