Universidade do Minho
Escola de Economia, Gestão e Ciência Política

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Capital structure under regulatory risk in the U.S. electric industry

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Capital structure under regulatory risk in the U.S. electric industry

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Conducted under the supervisions of
Professor Manuel José Da Rocha Armada, PhD
and
Professor Wilson Toshiro Nakamura, PhD

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Liberavit me Dominus ab omni opere malo: et salvum faciet in regnum suum cæleste, cui gloria in sæcula sæculorum. Amen. (2 Timotheum 4:18)

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

Estrutura de capitais sob risco regulatório no sector elétrico dos Estados Unidos

Resumo

Esta tese investiga a relação entre o risco regulatório e as decisões de estrutura de capitais entre empresas elétricas de propriedade privada nos Estados Unidos. Embora as teorias tradicionais de estrutura de capitais, como os modelos de trade-off e pecking order, tenham sido amplamente aplicadas a sectores competitivos, o seu poder explicativo em sectores regulados continua limitado. No sector da eletricidade, as decisões financeiras são moldadas não apenas pelos fundamentos das empresas, mas também pelos enquadramentos regulatórios ao nível estadual, que regem os preços, o investimento e a recuperação do capital investido. Este estudo testa três hipóteses com base em dados em painel referentes ao período de 2012 a 2023. Em primeiro lugar, avalia se um nível mais elevado de risco regulatório está associado a uma menor alavancagem, partindo da premissa de que, em contextos de incerteza regulatória, as empresas poderão reduzir a dependência do endividamento. Em segundo lugar, analisa se o efeito do risco regulatório sobre a alavancagem é moderado pela estrutura de mercado do estado, comparando mercados elétricos não reestruturados, parcialmente reestruturados e totalmente reestruturados. Por fim, examina se as empresas ajustam a sua alavancagem de forma dinâmica em resposta a alterações no risco regulatório ao longo do tempo. A abordagem empírica combina modelos estáticos com efeitos fixos e estimadores dinâmicos do tipo GMM em sistema, controlando pelas características ao nível da empresa. Foram ainda realizadas análises de robustez adicionais para verificar a estabilidade e fiabilidade dos resultados estatísticos. Os resultados não evidenciam efeitos estatisticamente significativos do risco regulatório sobre a alavancagem, quer no modelo de base quer nas interações com o estatuto de reestruturação. Embora a direção esperada dos coeficientes esteja alinhada com a teoria, os resultados sugerem que as percepções regulatórias poderão ter um peso inferior ao dos fundamentos empresariais na determinação da estrutura de capital neste sector. Adicionalmente, os resultados indicam que as empresas poderão adotar um comportamento de ajustamento parcial, compatível com a teoria dinâmica do trade-off. No entanto, as variações no risco regulatório não apresentam significância estatística na explicação desses ajustamentos. Esta investigação contribui para a literatura sobre estrutura de capitais ao integrar dimensões institucionais e regulatórias na modelização financeira. Oferece também uma perspetiva sectorial sobre o comportamento financeiro de empresas reguladas e levanta questões relevantes para decisores políticos e investidores ao avaliarem o impacto dos ambientes regulatórios nas estratégias de financiamento corporativo..

Palavras-chave: alavancagem, regulação tarifária, empresas de serviços públicos

Capital structure under regulatory risk in the U.S. electric industry

Abstract

This thesis investigates the relationship between regulatory risk and capital structure decisions among investor-owned electric utilities (IOUs) in the United States. While traditional capital structure theories—such as the trade-off and pecking order models—have been extensively applied to competitive industries, their explanatory power in regulated sectors remains limited. In the electric utility industry, financial decisions are shaped not only by firm fundamentals but also by state-level regulatory frameworks that govern pricing, investment, and capital recovery. This study tests three hypotheses based on panel data from 2012 to 2023. First, it evaluates whether higher regulatory risk is associated with lower leverage, as firms may reduce reliance on debt in uncertain policy environments. Second, it explores whether the effect of regulatory risk on leverage is moderated by the state's market structure—comparing non-restructured, partially restructured, and fully restructured electricity markets. Finally, it examines whether firms adjust their leverage dynamically in response to changes in regulatory risk over time. The empirical approach combined static fixed effects models and dynamic system GMM estimators, controlling for firm-level characteristics. Additional robustness analyses were performed to verify the stability and reliability of statistical results. The findings show no statistically significant effect of regulatory risk on leverage in either the baseline model or its interaction with restructuring status. While the expected direction of coefficients aligns with the theory, the results suggest that regulatory perceptions may be less influential on capital structure than firm-level fundamentals in this sector. Additionally, results show firms may engage in partial adjustment behavior, consistent with dynamic trade-off theory. However, regulatory risk changes do not show statistical significance in explaining such adjustments. This research contributes to capital structure literature by incorporating institutional and regulatory dimensions into financial modeling. It also offers a sector-specific perspective on financial behavior in regulated utilities and raises important considerations for policymakers and investors in evaluating the impact of regulatory environments on corporate finance strategies.

Keywords: leverage, rate regulation, utilities.

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List of Acronyms

DOE	Department of Energy
FERC	Federal Energy Regulatory Commission
ISO	Independent System Operator
PUC	Public Utilities Commission
RRA	Regulatory Research Associates
RTO	Regional Transmission Organization

Chapter 1: Introduction

Capital structure theory has evolved significantly since the foundational propositions of Modigliani and Miller (1958). Building on that work, subsequent research introduced tax considerations (Modigliani & Miller, 1963), trade-offs between tax shields and bankruptcy costs (Baxter, 1967; Kraus & Litzenberger, 1973), and frameworks incorporating agency costs (Jensen & Meckling, 1976), signaling (Ross, 1977), and information asymmetries (Myers & Majluf, 1984). Despite this extensive body of literature, capital structure remains a complex and unsettled puzzle (DeAngelo, 2022).

Most of the existing research has focused on competitive industries. However, firms in regulated sectors, such as investor-owned electric utilities (IOUs), operate within a fundamentally different institutional framework. As a result, these firms are often excluded from research samples with little explanation, other than the assumption that their financing decisions are influenced by regulation (Frank & Goyal, 2022; Hackbarth & Sun, 2023).

In fact, these firms are subject to state Public Utility Commissions (PUCs) oversight, which regulates cost recovery mechanisms and return on capital (Quackenbush, 2020; FERC, 2024). Consequently, it is commonly assumed that regulatory behavior directly impacts the financial decisions made at the firm level. However, this assumption requires further investigation.

Adding further complexity, the U.S. Electricity Industry restructuring has created institutional heterogeneity across states. Some states have adopted competitive retail frameworks that separate generation from transmission and distribution, while others have retained vertically integrated models. These structural differences introduce variations in cost recovery mechanisms, regulatory stringency, and financial autonomy (Borenstein & Bushnell, 2015; Rose et al., 2024).

This institutional environment motivates the present investigation, raising the question: Does state-level regulatory risk influence U.S. investor-owned electric utilities' capital structure, and does industry restructuring and dynamic regulatory change moderate this relationship?

The first hypothesis (H1) posits that higher regulatory risk leads to lower leverage, consistent with capital structure theories that associate increased risk with reduced debt usage (Taggart, 1985; Rao & Moyer, 1994). The second hypothesis (H2) considers the effect of industry restructuring, given that firms in restructured states may face greater revenue uncertainty and limited regulatory protection (Sanyal & Bulan, 2011; Parinandi, 2023). Finally, the third hypothesis (H3) evaluates whether firms adjust their capital structure dynamically in response to regulatory changes, in line with dynamic trade-off models (Fischer et al., 1989; Esghaier, 2024).

Understanding financing decisions in regulated industries requires specific attention to regulatory risk and restructuring dynamics. This thesis addresses this by investigating the impact of these factors on corporate capital structure, thereby offering a more nuanced perspective to the literature.

1.1 The U.S. electric power industry

The U.S. electric power industry consists of a multi-layered structure of regulatory authorities at the federal, state, and regional levels responsible for managing the entire system. Leading agencies are the Federal Energy Regulatory Commission (FERC), the North American Electric Reliability Corporation (NERC), Independent System Operators (ISOs), Transmission Organizations (RTOs), and Public Utility Commissions (PUCs).

FERC regulates interstate bulk electricity transmission and oversees reliability and market operations at the federal level. NERC, a nonprofit, establishes and enforces power system reliability standards across six regions.[1] ISOs and RTOs manage the transmission system and electricity wholesale market competition regionally.[2] PUCs regulate electric public utility firms' operations and retail activities in non-restructured and restructured states[3] (FERC, 2023a, 2024).

The U.S. Department of Energy, Office of Electricity (DOE OE) defines an electric public utility as owning and operating the infrastructure needed to provide electricity to consumers. They are categorized into for-profit (investor-owned) and not-for-profit (cooperatives and government-owned).

Investor-owned utilities (IOUs) operate under a regulated rate of return framework, which governs their provision of retail services as either vertically integrated enterprises or as companies focused solely on transmission and distribution of power. In contrast, the industry encompasses independent power producers (IPPs), a non-utility entity that generates electricity for sale within competitive wholesale markets and contractual arrangements (power purchase agreements) with utilities and other customers (FERC, 2024).

IOUs and IPPs operate in 49 states[4] and the District of Columbia (U.S. Energy Information Administration [EIA], 2022).

[1] Midwest Reliability Organization (MRO); Northeast Power Coordinating Council (NPCC); Reliability First (RF); SERC Reliability Corporation (SERC); Texas Reliability Entity (Texas RE); Western Electricity Coordinating Council (WECC).

[2] FERC-regulated RTOs/ISOs: California ISO (CAISO), Midcontinent ISO (MISO), New England ISO (ISO-NE), New York ISO (NYISO), Pennsylvania-New Jersey-Maryland Interconnection (PJM), and Southwest Power Pool (SPP). Texas regulated ISO: Electric Reliability Council of Texas (ERCOT).

[3] The topic is further discussed in subsection 2.2.2 Electricity industry regulatory restructuring.

[4] In the state of Nebraska, electricity is solely provided to customers by either public power districts, municipal power systems, or rural electric cooperatives. https://www.eia.gov/state/analysis.php?sid=NE

Electric utility firms exhibited continued growth in earnings in 2024. However, consistent cash shortfalls have led to an increased reliance on debt financing, which accounts for approximately 60% of total capital on average (DeLucia, 2025).

In 2022, the U.S. Electric Power Industry served 160,161,776 ultimate customers and registered a total of U$ 485,249 million dollars in revenue from sales of electricity, which represented a 14.9% increase in revenue compared to the previous year (Table 1).

Table 1: Revenue from Sales of Electricity by Sector, by Provider in 2022

	Number of Ultimate Customers	**Share**	**Sales to Ultimate Customers (Thousand Megawatthours)**	**Share**	**Revenue From Ultimate Customers (Million Dollars)**	**Share**
Residential	139,854,178	87.32%	1,509,233	38.43%	226,990	46.78%
Commercial	19,257,529	12.02%	1,390,873	35.42%	172,600	35.57%
Industrial	1,049,983	0.66%	1,020,464	25.98%	84,895	17.50%
Transportation	86	0.00%	6,599	0.17%	765	0.16%
All sectors	160,161,776	100.00%	3,927,169	100.00%	485,249	100.00%

Note. Data compiled from EIA (2023b). Public municipality lights are not included.

From the total of 160,161,776 ultimate customers, 90,37% (144,738,222) of them have their electricity – energy and delivery – served by full-service providers.

Table 2: Number of Ultimate Customers Served by Sector, by Provider in 2022

Ultimate Customers Served		
Sector	Full-Service Providers (vertical firms)	Energy-Only Providers
Residential	126,936,159	12,918,019
Commercial	16,800,418	2,457,111
Industrial	1,001,592	48,391
Transportation	53	33
Total	144,738,222	15,423,554

Note. Data compiled from EIA (2023b).

From the total revenue from sales to ultimate customers, energy-only providers contributed to 9,42% (45,709) portion of revenue. The energy sold by these providers is delivered to customers by an incumbent utility distribution firm that provides delivery-only services. These firms represent 6,93%

(33,638) of the total revenue. Thus, full-service providers are responsible for 83,65% (405,902) of the total revenue.

Table 3: Revenue from sales of electricity by sector in 2022

	Revenue (Million Dollars)		
Sector	Full-Service Providers (vertical firms)	Energy-Only Providers	Delivery-Only Providers
Residential	206,032	10,100	10,857
Commercial	131,400	22,791	18,408
Industrial	68,249	12,458	4,187
Transportation	220	360	185
Total	405,902	45,709	33,638

Note. Data compiled from EIA (2023b).

Table 4: Major Investor-Owned Electric Utilities' Revenue and Expense for 2022

Description	Revenue and Expense (Million Dollars)
Utility Operating Revenues	381,129
Electric Utility	344,355
Other Utility	36,774
Utility Operating Expenses	315,491
Electric Utility	292,247
Operation	196,589
Production	140,287
Cost of Fuel	49,486
Purchased Power	80,032
Other	10,768
Transmission	15,872
Distribution	5,973
Customer Accounts	5,658
Customer Service	6,659
Sales	255
Administrative and General	21,886
Maintenance	21,834
Depreciation	42,104
Taxes and Other	31,720
Other Utility	23,244
Net Utility Operating Income	65,638

Note. Data compiled from EIA (2023b).

Table 5: Capacity by Producer Type in 2022

Producer Type	Number of Generators	Generator Nameplate Capacity (Megawatts)
Electric Utilities	9,649	664,893.00
Independent Power Producers, Non-Combined Heat and Power Plants	11,854	521,243.40
Independent Power Producers, Combined Heat and Power Plants	441	30,627.50
Total	21,944	1,216,763.90

Note. Data compiled from EIA (2023b).

In 2022, investor-owned electric utilities in the United States reported total operating revenues of $381.1 billion and operating expenses of $315.5 billion (EIA, 2023b). This capital-intensive industry registered major cost components including operation ($196.6 billion), purchased power ($80.0 billion), depreciation ($42.1 billion), and fuel ($49.5 billion). These high operating and capital costs underscore the importance of financial planning and capital structure decisions. In terms of generation capacity, independent power producers, both combined and non-combined heat and power facilities, collectively operated a larger number of generators and supplied over 550,000 MW of capacity. The data reflects the growing presence of non-utility generators, reinforcing the importance of investigating the regulatory context within the U.S. electric industry.

1.2 Research Gap and Motivation

Capital structure literature has few studies on regulated industries and quantifies the impact of regulatory risk on leverage decisions. Research emphasizes traditional factors while overlooking the unique institutional and regulatory constraints (Frank & Goyal, 2009; 2022; Fukui et al., 2023; Hackbarth & Sun, 2023).

Where regulation is considered, it is often treated as a binary condition between regulated versus unregulated, without capturing variations in regulatory behavior or the uncertainty firms face across different jurisdictions (Rose et al., 2024; Su, 2015). The absence of dynamic and measurable proxies for regulatory risk is a major limitation in literature.

This study aims to fill the existing gap by utilizing the Regulatory Research Associates (RRA) scoring system, which measures state-level variations in regulatory risk on a nine-point ordinal scale. Unlike previous research (e.g., Rose et al., 2024; Su, 2015), this study includes all U.S. jurisdictions in

the research sample[5]. This comprehensive approach enables the analysis to examine the direct impact of the regulatory climate on capital structure and how firms adapt to changes in regulatory conditions over time.

The motivation for this research lies in understanding how capital-intensive firms exposed to regulatory influence adjust leverage in response to institutional uncertainties and constraints. By clarifying these dynamics this thesis contributes to academic theory and practical insights for practitioners, investors, and regulators acting in an evolving energy sector (Myers, 2015; Graham et al., 2015).

1.3 Research Question, Aim, and Objectives

Research question: Does state-level regulatory risk influence U.S. investor-owned electric utilities' capital structure, and does industry restructuring and dynamic regulatory change moderate this relationship?

Main objective: To evaluate the state-level regulatory risk and market restructuring influence the capital structure decisions of investor-owned electric utilities in the U.S. and to assess whether firms adjust their leverage in response to changes in regulatory conditions over time.

Specific objectives: i) Analyze the relationship between regulatory risk and firm leverage in the U.S. electric utility sector; ii) Assess whether the impact of regulatory risk on leverage differs across restructured and non-restructured states, iii) Examine whether firms adjust leverage dynamically in response to annual changes in regulatory risk.

1.4 Research Contributions

By incorporating regulatory risk measures into the analysis of firm financing, this research brings forth how the inherent regulatory climate of each U.S. state may affect the level of firm debt, filling a gap in the current literature and expanding the theory on capital structure.

