The Dynamic Relationship between Firm Capabilities, Regulatory Policy, and Environmental Performance: Renewable Energy Policy and Investment in the U.S. Electric Utility Sector

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Dedication

To my parents,

Who supported me from the start and were always eager to listen.

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CHAPTER 1.

1.1 Introduction

The choice by a firm to improve its environmental performance is a result of both characteristics that distinguish firms from one another and the public policy that compels such action. My dissertation examines how policy outcomes and subsequent firm responses are contingent upon the capabilities of the firms to respond to such policy. I present a theory of compliance specificity that ties firms and regulators together based on the heterogeneity of capabilities that firms hold with regards to a pending public policy of variable stringency. I test this theory within the context of the regulation and investment of renewable power in the U.S. electric utility sector and the growth of a utility scale renewable energy industry. My theoretical approach and empirical analyses provides a more sophisticated depiction of the interrelationships between firms and regulators within this industry context.

My central argument is that firms influence regulatory policies by their ability to comply with regulation. This is because regulators[1] face greater costs of regulating firms

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[1] In this dissertation I refer to regulators as a policy maker. Regulators are either appointed or elected bureaucratic officials that are charged with overseeing and directing an area of industrial or social activity. Policy can be enacted either through the bureaucratic office that is led by the regulator or legislated by politicians. In the latter case, the regulator plays an important role in presenting policy alternatives and informing politicians and legislative committees of the various costs and benefits of particular policy types. As a result, these bureaucratic officials have considerable influence in the stringency of particular policy even when the policy is set by others through the legislative process. Within the empirical context of this dissertation there is a split between policies that are set by regulators and by state legislatures. Interviews with state level officials and archival records did indicate that when policy was set by legislators the regulators had an integral role to play in initiating the policy and petitioning what can be considered to be reasonable demands upon industry.

that are out-of-compliance (e.g. monitoring and enforcement). Therefore, regulators have incentives to choose policies that account for firm capabilities. Similarly, firms that have the competences to respond to particular policy types are more likely to be able to find gainful opportunity by redeploying such competence to meet the demands of such policies. Ultimately, I expect that this is an iterative process that has implications for not only firm decision making but also further generations of regulatory policy. In the case of environmental policy, I believe that this expectation can explain why firms undertake *greening* activities and is distinct from much of the work that has focused on the performance implications of such activities, also known as the "pays to be green' literature.

The management literature has generally considered firms as responders to environmental public policy with little role in shaping the nature of those laws. I argue that firms are not only responders to such policy but that such responses will be contingent on the manner by which they are able to shape policy. Specifically, firms are able to influence the demands of environmental policies based on how regulators consider the technological, operational, and financial capabilities of the firms that are required to comply. The incentive for firms to be responsible environmental stewards is not only founded in particular attributes of management or pressure from outside interests, but from their inherent capability to comply with more demanding public policy. This questions the fundamental roles of business and governing institutions in the context of the natural environment and the exogeneity condition that underlies much of the management research in this area. Furthermore, my arguments connect the management literature with developments in both positive political theory and regulatory economics, which have independently considered the policy making process but either ignore the role of the heterogeneous pool of firms or downplay their significance.

The next chapter of this dissertation provides thorough background on the U.S. electric utility sector and the benefits and challenges presented by renewable power. It also explains my approach for this dissertation and the general findings that are reported in greater detail in chapters 3 and 4. Those two chapters are presented separately but are closely related as they each examine the issues surrounding environmental performance by firms and a state-level renewable energy policy. Chapter 3 examines the policy development stage and the determinants of more demanding environmental policy. Chapter 4 provides an empirical examination of environmental performance and specifically the adoption of renewable energy by Investor Owned Utilities (IOUs). Chapter 5 concludes the dissertation and offers implications.

Chapter 3 of this dissertation focuses on the policy making process. I develop a theoretical framework that identifies how firms influence regulatory policy outcomes through their technological capability profiles and competitive positions. The costs of developing, implementing and enforcing policy increase as the likelihood of compliance by firms diminishes. Regulators balance their public mandate with the costs of regulation, which depend in part on the capabilities of the firms that they oversee. As a result, firms influence policy by their relative ability to comply. I develop a series of predictions that explains how the stringency of Renewable Portfolio Standards (RPS), state-level environmental policy in the U.S. electric utility industry, is determined by the regulator strategically accounting for firms' technical ability to manage a diverse fuel portfolio, their financial capacity, and market position. Using a dataset of 144 firms in 48 states between 1991 and 2006, I find that states were more likely to adopt aggressive policies when the regulated jurisdiction was simultaneously populated with both (1) technologically capable firms and (2) a single market dominant firm that had the technical and financial capacities to respond in kind. Moreover, when the market dominant firm was a technical laggard, the likelihood of a demanding environmental policy was reduced despite the strength of other firms in the jurisdiction. This emphasizes the importance of the competitive environment in influencing the policy making process and the ability for particular firms to have discretion to influence public policy. What further distinguishes this approach is that those firms that are privy to discretion are not necessarily those that have spend lobbying dollars or acted as part of a trade association, but rather have developed an attractive technical competence. Therefore, when firms within a regulated jurisdiction are heterogeneous, the regulator can strategically set environmental policy that leads to an asymmetric distribution of costs and benefits. This can have important implications for firm strategy as the incentive for firms to invest to become technological leaders - especially in the case of a dominant firm - may be reduced as they anticipate an onset of more stringent environmental standards in response. Firm strategies that do not incorporate the regulator's strategic behavior can be ineffective as they have not taken into account all requisite information.