The study provides empirical evidence on the relationship between the capital structure choices of investor-owned electric utilities in the U.S. and state-level regulatory climate ratings. As it strives to differentiate the impact of regulatory risk across different electric market structures, specifically comparing restructured and non-restructured states, this research contributes to academia by broadening the scope of existing empirical studies.

[5] Except for the state of Nebraska since electricity is solely provided to customers by either public power districts, municipal power systems, or rural electric cooperatives. https://www.eia.gov/state/analysis.php?sid=NE

The findings provide evidence-based insights into how regulatory uncertainties affect financing structures for managers, investors, and policymakers. This points to a potential conflict between public interest and private interest theories in regulatory behavior, highlighting the impact on firms' financing decisions.

Although capital structure policy decisions also carry an embedded managerial behavior component that transcends finance theory, the current research contribution rests on the notion that it can provide valuable insights for capital structure managerial decisions.

Chapter 2: Literature Review

2.1 Capital Structure Decisions

Notwithstanding being held in the economic field, the beginning of broad discussions on matters related to capital structure, such as sources and costs of capital, risks, and prudent management of funds, can be traced back to the 19th century[6]. Irving Fisher's publications in the 1900s furthered discussions on the relationship between firm value and capital structure, contributing to the basis for the capital structure theories we rely on today (Cardao-Pito, 2021).

Miller (1988) openly admitted adopting "Irving Fisher´s view of the firm - now the standard one in finance [...]" (p.103) when elaborating the propositions for the irrelevance of the capital structure to firm market value with coauthor Franco Modigliani in their seminal paper – Modigliani and Miller (1958) (hereinafter MM).

Following Fisher´s use of the separation theorem[7], MM included in their model "[...] the law of one price." (Varian, 1993, p. 166), a "[...] then-novel arbitrage proof [...]" (Miller, 1988, p. 99), to demonstrate that under a simple hypothetical world[8], the proportional substitution between equity and leverage did not affect the value of the firm.

As a result, MM´s theorem inspired "[...] a stream of important theoretical and empirical literature." (Weston, 1989, p. 36), thus changing "[...] financial economics forever." (Grundy, 2001, p. 1185) by paving the ground for the emergence of what came to be known as neoclassical finance (Ross, 2004).

Initially, MM asserted that a firm's average cost of capital is independent of its capital structure but equivalent to the capitalization rate of a stream of pure equity. However, they later amended their original model to account for corporate taxes, recognizing that interest payments on debt are deductible from business tax obligations, thus lowering the capital cost. MM also considered that lenders set borrowing limits related to the firm's equity. Hence, despite the presence of tax advantages, it "[...] does not necessarily mean that corporations should at all times seek to use the maximum possible amount of debt in their capital structures." (Modigliani & Miller, 1963, p.442).

Still, under the specific condition assumed by the authors, the value of the firm is determined by its return on assets instead of debt-to-equity mix (Modigliani & Miller, 1958; 1966).

---

[6] Although practical and descriptive rather than formal or systematic or based on theoretical frameworks, works from John Stuart Mill (Principles of Political Economy, 1848), Henry Sidgwick (The Principles of Political Economy, 1883), and Alfred Marshall (Principles of Economics, 1890), among others, brought influential premises that helped to lay the foundations for the subsequent development of the corporate finance though.

[7] Under the separation theorem, financing and investment decisions are assumed to be isolated and made independently (Fisher, 1930).

[8] In a world without a corporate income tax, investors have homogeneous expectations, and the capital market is complete and perfect (Modigliani & Miller, 1958).

Subsequent research to MM sought to investigate how firms structure their capital as the efforts of different authors resulted in prominent propositions and theories, of which stood out: i) Trade-off theory (Baxter, 1967; Kraus & Litzenberger, 1973); ii) Agency Cost (Jensen & Meckling, 1976); iii) Signaling model (Ross, 1977); iv) Pecking-order theory (Myers, 1984; Myers & Majluf, 1984); v) Dynamic trade-off (Fischer et al., 1989); vi) Market Timing (Baker & Wurgler, 2002). However, the matter remains an unsolved puzzle (DeAngelo, 2022).

Following discussions about optimal capital structure, Baxter (1967) built upon Modigliani and Miller (1958; 1963) to study the influence of leverage on firm value to conclude that the firm's capacity to bear higher amounts of leverage is dependent upon the firm's capacity to generate constant income streams. Additionally, despite debt tax benefits, the risk of ruin associated with higher amounts of leverage cancels the benefits, thus lowering the firm's market value.

Furthering Baxter´s discussion, Kraus and Litzenberger (1973) formally integrated market imperfections, such as corporate tax advantages from debt and bankruptcy costs, into a single-period valuation model within a complete capital market. Under this scenario, the firm may adopt an optimal financial leverage level by promoting a trade-off between the benefits from the marginal value of tax savings linked to debt against the present value of the bankruptcy costs relative to the same level of debt (Kraus & Litzenberger, 1973; Scott, 1976).

Despite leading to an optimal capital structure, Jensen and Meckling (1976) argued for the incompleteness of the trade-off theory. Building upon the separation of ownership (principals) and control (agents) phenomenon previously discussed by Berle and Means (1932), the authors explored the principal-agent relationship issue, assuming a single investment-financing decision scenario in which agency costs, such as monitoring of management costs and other costs associate with the discipline of the capital market, will vary according to the firm´s choice of debt and equity mix, thus influencing the value of the firm.

Challenging the MM theorem while assuming a perfect and competitive financial market, Ross (1977) examined how a firm's capital structure choice can influence market perceptions in the context of asymmetric information between managers and investors. By having management compensation tied to the firm's performance and financial decisions and assuming managers hold insider information about the firm's prospects, the market views managerial decisions regarding financing as signals that convey valuable information about the firm.

Also guided by information asymmetry, Myers (1984), building on Donaldson's (1961) exploration of a firm's financing decisions, examined the use of internally generated capital and outside

debt to the detriment of equity to finance its investments. Thus, Myers and Majluf (1984) suggested a hierarchical sequence for asset financing sources in the pecking-order theory, starting from the lowest to the highest cost of capital, i.e., retained earnings, followed by debt, preferred shares, and common equity financing as the last option (Klein et al., 2002; Myers, 1984; Myers & Majluf, 1984).

Shifting from the static single-period model used in earlier theories to a continuous-time framework, Fischer et al. (1989) sought to understand better how recapitalization costs affect capital structure decisions in a dynamic trade-off setting. Rather than proposing a fixed optimal debt level, the authors suggest an optimal range for debt that varies based on the firm's specific characteristics. Thus, the firm adjusts its debt level over time if the cost of straying from the target exceeds the cost of adjusting to the target. In contrast, Chen and Frank (2023) argue that firms actually have an optimal capital target, adding that adjustment to the target are promptly made when funds become available.

Chen and Frank (2023) challenge the theoretical underpinnings of how dynamic trade-off is often tested empirically, focusing on leverage versus capital targets, gradual and immediate adjustment, while Esghaier (2024) provides empirical evidence supporting the idea that firms do adjust their leverage towards targets over time, albeit with complexities like asymmetry and sensitivity to measurement.

Assuming a segmented or inefficient capital market setting, Baker and Wurgler (2002) argue that a strong relationship exists between a firm's current capital structure and historical market values. They suggest that managers make financing decisions by timing fluctuations in market share prices and comparing these prices to the firm's book and past market values. When shares perform well and investors express excitement over potential earnings, managers are likely to issue equity rather than debt. Conversely, repurchasing equity may be the option if the situation is less favorable.

Initial findings from Shyam-Sunder and Myers (1999) on the pecking order suggest that firms primarily relied on debt to cover funding shortfalls. Frank and Goyal (2003) questioned that and, contrary to previous findings, argued that the pecking order theory struggles to explain observed financing decisions fully.

Lemmon and Zender (2010) proposed that firms generally adhere to the pecking order preference for debt but are forced to issue equity when they become constrained by their ability to borrow more. Building on this, Shen (2014) further refined the understanding of debt constraints by focusing on access to public debt markets. The author suggested that increasing information asymmetry, while theoretically strengthening the preference for debt under the pecking order, simultaneously restricts a firm's access to public debt, limiting its effective debt capacity and forcing reliance on private debt or equity, thus explaining deviations from simple pecking order prediction.

Empirical studies show that only a few variables consistently explain capital structure decisions. Frank and Goyal (2009) find that while several factors are associated with market-based leverage, only profitability, asset tangibility, and industry median leverage remain reliable for book-based measures. Fukui et al. (2023) further refine this understanding by systematically testing 55 determinants and finding that variables linked to information asymmetry and supply frictions are the most robust.

DeAngelo et al. (2022) demonstrate that leverage volatility is driven by the stability of firms' cash holdings, highlighting the importance of internal financial management in capital structure decisions. In contrast, Leary and Roberts (2014) emphasize external influences, showing that firms adjust their financing behavior in response to peer actions and industry norms.

2.2 Industry Regulation

This section briefly overviews the underlying motivations for regulating public utility service providers in the United States.

The development of the U.S. electric power industry progressed from a period of low regulation in the 1880s to a structured framework of regulatory oversight involving municipalities, state authorities, and, subsequently, the federal government (Tuttle et al., 2016). State-level regulation established commissions in New York and Wisconsin in 1907, reaching 27 Public Utility commissions seven years later (Taggart, 1985).

The United States Supreme Court laid the groundwork for rate regulation in the case of Munn v. Illinois (1876) by stating that "[...] when private property is devoted to a public use, it is subject to public regulation." (p. 130). This ruling served as a normative mechanism for the protection of public interest (Hadley, 1886) at a time when there was tension between the welfare of the population and the private interests of utility firms (Sharfman, 1914) due to market imperfections such as monopoly power and information asymmetries (Pigou, 1920).

The ruling established a precedent for government regulation of private firms to tackle inefficiencies caused by vertically integrated monopolies in the utility industry (Hadley, 1886; Pigou, 1920). This commitment to regulation has remained strong, even amid various federal and state-level regulatory restructuring reforms over the past four decades that have gradually fostered competition in the electricity industry (FERC, 2024).

Before discussing the role of regulatory authorities over firms, two distinctive overlapping dimensions of regulation are acknowledged: economic and social.[9] Thus, following Dudley and Brito (2012) and Veljanovski (2010), this investigation examines the economic aspect of regulation, which concerns government intervention issues influencing firms' financing and investment decisions.

To expand the comprehension of the topic, without specifically diving into the conundrum of the many different economic theories of regulation, it is important to recognize the overlapping of public interest theories of regulation and private interest theories of regulation underlying regulatory commissions, commissioners, consumer advocates, firm managers, and shareholders' interests.

The public interest strain assumes the government has enough information and power to effectively correct market failures to maximize social welfare. In contrast, private interest theories assume self-interest, information asymmetry, and enforcement limits dominate (Den Hertog, 2012).

As observed in the utility sector (Baron, 1989), public interest is concerned with limiting the monopoly power through industry-specific oversight guided by government-established boundaries on rates, which directly affects a firm's financial performance (Dudley & Brito, 2012; FERC, 2024; Joskow & Rose, 1989).

According to federal guidelines, regulators are expected to balance social welfare with ensuring a fair and reasonable return for investors (FERC, 2024), as indicated by public interest theory (Den Hertog, 2012). However, some studies suggest that regulatory commission variations in stringency levels influence firms' financial decisions (Archer, 1981; Navarro, 1983; Trout, 1979). Others show the use of leverage to influence regulatory outcomes, such as higher returns (Chen & Fanara, 1992; Dasgupta & Nanda, 1993; De Fraja & Stones, 2004; Rao & Moyer, 1994; Reboul & Toldrà-Simats, 2016; Resende, 2010; Spiegel, 1994a, 1996; Spiegel & Spulber, 1994, 1997; Taggart, 1981). Both approaches point to private interest theories (Den Hertog, 2012).

The following subsection explores the role of regulatory commissions in regulating utilities according to government guidelines to understand regulators' expected role and behavior. Identifying the regulatory objective helps interpret observed capital structure under varying regulatory behaviors.

[9] "Social regulations are designed to address issues related to health, safety, security, and the environment." (Dudley & Brito, 2012, p. 77). "Social regulation embraces health and safety, environmental, anti-discrimination and other laws." (Veljanovski, 2010, p. 02).

2.2.1 Regulation primers

This subsection emphasizes the role of regulatory authorities in balancing investors' and consumers' interests (Quackenbush, 2020). It outlines the main principles of economic regulation in the U.S. Electric Power Industry, which affect commissioners' actions and firm managers' financing decisions.

United States electric utilities are regulated at federal and state levels. The Federal Energy Regulatory Commission (FERC) manages federal regulations, while Public Utilities Commissions (PUCs) manage state-specific regulations. Despite their operational independence from political influence, PUCs share common legal principles to ensure reliable service delivery at fair prices while also guaranteeing a reasonable return for investors on capital investments (DOE OE, n.d.; Federal Power Act, 1920/2024; FERC, 2024; Joskow & Schmalensee, 2024).

FERC regulates wholesale electricity sales, interstate transmission, power marketers, power pools, power exchanges, and independent system operators. It authorizes market-based rates, supervises security issuances, evaluates mergers, and monitors directorial appointments to prevent conflicts of interest (FERC, 2023b; 2024). PUCs, on the other hand, regulate retail electricity prices charged by vertically integrated utilities and transmission and distribution-only firms. They set rates based on residential, commercial, and industrial customer sectors to ensure fairness and reasonableness (DOE OE, n.d.; FERC, 2024; Quackenbush, 2020).

Requests for rate adjustments based on firm complaints or commission motions must follow a rate case process. The complaint or motion must show that the current rates are unjust and unreasonable and propose fair new rates. After analyzing the case, the commission will decide on the appropriate rate adjustment (DOE OE, n.d.; Federal Power Act, 1920/2024; FERC, 2024; Quackenbush, 2020).

The commission then thoroughly reviews the case, considering key factors such as the revenue requirement, which includes the firm's rate base[10], expected return, operating costs, depreciation, and taxes (Ernst & Hlinka, 2023; 2024). This revenue requirement represents the minimum income necessary to cover operational expenses, satisfy investor returns, and serve as the foundation for rate design, ensuring equitable pricing among different customer groups (American Public Power Association, 2019; DOE OE, n.d.; FERC, 2024).

[10] Rate base is the firm's prudently invested capital in assets utilized for operational activity, as determined by the regulatory body, net of cumulative depreciation and further adjustments such as construction work in progress, working capital requirements, equipment inventory and prepayments, customer advancements, investment tax credits and accumulated deferred income taxes, employee pension assets, and regulatory liabilities/assets (Ernst & Hlinka, 2023; 2024). Myers (1972) offers a concise definition: “The rate base is essentially the book value of the utility's capital investment”. (p. 60).

Determining a fair rate of return is a central of the rate cases. The process involves defining the firm's weighted average cost of capital (WACC) to ensure the utility will collect enough revenue to meet debt obligations and attract necessary investments, while avoiding excessive consumer charges (Quackenbush, 2020).

Nevertheless, disagreements often arise during rate case evaluations, with the the firm's capital structure proportions and cost of equity (COE) estimations being highly contested in utility ratemaking (Quackenbush, 2020).

Different financial models are utilized during these evaluations, including Discounted Cash Flow (DCF), Capital Asset Pricing Model (CAPM), Risk Premium Method, Comparable Earnings Method, and Expected Earnings Method. Additionally, comparisons with industry peers help evaluate a firm's capital structure decisions (Quackenbush, 2020).

Disagreements about revenue requirements can lead to litigation process, with the commission holding the ultimate decision-making authority. Generally, the entire case is publicly documented, providing financial information, expert analysis, and hearings provided throughout the rate cases offer resourceful information for investors (FERC, 2024, Morin, 1994).

2.2.2 Electricity industry regulatory restructuring

Regulatory restructuring involves a range of interconnected dimensions. At the macro level, three key components include providing market-based compensation for wholesale, establishing centralized organizations for power system management, and ensuring consumers have retail choice access. At the micro level, restructuring impacts generation and retail power marketers (Borenstein & Bushnell, 2015).

The current industry framework evolved in response to rising electricity prices from the 1970s oil crisis. It began at the wholesale level with the Public Utility Regulatory Policies Act (PURPA) of 1978, which established a category for independently owned generation firms called qualifying facilities (QFs) (Hirsh, 1999; Isser, 2015).

Classified as nonutility, QFs enjoyed advantages that allowed them to "[...] exploit highly leverage financing structures unavailable to conventional utilities." (Isser, 2015, p. 84) at the time. These advantages stem from PURPA impositions, which, according to FERC (1980), provided that "[...] electric utilities must purchase electric energy and capacity made available by qualifying cogenerators and small power producers [...] (p. 12215) at a purchasing rate equal to the utility's "[...] full avoided cost, or at a lower rate if the State regulatory authority or nonregulated electric utility determines that the lower rate will provide sufficient encouragement of cogeneration and small power production." (p. 12223).

Despite criticism of the QFs financing advantages and utilities' burdensome overpriced power purchase agreements, PURPA managed to eliminate "[...] utilities's monopoly control over the generation sector." (Hirsh, 1999, p. 101), laying the groundwork for further restructuring and competitiveness.

By the early 1990s, the growing number of independent power producers (IPPs), electrical technological advancements, and changing market dynamics pushed for further regulatory reforms. The 1992 Energy Policy Act and FERC's Orders 888, 889, and 2000 paved the way for the establishment of independent system operators (ISOs) and Regional Transmission Organizations (RTOs), accelerated the move toward market-based price competition in wholesale electricity, which was later achieved in some regions of the country (Isser, 2015). Meanwhile, many states began exploring restructuring at the retail level (Isser, 2015; Su, 2015). Table 6 summarizes key federal electricity regulation policies and developments.

Table 6: Key Federal electricity regulation restructuring polices

Year	Policies	Key Developments
1978	PURPA	Promoted competition and reduced reliance on traditional utilities by establishing qualifying facilities (QFs) and requiring utilities to buy from non-utility generators at avoided cost.
1992	Energy Policy Act	Further promoted and formalized the role of independent power producers (IPPs) by facilitating their presence in the wholesale market.
1996	FERC Order 888	Enhanced wholesale market and lowered consumer electricity costs by promoting the concept of ISOs, which led to open access, non-discriminatory transmission services, and tariffs.
1996	FERC Order 889	Enforced the separation of transmission and wholesale power merchant functions and introduced the Open Access Same-time Information System (OASIS) to provide data on available transmission capacity and prices.
1999	FERC Order 2000	Encouraged utilities to form RTOs for efficient grid management and standardized market rules to improve reliability, competition, and regional coordination.
2005	Energy Policy Act (EPAct 2005)	Enabled market entry for electricity by repealing the Public Utility Holding Company Act of 1935 (PUHCA), which facilitated mergers and acquisitions involving non-electricity-related firms.
2007	FERC Order 697	Established a framework for obtaining market-based rate (MBR) authorization for wholesale sale of electricity, capacity, and ancillary services.

Year	Policies	Key Developments
2011	FERC Orders 745 & 1000	Integrated demand response into the market on equal terms with traditional generation. Ensured fair compensation and broader participation while reforming transmission planning to be more collaborative, equitable, and aligned with regional benefits.

Note. Data compiled from FERC (2024; 2023a; 2023b); Isser (2015); Hempling (2020); Lifset (2014); Melnyk and Lamb (2006); Rose et al. (2024); Warwick (2002).

Before moving to RTOs/ISOs centralized procurement auctions, the wholesale of power mostly resorted to power pool agreements and bilateral transactions that involved competitive bidding, although it still followed PURPA price regulations (Isser, 2015). Following FERC Order 2000, EPAct 2005 promoted wholesale competition and market efficiencies through two key measures. First, repealing the PUHCA removed barriers to mergers and acquisitions, which facilitated the entry of investors from outside the energy sector into utility ownership (Keglevic et al., 2006; Melnyk & Lamb, 2006). Second, it allowed for a more precise determination of future avoided energy cost rates by revoking mandatory purchase obligations established by PURPA (Isser, 2015).

Notwithstanding having started at the federal level, the restructuring of the electric industry at the wholesale level also depended upon state-level decisions toward restructuring reforms (Rose et al., 2024).

The restructuring process at the state level considered two opposing but complementary directions: upstream and downstream. The upstream approach required vertically integrated firms to divest their generation assets or hand them over to unregulated power subsidiaries within a holding company framework. In contrast, the downstream approach focused on opening the electricity market to retail power marketers to serve all consumer classes (Borenstein & Bushnell, 2015; FERC, 2024; Harrison & Welton, 2021; Isser, 2015; Quackenbush, 2020; Warwick, 2002).

Despite adoption efforts, state level restructuring faced different challenges. Firms in the Midwest and Southeast regions remained vertically integrated (Borenstein & Bushnell, 2015), while Southern utility firms showed minimal interest in embracing restructuring their electricity systems (Harrison & Welton, 2021). Additionally, some states initiated the process but suspended legislation favoring retail choice (Rose et al., 2024).

No consensus exists on categorizing state-level restructuring in existing literature and other information sources.[11] There are three plausible explanations for the lack of homogeneity.

[11] Abito et. al. (2024), American Coalition of Competitive Energy Suppliers (2025), Borenstein and Bushnell (2015), Electric Choice (2025), Hill (2023, 2021), Isser (2015), National Governors Association (2021), Rose et. al. (2024), Sanyal and Bulan (2011), Su (2015), U.S. Energy Information Administration [EIA] (2024).

First, the implementation of electricity restructuring has varied across states, with varied outcomes and no identical approaches. Second, the existence of state-regulated vertical firms associated with RTOs. Lastly, the specific objectives of different studies on the industry influence classification decisions, further contributing to the lack of a unified classification system.

Outlining which states have restructured their electricity industry is important for this investigation as firms in these states face varying economic forces that contrast with those faced by rate-regulated utility firms. Unlike firms that operate under traditional rate regulation, the restructuring initiatives based on market-oriented principles significantly altered how generation firms earn revenue (Fabrizio et al., 2007).

Consequently, a review of legislative sources and Public Utility Commission (PUC) websites for each U.S. state and the District of Columbia was conducted to identify states that enacted restructuring legislation and offered full retail choice. Additionally, a follow-up search from 2011 to 2025[12] on the S&P Capital IQ Pro Utility Rate Case database was performed to check for vertically integrated firms in restructured states. Finally, a cross-check confirmed whether these states participated in RTO/ISO markets.

As a result of the analysis, the following 13 jurisdictions have met the criteria necessary for classification as restructured: Connecticut (CT), Delaware (DE), District of Columbia (DC), Illinois (IL), Maine (ME), Maryland (MD), Massachusetts (MA), New Hampshire (NH), New Jersey (NJ), New York (NY), Ohio (OH), Pennsylvania (PA), and Rhode Island (RI). Table 7 summarizes the acts related to retail restructuring and the market access timelines supporting this classification.

Table 7: Retail Restructuring Jurisdictions

State	Act	Effective Year	Full Retail Market
CT	An Act Concerning Electric Restructuring (Public Act 98-28)	1998	2007
DE	Electric Utility Restructuring Act	1999	2006
DC	Retail Electric Competition and Consumer Protection Act	1999	2005
IL	Electric Industry Deregulation Act	1997	2007
ME	An Act to Restructure the State's Electric Industry (LD 1804 / HP1274)	1997	2000

[12] The temporal scope follows Dormady et al. (2019), Pennsylvania Public Utility Commission (2011), and Simeone and Hanger (2016), which indicate that Ohio and Pennsylvania were the last states to open retail markets.

State	Act	Effective Year	Full Retail Market
MD	Electric Customer Choice and Competition Act	1999	2008
MA	Electric Industry Restructuring Act	1997	2005
NH	Electric Utility Restructuring Act (RSA 374-F)	1996	2006
NJ	Electric Discount and Energy Competition Act (EDECA)	1999	2004
NY	New York PSC Opinion No. 96-12 (Cases 94-E-0952)	1996	2011
OH	Restruc electric indstry-permt competition (Senate Bill 3)	1999	2011
PA	Electricity Generation Customer Choice and Competition Act (HB 1509)	1996	2011
RI	Utility Restructuring Act (H-8124 Substitute B3)	1996	2008

Note. Information in the "Act" and "Effective Year" columns was obtained from the following sources: Connecticut General Assembly (1998), Delaware General Assembly (1999), District of Columbia Public Service Commission (1999), Illinois Commerce Commission (1997), Maine Legislature (1997), Massachusetts General Court (1997), Maryland Public Service Commission (1999), New Hampshire Legislature (1996), New Jersey Legislature (1999), New York Public Service Commission (1996), Ohio General Assembly (1999), Pennsylvania General Assembly (1996), and Rhode Island General Assembly (1996). The dates on the "Full Retail Market" column are primarily based on Rose et al. (2024), except for PA entry, which cites Pennsylvania Public Utility Commission (2011) and Simeone and Hanger (2016).

The analysis also classified five states, California (CA), Michigan (MI), Oregon (OR), Texas (TX), and Virginia (VA) as partially restructured (hybrid) due to the presence of vertically integrated firms and selective retail choice alternatives. Table 8 summarizes these states.

Table 8: Partially Restructured States

State	Particularity
CA	Retail choice is available in Community Choice Aggregation (CCA) and Direct Access (DA). CCA may serve residents and businesses within the PG&E, SCE, and SD&GE service areas. DA allows non-residential customers to procure electricity from an Electric Service Provider (ESP). However, DA has a load cap.
MI	Only 10% of retail customers are allowed to choose an alternative electric supplier (AES). The remaining 90% continue with their current utility's regulated rates.
OR	No residential retail choice is available. Nonresidential consumers have the right to purchase power from a electricity service supplier (ESS) other than their current utility.

State	Particularity
TX	In the ERCOT area, residential and nonresidential consumers can choose a retail electricity provider (REP). Non-ERCOT consumers are captive of traditional monopoly-granted franchised utility.
VA	Residential retail choice is only available under two conditions: if shopping for 100% renewable energy and the local utility does not offer renewable energy. Nonresidential retail choice is available only for large, over five megawatt consumers.

Note. Data compiled from California Public Utilities Commission [CPUC] (2025), Michigan Public Service Commission [MPSC] (2025), Oregon Public Utility Commission [PUC Oregon] (n.d.) Public Utility Commission of Texas [PUCT] (2025), and Virginia State Corporation Commission [SCC Virginia] (2025). CA suspended retail choice in 2001 and reintroduced it for nonresidential customers in 2009 and residential customers in 2010 (CPUC, 2018). VA suspended retail choice in 2001 and reintroduced it in 2009 (Virginia General Assembly, 2009). MI limited retail choice in 2008 (MPSC, 2024).

The remaining 33 states have kept the vertically integrated monopoly framework for retail of electricity.

The restructuring period was lengthy and complex for the most part. To ease this transition, states like MD, NY, and OH opted for a gradual phase-in process in which firms began transitioning at different moments, prolonging the change to the retail market (Fabrizio et al., 2007; Rose et al., 2024; Su, 2015).

States also included provisions for recovering stranded costs, such as rate freezes and rate caps (Abito et al., 2024; Borenstein & Bushnell, 2015; Bowen et al., 2023; Dormady et al., 2019; Isser, 2015; Kwoka, 2008; Rose et al., 2024; Su, 2015). The duration of these provisions varied by firm and state. For instance, in Ohio and Pennsylvania, the recovery of regulatory stranded costs ended on December 31, 2010 (Dormady et al., 2019; Pennsylvania Public Utility Commission [PPUC], 2011; Simeone & Hanger, 2016).

Pennsylvania's end of the rate freeze enabled over 60 percent of consumers to choose power at market rates (PPUC, 2011).

The introduction of market price dynamics presented a significant departure from the traditional cost-of-service ratemaking scheme of rate-regulated utility firms since retail power marketers operate within a landscape subject to market price fluctuations. However, there is an important caveat in restructured states: even though electricity prices may vary in the market, utility delivery charges remain regulated by the state commission (Hortaçsu et al., 2017; Rose et al., 2024; Su, 2015).

While restructuring has allowed new competitors to enter the market, it has weakened utility firms' ability to contest regulatory actions. For instance, introducing renewable portfolio standards (RPS) policies increases costs and uncertainties related to procuring renewable energy or purchasing renewable energy credits, particularly due to limitations in cost recovery mechanisms. In contrast, utility firms in

non-restructured states are in a better position to oppose new policies, which make regulatory commissions less likely to implement unpopular measures (Parinandi, 2023).

2.3 Capital Structure of Regulated Firms

According to Frank and Goyal (2022), capital structure decisions of regulated firms are shaped by regulatory influences. While literature generally supports this view, the specific mechanisms through which regulation affect these decisions remain underexplored. Graham et al. (2015), in their historical analysis of a century of capital structure patterns in corporate America, highlighted the need for further research focused on regulated industries.

The absence of recent finance studies addressing capital structure within a regulatory context confirms Graham et al.'s (2015) observation, reinforcing the relevance of understanding how regulated firms determine their financing policies. Furthermore, the restructuring process of the electric industry in 18 U.S. jurisdictions provides additional motivation to revisit this topic, as it brings new institutional and financial dynamics that may influence capital structure decision-making.

In contrast to unregulated companies, under the trade-off theory regulated firm managers would have little incentive to maximize shareholders' wealth by adding debt to the balance since tax shield benefits are passed on to consumers (Miller & Modigliani, 1966; Myers 1984, 2015). Additionally, increasing debt should be unattractive to managers since the regulatory commission does not account for the effects of consequent increased financing risk when computing the firm's allowed return on equity (Myers, 2015). However, regulated firms have historically supported higher debt-to-equity ratio than non-regulated ones (Bradley et al., 1984; Sanyal & Bulan 2011; Spiegel & Spulber, 1994, 1997).

A plausible explanation for this phenomenon relies on the behavior of firm managers, who exploit Public Utility Commissions' (PUCs) concerns regarding service instability and financial distress of the firms they oversee (Owen & Braeutigam, 1978). The survey on PUCs and utility firms conducted by Besley and Bolten (1990) confirms that, as they identified, both parties believe debt increases threaten the firm´s ability to meet its obligations, leading to increased allowed returns.

These findings suggest that managers have a compelling incentive to deliberately use increased bankruptcy risk caused by debt to steer commissioners' decision-making in favor of shareholders by achieving higher allowed returns. As several studies on the topic have shown, debt is strategically used as a mechanism to induce regulators to increase authorized returns (Chen & Fanara, 1992; Dasgupta & Nanda, 1993; De Fraja & Stones, 2004; Rao & Moyer, 1994; Reboul & Toldrà-Simats, 2016; Resende, 2010; Spiegel, 1994a, 1996; Spiegel & Spulber, 1994, 1997; Taggart, 1981).

In bringing the prescribed role of the regulatory commission of safeguarding public interest by implementing regulations, ensuring compliance, and monitoring to the discussion, managers would two more reasons increase leverage: to reduce the likelihood of shareholders' resources being expropriated by regulatory commissions favoring customers seeking lower rates and as response to a more restrictive business environment created by regulators (Taggart, 1985; Dasgupta & Nanda, 1993; Rao & Moyer, 1994).

Assuming that Public Utility Commissions (PUCs) closely monitor regulated firms, the role of debt in controlling managerial behavior, as emphasized by Jensen and Meckling's agency theory, might be diminished. In fact, utilities typically face significantly lower information asymmetry than industrial firms, precisely due to the intense scrutiny involved in regulation. This implies that regulated utilities have limited capability to exploit informational advantages, thereby reducing their incentive for debt financing (Masulis & Kowar, 1986).

Examining capital structure, Ovtchinnikov (2010) found that restructuring significantly impacted firms' operating environment, ultimately leading to dynamic capital structure adjustments by issuing more equity following restructuring. Sanyal and Bulan (2011) report a similar conclusion, noting a reduction in debt levels in response to regulatory and competitive uncertainty induced by restructuring processes.

Capital structure decisions in utilities are also significantly shaped by regulatory mechanisms such as regulatory lag and revenue adjustment stabilization mechanisms (RAM) or decoupling. Regulatory lag is recognized as a major determinant of systematic risk due to regulators' slow adjustments of rates, meaning that much of the systematic risk utilities face remains unaccounted for in customer charges (Haugen et al., 1978; Myers, 1972). Decoupling revenues should account for that, but the mechanism has been shown to have an insignificant statistical impact on business risk and equity cost reduction (Michelfelder et al., 2020). Despite lacking empirical proof, 46 utilities in 18 jurisdictions have adopted RAM (NRDC, 2020).

These findings confirm that the capital-intensive nature of utilities depends upon regulatory frameworks, as PUCs can promptly adjust revenue requirements, thus providing more stable income streams and allowing firms to take on debt (Baxter, 1967).

While regulation may offer a stable environment, utilities continue to face disputes over their cost of capital in regulatory proceedings. Such disputes stem from potentially biased outcomes from financial models used in rate decisions (Biggar, 2023; Owen & Braeutigam, 1978; Quackenbush, 2020). Although the Capital Asset Pricing Model (CAPM) is prevalent in rate cases despite critiques by Fama and French

(2004), it inadequately replicates market pricing and output decisions under conditions of uncertainty faced by regulated utilities (Myers, 1973; Biggar, 2023).