Chapter 4 focuses on the choices that firms make once an environmental policy has been set by a regulator. I argue that firm response to a policy may not merely be an effort to comply with a standard, but an opportunity to gainfully redeploy capabilities and preempt future policy types. Within a competitive market environment or non-market environment for public policy, this may provide firms with an advantage over others in the regulated jurisdiction. My empirical examination focuses on the growth of renewable energy use by investor-owned utilities (IOUs) in the United States between 2001 and 2006. The environmental policy that I observe is a state-level Renewable Portfolio Standards (RPS) that mandates the use of renewable power used by IOUs. Interestingly, these policies vary widely on a state-by-state basis and in some cases vary within a state as regulators have chosen to intensify the demands on utility firms over time. I find a contingent relationship between the stringency of an RPS and a firm's competence at complying. Firms that have the necessary capabilities to comply more actively increase the amount of renewable power they use as the stringency of an RPS policy increases. In other words, firms that are more likely to be able to meet the demands of an RPS are actively redeploying their firm-specific attributes in a manner that improves their environmental performance. In addition, as competitors' exposure to an RPS increase, a focal firm is likely to increase its own renewable power. However, when a state contiguous to where a utility firm operates adopts an RPS, the utility firm's fuel mix is unaffected. When both measures are considered, the competitive exposure to an RPS continues to increase a utility firm's use of renewable energy, but now the geographic factor leads utility firms to reduce renewable energy use. Therefore, the decisions that firms make with regards to environmental performance is sensitive to the types of policies that are faced by other firms.

In relation to the previous chapter, the fourth chapter now identifies (1) how firms that have their particular strengths or compliance-specific capabilities leveraged by regulators (through relatively more stringent policy) are likely to differentially improve their environmental performance by increasing their use of renewable technologies and (2) how firms actively alter their environmental performance to the public policies faced by other firms. Together these findings support the notion that firm capabilities can not only first shape regulatory policy, but also impact environmental performance as a result of the contingent relationship between these competences and the stringency of the public policy that has been enacted. These capabilities can independently provide reason for firms to undertake environmentally responsible actions, yet it is apparent that when the incentives are aligned between firms and regulators and demanding policy is set then there is an additional role that is played by regulatory policy to motivate more vigorous action. Together the two chapters bring together approaches from strategic management and the political economy of regulation to provide a more comprehensive understanding for how firms can shape and respond to new environmental policy.

Chapter 5 will conclude the dissertation by providing a brief summary of the findings and a general conclusion. This chapter offers important implications for managers that are facing the prospect of imminent regulatory policies and for policy makers that must consider the types of strategic responses that they would prefer in response to the setting of a new policy outcome.

CHAPTER 2

2.1 Introduction

This dissertation focuses on regulation and investment in the U.S. renewable energy sector. It presents a novel perspective on why particular investor-owned utilities (IOUs) face more stringent demands upon their use of renewable power and why some IOUs are more active in retailing power generated from such technologies. I assert that these two phenomena are closely related, but they operate at two different levels of analysis. Whereas the first level concerns the government regulators who are responsible for an entire jurisdiction, the second is at the firm level with corporate managers taking responsibility for procuring electricity by a variety of means. My framework presents the IOUs as possessors of particular attributes ("compliance-specific capabilities") that differentiate them with regards to the rules that the policymakers design. Moreover, the regulators act as policymakers that are concerned with the degree to which the firms that they oversee are out-of-compliance. In particular, I focus on the case where there is a symbiosis in the incentives for both the IOU and the policy maker--under the right circumstance this can lead to improved environmental performance by an IOU. Therefore, I present a counter-conventional theory of firm-regulator behavior that is grounded in firm strategy and competitive interaction, which can help inform and advance the classic approach developed by Stigler, Peltzman and other scholarship produced in this field during the past 40 years. This chapter helps to position this theory by outlining the background information on renewable energy use in the U.S. electric utility industry, the aspects of the firm-regulator relationship that I am interested in, and the general results that I reveal through the two interrelated sets of quantitative analyses.

2.2 The U.S Electric Utility Industry and Renewable Power

The creation of a utility-scale renewable energy sector in the U.S., beyond small scale and experimental projects, has been in the works for over thirty years. Collaborative efforts between the Department of Energy's National Renewable Energy Laboratory, academic institutions, private firms and electric utilities date back to the 1970s and helped lay the basic groundwork for the development of this industry. The benefits of a utility scale renewable energy sector are founded in not only the environmental benefits from reduced greenhouse gas (GHG) emissions as utilities substitute clean and replenishable fuels for dirty fossil fuels, but also significant domestic economic development and improved energy security. These two latter benefits should not be overlooked considering the precarious state of the U.S. economy through the 2000s and within the geopolitical context of deteriorating relationships with many of the energy producing regions of the world. Despite these benefits as well as the significant initiative and investment in renewable energy technology, the IOU's in the U.S. have made very little progress to include wind, biomass, solar, geothermal, and hydro in their portfolios of fuel mix technologies. In fact, in 2007 only about 9% of all electricity sold came from these sources. Hydro comprised 67%, of the total in the US followed by biomass at 15%, wind at 14%, geothermal at 4% and solar energy at 0.2% of this total. This lack of adoption was in spite of the growth in use of such technologies in both developed and developing countries. Figure 2.1 illustrates how the U.S. lags far behind many other countries in the adoption of renewable energy.

The lack of initiative in adopting renewable energy sources by IOU's came from several sources. These are founded in the structure of the institutional environment that regualtes the industry at both a state and federal level, the dominant organizational culture that pervades the executive tier of IOUs, and the operational obstacles that are inherent in the construction of new generating facilities.

2.2.1 Insitutional Constraints

The first constraint concerns the fact that utilities were required to operate within regulated environrments which often placed a priority on providing consumers with a reasonable price for electricity. As a result, decisions to invest in new and, in most cases, more costly energy sources such as solar or wind faced a significant external hurdle as Public Utility Commissions (PUCs) were sensitive to passing costs on to ratepayers (Fremeth and Holburn, 2009). Similarly, well organized interests, such as industrial customers or conusmer advocates, would likely create opposition to increased energy costs related to these technologies.