Ultimately, regulatory behavior profoundly affects capital structure decisions. The regulatory climate, characterized by uncertainties on authorized returns shifts the nature of risk experienced by these utilities (Grout & Zalewska, 2006; Norton, 1985; Sanyal and Bulan, 2011). Thus, while regulation theoretically encourages higher leverage through predictable income streams and stable business environments (Taggart, 1985), it simultaneously introduces regulatory risk factors that utilities must carefully navigate in managing their capital structures (Morin, 2006; FERC, 2024).

Regulatory risk is defined as the uncertainty firms face concerning PUC's behavior, future policies, and the potential implications these have on investment decisions and firm performance. According to Fiocco and Guo (2020), regulatory risk is particularly impactful in infrastructure industries with irreversible investments.

The Supreme Court of the United States has recognized this type of risk as a unique category, emphasizing its detrimental impact on investment activities due to policy uncertainties (Duquesne Light Company v. Barasch, 1989; Fiocco & Guo, 2020).

This uncertainty emerges from the diverse preferences and information asymmetries held by regulatory commissions, which create unpredictable environments negatively affecting firms' investment plans and expected investor returns (Woroch, 1988). Taggart (1985) also reported differences in individual PUC behaviors, indicating the non-uniform nature of regulatory risk.

It is recognized that regulatory commissions in some states have the power to regulate the issuance of securities, but they seldom exercise this power. As noted by the Colorado Supreme Court[13], a fundamental principle of utility regulation is that management should be free to determine the optimal debt-to-equity ratio, allowing for managerial discretion in financial decision-making (Spiegel, 1994b).

Frank and Goyal (2009) suggest that despite stable cash flows and lower financial distress risk may favor debt financing, the intense scrutiny from regulatory oversight and consumer advocacy can make debt financing less appealing from a shareholder's perspective.

Robichek (1978) reports an inherent circularity in regulatory consideration of firm-specific risk, as the regulatory processes substantially shape the risk profiles they evaluate. Regulatory practices aim to protect consumers in natural monopoly contexts, necessitating a delicate balance between consumer protection and investor interests (Hempling, 2020).

[13] In Re Mountain States Teleph. & Teleg. Co. 39 PUR 4th 222, 247-248.

Archer (1981), Navarro (1983), and Trout (1979) demonstrate that firms in stricter regulatory environments generally face higher capital costs, further confirming that regulatory commission behaviors critically influence firms' capital structures and amplify regulatory climate risk.

Navarro's (1983) influential research on Wall Street's perception of Public Utility Commissions (PUCs) underscores metrics such as allowed returns and the inclusion of construction work in progress as key indicators of favorable regulatory environments, directly impacting perceived investment risk. Similarly, Gordon and McCallum (1972) argue that regulatory decisions regarding shareholder returns significantly affect earnings risk, potentially even more than traditional market uncertainties (Sherman, 1977).

Empirical studies consistently illustrate the financial consequences of regulatory risk. Moyer et al. (1987) found that regulatory commissions with above-average ratings approved returns notably higher than those granted by lower-rated commissions. Butler and McNertney (1991) observed that negative regulatory shifts reduced abnormal returns, signaling decreased future profitability.

Moyer et al. (1992) noted strategic financial adaptations in response to regulatory challenges in the form of higher dividend payout ratios for firms operating under higher regulatory risk.

Dasgupta and Nada (1993) and Rao and Moyer (1994) indicate that firms facing harsher regulatory climates rely more heavily on debt financing, strategically utilizing debt to manage and mitigate regulatory risk. Atkinson and Nowell (1994) add that regulatory lag notably affects investor expectations, intensifying regulatory risk's influence on capital structure decisions.

Market evaluations of regulatory outcomes also reflect this risk. Loudder et al. (1996) and Claggett and Moyer (1997) report that favorable regulatory climates positively influence market-to-book ratios, suggesting greater investor confidence due to regulatory predictability. Conversely, Nwaeze (1998, 2000) demonstrates that price adjustments and stock price reactions to earnings surprises are more significant and predictable in tolerant regulatory environments than stringent ones.

Cambini and Spiegel (2016) extend these findings to an international context, demonstrating that firms regulated by more independent agencies in Europe tend to issue greater amounts of debt.

These theoretical and empirical works collectively reinforce the widespread relevance and profound impact of regulatory climate risk on corporate behavior and capital structure decisions.

Chapter 3: Research Hypothesis

Capital structure theories often assume relatively stable institutional conditions. In the electric utility sector context, state-level regulatory environments and market design introduce additional layers of complexity that directly influence leverage decisions (Frank & Goyal, 2022; Graham et al., 2015).

Regulated utilities differ significantly from nonregulated firms primarily because Public Utility Commissions (PUCs) determine their rate of return. These regulatory constraints can affect utilities' risk profile and ability to raise capital.

In constructive regulatory environments, utilities may have greater access to debt markets because regulators provide predictable rate-setting frameworks and permit reasonable returns on capital (Moyer et al., 1987; Claggett & Moyer, 1997). Conversely, in restrictive regulatory environments, uncertainty about cost recovery and political interference may deter utilities from relying heavily on debt (Taggart, 1985; Rao & Moyer, 1994; Dasgupta & Nada, 1993).

Additionally, the restructuring of electricity markets has introduced institutional heterogeneity across states. In non-restructured states, utilities remain vertically integrated and subject to traditional cost-of-service regulation, while in restructured states, utilities do not earn a profit from the generation of electricity (Rose et al., 2024; Borenstein & Bushnell, 2015; Fabrizio et al., 2007). This variation affects how regulation influences firm behavior.

In restructured states, utilities appear to have lower bargaining power than vertically integrated firms. They also interact with the market, exposing them to uncertainties about cost recoveries, potentially amplifying the effect of regulatory risk on capital structure decisions (Parinandi, 2023; Borenstein & Bushnell, 2015). Prior research suggests that post-restructuring environments often increase financial uncertainty, affecting firms' investment incentives (Sanyal & Bulan, 2011; Ovtchinnikov, 2010).

There is a dynamic behavior aspect to regulatory risk, making it essential to understand how firms adjust their leverage in response to temporal changes in regulatory risk (Fiocco & Guo, 2020; Taggart, 1985). Regulatory Research Associates (RRA) scores allow for a dynamic measure of regulatory risk that can be tracked across states and over time (Moyer et al., 1992; Navarro, 1983). Dynamic regulation is particularly relevant given the increased capital needs associated with investments (Parinandi, 2023; Rose et al., 2024).

In light of the above, the following hypotheses are proposed:

H1: Regulatory Risk and Leverage

Firm leverage decreases with increases in regulatory risk, controlling for firm-level characteristics.

Rationale: Regulatory risk increases the perceived risk associated with debt financing, discouraging regulated firms from maintaining high leverage positions. Prior studies indicate that firms in such environments will likely rely less on leverage financing to mitigate increased regulatory exposure (Rao & Moyer, 1994; Dasgupta & Nada, 1993).

H2: Moderating Effect of Restructuring on Leverage

Restructuring status significantly moderates the relationship between regulatory risk and leverage, such that the negative impact of regulatory risk on leverage is greater for firms in fully restructured states than non-restructured states.

Rationale: Restructuring caused changes in the operating environment, increasing regulatory uncertainty and complexity. The heightened regulatory risk leads to more pronounced responses than in traditionally regulated environments (Borenstein & Bushnell, 2015; Ovtchinnikov, 2010; Sanyal & Bulan, 2011).

H3: Leverage Dynamic Adjustment to Regulatory Changes

Changes in regulatory risk prompt corresponding adjustments in leverage for regulated firms; leverage tends to decrease following risk increases and increase following risk decreases, consistent with dynamic target adjustment behavior.

Rationale: Dynamic tradeoff theories posit that optimal leverage is inversely related to firm risk, including regulatory risk. Therefore, when regulatory risk pertinent to the firm change, firms are expected to dynamically adjust their leverage towards the new optimum – reducing debt following risk increases and potentially increasing debt following risk decreases – to maintain an appropriate risk-adjusted capital structure (Sanyal & Bulan, 2011; Ovtchinnikov, 2010, Taggart, 1985).

Chapter 4: Research Design

This section outlines the empirical strategy to assess the effects of regulatory risk on capital structure decisions in the U.S. electric utility industry. The research design includes the data source and hypotheses-driven sample structure, key variables definition, regression models, and the statistical method used to analyze datasets.

4.1 Research type

Research can be classified into three main categories based on its objectives: exploratory, descriptive, and causal. Exploratory research is performed when knowledge about the subject is scarce or outdated. Descriptive research uses data to describe the characteristics of the subject in question. Causal research strives to assert the causal influence of one event on another (Hair et al., 2020).

Therefore, the present investigation is categorized as descriptive research, as it aims to identify and describe observed variations in occurrences of a given phenomenon. Additionally, this study is guided by the quantitative approach and classified as *ex post facto* since it uses existing recorded data to describe variables' relationship outcomes utilizing statistical methods for data analysis (Creswell & Creswell, 2023; Hair et al., 2020).

4.2 Sample Selection, Time Frame, and Data Collection

A comprehensive collection of annual secondary data was sourced from S&P Capital IQ Pro® (CIqPro). The platform was selected due to the granular level of industry-specific[14] information and detailed coverage of subsidiary-level financials. In addition to providing standardized financial data collected from regulatory fillings[15], the platform also supports evaluations of state-level regulatory climate risks, which is crucial for addressing the research question and hypotheses.

In contrast to prior research that relied on SIC codes for sampling firms (e.g., Haugen et al., 1978; Loudder et al., 1996; Moyer et al., 1992; Rao & Moyer, 1994; Nwaeze, 2000; Ovtchinnikov, 2010), this research adopts a novel approach by utilizing the CIqPRO "Regulated Energy Companies" screening tool to search for regulated companies. The tool is developed explicitly for U.S. regulated firm search, allowing for a thorough selection and evaluation of regulated firms.

[14] The S&P Capital IQ Pro platform offers industry-specific data sourced by SNL Energy, which periodically collects and examines regulatory data from different federal and state regulatory bodies at the company level, such as the FERC Form 1 and the EIA 861. Filings and data are subsequently provided to S&P Capital IQ Pro.

[15] Annual filing is required for all utilities classified as major based on one of four requirements: i) one million MWh of total annual sales; ii) 100 MWh of annual sales for resale (wholesale); iii) 500 MWh of annual power exchanges delivered; or iv) 500 MWh of annual wheeling that exceeds for others (18 C.F.R. § 141.1, 2025).

Sample selection encompassed publicly traded and privately held investor-owned, regulated electric and diversified utility companies operating in the United States electricity market. Cooperatives, municipal and federal utilities, and other non-investor-owned firms are not-for-profit, thus not considered. Independent power producers, qualifying facilities, and transmission-only firms were omitted, as they primarily operate at the wholesale level and are subject to the Federal Energy Regulatory Commission. Retail power marketers, power marketers, and brokers were also omitted, as they function as intermediaries and typically do not own generation or transmission assets (McNabb, 2005).

Regulated utilities often function as subsidiaries of larger corporations, typically part of pure or mixed holding companies that integrate inter-regional or international systems.[16] Based on prior research from Baron and Taggart (1977), Hughes et al. (2012), and Sanyal and Bulan, 2011), situations in which a subsidiary and its parent holding company are concurrently listed, the parent company is excluded from the sample. This exclusion is justified by at least one of the following reasons: it concentrates on consolidated financial information only, does not carry regulated utility operations, and may not be regulated.

A summary of sample selection is presented on Table 9.

Table 9: Sample selection

Company type	Number of companies
Regulated energy companies	3476
Public Power	2018
Electric Cooperative	872
Gas Pipeline	171
Electric Utility	131
Gas Utility	116
Wholesale/Transmission	90
Diversified Utilities	80
Electric Utilities & Diversified Utilities	211
Top Tier Consolidated	54
Operating utility companies	157

A total of 157 distinct operating firms were initially identified for analysis. However, 20 firms were excluded due to insufficient financial data, resulting in a final sample of 137 firms. Of the total, 131 firms

[16] For example, Berkshire Hathaway has utility subsidiaries in Washington State, Nevada, Oregon, California, Utah, Wyoming, and Iowa. Iberdrola (Spain) owns United Illuminating, New York State Electric & Gas, Rochester Gas & Electric and Central Maine Power (Hempling, 2020, p. 42).

are privately held subsidiaries within this group, while 06 are publicly traded firms. The sample is organized as a firm-year panel, covering fiscal years 2012 to 2023, with 1,644 observations.

Sequentially, firm-state categorization was based on the primary operating jurisdiction of each company. This categorization was conducted using the S&P Capital IQ Pro® (CIqPro) "Energy Companies by State" screening tool. Sample firms operating in more than one state were assigned to a specific state based on their primary jurisdiction of operation, determined by retail revenue concentration, headquarters location, or the dominant state of regulatory filing. Sequentially, firms were grouped into non-restructured, partially restructured, or fully restructured groups according to their primary state of operation. Appendix A presents sample firms organized accordingly.

The starting period for the research covered time frame is defined by the diverse transitioning processes occurring in various restructuring states between 1996 and 2010. Among the restructured states, Pennsylvania was the last to achieve full retail choice, which began in 2011 (Simeone & Hanger, 2016). The selection of the cut-off year is influenced by the timing of annual regulatory filings, such as FERC Form 1, which major electric firms annually submit in mid-April.

Financial data was exclusively obtained from the CIqPro platform under the "Regulated Energy" financial section. The primary reason for selecting this specific financial data over other available data sources on CIqPro is twofold. It presents financial information collected at the firm's level, making it a more suitable option for the research sample. Additionally, the database provides a more significant amount of financial data compared to other options. Finally, it relates to the financial information regulated firms and regulatory commissions use in rate cases and other regulatory matters.

Data points were captured and expressed in thousands of US dollars and analyzed using Stata 14.2 software. The ratios discussed in the following sections were derived in Excel from the raw data obtained from CIqPro.

Winsorizing technique was applied to address outliers in the dataset. The data are sorted in ascending order, and the values falling within the first and last percentiles are replaced with the nearest values within the 1st and 99th percentile range. This technique aims to minimize the impact of outliers and allow for data distribution to closely approximate a standard curve by reducing the influence of extreme values without excluding any observations (Barnett & Lewis, 1994; Fukui et al., 2023).

4.3 Variables Selection

In all models, the dependent variable is firm-level book leverage. The econometric specifications include a set of primary interest explanatory variables and standard firm-level controls to account for other determinants of capital structure.

In Model 1, the main explanatory variable is the state-level regulatory risk score, which varies annually and captures the institutional environment in which the firm operates.

In Model 2, the explanatory structure includes regulatory risk and its interaction with two restructuring status dummies (partially and fully restructured states). These interaction terms allow the model to test Hypothesis 2, namely whether the effect of regulatory risk on leverage varies across different market structures.

In Model 3, which tests for dynamic capital structure adjustment (Hypothesis 3), the explanatory variables include the lag of leverage and the year-over-year change in regulatory risk. The change in risk captures the firm's exposure to evolving regulatory uncertainty and is used to test whether firms adjust their leverage in response to new regulatory conditions.

Across all models, a common set of firm-level control variables is included: firm size, profitability, asset tangibility, capital expenditures, and the median industry leverage for the corresponding year.

Variables were selected based on capital structure literature, such as Bradley et al. (1984), Chen and Fanara (1992), Frank and Goyal (2003; 2009), Fukui et al. (2023), Welch (2011), and works in regulation and capital structure as in Dasgupta and Nanda (1993), Moyer et al. (1992), Rao and Moyer (1994), Reinartz and Schmid (2016), Sanyal and Bulan (2011), and Spiegel and Spulber (1994).

As noted by Barclay and Smith (2020), DeAngelo (2022), Frank and Goyal (2022), and Hossain (2021), capital structure decisions remain a complex and fundamental puzzle in finance, and there is no unified theory capable of explaining all influential factors.

4.3.1 Dependent Variable

In this research, financial leverage is treated as the dependent variable. It is important to recognize that no universally accepted measure for leverage exists. This is highlighted by Welch (2011), Mitton (2022), and Fukui et al. (2023, p. 2447), who noted that there are "dozens of different measures of leverage as dependent variables." Both Welch (2011) and Keefe and Yaghoubi (2016) recommend that researchers examine the connections within their research problem and select the most suitable proxy from the existing literature that corresponds with the proposed question.