The PUC is the state-level regulatory body responsilbe for overseeing and directing IOUs. They are responsible for regulating the sale of electricity as well as gas and in some cases transportation and cable television. On average, a PUC oversees 4.5 electric utilities. This ranges from a single IOU in Alabama and Delaware to as many as 12 in Wisconsin. These bodies are led by Commissioners that are either directly elected to their position or appointed by the governor or state legislature. Generally, commissioners are either lawyers, engineers, or community leaders who aspire for greater political or corporate positions and hold these public positions for an avergae time of 5 years. The primary role of PUCs are to set the prices that utilities can charge and the rates of return that they can earn. All major investments that are made by IOUs undergo a rigorous approval process to determine whether they can be included in the rate base that is used in the rate of return calculations. As a result, an IOU's relationship with the PUC is a top managerial priority as it will determine a firm's degree of success. In one of my interviews, a senior executive of a major IOU underscored this point when he claimed that "the PUC has the final word on what we do, no matter what our mission statement reads." While several states have restrucutred and deregulated their utility industry to allow for competitive access to the retail electricity market, the PUC and decisions made by its commissioners are no less pertinent as pricing, mergers and acquisition activity, investment decisions, and environmental matters continue to be monitored by the PUC and require approval. Furthermore, the industry releveant decisions that are made by the state legislature are often heavily shaped by the PUC as it is able to contribute resources and expertise to the policymaking process.

State level regulation of IOUs by PUCs are accompanied by federal regulation from the Federal Energy Regulatory Commission (FERC) and the Environmental Protection Agency (EPA). FERC is an independent federal agency that regulates the interstate transmission of electricity, which includes interstate commerce that results from wholesale sales of electricity and the related energy markets. As the federal overseer of the interstate transmission network, FERC plays an important role in the creation of a national wholesale market for renewable power. FERC Order 888 and the later Order 2000 created an open access transmission system that required transmission owners to offer non-discriminatory, comparable transmission service to others seeking such services over its own facilities. These efforts restructured the wholesale market for power and permitted IOUs to purchase the power they required to sell to retail customers. This helped to support the activities of small and, in some cases, large independent power producers (IPPs) that could build merchant power plants with the sole intention of marketing power to IOUs. This presented a stark change to an industry that for over a century had operated with fully integrated utilities that not only distributed power to customers but also generated and transmitted the power. For the renewable power sector, this meant that IOUs were now able to access power generated from such technologies through purchase power agreements with IPPs even if the IOU was poorly located geographically in the country to generate such power on its own. Therefore, new options became available for IOUs to expand their fuel mix portfolio beyond their traditional technologies. The EPA, on the other hand, acts as the federal government's environmental regulator and its Clean Air Act Amendments of 1990 set strict limits on the pollution that power plants could emit and added specific provisions for addressing acid rain, ozone depletion and toxic air pollution, established a national permits program, and proposed a trading system. Furthermore, the state level EPAs are required to implement these policies and develop state implementation plans (SIPs) that explain how its state intends to clean up polluted areas. For IOUs, this meant that they would face mounting pressure to change their practices and would have to seek possible alternatives to reduce their environmental impact.

2.2.2 Organizational Constraints

The second constraint pertains to the longheld culture and institutional memory among senior executives at many IOUs. These had been formed around the traditional generating technologies that were based on boilers and steam-powered turbines that are used in fossil fuel based generation. In 2007, there were 169 IOUs in the U.S. that distributed power to consumers. 96% of these IOUs relied on a form of fossil fuel based generating technology in its fuel mix (i.e. coal, oil, natural gas). An environmental manager at a major electric utility remarked that this engrained culture began in the US Navy during WWII and after the war it was instituted by the executives and engineers who had transferred their knowledge from their experience powering warships to the electric industry. As a result, coal had remained the core fuel used by many IOUs even though it had a devestating impact on the natural environment. Despite this culture there have been some recent developments that have propelled the industry to change.

First, as retail and wholesale deregulation began to be implemented in parts of the country, small and large scale renewable energy developers were taking advantage of the qualifying facility (QF) status provided under FERC's *Public Utility Regulatory Policies Act*. While the legitimacy of these IPPs were limited due to the lack of familiarity and the questions surrounding the technology, the QF status of the projects compelled IOUs to consider introducing the new technologies presented through long term purchased power agreements (PPAs) with these entities. In some cases, these renewable energy developers were IOUs seeking new profitable opportunities outside their regualted jurisdictions--as in the case of Florida Power & Light (FP&L) that was developing fields of wind turbines across the coutnry and selling the power through PPAs or even the entire projects to other IOUs upon completion. Relationships with IPPs grew dramatically through the end of the 1990s and up to the present as IOUs were facing greater demand requirements and were less apt to undergo the lengthy process to build their own new generation capacity. However, as such practices were still realtively new to many IOUs, the contracting skills were often lacking and there was some hestiancy by IOUs to sign long term purchase power agreements. A business development manager of the American arm of one of the largest European wind farm developers remarked in an interview that she was astonished by the naïveté of the senior executives at one IOU when it came to negotiating a PPA for a potential wind farm. Furthermore, the accounting treatment of these PPAs caused great concern for IOUs as they could be considered debt on a utility's books, which is troublesome for firms in an industry that are accutely aware of their bond rating. In fact, IOUs that had already had poor bond ratings often had a difficult time contracting in the long term for power as energy development partners feared that they were not going to be able to recoup and profit on their investment if the utility were to enter bankruptcy over the life of the contract. All of these considerations created a serious obstacle for a firm seeking to diversify its fuel mix without its own considerable investment in new generating capacity.

Second, some IOUs had begun to take on a more forward leaning position when it came to managing environmental matters. The opportunity to use what one environmental manager called "Green Superlatives" in marketing efforts was beginning to be viewed as a significant advantage. Similarly, electric utilities can have a distint role as a leader in a local business community and the importance that their customers place on environmental concerns can begin to shape firm policy. For instance, it comes as little surprise that the IOUs in California have taken a very proactive stance to managing the enviornment. Furthermore, some utilities have identified that they have developed an aptitude at managing a diverse fuel mix and this provided for a distinct set of management capabilities. In particular, this would allow them to overcome the steep learning curve for managing renewables. Such capabilities would allow particular firms to not only introduce more renewables to their mix but also meet increasing environmental regulatory demands as they continue to be introduced.