The measure of leverage adopted in this research is the ratio of total debt to total capitalization, defined as the sum of short-term and long-term debt divided by the sum of total debt and total equity at book value (Chen & Fanara, 1992; Frank & Goyal, 2003; Reinartz & Schmid, 2016; Sanyal & Bulan, 2011; Welch, 2011) as presented in Table 10. This proxy for leverage is particularly relevant in regulated utilities, where capital structure decisions are often assessed regarding capital mix rather than asset financing.

Table 10: Dependent variable: Leverage

Variable	Abbr.	Ratio	References
Book leverage	Lev	$\frac{TOTAL\ DEBT}{TOTAL\ DEBT\ +\ TOTAL\ EQUITY}$	Chen and Fanar (1992), Frank and Goyal (2003), Reinartz and Schmid (2016), Sanyal and Bulan (2011), Welch (2011).

Leverage is assessed at book values due to two primary factors. Most sample firms are privately owned, rendering market evaluation impracticable for the time being. Secondly, although public utility commissions conduct market valuations of private firms for ratemaking purposes using different methods, they generally examine one firm at a time, not a large group of firms.

Even if such an endeavor were to be undertaken, the reported data for the proxy group would contain past regulatory decisions that affect the figures (Myers, 1977). As Myers (1972) noted, basing "current regulatory decisions partly on past decisions leads to a dangerously arbitrary standard" (p. 63). Another limitation is the difficulty of selecting the appropriate method to estimate the cost of equity capital for the regulated firm. This process has proven complex and often contentious in light of new findings (Havyatt & Johnstone, 2024).

4.3.2 Independent Variables of Interest

The central independent variable for all hypotheses is regulatory risk, a state-level indicator score ranging from 1 to 9 capturing the degree of uncertainty and discretion that regulated utilities face. Next, the score interacts with two restructuring state status dummies to test the second hypothesis. Lastly, an annual change in a firm's regulatory risk and a partial adjustment term are introduced in the third model.

The expected sign of the coefficient on regulatory risk is negative, based on the rationale that firms operating under more uncertain or restrictive regulatory environments may perceive greater financing risk and reduce their reliance on debt. This expectation is supported by prior theoretical and empirical studies (e.g., Spiegel & Spulber, 1994; Moyer et al., 1992; Litzenberger & Sosin, 1979), which

argue that regulatory discretion and risk influence firms' cost recovery expectations and capital structure strategies. Table 11 summarizes the variables of interest.

Table 11: Variables of interest

Variable Name	Definition / Description	Model(s)	Expected Effect
RR	State-level regulatory risk score (ordinal scale from 1 to 9; higher values indicate more restrictive environments)	1, 2, 3	Negative
RR × DP	Interaction between regulatory risk and partial restructuring dummy (1 if state is partially restructured)	2	Negative (stronger effect in partial restructuring)
RR × DF	Interaction between regulatory risk and full restructuring dummy (1 if state is fully restructured)	2	Negative (stronger effect in partial restructuring)
ΔRR	Change in regulatory risk from year t−1 to t (captures dynamic adjustment to evolving regulatory environments)	3	Negative (firms may deleverage in response to increased risk)
Lev_t-1	Lagged value of leverage (captures persistence and adjustment behavior over time)	3	Positive (captures gradual adjustment toward target leverage)

Note. Regulatory Risk (Moyer et al., 1987, 1992; Loudder et al., 1996; Claggett & Moyer, 1997; Rao & Moyer, 1994; Nwaeze, 1998; Dasgupta & Nanda, 1993; Chen & Fanara, 1992; Malko & Skinner, 2011).

The regulatory risk measure used in this research, the RRA state regulatory climate evaluation, is prepared by the Regulatory Research Associates (RRA) and obtained from the S&P Capital IQ Pro® platform. As a unit of S&P Global, RRA is an independent research and consulting organization that has provided research services focused on public utility and electric utility regulation for over four decades (S&P Global Market Intelligence, 2025). The evaluation aims to provide a standardized comparative rank assessment of state regulatory environments, assigning each U.S. jurisdiction a single score that is periodically reviewed, reflecting the interests of fixed-income and equity investors (Federico, 2025).

The RRA state regulatory climate evaluation is similar to the Value Line Investment Survey discussed in previous studies by Claggett and Moyer (1997), Loudder et al. (1996), Malko and Skinner (2011), Moyer et al. (1987, 1992), Nwaeze (1998), and Rao and Moyer (1994). It is also connected to Duff and Phelps' index of regulatory climate (now known as Kroll), which was utilized in studies by Chen and Fanara (1992) and Dasgupta and Nanda (1993).

The main difference between RRA, Value Line Investment, and Duff and Phelps is that RRA utilizes a nine-level scale, whereas Value Line employs a three-point scale, and Duff and Phelps use a six-point scale. RRA methodology considers specific categories that are weighed differently across more than 30

metrics. Key factors in this evaluation include the state's track record for authorized equity returns, outcomes of rate cases, ratemaking methodologies, and the overall impact of Public Utility Commission decisions (Federico, 2025).

The RRA evaluation is organized into three primary risk ranking categories: Above Average, Average, and Below Average. Within each category, three levels represent different risk-related positions. This classification is quantified on a scale from one to nine, creating an ordinal categorical variable for this research, with one signifying the lowest regulatory risk and nine denoting the highest. Table 12 provides a summary of the RRA ranking system.

Table 12: RRA state regulatory ranking system

Ranking Category	Description	Relative Position	RRA Description	Score
Above Average	Lower-risk regulatory climate	1	Strong or more favorable ranking	1
		2	Midrange rating	2
		3	Less favorable rating	3
Average	Average-risk	1	Strong or more favorable ranking	4
		2	Midrange rating	5
		3	Less favorable rating	6
Bellow Average	Higher-risk regulatory environment	1	Strong or more favorable ranking	7
		2	Midrange rating	8
		3	Less favorable rating	9

Note. Data compiled from Regulatory Research Associates (S&P Global Market Intelligence, 2025).

The RRA ranking scale has been referred in utility rate cases to assess regulatory risk and support arguments and calculations related to the cost of equity, shaping financial assessments in various rate cases. RRA's evaluations are frequently cited as evidence of a state's regulatory climate, particularly in proceedings before the Florida Public Service Commission (2021, 2024) and Utah Division of Public Utilities (2020), and in testimony to the Kansas Legislature (Kansas Corporation Commission, 2023; Kansas Legislature, 2023).

Utilizing this regulatory risk measure shall enable the identification of incremental changes in risk, even within the same broader category. Consequently, a higher level of accuracy in assessing how changes in regulatory risk might impact a firm's leverage choices is expected. Sample firms were assigned

a risk score based on their primary state of operation and the respective year. If there were any changes in the state score within the year, the score at the end of the year was considered. A thorough compilation of regulatory risk scores is delineated in Appendix B.

4.3.3 Control variables

To test the hypotheses, the empirical models include a set of firm-level control variables commonly used in the capital structure literature. These variables account for alternative explanations of leverage variation and help reduce omitted variable bias. Specifically, the model controls for firm size, profitability, asset tangibility, capital expenditures, and median industry leverage. Table 13 presents a summary of the control variables.

Table 13: Control variables

Variable	Abbr.	Definition	Expected Effect	References
Size	size	The natural logarithm of total asset	+/-	Sanyal and Bulan (2011), Rajan & Zingales (1995)
Profitability	prof	EBITDA / total asset	+/-	Fukui et al. (2023), Sanyal and Bulan (2011), Frank and Goyal (2009)
Asset tangibility	tang	Net utility plant / Total Assets	+	Sanyal and Bulan (2011), Frank and Goyal (2009)
Capital expenditures	capex	CapEx/Total Assets	+	Frank & Goyal (2009)
Median industry leverage	milev	The median of sampled industry leverage by year	+	Frank and Goyal (2009)

Note. EBITDA stands for earning before deductions of interest, taxes, depreciation, and amortization. In regulatory accounting, net utility plant is the equivalent to property, plant, and equipment. All data was sourced from Capital IQ Pro regulated energy financials.

Although Rajan & Zingales (1995) found a positive relationship between firm size and leverage, when analyzing the regulated electric industry Sanyal and Bulan (2011) found a negative relationship suggesting larger utilities used less debt, potentially due to regulatory effects.

Contrasting views also surround profitability, which should have a negative relation with debt according to Myers and Majluf (1984), has been found to positively determine leverage (Sanyal & Bulan, 2011), Frank and Goyal (2009).

In respect to tangibility, more tangible assets are associated with better collateral options, reducing lender risk and allowing higher leverage (Sanyal and Bulan, 2011; Frank and Goyal, 2009). As

proxy for growth, capital expenditure represents investment cash outflows that may generate a financing gap and consequent increases in leverage (Frank & Goyal, 2009). Regarding median industry leverage, firms tend to positively relate leverage with median industry (Frank & Goyal, 2009).

4.4 Econometric Models

4.4.1 Methodology for Hypotheses Testing

The following econometric procedures were designed to test each of the hypotheses proposed in this study:

Data and initial preparation (Common to all hypotheses).

Data Collection: Annual firm-level financial and operational data, along with state-level regulatory risk scores (RRA state regulatory climate evaluation), were obtained for the period 2012–2023 from S&P Capital IQ Pro®, as previously described.

Data Cleaning and Structuring: Missing values were treated appropriately, and the dataset was structured in a panel format (firm-year).

Variable Construction:

- Dependent Variable:

Leverage (Book Leverage) was calculated as the ratio of total debt to total capitalization at book value.

- Independent Variables of interest:

Regulatory Risk (RR) was constructed as the RRA score of the firm's primary state of operation in a given year.

Restructuring Dummies:

Partial Dummy (DP) was defined as 1 if the state was partially restructured, and 0 otherwise.

Full Dummy (DF) was defined as 1 if the state was fully restructured, and 0 otherwise.

Lagged and Differenced Variables (for H3):

Lev_t-1 (lagged leverage) and ΔRR (change in RR from t–1 to t).

- Control Variables:

Size (natural logarithm of total assets),

Profitability (EBITDA / total assets),

Tangibility (net utility plant / total assets),

Capex (capital expenditures / total assets),

MILEV (median industry leverage per year).

The base group includes firms in non-restructured states, as well as firms in partially and fully restructured states.

Winsorization: To mitigate the influence of outliers, winsorization was applied to continuous variables at the 1st and 99th percentiles, as recommended in the literature.

Panel Declaration: The panel structure was declared in Stata using the `xtset` command with firm ID and year identifiers.

Descriptive statistics and Pearson correlation matrices were examined to understand variable distributions and assess potential multicollinearity.

- Hypothesis 1 (H1): Firm leverage decreases with increases in regulatory risk, controlling for firm-level characteristics.

Baseline Model: A static panel regression model was estimated as follows:

$$Lev_{it} = \beta_0 + \beta_1 RR_{st} + \beta_2 Size_{it} + \beta_3 Prof_{it} + \beta_4 Tang_{it} + \beta_5 Capex_{it} + \beta_6 Milev_{jt} + \alpha_i + \gamma_t + \varepsilon_{it} \quad (1)$$

Where: RR is regulatory risk; Size is the natural logarithm of total assets; Prof is profitability; Tang is tangibility; Capex is capex; β_0 is the constant; *i* indexes firms; *t* indexes years; *s* indexes states, α_i captures firm-specific unobserved heterogeneity (fixed effects), γ_t captures year fixed effects, and ε_{it} is the idiosyncratic error term.

Estimator Selection: Panel Effects Test: The Breusch-Pagan LM test was used to compare pooled OLS with the random effects (RE) model, followed by Hausman Test: Fixed effects (FE) and random effects (RE) estimators were compared using the Hausman test. If the p-value < 0.05, the FE model is preferred, as it accounts for possible correlation between regressors and α_i . Otherwise, RE may be more efficient.

Year fixed effects were latter used to test whether controlling for time trends changed results. Finally, a comparison between the two fixed effects models, one with year fixed effects, and one without, was conducted.

Diagnostics and Corrections: To detect and address heteroskedasticity and autocorrelation**,** Serial Correlation Test (Wooldridge) and Variance-covariance matrix (VCE) clustered by the identifier were applied.

Interpretation: The coefficient β_1 captures the effect of regulatory risk on leverage. H1 predicts a negative and statistically significant β_1 ($p < 0.05$).

- Hypothesis 2 (H2): Restructuring status significantly moderates the relationship between regulatory risk and leverage, such that the negative impact of regulatory risk on leverage is greater for firms in fully restructured states than non-restructured states.

To assess whether the relationship between regulatory risk and capital structure is moderated by the level of regulatory restructuring across states, interaction terms were introduced in the empirical specification. The model includes dummy variables capturing the restructuring status of a firm's primary operating state, classified as either partially or fully restructured. The base category comprises firms located in states that remain traditionally vertically integrated (non-restructured).

The following extended static panel data model was estimated:

Interaction Model:

$$Lev_{it} = \beta_0 + \beta_1 RR_{st} + \beta_2(RR_{st}\ x\ DP_s) + \beta_3(RR_{st}\ x\ DF_s) + \beta_4\ x\ Size_{it} + \beta_5 Prof_{it} + \beta_6 Tang_{it} + \beta_7 Capex_{it} + \beta_8 Milev_{jt} + \alpha_i + \gamma_t + \varepsilon_{it} \quad (2)$$

Where: RR is regulatory risk; DP is the interactional dummy for partially restructured state; DF is the interactional dummy for fully restructured state; Size is the natural logarithm of total assets; Prof is profitability; Tang is tangibility; Capex is capex; β_0 is the constant; *i* indexes firms; *t* indexes years; *s* indexes states, α_i captures firm-specific unobserved heterogeneity (fixed effects), γ_t captures year fixed effects, and ε_{it} is the idiosyncratic error term.

Estimator selection followed the same approach used in H1, with both fixed and random effects estimated.

Year fixed effects were latter used to test whether controlling for time trends changed results. Finally, a comparison between the two fixed effects models, one with year fixed effects, and one without, was conducted.

Diagnostics and Corrections: To detect and address heteroskedasticity and autocorrelation**,** Serial Correlation Test (Wooldridge) and Variance-covariance matrix (VCE) clustered by the identifier were applied.

Interpretation: β_1: Effect of RR in the base group (non-restructured states), expected to be negative. β_2: Additional effect of RR in partially restructured states. β_3: Additional effect of RR in fully restructured states.

H2 predicts that β_2 and β_3 are negative and statistically significant, indicating a stronger (more negative) effect of regulatory risk in fully and partially restructured states. Post-estimation analysis to explore relationships between variables is tested using linear combinations of parameters (lincom)..

- Hypothesis 3 (H3): Changes in regulatory risk prompt corresponding adjustments in leverage for regulated firms; leverage tends to decrease following risk increases and increase following risk decreases, consistent with dynamic target adjustment behavior.

To examine whether firms dynamically adjust their capital structure in response to changes in regulatory risk, lagged variables were introduced in the empirical specification. The model includes a leverage lagged to one-year and a change in regulatory risk measure as independent variables.

Dynamic Panel Model:

$$Lev_{it} = \beta_0 + \beta_1 Lev_{it-1} + \beta_2 \Delta RR_{st} + \beta_3 Size_{it} + \beta_4 Prof_{it} + \beta_5 Tang_{it} + \beta_6 Capex_{it} + \beta_7 Milev_{jt} + \alpha_i + \gamma_t + \varepsilon_{it} \quad (3)$$

Where: RR is regulatory risk; Lev_{it-1} is leverage lagged to one year, ΔRR_{st} is the result of RR_{st} - RR_{st-1}; Size is the natural logarithm of total assets; Prof is profitability; Tang is tangibility; Capaex is capex; β_0 is the constant; *i* indexes firms; *t* indexes years; *s* indexes states, α_i captures firm-specific unobserved heterogeneity (fixed effects), γ_t captures year fixed effects, and εit is the idiosyncratic error term.

Estimator Selection (Dynamic Panel): To address endogeneity concerns stemming from including a lagged dependent variable in the model, as it introduces the Nickell bias in short panels, the use of difference and system generalized method-of-moments estimators was initially considered. Due to the persistent nature of the dependent variable, the Blundell-Bond system GMM (xtabond2) with robust Windmeijer-corrected standard errors is preferred as it complement the test by adding more informative

instruments from the level equation and provides a finite-sample correction that addresses bias in standard errors.

To mitigate the risk of instrument proliferation and ensure model stability (Roodman, 2009), the GMM instrument matrix was limited to a single lag (lag 2 only) to avoid overfitting, resulting in a conservative and parsimonious set of instruments.

Interpretation: ρ: Measures leverage persistence. Expected to be between 0 and 1, indicating partial adjustment. Adjustment speed = (1 – ρ). β_1: Measures the effect of changes in regulatory risk. H3 expects a negative and statistically significant coefficient, indicating that increased regulatory risk leads to a reduction in leverage in the following period.

By following these procedures, the hypotheses of this thesis can be empirically tested. All models, specification tests, and interpretations of the key coefficients will be reported and discussed in the results section.

Chapter 5: Empirical Analysis and Interpretation of Results

Descriptive statistics (Table 14) show that the mean leverage level is 46.9%, suggesting debt constitutes a considerable portion of the capital composition.

Table 14: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lev	1,558	0.4693989	0.0783479	0.0295295	0.8118755
rr	1,644	4.722019	1.665219	1	9
siz	1,610	15.11655	1.77022	7.580189	18.74879
prof	1,599	0.0814097	0.0242626	-0.0806859	0.2860971
tan	1,597	0.714618	0.1045468	0.2426378	0.9358136
capex	1,590	0.0725238	0.0381406	0.022937	0.8265034
milev	1,644	0.4809583	0.0034348	0.4753181	0.4878444

The result is broadly consistent with national figures reported by Capital IQ Pro rate case statistics during the same period (2012–2023), where the authorized common equity average used in rate cases accounted for 50.95% of total capital, implying a leverage level of approximately 49.05%. This close alignment suggests that the sample used in this research reflects the general capital structure patterns observed among U.S. regulated electric utilities during the study period. However, considerable heterogeneity, with leverage ranging from a low of 3.0% to a high of 81.2%, and a standard deviation of 7.8 calls for further investigation to understand the reason for such a difference in this industry.

Firm size, represented by the natural logarithm of total assets, also shows substantial variation (mean 15.1, std. dev. 1.77), indicating a wide range of firm scales in the sample. The considerable differences in size between firms could be justified by the state where they operate, as firms in restructured states do not carry generation assets. Another reason could be the size of the franchised area in which the firm operates.

The average profitability standing at 8.1% is close to the national figures reported by Capital IQ Pro rate case statistics during the same period, where the average authorized return on capital was 7.59%. Results show firms achieving up to 28.6% profitability, while there is a presence of loss-making firm-year observations. Relative to the negative profit firms, that could result from operating expenses in excess, reductions in operating revenue due to customer refunds in the form of rate adjustment, or both.

Asset structure appears weighted towards tangible assets, with an average ratio of 71.5%, confirming the heavy dependence of the industry on tangible assets. Capital expenditure (capex) averages 7.3% (scaled by assets). However, the reported minimum value for capex is negative (-9.2%) indicates the

presence of firms not acquiring, upgrading, or maintaining long-term assets, which raises the need for more investigations. It also indicates further outlier treatment needs. Finally, the median level of regulatory risk (RR) is 4.7 with significant dispersion (std. dev. 1.67).

The correlation matrix (Table 15) shows that leverage (lev) presents a weak positive correlation with regulatory risk (rr), suggesting slightly higher leverage in higher-risk states, contrary to theoretical predictions. Size (siz) indicates a moderate positive correlation, where larger firms tend to carry more debt, possibly due to higher credit access.

Table 15: Correlation Matrix

	lev	**rr**	**siz**	**prof**	**tan**	**capex**	**milev**
lev	1						
rr	0.0830* 0.0010	1					
siz	0.2629* 0.0000	0.0655* 0.0085	1				
prof	-0.0935* 0.0002	-0.1240* 0.0000	-0.2497* 0.0000	1			
tan	0.0788* 0.0019	0.0007 0.9770	-0.0075 0.7659	0.2946* 0.0000	1		
capex	0.0720* 0.0046	-0.0673* 0.0072	-0.0130 0.6031	0.0856* 0.0006	0.3186* 0.0000	1	
milev	0.0289 0.2542	0.0352 0.1532	-0.0345 0.1659	0.0322 0.1980	-0.1217* 0.0000	-0.0151 0.5467	1

Note. Values marked with * are statistically significant at $p < .05$.

Profitability (prof) has a weak but significant negative correlation, aligning with the pecking order theory, as more profitable firms use less debt. Tangibility shows a small positive correlation indicating that firms with more tangible assets tend to use more debt, consistent with collateral value. Capital Expenditure (capex) has a small positive correlation, indicating that firms investing more tend to have higher leverage. Appendix C compiles the statistical and correlation matrix results.

5.1 Hypothesis 1

(H1): Firm leverage decreases with increases in regulatory risk, controlling for firm-level characteristics.

To test H1, both Random Effects (RE) and Fixed Effects (FE) models were estimated. Control variables included firm size (size), profitability (prof), asset tangibility (tang), capital expenditures (capex),

and industry median leverage (milev). The dependent variable was book leverage (lev), while regulatory risk was measured using the variable RR.

The Breusch-Pagan LM test ($\chi^2 = 3658.62$, $p < 0.01$) rejected the null hypothesis of no panel effects, justifying the use of panel estimators. The Hausman test ($\chi^2(6) = 42.84$, $p < 0.01$) indicated that FE is preferred, as it provides consistent estimates in the presence of correlation between regressors and unobserved firm-specific effects.

In the final FE model with robust standard errors clustered at the firm level (Table 16), the coefficient for regulatory risk (RR) was negative but statistically insignificant (coef. = –0.0006593; p = 0.809). The profitability variable was negative and significant (coef. = –0.4544649; p = 0.009), consistent with the pecking order theory. Capex was positively associated with leverage (coef. = 0.1558065; p = 0.008) confirming firms use debt to finance their investments. Size, tangibility, and median industry leverage were not statistically significant.

Table 16: H1 Final Estimation (with Robust Standard Errors)

	Coef.	**Robust Std. Err.**	**t**	**P>|t|**	**[95% Conf. Interval]**	
rr	-0.0006593	0.0027221	-0.24	0.809	-0.0060442	0.0047257
siz	0.0268034	0.0152197	-1.76	0.081	-0.0569117	0.0033048
prof	0.4544649	0.1712519	-2.65	0.009	-0.793242	-0.1156878
tan	0.1266145	0.1227186	1.03	0.304	-0.1161521	0.3693811
capex	0.1558065	0.0580978	2.68	0.008	-0.0408752	0.2707378
milev	0.7314577	0.5064238	1.44	0.151	-0.203694	1.733285

When comparing the two fixed effects regressions (Table 17), one with firm-level controls only and another that includes year-fixed effects to account for macroeconomic or policy trends, the coefficient on regulatory risk remained small and statistically insignificant, indicating no support for Hypothesis 1. Profitability consistently shows a significant negative association with leverage, reinforcing the pecking order theory. Capital expenditures positively relate to leverage, suggesting debt is used to finance investment. Including year-fixed effects does not materially alter these relationships, although it absorbs variation from size and industry leverage. These results highlight the robustness of the core firm-level drivers of capital structure.

Table 17: H1 Fixed Effects Regressions Comparison

Variable	(1) lev	(2) lev
rr	-0.000659	-0.000467
	(0.00272)	(0.00264)
siz	-0.0268	-0.0502
	(0.0152)	(0.0345)
prof	-0.454**	-0.450**
	(0.171)	(0.169)
tan	0.127	0.153
	(0.123)	(0.121)
capex	0.156**	0.154*
	(0.0581)	(0.0612)
milev	0.731	3.374
	(0.506)	(3.362)
2012.year		0
		(.)
2013.year		-0.00841
		(0.00759)
2014.year		0.0101
		(0.0100)
2015.year		0.00499
		(0.0100)
2016.year		0.0190
		(0.0229)
2017.year		0.0191
		(0.0210)
2018.year		0.0167
		(0.0260)
2019.year		0.00314
		(0.0101)
2020.year		-0.00249
		(0.00457)
2021.year		-0.00336
		(0.00309)
2022.year		-0.00751
		(0.00619)
2023.year		0
		(.)
cons	0.464	-1.160
	(0.331)	(2.074)
N	1547	1547

Note. Standard errors are in parentheses. $p < .05$; $p < .01$; $p < .001$.

Thus, although the direction of the regulatory risk coefficient was consistent with theoretical expectations, it lacked statistical significance. Internal firm characteristics such as profitability and capex

emerged as more relevant determinants of leverage. Appendix D contains Stata's main results for hypothesis 1 regressions.

5.2 Hypothesis 2

(H2): Restructuring status significantly moderates the relationship between regulatory risk and leverage, such that the negative impact of regulatory risk on leverage is greater for firms in fully restructured states than non-restructured states.

Both random effects (R) and fixed effects (FE) models were estimated. The Hausman test ($\chi^2(8) = 45.30$; $p < 0.01$) again supported the use of the FE estimator.

In the FE model with clustered robust standard errors the coefficient of regulatory risk (RR) was negative, but not statistically significant (coef. = –0.0013748; p = 0.744).

Table 188: H2 Final Estimation (with Robust Standard Errors)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
rr	-0.0013748	0.0041973	-0.33	0.744	-0.009678	0.0069284
rr x dp	-0.0003004	0.0074551	-0.04	0.968	-0.0150483	0.0144475
rr x df	0.0013839	0.0052227	0.26	0.791	-0.0089478	0.0117156
siz	-0.0262983	0.0150926	-1.74	0.084	-0.0561551	0.0035585
prof	-0.4518979	0.1739482	-2.60	0.010	-0.7960089	-0.1077869
tan	0.1271685	0.1239337	1.03	0.307	-0.1188002	0.372339
capex	0.1555572	0.0588773	2.64	0.009	0.0390839	0.2720304
milev	0.7244905	0.5029246	1.44	0.152	-0.2704144	1.7199395

The interaction terms $(RR_{st}\ x\ DP_s)$ and $(RR_{st}\ x\ DF_s)$ were also not significant (p > 0.7). The linear combination $RR_{st} + (RR_{st}\ x\ DP_s)$ was not significant (coef. = -.0016752; p = 0.788). The same result was obtained for $RR_{st} + (RR_{st}\ x\ DF_s)$ (coef. = 0.00000916; p = 0.998). Tables 19 and 20.

Table 199: Total marginal effect in partially restructured states

lev	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
(1)	-0.0016752	0.006211	-0.27	0.788	-0.0139621	0.010617

Table 20: Total marginal effect in fully restructured states

lev	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
(1)	0.00000916	0.0035449	0	0.998	-0.0070035	0.0070218

Year-fixed effects were added to control for macroeconomic and policy trends over time to test the robustness of the moderating effect of restructuring on the relationship between regulatory risk and leverage.

Table 21: H2 Fixed Effects Regressions Comparison

Variable	Model (1) Coef.	Model (2) Coef.
rr	-0.00137	0.000283
	(0.00420)	(0.00433)
rr x dp	-0.000300	-0.00135
	(0.00746)	(0.00795)
rr x df	0.00138	-0.00104
	(0.00522)	(0.00579)
siz	-0.0263	-0.00523
	(0.0151)	(0.0341)
prof	-0.452*	-0.450**
	(0.174)	(0.171)
tan	0.127	0.153
	(0.124)	(0.122)
capex	0.156**	0.155*
	(0.0589)	(0.0619)
milev	0.724	3.427
	(0.503)	(3.457)
2012.year		0
		(.)
2013.year		-0.00848
		(0.00765)
2014.year		0.0103
		(0.0105)
2015.year		0.00522
		(0.0105)
2016.year		0.0194
		(0.0238)
2017.year		-0.0193
		(0.0215)
2018.year		0.017
		(0.0266)
2019.year		-0.00318
		(0.0103)
2020.year		-0.00247
		(0.00463)
2021.year		-0.00332
		(0.00309)
2022.year		-0.00759
		(0.00634)
2023.year		0

Variable	Model (1) Coef.	Model (2) Coef.
cons	0.460 (0.333)	(.) -1.186 (2.123)
N	1547	1547

5.3 Hypothesis 3

(H3): Changes in regulatory risk prompt corresponding adjustments in leverage for regulated firms; leverage tends to decrease following risk increases and increase following risk decreases, consistent with dynamic target adjustment behavior.

A dynamic panel model using two-step system GMM estimator (xtabond2) was employed to test whether leverage responds dynamically to changes in regulatory risk. The core specification includes a one-period lag of the dependent variable and the first difference of the regulatory risk score.

Estimation details: Leverage lagged (Lev_{it-1}) was treated as endogenous, ΔRR as predetermined, controls as exogenous. The initial test was conducted considering unrestricted lag range (lag(2 .)), which had an instrument count of 114. A limited lag depth analysis was conducted to correct for the generalized inverse (Moore–Penrose pseudoinverse) employed by Stata to complete the estimation, as such method may influence difference-in-Hansen test results. First, the restricted lag structure (lag(2 3)) with 58 instruments, and then (lag(2 2)) with 42 instruments were used to keep the instrument count below the number of groups. Using a restricted lag structure should confirm instrument validity and acceptance of moment conditions, thus supporting the robustness of the model.

Among all specifications tested, the final specification of the dynamic panel model was estimated using two-step System GMM with robust standard errors and GMM-style instruments restricted to lag(2 2), yielding a total of 42 instruments, Hansen p-value of 0.007 and AR(2) p-value of 0.953, thus offering the best balance between estimator validity and parsimony as the reference model for Hypothesis 3 (Table 22).

Table 22: H3 Dynamic panel-data estimation, two-step system GMM

lev	Coef.	Corrected Std. Err.	z	P>|z|	[95% Conf. Interval]	
lev L1.	0.839073	0.0694873	12.08	0	0.7028804	0.9752655
D_rr	-0.0019209	0.005354	-0.36	0.72	-0.0124145	0.0085727
siz	0.0039399	0.0014351	2.75	0.006	0.0011271	0.0067528
prof	-0.1883151	0.0946625	-1.99	0.047	-0.3738502	-0.00278
tan	0.0154027	0.0220237	0.7	0.484	-0.0277629	0.0585683
capex	0.1635521	0.0970925	1.68	0.092	-0.0267457	0.3538498
milev	0.1384839	0.252177	0.55	0.583	-0.3557739	0.6327417
Arellano-Bond test for AR(1) in first differences:					z = -4.89	Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences:					z = -0.06	Pr > z = 0.953

Sargan test of overid. restrictions:	chi2(34) = 63.84	Prob > chi2 = 0.001
Hansen test of overid. restrictions:	chi2(34) = 57.69	Prob > chi2 = 0.007
Difference-in-Hansen tests of exogeneity of instrument subsets:		
GMM instruments for levels		
Hansen test excluding group:	chi2(16) = 25.53	Prob > chi2 = 0.061
Difference (null H = exogenous):	chi2(18) = 32.17	Prob > chi2 = 0.021
iv(siz prof tan capex milev)		
Hansen test excluding group:	chi2(29) = 48.63	Prob > chi2 = 0.013
Difference (null H = exogenous):	chi2(5) = 9.06	Prob > chi2 = 0.107

Despite Hansen test (p = 0.007) and difference-in-Hansen statistics suggesting moderate instrument validity concerns, diagnostic tests confirmed no second-order autocorrelation (AR(2) p = 0.953). Nonetheless, the model's structure, instrument count, and empirical stability support its use as the final specification.

Results show that the coefficient on lagged leverage (ρ = 0.839, p < 0.01) is statically significant, confirming strong persistence in firm capital structure, which is consistent with dynamic adjustment theories. The implied adjustment speed is 16.1% per year. However, the coefficient on changes in regulatory risk was negative but statistically insignificant (p = 0.720), providing no support for Hypothesis 3. Appendix F contains Stata's main results for hypothesis 3 regressions.

5.4 Final Consideration

Hypothesis 1 (H1) was not supported as state-level regulatory risk was not statistically significant in explaining firm leverage. Hypothesis 2 (H2) also lacked empirical support: regulatory restructuring did not moderate the relationship between regulatory risk and capital structure. Although confirming dynamic adjustment of capital structure, Hypothesis 3 (H3) was not confirmed, as changes in regulatory risk were not statistically significant in explaining capital structure adjustments.

These findings suggest that, although state-level regulatory frameworks represent an important institutional dimension, the variation in regulatory risk and restructuring status do not significantly explain capital structure decisions for firms in the electric industry within the analyzed sample.

Chapter 6: Conclusion

This thesis set out to investigate the relationship between regulatory risk and capital structure in the U.S. electric utility industry, with a particular focus on the moderating role of industry restructuring and the dynamic adjustment of leverage in response to evolving regulatory conditions. Grounded in both classical and contemporary theories of capital structure, this study addressed the gaps in prior literature that often overlook institutional determinants, particularly in regulated sectors characterized by earning oversight, restricted competition, and complex state-level governance.