Finally, IOUs were facing new pressure to change their engrained culture from the cooperative (coops) and municipal (munis) utilities that also operated in the same state. In 2008, there were approximately 2,800 coops and munis that were also active in the U.S. electric utility market. Most of these entities were small with limited generation and few customers, yet they were not as constrained as IOUs by state or federal regulation. However, due to their rural roots some of these entities had begun to take on a proactive role in managing the natural environment. For instance, Great River Energy, a coop in Minnesota, had made a foray into renewable energy with the its own biomass plants and PPAs from six wind farms. These smaller entities that generally rely on purchased power or smaller generating units found it easier to change practices. Morevoer, considering that they distribute 20% of the country's electricity, it is fair to suggest that the way that these entities change their practices can impact the larger IOUs that they neighbor and interact with on a regular basis.

2.2.3 Technical Constraints

Beyond the institutional and organizational constraints that came with the nature of the industry, there were still considerable technical constraints that prevented the development of a utility scale renewable energy sector. Foremost of these constraints was the antiquated transmission network that lacked the capacity and sophisticaiton to appropriately carry renewable power. Renewable power is generally located in outlying regions of the U.S. and comes online intermittently, but many of the key transmission lines in these areas were 50 to 100 years old and would need a considerable upgrade to carry the quantities of power needed to support utility scale projects. In one of my interviews, the Vice President of Transmission Asset Management for the Midwest

Independent Sytstem Operator (MISO), the organization responsible for the operation of transmission in 15 states and one Canadian province, identified a transmission interchange in Pipestone, MN that was built in the 1950s with the objective to transmit power to a population of about 15,000 people. Although now the population is less than 10,000 people, he noted that over 200 wind turbines had been recently built in this community with all seeking access to the transmission interchange. These projects were intended to transmit power to the urban centers towards the east such as Minneapolis, Chicago and even some cities on the eastern seaboard with the objective of bringing significant interstate revenue to Minnesota. To put this in context, the current electricity demand for Pipestone county is about 70,000 Megawatt Hours (MwH) per year while the current wind production seeking access to the interchange is 400,000 MwH. This creates an obvious strain on the sixty year old infrastructure. To make matters worse, as of 2007 MISO had a queue of over 400 wind projects seeking an interconnection to the midwest transmission network. According to one study, at its current rate MISO would be able to clear its queue by August 26, 2362, or about 350 years. The problem was that FERC had designed a first in/first out tariff requirement for Independent System Operators (ISOs) to follow for interconnection requests that worked well with large scale projects (ie. coal base-load plants or natural gas peakers), but was a major obstacle for the onslaught of small plants, such as biomass generators or wind farms, that were being introduced. This tariff requirement was part of a multi-step process that involved a series of technical studies to determine how the project would be integrated into the tranmission network. However, the requirements to enter the queue for this process were limited to a $10,000 fee and no further assurance that the project would actually be implemented. Understandably, not only would considerable investment in new tranmission be required, but it also required both billions of investment dollars and political capital to get highly contentious transmission lines sited. In addition, the technical approval process would need to be overhauled to ensure that projects would eventually come online.

The growing queue for interconnections meant there was great demand for wind turbines and related equipment. As the growth of wind power had initially taken off in Europe the largest production facilities of such equipment was still located across the Atlantic Ocean. As a result, there was a supply constraint for IOUs or renewable energy developers seeking the necessary materials in the U.S.. This meant that utility firms often had to wait to receive the turbines even if they were keen on adopting renewable energy. However, one senior utility executive noted that such issues were of lesser concern to the larger utilites or projects that were backed by such firms who maintained preferential treatment from the large turbine manufacturers such as General Electric (U.S), GAMESA (Spain), and Vestas (Denmark).

The intermittency issue related to both wind and solar power also presented a particular concern to IOUs. Managing a resource that was not always available meant that utility firms would require flexibility and have options available when the wind was not blowing or when the sun was not shining. In particular, studies had indicated how wind intensity was down in the summer months when peak power was needed the most and that 35%-45% of wind power would come online in the evenings at times when electricity was needed the least. Some new but pricey battery technolgoies were coming out of Japan that could allow utilities to store intermittent power when it was not required. Alternatively, there was some hope that growth of a prospective electric car market would mean that car batteries could act as a personal storage device for the wind power that would come online in the evenings. Electric car owners would plug their cars into the electric grid at night and allow IOUs to reduce their dependence on traditional genereating technologies at such times. However, the uncertainty and costs that surrounded both technologies accentuated the value on the managerial and technical capabilities that were housed within the firm. In particular, the ability for an IOU to be able to manage the technical aspects of a number of different types of power no matter how they were procured would be important to ensure reliability.

The reliability in the delivery of power was paramount for IOUs and outages were a grave concern. A senior executive of a major utility that already had developed a competence at managing a diverse fuel mix considered the utility scale growth of renewable power as “uncharted territory”. In particular, he stated that procuring renewable power at utility scale quantities, voltage regulation, load following and spinning reserve were all important technical capabilities that his firm had developed, but never used to the degree forseen with 25% or more renewable power on their grid. This firm along with others had modeled these operations, but no one knew exactly what it would be like to manage them. What became clear to the IOUs was that such unceratinties posed risks that would only increase moving forward.

2.3 Symbiosis of Incentives and Growth of Renewable Energy in the U.S.

As an emerging industry, the renewable energy sector would need to overcome the many obstacles put forth by the positions of the regulators, the IOUs, and the inherent technology. Although this created a significant hurdle there had been some initiative put forth in the mid-to-late 1990s. Beginning in the late 1990s, states had begun to mandate objectives, known generally as renewable portfolio standards (RPS), which compelled utilities to include increasing numbers of renewable power in their generation or procurement portfolio. These objectives were generally developed by the state PUC and in some cases legislated by the legislature based on the PUC's recommendations. They varied widely throughout the U.S. in the intensity of the targets they set for renewable energy adoption. These policies were set state-wide so all IOUs that operate within the state had to meet their demands, no matter how the particular strengths of these firms may differ in their ability to meet these targets. In essence, these acted as a 'command-and-control' policy that levied penalties for utilities that were unable to meet its objective. However, many of these policies did offer 'escape clauses' if the cost to acquire renewable resources were excessive. A similar mandate had been discussed nationally in Congress ranging from 10% to 15% of power sold for all utilities, but I must note that this had yet to pass as of the end of the 2008 session.[2] All of these policies were seen as a means to "prime the pump" and enable a wider market for renewable power. These state-level policies were expected to increase the role that renewable energy played in the U.S. by more than ten-fold. However, the ultimate impact of these policies is yet to be determined since many of the goals are only expected to be reached in 15 to 20 years.

Considering this context laid out above regarding the constraints involved in the shift to renewable energy, the goal of this dissertation is to understand how the utility scale renewable energy sector in the U.S. has developed. Specifically, I focus on the creation of the RPS policies and the resultant effect these policies have had on the decision making of IOUs with respect to renewable energy use. As I have just presented, there are many reasons why the industry should not have taken off at all. This included many layers of risk and novel challenges that were being presented to firms who could be considered highly conservative in their practices. The economic theory of regulation, the classic approach to understanding the utility industry and its regulatory compact, provides an insufficient model to understand what has happened to this specific industry. This traditional model depicts industry as a monolithic organization that uses its resources and informational advantage to shape policy and challenge regulators. However, in some cases in the U.S., IOUs were beginning to embrace environmental regulation that was in effect restructuring their market in a manner that was distant from the industry's traditional business model. As a result, what is needed is an appropriate theory to

[2] The Energy Information Administration's report "Impacts of a 10-Percent Renewable portfolio Standard" that was requested by Senator Frank Murkowoski, the ranking member on the Senate Energy and Natural Resources committee.

consider a situation where some firms respond differently to the implementation of varying renewable energy policies.

Due to the heterogeneity in responses by IOUs that was beginning to emerge and the variety of RPS policies that states were implementing, it seemed necessary to consider a firm-regulator relationship that relaxed many of the earlier economic assumptions. I develop a theory where (1) not all firms are the same in terms of their technical/financial competence nor market dominance and as a result they do not share a set of universal preferences or competences with regards to managing environmental concerns, (2) firm interests are not necessarily at odds with those of the regulator that develops policy, (3) firms compete for public policy and are sensitive to the policy decisions that may "bleed" through from neighboring states and that are faced by competing firms that are regulated differentially elsewhere, and (4) the regulator is concerned with the potential costs of overseeing firms that are out-of-compliance at the state level and can act strategically when setting the stringency of a policy in order to mitigate such costs. I argue that we need to make better sense of the interrelationships of firms and regulators in order to understand the development of this industry and a firm's decision to increase their use of renewable power.

I highlight the potential for the interests of both the regulator and firms to be aligned so that there is an incentive symbiosis, or a so called 'win-win.' This symbiosis explains a situation whereby a regulator sets an environmental policy that they are confident will allow them to successfully regulate the firms within their jurisdiction without accruing excessive costs while the firms are able to gainfully redeploy their capabilities in a manner that ensures regulatory compliance. The underlying factor that drives the interrelationship is that firms differ based upon their competence at meeting the requirements of a potential regulatory policy and that these differences can impact the decision making processes of a regulator. I label this competence a ‘compliance specific capability’ since it would allow a particular firm to more efficiently meet the objectives or comply with a specific public policy. If a firm used this competence following the release of a policy, then it would provide this firm with an advantage over competing firms or at least explain particular firm choices following policy adoption. Similarly, it would mitigate the out-of-compliance costs that a regulator incurs as it works to ensure conformity with a particular policy. As my interviews confirmed, it is in the regulators interest to set more demanding policies when the costs are lower. This was the case when regulators oversee firms that are endowed with the necessary capabilities or at least when those firms that would be costlier to regulate (i.e. larger and dominant) possess such capabilities. Upon setting a demanding policy those firms that have the necessary capabilities now have opportunities to redeploy them as they have been established by the regulator. In the electric utility industry this would be especially the case as investments in renewable generating technology and large purchases of renewable power require PUC approval. Consequently, I would expect to observe growth in renewable power use by those firms that jointly face a more demanding RPS and are endowed with the requisite compliance-specific capabilities.

To examine this interrelationship of firms and regulators, I require analyses at two separate levels. The first is at the state level where a regulator is making a decision based on the pool of firms that they oversee and the second is at the firm level where a firm decides its renewable energy strategy. While it would be preferable to examine these two decisions jointly, the levels of analysis (state and firm) prevent me from doing so. As a result, I examine these decisions separately and present their analyses in the two separate but closely related chapters that follow this one. In the first study, the dependent variable is whether a regulator adopts a stringent RPS in a particular state and the key independent variables are the strength of the compliance-specific capabilities of the firms in a state and the presence of single market dominant firm that either is or is not endowed with these necessary capabilities. In the second study, the dependent variable is the proportion of renewable power that an IOU is using and the key independent variables include the stringency of the RPS policies that the IOU is facing, the IOU's endowment of compliance specific capabilities, and the RPS policies that the IOUs competitors or neighboring states must comply. Appropriate statistical techniques are used to examine these relationships and robustness is provided to support the results.

2.4 General Findings

The findings of the two interrelated studies generally support the theory that I have briefly described above and which is developed in further detail in the subsequent chapters. In general, I have identified that firms are able to shape the stringency of an environmental policy in the electric utility sector as the heterogeneity among firms can impact the potential costs that a regulator would face in the case that a policy is set that would leave firms out-of-compliance. Further, the choices that firms make with regards to their use of renewable power is conditioned on the contingent relationships of the capabilities that they possess and these same policies that they have influence over.

Of particular interest at the policymaking stage was the role of a dominant IOU in a market. My results indicate that an IOUs role within the marketplace has important implications on the stringency of a policy, as states that had a single firm that controlled the marketplace (held over 60% of the market share) and was endowed with the requisite capabilities were most likely to attain policies favorable to their strategy. Therefore, the endowment of compliance specific capabilities within a state had to be conditioned on the competitive market environment for the results to support my expectations. Another interpretation of this result could be that the dominant firms that have the necessary capabilities have choices or discretion in the policies that they encounter. Interestingly, a group of atomistic firms that hold similar capabilities do not have this same discretion to influence policy on their own. Related to this point is how technology choices and competences are able to act as a passive mechanism to influence public policy. This is quite different from much of the literature that focuses on more active movements, such as industry associations or heavy handed lobbying. Finally, these findings have implications for research on integrated firm strategies that tie together market and non-market elements, as I identify how the competitive dynamic can impact a regulator's decision making processes to benefit particular firms.