To answer the research question of whether state-level regulatory risk influences U.S. investor-owned electric utilities' capital structure, and whether industry restructuring and dynamic regulatory change moderate this relationship, three hypotheses were tested using panel data spanning 2012 to 2023.

The empirical approach combined static fixed effects models and dynamic system GMM estimators, controlling for firm-level characteristics and addressing standard econometric issues such as heteroskedasticity, autocorrelation, and cross-sectional dependence. Additional robustness analyses were performed to verify the stability and reliability of statistical results.

The findings indicate that regulatory risk, as measured by the RRA scoring system, does not exert a statistically significant influence on firm leverage in the baseline fixed effects model. Although the coefficient was negative, as theoretically predicted by trade-off and regulatory risk in previous work, it lacked statistical significance. Similarly, the interaction model did not support the moderating role of restructuring. Neither partial nor full restructuring status significantly altered the effect of regulatory risk on leverage, suggesting that the structural configuration of electricity markets across states does not fundamentally change how firms incorporate regulatory risk into their financing decisions.

The third hypothesis, which evaluates dynamic leverage adjustment to changes in regulatory risk, was not confirmed. Theoretical expectations suggest that firms may engage in partial adjustment behavior, consistent with dynamic trade-off theory, and results do indicate that an adjustment speed is 16.1% per year. However, regulatory risk changes do not show statistical significance in explaining such adjustments.

Despite the absence of statistically significant effects in the three hypotheses, this research contributes to the finance literature by integrating a structured, state-level measure of regulatory risk into capital structure modeling. It also advances empirical analysis by distinguishing between non-, partially, and fully restructured states—offering a richer institutional lens for examining utility financing decisions.

These refinements are valuable in an industry where traditional financial theories alone are insufficient to explain firm behavior.

The lack of statistically significant results also underscores the possibility that regulatory behavior, while conceptually important, may not translate directly into observable financial policy changes at the subsidiary level, especially in a mature and capital-intensive industry where leverage is persistently high and influenced by long-term strategic planning rather than short-term regulatory fluctuations. Thus, the absence of statistically significant results may likely stem from the intricate and multifaceted nature of the electric sector.

Policy and managerial implications. For regulators, the findings suggest that regulatory risk perceptions may not materially affect leverage policies among electric utilities in the short run. This might be due to institutional rigidity or firms' ability to hedge regulatory exposure through corporate structure and intra-holding capital allocation. For utility managers and investors, the results imply that capital structure remains largely driven by internal fundamentals, such as profitability and capital investment, rather than state-specific regulatory climate alone.

The findings also highlight a possible conflict between public interest and private interest theories in regulatory behavior. If public interest goals guide regulation, firms' capital structure decisions may reflect responses to clearly defined and welfare-oriented rules. In contrast, if private interests influence regulatory behavior, firms may adjust their leverage strategically to protect themselves, exploit regulatory weaknesses, or gain favorable treatment.

Limitations and Future Research. This study faces certain limitations. While the RRA score offers a consistent regulatory risk measure, it may not capture the full nuance regulatory commission behavior. Moreover, this analysis is limited to a single sector and period; extending the sample across longer horizons or including other infrastructure sectors may yield more variation.

Future research should explore firm-specific regulatory interactions, possibly by leveraging textual analysis of rate cases or commission dockets, and extend the analysis to incorporate political economy factors, such as commissioner turnover, public sentiment, and lobbying activity. Additionally, further work could evaluate cross-subsidiary financial flows within holding companies, which may obscure the direct impact of state regulation on subsidiary leverage.

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Appendix A – State-firm list

Non-restructured States	Number of firms	Firms
Alabama (AL)	1	Alabama Power Company
Alaska (AK)	1	Alaska Electric Light and Power Company
Arizona (AZ)	3	Arizona Public Service Company Tucson Electric Power Company UNS Electric, Inc.
Arkansas (AR)	1	Entergy Arkansas, LLC
Colorado (CO)	2	Black Hills Colorado Electric, Inc. Public Service Company of Colorado
Florida (FL)	4	Duke Energy Florida, LLC Florida Power & Light Company Florida Public Utilities Company Tampa Electric Company
Georgia (GA)	1	Georgia Power Company
Hawaii (HI)	3	Hawaii Electric Light Company, Inc. Hawaiian Electric Company, Inc. Maui Electric Company, Ltd.
Idaho (ID)	1	Idaho Power Company
Indiana (IN)	5	AES Indiana Duke Energy Indiana, LLC Indiana Michigan Power Company Northern Indiana Public Service Company, LLC Southern Indiana Gas and Electric Co.
Iowa (IA)	2	Interstate Power and Light Company MidAmerican Energy Company
Kansas (KS)	2	Evergy Kansas South, Inc. Westar Energy (KPL)
Kentucky (KY)	4	Duke Energy Kentucky, Inc. Kentucky Power Company Kentucky Utilities Company Louisville Gas and Electric Company
Louisiana (LA)	4	Cleco Power LLC Entergy Louisiana, LLC Entergy New Orleans, LLC Southwestern Electric Power Company
Minnesota (MN)	3	Minnesota Power Enterprises, Inc. Northern States Power Company MN Otter Tail Power Company
Mississippi (MS)	2	Entergy Mississippi, LLC Mississippi Power Company
Missouri (MO)	4	Evergy Metro, Inc.

		Evergy Missouri West, Inc. The Empire District Electric Company Union Electric Company
Montana (MT)	1	NorthWestern Energy Group, Inc.
Nebraska (NE)	0	
Nevada (NV)	2	Nevada Power Company Sierra Pacific Power Company
New Mexico (NM)	1	Public Service Company of New Mexico
North Carolina (NC)	2	Duke Energy Carolinas, LLC Duke Energy Progress, LLC
North Dakota (ND)	1	MDU Resources Group, Inc.
Oklahoma (OK)	2	Oklahoma Gas and Electric Company Public Service Company of Oklahoma
South Carolina (SC)	2	Dominion Energy South Carolina, Inc. Lockhart Power Company
South Dakota (SD)	1	Black Hills Power, Inc.
Tennessee (TN)	1	Kingsport Power Company
Utah (UT)	1	PacifiCorp
Vermont (VT)	1	Green Mountain Power Corporation
Washington (WA)	2	Avista Corporation Puget Sound Energy, Inc.
West Virginia (WV)	2	Monongahela Power Company Wheeling Power Company
Wisconsin (WI)	11	Consolidated Water Power Company Dahlberg Light & Power Company Madison Gas and Electric Company North Central Power Co., Inc. Northern States Power Company WI Northwestern Wisconsin Electric Co Inc Pioneer Power and Light Company Superior Water, Light and Power Co. Wisconsin Electric Power Company Wisconsin Power and Light Company Wisconsin Public Service Corporation
Wyoming (WY)	1	Cheyenne Light, Fuel and Power Company
TOTAL	74	

Partially Restructured States	**Number of firms**	**Firms**
California (CA)	4	Liberty Utilities (CalPeco Electric) LLC Pacific Gas and Electric Company San Diego Gas & Electric Company Southern California Edison Company
Michigan (MI)	4	Consumers Energy Company DTE Electric Company

		Upper Michigan Energy Resources Corporation Upper Peninsula Power Company
Oregon (OR)	1	Portland General Electric Company
Texas (TX)	8	AEP Texas Inc. Center Point Energy Houston Elec., LLC El Paso Electric Company Entergy Texas, Inc. Oncor Electric Delivery Company LLC Sharyland Utilities, L.L.C. Southwestern Public Service Company Texas-New Mexico Power Company
Virginia (VA)	2	Appalachian Power Company Virginia Electric and Power Company
TOTAL	19	

Fully Restructured States	**Number of firms**	**Firms**
Connecticut (CT)	2	The Connecticut Light and Power Co. The United Illuminating Company
Distric of Columbia	0	
Delaware (DE)	1	Delmarva Power & Light Company
Illinois (IL)	3	Ameren Illinois Company Commonwealth Edison Company Mt. Carmel Public Utility Co.
Massachusetts (MA)	4	Fitchburg Gas and Electric Light Co. Massachusetts Electric Company Nantucket Electric Company NSTAR Electric Company
Maryland (MD)	3	Baltimore Gas and Electric Company Potomac Electric Power Company The Potomac Edison Company
Maine (ME)	2	Central Maine Power Company Versant Power
New Hampshire (NH)	3	Liberty Utilities (Granite St. Elec.) Corp. Public Service Company of New Hampshire Unitil Energy Systems, Inc.
New Jersey (NJ)	4	Atlantic City Electric Company Jersey Central Power & Light Company Public Service Electric and Gas Co. Rockland Electric Company
New York (NY)	6	Central Hudson Gas & Electric Corp. Consolidated Edison Company of NY

		New York State Electric & Gas Co. Niagara Mohawk Power Corporation Orange and Rockland Utilities, Inc. Rochester Gas and Electric Corporation
Ohio (OH)	6	Duke Energy Ohio, Inc. Ohio Edison Company Ohio Power Company The Cleveland Electric Illuminating Co. The Dayton Power and Light Company The Toledo Edison Company
Pennsylvania (PA)	9	Duquesne Light Company Metropolitan Edison Company PECO Energy Company Pennsylvania Electric Company Pennsylvania Power Company Pike County Light and Power Company PPL Electric Utilities Corporation UGI Utilities, Inc. West Penn Power Company
Rhode Island (RI)	1	The Narragansett Electric Company
TOTAL	44	

Note. Data compiled from Capital IQ Pro.

Appendix B – State´s Regulatory Risk

Year	State	Score	State	Score	State	Score	State	Score
2012	AK	5	AL	2	AR	6	AZ	6
2013	AK	5	AL	2	AR	6	AZ	6
2014	AK	5	AL	2	AR	6	AZ	6
2015	AK	5	AL	2	AR	6	AZ	6
2016	AK	6	AL	2	AR	5	AZ	6
2017	AK	7	AL	1	AR	4	AZ	6
2018	AK	7	AL	1	AR	4	AZ	6
2019	AK	7	AL	1	AR	4	AZ	6
2020	AK	7	AL	1	AR	4	AZ	6
2021	AK	7	AL	1	AR	4	AZ	8
2022	AK	7	AL	1	AR	4	AZ	9
2023	AK	7	AL	1	AR	4	AZ	9
2012	CA	4	CO	4	CT	9	DE	5
2013	CA	4	CO	4	CT	8	DE	5
2014	CA	4	CO	4	CT	8	DE	6
2015	CA	4	CO	4	CT	8	DE	6
2016	CA	4	CO	4	CT	8	DE	6
2017	CA	3	CO	5	CT	8	DE	6
2018	CA	3	CO	5	CT	7	DE	6
2019	CA	5	CO	5	CT	7	DE	6
2020	CA	5	CO	5	CT	6	DE	6
2021	CA	5	CO	4	CT	7	DE	6
2022	CA	4	CO	4	CT	7	DE	6
2023	CA	4	CO	4	CT	8	DE	5
2012	FL	4	GA	4	HI	5	IA	3
2013	FL	3	GA	3	HI	4	IA	3
2014	FL	3	GA	3	HI	4	IA	3
2015	FL	3	GA	3	HI	4	IA	3
2016	FL	3	GA	3	HI	5	IA	3
2017	FL	2	GA	2	HI	5	IA	4
2018	FL	2	GA	2	HI	5	IA	4
2019	FL	2	GA	2	HI	5	IA	4
2020	FL	2	GA	2	HI	5	IA	3
2021	FL	2	GA	2	HI	5	IA	3
2022	FL	2	GA	2	HI	5	IA	3
2023	FL	2	GA	2	HI	5	IA	3
2012	ID	5	IL	8	IN	3	KS	5
2013	ID	5	IL	8	IN	3	KS	5
2014	ID	5	IL	7	IN	3	KS	5
2015	ID	5	IL	7	IN	3	KS	5
2016	ID	5	IL	7	IN	3	KS	5
2017	ID	5	IL	5	IN	4	KS	7
2018	ID	5	IL	5	IN	4	KS	7
2019	ID	5	IL	5	IN	4	KS	7
2020	ID	5	IL	5	IN	4	KS	7

Year	State	Score	State	Score	State	Score	State	Score
2021	ID	5	IL	5	IN	4	KS	7
2022	ID	5	IL	5	IN	4	KS	7
2023	ID	5	IL	6	IN	4	KS	7
2012	KY	4	LA	4	MA	5	MD	8
2013	KY	4	LA	4	MA	6	MD	8
2014	KY	4	LA	4	MA	6	MD	8
2015	KY	4	LA	4	MA	6	MD	8
2016	KY	4	LA	4	MA	6	MD	8
2017	KY	4	LA	5	MA	6	MD	9
2018	KY	4	LA	5	MA	5	MD	9
2019	KY	4	LA	5	MA	5	MD	8
2020	KY	4	LA	4	MA	5	MD	8
2021	KY	4	LA	5	MA	5	MD	6
2022	KY	5	LA	5	MA	5	MD	6
2023	KY	5	LA	5	MA	5	MD	8
2012	ME	5	MI	4	MN	5	MO	5
2013	ME	5	MI	4	MN	5	MO	5
2014	ME	5	MI	4	MN	5	MO	5
2015	ME	5	MI	4	MN	5	MO	5
2016	ME	5	MI	4	MN	5	MO	5
2017	ME	5	MI	3	MN	5	MO	7
2018	ME	5	MI	3	MN	5	MO	6
2019	ME	5	MI	3	MN	5	MO	6
2020	ME	6	MI	3	MN	5	MO	6
2021	ME	6	MI	3	MN	5	MO	6
2022	ME	6	MI	3	MN	5	MO	6
2023	ME	6	MI	3	MN	5	MO	6
2012	MS	3	MT	7	NC	3	ND	4
2013	MS	3	MT	7	NC	4	ND	4
2014	MS	3	MT	7	NC	4	ND	4
2015	MS	3	MT	7	NC	4	ND	4
2016	MS	3	MT	7	NC	4	ND	4
2017	MS	3	MT	7	NC	4	ND	4
2018	MS	4	MT	7	NC	4	ND	4
2019	MS	4	MT	7	NC	4	ND	4
2020	MS	4	MT	7	NC	4	ND	4
2021	MS	4	MT	7	NC	3	ND	4
2022	MS	4	MT	7	NC	3	ND	4
2023	MS	4	MT	7	NC	3	ND	4
2012	NH	6	NJ	6	NM	7	NV	4
2013	NH	6	NJ	6	NM	7	NV	4
2014	NH	6	NJ	6	NM	7	NV	4
2015	NH	6	NJ	6	NM	7	NV	4
2016	NH	6	NJ	6	NM	7	NV	4
2017	NH	6	NJ	8	NM	8	NV	4
2018	NH	6	NJ	7	NM	8	NV	4
2019	NH	6	NJ	7	NM	8	NV	4

Year	State	Score	State	Score	State	Score	State	Score
2020	NH	6	NJ	7	NM	8	NV	4
2021	NH	5	NJ	7	NM	8	NV	4
2022	NH	5	NJ	7	NM	8	NV	4
2023	NH	5	NJ	7	NM	7	NV	5
2012	NY	6	OH	5	OK	5	OR	6
2013	NY	5	OH	5	OK	5	OR	6
2014	NY	5	OH	5	OK	5	OR	6
2015	NY	5	OH	5	OK	5	OR	6
2016	NY	5	OH	5	OK	5	OR	6
2017	NY	4	OH	5	OK	6	OR	5
2018	NY	4	OH	5	OK	6	OR	5
2019	NY	4	OH	5	OK	6	OR	5
2020	NY	5	OH	6	OK	6	OR	5
2021	NY	5	OH	6	OK	5	OR	5
2022	NY	5	OH	6	OK	5	OR	5
2023	NY	5	OH	5	OK	6	OR	5
2012	PA	6	RI	6	SC	4	SD	6
2013	PA	6	RI	6	SC	4	SD	6
2014	PA	6	RI	6	SC	4	SD	6
2015	PA	5	RI	6	SC	4	SD	6
2016	PA	5	RI	6	SC	4	SD	6
2017	PA	3	RI	5	SC	5	SD	5
2018	PA	3	RI	5	SC	6	SD	5
2019	PA	2	RI	5	SC	6	SD	5
2020	PA	2	RI	5	SC	6	SD	5
2021	PA	2	RI	5	SC	6	SD	5
2022	PA	2	RI	5	SC	6	SD	5
2023	PA	2	RI	5	SC	6	SD	5
2012	TN	4	TX	7	UT	5	VA	2
2013	TN	4	TX	7	UT	5	VA	2
2014	TN	4	TX	7	UT	5	VA	2
2015	TN	4	TX	7	UT	5	VA	2
2016	TN	4	TX	7	UT	5	VA	2
2017	TN	3	TX	6	UT	4	VA	2
2018	TN	3	TX	6	UT	4	VA	2
2019	TN	3	TX	5	UT	4	VA	3
2020	TN	3	TX	5	UT	5	VA	4
2021	TN	3	TX	6	UT	5	VA	4
2022	TN	3	TX	6	UT	5	VA	4
2023	TN	3	TX	6	UT	5	VA	5
2012	VT	6	WA	6	WI	2	WV	6
2013	VT	6	WA	5	WI	2	WV	7
2014	VT	6	WA	5	WI	2	WV	7
2015	VT	6	WA	6	WI	2	WV	7
2016	VT	6	WA	6	WI	2	WV	7
2017	VT	5	WA	6	WI	2	WV	7
2018	VT	6	WA	6	WI	2	WV	8

Year	State	Score	State	Score	State	Score	State	Score
2019	VT	6	WA	6	WI	2	WV	8
2020	VT	6	WA	6	WI	2	WV	8
2021	VT	6	WA	6	WI	2	WV	8
2022	VT	6	WA	6	WI	2	WV	8
2023	VT	6	WA	6	WI	3	WV	7
2012	WY	5						
2013	WY	5						
2014	WY	5						
2015	WY	5						
2016	WY	5						
2017	WY	6						
2018	WY	6						
2019	WY	6						
2020	WY	6						
2021	WY	5						
2022	WY	5						
2023	WY	5						

Source. RRA state regulatory climate evaluation data compiled from S&P Capital IQ Pro.