The general finding of the analysis that examined firm choices to adopt renewable power was as expected. IOUs that faced more demanding RPS policies were more likely to increase their use of renewable power when they were endowed with the compliance-specific capabilities that would more easily allow them to do so. Therefore, it appears that regulators seem to have made good bets by introducing more demanding environmental policies when the firms were likely to respond positively and mitigate the potential out-of-compliance costs. Once again the competitive nature of the industry appears to play a less than obvious role in firm decision making as there is an inter-jurisdictional "bleeding" that shapes an IOUs choice for renewable power. In particular, IOUs were changing their renewable power use based on the RPS policies that (1) competing firms faced in other states and (2) were being introduced in adjacent states. Therefore, despite not being directly impacted by these other policies they do have a role to play on the overall market for renewable power and as a result can shape the decisions that IOUs make when undertaking such choices. This can have broader implications at the national level as both intrastate and interstate dynamics impact federal policy decisions and the development of a national market for renewable power.

CHAPTER 3.

3.1 Introduction

Regulation can shape firm behavior by mandating action. Regulatory policies often demand innovative responses to enhance public welfare, lessen externalities, and solve market failure. Yet such policies often encounter varied responses as firm heterogeneity can determine how firms choose to act (Helfat & Peteraf, 2003; Yao, 1988). Similarly, there is substantial variation in the types and demands of policies that regulators, with political consent, enact (Majumdar & Marcus, 2001). Given the relative uncertainty in the responses that result from firm heterogeneity, why would a regulator choose an aggressive regulatory policy versus a weaker option?

I argue that regulatory policy outcomes[3] are the result of a complex set of interrelationships between a strategically-oriented regulator chosen for its industrial knowledge and a group of regulated firms with heterogeneous capabilities. These parties have converging and diverging incentives. As a result, the policies which are enacted have been designed and shaped, to an extent, by the firms that they are meant to regulate. From this perspective, the regulator acts as a strategic actor that favors particular policy types as it attempts to meet its mandate and limit the 'out-of-compliance costs'. Out-of-

[3] I use the term regulatory policy outcomes to consider a wide range of public policy that may include regulating, deregulating, or re-regulating by a bureaucratic agency charged with overseeing industrial behavior.

compliance costs would result from policy types which have demands that exceed what would reasonably expected from the capabilities of the regulated firms. Understanding the decision making process of this strategic actor is key for examining firm strategy and performance. Policies that create a challenge for firms to be in compliance would be costly to enforce and encounter significant political hostility. In particular, I argue that because regulators are forced to balance these divergent pressures, they are sensitive to the capabilities and market position of the firms that they oversee and as a result firms can influence policy by their relative ability to comply.[4] In other words, the firm-regulator relationship does not necessarily need to be characterized as one that is (1) controlled by industry or other interests (Stigler, 1971) or (2) adversarial (Marcus, 1984), but rather can be compatible when incentives of both parties align to allow the regulator to cost-effectively meet its mandate.

The implication for firms is that the regulator represents an important strategic actor who like competitors, financiers, or alliance partners can shape the competitive environment and influence firm behavior. Firm strategies that do not acknowledge the regulator's rationale for creating a particular regulatory policy can be less effective as they have not taken into account the requisite information. This would be analogous to a firm choosing to locate in a particular region without considering how other firms will react to the positive or negative externalities of that decision (Shaver & Flyer, 2000). This perspective can help managers make decisions in a world that continues to undergo a

[4] Increasingly stringent policies that require aggressive firm action yet are incongruent with firm aptitude can lead to 'foot-dragging', delay, counter-productive investment, and legal challenges that are costly and reflect poorly on the regulator (Yao, 1988).

significant increase in the prevalence of government action (Ring, Bigley, D'Aunno, & Khanna, 2005).

Differences in the type and stringency of regulation can have important implications on a firm's decision to act upon environmentally-friendly alternatives. A policy requiring an environmentally beneficial response may not necessarily be at odds with firm objectives and a new policy can present a novel set of incentives for firm action. These options may have been value enhancing prior to the policy, but the impetus to overcome organizational inertia was lacking.[5] Despite this fact, much of the literature on corporate environmentalism has focused on firm-initiated actions (King, 1999; Delmas, Russo, and Montes-Sancho, 2007) or the priorities placed upon the interests of external stakeholder groups (Bansal, 2003; Sharma & Henriques, 2005). However, many contributors to this literature have identified that the factors which support strong environmental practices within a firm are still largely unknown (Delmas & Toffel, 2004; King & Lenox, 2002; Klassen, 2001). One explanation is that firms are characterized as 'policy-takers' and the interaction between firms and regulators has been deemphasized (Wholey & Sanchez, 1991).[6]

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[5] This would be consistent with the 'Porter Hypothesis' that regulation can be used to encourage innovation in search of more efficient or environmentally viable processes (Porter & Van der Linde, 1995).

[6] Henriques and Sadorsky (1996) and Delmas and Toffel (2004) have both identified that public policy represents the one of the most important sources of pressure on firms to consider environmental issues. Similarly, Rugman and Verbeke (1998) provide a model for how environmental policy may impact firms at both the industrial and environmental levels.

My theoretical framework develops a series of empirical predictions for how the stringency of a state-level environmental policy in the U.S. electric utility industry can be determined when a regulator approaches their interests with a strategic consideration of the positions presented by firms. I find that regulators are more likely to adopt aggressive policies when the regulated jurisdiction is simultaneously populated with both (1) technologically capable firms and (2) a single market dominant firm (based on market share) that has the technical and financial capacities to respond in kind. Moreover, when the market dominant firm is a technical laggard the likelihood of a demanding environmental policy is doubtful despite the strength of the other firms in the regulated jurisdiction. These empirical results expand our understanding of how regulators account for industry structure and the market capabilities of the firms that they regulate when selecting an environmental policy. As a strategic actor, regulators would appear to choose policies that, as expected, would shape firm behavior in a socially desirable manner but also lead to an asymmetric distribution of the costs and benefits to firms depending on their market position and capability endowment. What is of particular interest is that this result leads to both policy adoption and non-adoption depending on the conditions present, which would indicate that the regulator is acting strategically in balancing its ability to efficiently meet its mandate.

The theoretical framework and empirical findings that I present here make three principal contributions to the literature on corporate strategy and environmentalism. First, identifying the regulator as a strategic actor helps to clarify the interactive nature of the external environment. Characterizing firms as policy-takers disregards the trade-offs that regulators make and their ability to choose policies that are contingent on the nature of the firms. Models of firm behavior that captures this dynamic relationship may better explain firm strategy and performance. Second, I offer insight to the differential impact of technological position and market share when isolating the benefits of public policy. This builds upon prior findings in the innovation and internationalization literatures that identify the strategic differences of leaders and laggards. Finally, asking whether it 'pays to be green' can not be understood in a static sense. Rather it needs to be explored dynamically as decisions to invest in compliance-specific capabilities may provoke a strategic regulator to leverage that firm's resources or simply overlook it, depending on their market position and the position of the other firms in the jurisdiction. Therefore, the performance implications of corporate environmentalism can depend on the future regulatory decisions that present value-enhancing opportunities for firms to redeploy their compliance-specific capabilities.

The next section of this paper develops the relationship between firms and regulators and the impact of firm heterogeneity on policy type. The data and empirical model follow. I then present the analysis and conclude with implications for firm strategy.

3.2 Compliance-Specific Capabilities and Policy Stringency

Most industries, if not all, face some degree of regulatory policy compliance and a role for government action in its operations (Buchholz, 1990). The demands of a policy may be congruent with a firm's current strategy or may introduce a novel set of requirements that enhance social welfare but compel a firm to significantly modify its behavior[7]. Policies can have an important impact on firm performance as non-compliance may lead to costly penalties (Kassinis & Vafeas, 2002), reputation loss (King, Lenox & Barnett, 2002), and temporary or permanent cessation of operations (Wholey & Sanchez, 1991). The actions that firms undertake in response to such policies can provide important benefits such as raising the barriers to entry into an industry (Dean & Brown, 1995), developing valuable technology offsets (Porter & Van der Linde, 1995), and differentiating a commodity product for market niches (Delmas et al., 2007; Reinhardt, 1998).

Despite the many important outcomes of regulatory policy, when studied in management the firm is often considered a 'policy-taker'. This assumes that a policy change occurs at time *t* and a firm responds at *t+1* contingent on the heterogeneity in firm strategy, capabilities, and management preferences. However, firms clearly have an incentive to shape the transactional environment for their own advantage (Jacobides and

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[7] For instance, deregulation in the electric utility industry allowing retail competition has forced many one-time monopolists to adopt a marketing competence. Similarly, FDA policy requiring nutritional labeling on food products meant that small business operators, who were less likely to have already done so, were compelled to have their products laboratory tested and packaging redesigned in an effort to be in compliance.

Winter, 2005). Policies that not only compel welfare enhancing activities but also provide new outlets for knowledge or capability bases can be valuable for firms that can isolate and accrue those benefits. Moreover, the statutory requirements of the policy making mechanism in most liberal democratic political systems provides for multiple points of entry by which firms or their collective industry representatives can become actively engaged.

The literature on interest group politics and non market strategy has clearly identified that firms and other groups influence policy decisions at 't-1' (Grossman & Helpman, 2001; Bonardi, Holburn, & Vanden Bergh, 2006). For instance, the major Investor-Owned Utilities (IOUs) in California spent over $40-million in lobbying expenses in an effort to defeat a 1998 ballot initiative bill that would have halted deregulation of the California electric market.[8] In Texas, the IOUs and other related business interests controlled the board of directors of the Electric Reliability Council of Texas (ERCOT), the pseudo-governmental body responsible for designing and implementing market deregulation. Therefore, in the case of the two largest electric markets in the U.S., the firms that would be severely impacted by a significant policy change had a role in policy design and enactment. This questions the assumption that firms act as policy takers and motivates the need for more stylized models of firm-government relationships.

[8] Proposition 9 which was defeated by a 73.5% of the California electorate in 1998 would have prohibited the state's investor-owned utilities from passing on the costs related to market restructuring to its customers and would have demanded a further rate reduction of 10%. According to the Office of the Legislative Analysis for California this would bring significant changes to the laws restructuring the state's electricity industry.

Regulators, as the administrative heads of bureaucratic agencies, represent pivotal actors for firms intending to shape policy. Regulators are empowered with a clearly defined mandate that outlines a welfare enhancing objective and a resource base that it may use in meeting these goals.[9] This often means compelling firms to change behavior in an effort to ensure public safety, no matter the cost.

Failure to meet its mandate can lead politicians to increase their oversight of the regulator, reduce its resource base, or even relieve them of their position. McCubbins & Schwartz (1984) highlight that politicians can decide between 'fire-alarm' and 'police-patrol' approaches to bureaucratic oversight. The former is more hands-off and leaves the regulator alone except for when dire action is needed. The latter form of oversight requires that regulators have more frequent interaction at the political level and that they should be aware that regulatory decisions are being closely scrutinized. Starving a regulator of resources can be another strategy for politicians that are at ends with the regulator's position. At an extreme, regulators that fail to meet the requirements of their bureaucratic office can be replaced with individuals that are more in-line with political sentiment (Stephenson, 2008).

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[9] The objective function of a regulator and its informational disadvantage has garnered significant attention in the political economy of regulation. The economic theory of regulation associated with the Stigler-Peltzman model considers the potential for the regulator to be captured by well-organized industry interests and act in socially destructive manner (Stigler, 1971; Peltzman, 1976). Alternatively, Niskanen (1975) theorized that regulators may act opportunistically to maximize its administrative budget and personal benefit. While Wilson (1980) and Marcus (1984) provide a more practical approach that emphasizes how regulatory behavior is far too complex to be summarized by a single theory of capture or self-interest and that significant empirical evidence identifies how regulators attempt to meet their mandate and induce compliance given its resources.