Apendix C – Descriptive Statistics and Correlation Matrix

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lev	1,558	.4693989	.0783479	.0295295	.8118755
rr	1,644	4.722019	1.665219	1	9
siz	1,610	15.11655	1.77022	7.580189	18.74879
prof	1,599	.0814097	.0242626	-.0806859	.2860971
tan	1,597	.714618	.1045468	.2426378	.9358136
capex	1,590	.0725238	.0381406	-.0922937	.8265034
milev	1,644	.4809583	.0034348	.4753181	.4878444

Correlation Matrix

	lev	rr	siz	prof	tan	capex	milev
lev	1.0000						
rr	0.0830*	1.0000					
	0.0010						
siz	0.2629*	0.0655*	1.0000				
	0.0000	0.0085					
prof	-0.0935*	-0.1240*	-0.2497*	1.0000			
	0.0002	0.0000	0.0000				
tan	0.0788*	0.0007	-0.0075	0.2946*	1.0000		
	0.0019	0.9770	0.7659	0.0000			
capex	0.0720*	-0.0673*	-0.0130	0.0856*	0.3186*	1.0000	
	0.0046	0.0072	0.6031	0.0006	0.0000		
milev	0.0289	0.0352	-0.0345	0.0322	-0.1217*	-0.0151	1.0000
	0.2542	0.1532	0.1659	0.1980	0.0000	0.5467	

Appendix D – H1 Stata Results

Hypothesis 1: Regulatory Risk and Leverage

```
Random Effects Estimation
------------------------------------------------------------------------------
         lev |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          rr |   .0004746    .001361     0.35   0.727     -.002193    .0031421
         siz |   .0034745   .0030311     1.15   0.252    -.0024663    .0094153
        prof |  -.2836204   .0672446    -4.22   0.000    -.4154175   -.1518234
         tan |    .097971    .020761     4.72   0.000     .0572802    .1386618
       capex |   .1650878   .0333284     4.95   0.000     .0997654    .2304102
       milev |   1.193901   .3071395     3.89   0.000     .5919186    1.795884
       _cons |  -.2209014   .1648006    -1.34   0.180    -.5439046    .1021017
-------------+----------------------------------------------------------------
     sigma_u |  .06694546
     sigma_e |  .03904393
         rho |   .7461876   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Breusch-Pagan Lagrange Multiplier Test

```
Estimated results:
                         |       Var     sd = sqrt(Var)
                 ---------+-----------------------------
                      lev |   .0061415       .0783677
                        e |   .0015244       .0390439
                        u |   .0044817       .0669455

        Test:   Var(u) = 0
                                 chibar2(01) =  3658.62
                              Prob > chibar2 =   0.0000
```

Hausman Test

```
                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     H1_FE        H1_RE        Difference          S.E.
-------------+----------------------------------------------------------------
          rr |   -.0006593     .0004746       -.0011338        .0005012
         siz |   -.0268034     .0034745       -.0302779        .0048381
        prof |   -.4544649    -.2836204       -.1708445        .0285561
         tan |    .1266145      .097971        .0286434        .0080625
       capex |    .1558065     .1650878       -.0092813        .0043808
       milev |    .7314577     1.193901       -.4624434         .078083
------------------------------------------------------------------------------

chi2(6)    = (b-B)'[(V_b-V_B)^(-1)](b-B)
           =       42.84
Prob>chi2 =      0.0000
```

Serial Correlation Test (Wooldridge)

```
F(1, 131) =    114.984
 Prob > F =      0.0000
```

Final Estimation (with Robust Standard Errors)

lev	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
rr	-.0006593	.0027221	-0.24	0.809	-.0060442	.0047257
siz	-.0268034	.0152197	-1.76	0.081	-.0569117	.0033048
prof	-.4544649	.1712519	-2.65	0.009	-.793242	-.1156878
tan	.1266145	.1227186	1.03	0.304	-.1161521	.3693811
capex	.1558065	.0580978	2.68	0.008	.0408752	.2707378
milev	.7314577	.5064238	1.44	0.151	-.2703694	1.733285

Comparison between fixed effects regressions with firm-level controls only fixed effects regressions year fixed effects.

	(1) lev	(2) lev
rr	-0.000659	-0.000467
	(0.00272)	(0.00264)
siz	-0.0268	-0.00522
	(0.0152)	(0.0340)
prof	-0.454**	-0.450**
	(0.171)	(0.169)
tan	0.127	0.153
	(0.123)	(0.121)
capex	0.156**	0.154*
	(0.0581)	(0.0612)
milev	0.731	3.374
	(0.506)	(3.362)
2012.year		0
		(.)
2013.year		-0.00841
		(0.00759)
2014.year		0.0101
		(0.0100)
2015.year		0.00499
		(0.0100)
2016.year		0.0190
		(0.0229)
2017.year		0.0191
		(0.0210)
2018.year		0.0167
		(0.0260)
2019.year		0.00314
		(0.0101)
2020.year		-0.00249
		(0.00457)
2021.year		-0.00336
		(0.00309)

2022.year		-0.00751
		(0.00619)
2023.year		0
		(.)
_cons	0.464	-1.160
	(0.331)	(2.074)
N	1547	1547

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Appendix E – H2 Stata Results

Hypothesis 2: Moderating Effect of Restructuring on Leverage

Random Effects Estimation

lev	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
rr	-.000452	.0023197	-0.19	0.846	-.0049984	.0040945
dp	.01093	.0277174	0.39	0.693	-.043395	.065255
df	-.0053516	.0196781	-0.27	0.786	-.04392	.0332168
rr_x_dp	-.0002717	.0044983	-0.06	0.952	-.0090881	.0085447
rr_x_df	.0017681	.0030244	0.58	0.559	-.0041595	.0076958
siz	.0035003	.0030847	1.13	0.256	-.0025455	.0095461
prof	-.2841494	.067447	-4.21	0.000	-.4163432	-.1519556
tan	.0991309	.0209963	4.72	0.000	.0579789	.1402828
capex	.1640325	.0334176	4.91	0.000	.0985352	.2295298
milev	1.174603	.3107433	3.78	0.000	.5655576	1.783649

Breusch-Pagan Lagrange Multiplier Test

```
Estimated results:
                         |       Var     sd = sqrt(Var)
                 ---------+-----------------------------
                      lev |   .0061415       .0783677
                        e |   .0015263        .039068
                        u |   .0045121       .0671725

        Test:   Var(u) = 0
                                  chibar2(01) =  3573.27
                               Prob > chibar2 =   0.0000
```

Hausman Test

```
    ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     H2_FE        H2_RE        Difference          S.E.
-------------+------------------------------------------------------------------
          rr |   -.0013748     -.000452       -.0009228        .0010953
     rr_x_dp |   -.0003004    -.0002717       -.0000287        .0017789
     rr_x_df |    .0013839     .0017681       -.0003842         .001295
         siz |   -.0262983     .0035003       -.0297986          .00495
        prof |   -.4518979    -.2841494       -.1677485        .0286921
         tan |    .1271685     .0991309        .0280376        .0079864
       capex |    .1555572     .1640325       -.0084753        .0042303
       milev |    .7244905     1.174603       -.4501128        .0736868
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8)  = (b-B)'[(V_b-V_B)^(-1)](b-B)
                           =       45.30
                Prob>chi2 =      0.0000
```

Serial Correlation Test (Wooldridge)

```
F(1, 131) = 115.137
 Prob > F = 0.0000
```

Final Estimation (with Robust Standard Errors)

lev	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
rr	-.0013748	.0041973	-0.33	0.744	-.009678	.0069284
rr_x_dp	-.0003004	.0074551	-0.04	0.968	-.0150483	.0144475
rr_x_df	.0013839	.0052227	0.26	0.791	-.0089478	.0117156
siz	-.0262983	.0150926	-1.74	0.084	-.0561551	.0035585
prof	-.4518979	.1739482	-2.60	0.010	-.7960089	-.1077869
tan	.1271685	.1239337	1.03	0.307	-.118002	.372339
capex	.1555572	.0588773	2.64	0.009	.0390839	.2720304
milev	.7244905	.5029246	1.44	0.152	-.2704144	1.719395

Total marginal effect of regulatory risk in partially restructured states (Lincom)

lev	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
(1)	-.0016752	.006211	-0.27	0.788	-.0139621	.0106117

Total marginal effect of regulatory risk in fully restructured states (Lincom)

lev	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
(1)	9.16e-06	.0035449	0.00	0.998	-.0070035	.0070218

Comparison between fixed effects regressions with firm-level controls only and fixed effects regressions year fixed effects.

	(1) lev	(2) lev
rr	-0.00137	0.000283
	(0.00420)	(0.00433)
rr_x_dp	-0.000300	-0.00155
	(0.00746)	(0.00795)
rr_x_df	0.00138	-0.00104
	(0.00522)	(0.00579)
siz	-0.0263	-0.00523
	(0.0151)	(0.0341)
prof	-0.452*	-0.450**
	(0.174)	(0.171)
tan	0.127	0.153
	(0.124)	(0.122)
capex	0.156**	0.155*
	(0.0589)	(0.0619)
milev	0.724	3.427
	(0.503)	(3.457)
2012.year		0
		(.)
2013.year		-0.00848
		(0.00765)

2014.year		0.0103
		(0.0105)
2015.year		0.00522
		(0.0105)
2016.year		0.0194
		(0.0238)
2017.year		0.0193
		(0.0215)
2018.year		0.0170
		(0.0266)
2019.year		0.00318
		(0.0103)
2020.year		-0.00247
		(0.00463)
2021.year		-0.00332
		(0.00309)
2022.year		-0.00759
		(0.00634)
2023.year		0
		(.)
_cons	0.460	-1.186
	(0.333)	(2.123)
N	1547	1547

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Appendix F – H3 Stata Results

Hypothesis 3: Leverage Dynamic Adjustment to Regulatory Changes

Dynamic panel-data estimation, two-step system GMM - lag(2 .)

```
------------------------------------------------------------------------------
Group variable: id                              Number of obs      =      1417
Time variable : year                            Number of groups   =       132
Number of instruments = 114                     Obs per group: min =         2
Wald chi2(7)  = 595790.21                                      avg =     10.73
Prob > chi2   =     0.000                                      max =        11
------------------------------------------------------------------------------
             |              Corrected
         lev |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         lev |
          L1. |   .9348218   .0428543    21.81   0.000     .8508289    1.018815
             |
        D_rr |  -.0044105   .0030027    -1.47   0.142    -.0102956    .0014747
         siz |    .002095   .0008545     2.45   0.014     .0004203    .0037697
        prof |  -.1654514   .1116907    -1.48   0.139    -.3843612    .0534583
         tan |   .0043283   .0175803     0.25   0.806    -.0301284     .038785
       capex |   .2065683   .0721529     2.86   0.004     .0651513    .3479853
       milev |   .0682789   .2226629     0.31   0.759    -.3681323    .5046901
------------------------------------------------------------------------------

------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -5.05  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.02  Pr > z =  0.983
------------------------------------------------------------------------------

Sargan test of overid. restrictions: chi2(106)  = 147.39  Prob > chi2 =  0.005
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(106)  = 109.86  Prob > chi2 =  0.379
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(88)   =  85.73  Prob > chi2 =  0.549
    Difference (null H = exogenous): chi2(18)   =  24.13  Prob > chi2 =  0.151
  iv(siz prof tan capex milev)
    Hansen test excluding group:     chi2(101)  = 103.48  Prob > chi2 =  0.413
    Difference (null H = exogenous): chi2(5)    =   6.39  Prob > chi2 =  0.271
```

Dynamic panel-data estimation, two-step system GMM - lag(2 3)

```
------------------------------------------------------------------------------
Group variable: id                              Number of obs      =      1417
Time variable : year                            Number of groups   =       132
Number of instruments = 58                      Obs per group: min =         2
Wald chi2(7)  = 403629.15                                      avg =     10.73
Prob > chi2   =     0.000                                      max =        11
------------------------------------------------------------------------------
             |              Corrected
         lev |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         lev |
          L1. |   .9385397   .0471616    19.90   0.000     .8461047    1.030975
             |
        D_rr |   .0012447   .0044865     0.28   0.781    -.0075486     .010038
         siz |   .0020894   .0009978     2.09   0.036     .0001338     .004045
        prof |   -.175756   .0964675    -1.82   0.068    -.3648288    .0133169
         tan |   .0078871   .0162543     0.49   0.628    -.0239708     .039745
       capex |   .1837868    .080581     2.28   0.023      .025851    .3417226
       milev |   .1038723   .2464974     0.42   0.673    -.3792538    .5869984
       _cons |  -.0588747   .1221443    -0.48   0.630    -.2982732    .1805238
```

```
------------------------------------------------------------------------------

------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -5.05  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.11  Pr > z =  0.915
------------------------------------------------------------------------------

Sargan test of overid. restrictions: chi2(50)   =  88.35  Prob > chi2 =  0.001
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(50)   =  73.93  Prob > chi2 =  0.016
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(32)   =  50.24  Prob > chi2 =  0.021
    Difference (null H = exogenous): chi2(18)   =  23.70  Prob > chi2 =  0.165
  iv(siz prof tan capex milev)
    Hansen test excluding group:     chi2(45)   =  66.59  Prob > chi2 =  0.020
    Difference (null H = exogenous): chi2(5)    =   7.34  Prob > chi2 =  0.196
```

Dynamic panel-data estimation, two-step system GMM - lag(2 2)

```
------------------------------------------------------------------------------
Group variable: id                              Number of obs      =      1417
Time variable : year                            Number of groups   =       132
Number of instruments = 42                      Obs per group: min =         2
Wald chi2(7)  = 211477.21                                      avg =     10.73
Prob > chi2   =     0.000                                      max =        11
------------------------------------------------------------------------------
             |              Corrected
         lev |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         lev |
          L1. |    .839073   .0694873    12.08   0.000     .7028804    .9752655
             |
        D_rr |  -.0019209    .005354    -0.36   0.720    -.0124145    .0085727
         siz |   .0039399   .0014351     2.75   0.006     .0011271    .0067528
        prof |  -.1883151   .0946625    -1.99   0.047    -.3738502     -.00278
         tan |   .0154027   .0220237     0.70   0.484    -.0277629    .0585683
       capex |   .1635521   .0970925     1.68   0.092    -.0267457    .3538498
       milev |   .1384839    .252177     0.55   0.583    -.3557739    .6327417
------------------------------------------------------------------------------

------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -4.89  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.06  Pr > z =  0.953
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(34)   =  63.84  Prob > chi2 =  0.001
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(34)   =  57.69  Prob > chi2 =  0.007
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(16)   =  25.53  Prob > chi2 =  0.061
    Difference (null H = exogenous): chi2(18)   =  32.17  Prob > chi2 =  0.021
  iv(siz prof tan capex milev)
    Hansen test excluding group:     chi2(29)   =  48.63  Prob > chi2 =  0.013
    Difference (null H = exogenous): chi2(5)    =   9.06  Prob > chi2 =  0.107
```