Unlike the firms that they oversee, regulators have a fixed budget and cannot access a capital market in the case of a preferred policy that may otherwise increase the regulator's out-of-compliance costs. The out-of-compliance costs can include the expense involved in proving the technical feasibility of a new policy, the effort in selling a policy to elected politicians, and most importantly the cost in enforcing and monitoring a new policy. The out-of-compliance cost would be an increasing function of the difference between the demands of a regulatory policy and the firms' current capabilities (Kosnik, 2006; Olson, 1997). As a result, regulators must make tradeoffs between competing activities and have an incentive to choose policies that will efficiently lead to firm compliance (Barrett, 1991).[10]

The efficiency driven trade-offs can induce a regulator to consider scenarios for how firms in a regulated jurisdiction may respond to policy types. The firms' capability to meet more demanding policy can provide the regulator with a greater scope in policy alternatives. In other words, the regulator does not simply respond to political or interest group pressure but can act strategically and take advantage of the capabilities of the firms in its jurisdiction. Therefore, regulators that oversee jurisdictions populated with stronger firms can effectively adopt demanding policies with less concern of squandering its budget or taking on greater out-of-compliance costs.

[10] An example of an extreme case with a high out-of-compliance cost would be a technology-forcing policy that is designed to compel firm to innovate beyond their current capacity. Yao (1988) identifies how the U.S. EPA used such a policy in automotive sector and faced costly delays and legal challenges in implementation.

The nature of the compliance-specific capabilities will differ depending on the features of the relevant policy, but what is common is that the stock of such capabilities will increase the efficiency by which they allow a firm to achieve a particular objective (Dutta, Narasimhan, & Rajiv, 2005). In the case of policy compliance, these objectives are those set by a regulator. This may range from meeting environmental standards as in the case of automotive emissions to building codes in the construction industry to rules of origin in international trade policy.

The relevant compliance-specific capabilities can include firm attributes such as technological aptitude, operational efficiency, or financial capacity to more holistic factors such as absorptive capacity. On their own these 'compliance-specific capabilities' may contribute to a 'zero-level' activity (Winter, 2003), but in conjunction with the demands of a regulated environment and prospective policy types they may take on greater value and move up the capability hierarchy. For instance, an electric utility firm that has historically managed a diverse mix of fuel generation types (coal, nuclear, hydro, wind, etc.) would have developed specific technical knowledge that could be valuable if a regulator demanded more of this activity. With no policy mandating such activities this capability would support a firm's ordinary procedures. Yet when leveraged by a regulator as in conjunction with a policy to improve social welfare (e.g. reduce the cost of energy or improve energy independence) they can represent a potential comparative advantage that would not otherwise be available. This would be consistent with the research on the dynamics of industry architecture that has identified how the development of firm capabilities at the systemic level can shape the transactional environment and determine firm action (Jacobides & Winter, 2005).

The value of such capabilities would be directly related to the stringency of the policy that has been enacted. A regulator has a range of policy types available that they may choose to implement. These are often distinguished by the demands that they place upon firms as more stringent policies can require greater firm action in response. For instance, the U.S. Congress has been debating the stringency of a federal standard that would require electric utilities to increase renewable energy sources, with the amount ranging from 10% to 25% of their total power sold depending on the proposal (EIA, 2007). A more extreme policy, closer to 25%, could have severe implications on firm strategy. Similarly, policy stringency may not only come from statutory requirements but also the timeline provided for compliance. Tighter compliance schedules may escalate the necessity for immediate firm action and increase the regulatory hurdle that firms may need to overcome. Therefore, firms that have the capability to rapidly change their operating practices may contribute to shorter policy objective horizons.

The firm-regulator relationship becomes more complex when including interaction of performance-oriented firms with a strategic regulator. Firms that recognize the strategic nature of the regulator can attempt to shape this relationship to isolate the benefits of a more demanding policy outcome. Alternatively, firms may reconsider developing compliance-specific capabilities if this may result in policy types that they would not prefer. The case of eliminating chlorofluorocarbons (CFCs) during the 1980s and 1990s provides a very poignant example of such strategic behavior. DuPont had historically been the largest producer of CFC based products and was initially a staunch challenger of the ozone depletion theory that could undermine its market position (Barrett, 1991).[11] However, once its research and development efforts began to pay-off management actively promoted a stringent policy with an expedited timeline (Puller, 2006). Many recognize the viability of DuPont's CFC-free alternatives and its superior R&D capacity as a key contributor to the success of the Montreal Protocol that placed an outright ban on CFCs (Murphy, 2004). Interestingly, it was also in DuPont's interest for such a policy to be adopted as it would raise the costs of many of its smaller competitors and force them to look to DuPont as a source for CFC-free alternatives (Puller, 2006). DuPont's active promotion of its capability strength and position as the market dominant firm gave American and European regulators the confidence in pushing for a more demanding CFC policy.

In sum, regulators act strategically when balancing their welfare enhancing mandate with their concerns of forward looking out-of-compliance costs. When reform is necessary they have few options but to implement a demanding policy, yet given the opportunity to tactically assess the consequences of their decisions they can be more willing to make trade-offs. Similar to a venture capitalist that would evaluate a series of

[11] As late as 1987, representatives of DuPont had testified to Congress that they believed that there was "no immediate crisis that demands unilateral regulation".

investment projects and consider their potential viability under a variety of states of nature, a regulator would consider the compliance-specific capabilities of the firms that they oversee and predict how varying levels of regulation may affect their market strategies and subsequent cost of regulation. Firm strategies that are most likely to be successful under an increasingly demanding policy would represent credible positions that a regulator can then leverage. As long as the necessary social welfare maximizing requirement is met, a regulator would have scope to increase or decrease policy demands to strategically account for the possibilities of the firms that they are regulating.

3.3 Theory and Hypotheses

Regulatory policy is enacted at the local, state, national, or international level with a social welfare enhancing objective. Its requirements are, for the most part, non-discriminatory and apply equally to all firms. However, as we well know, not all firms are equal and the heterogeneity amongst firms can have important implications on the stringency of regulatory policies that are adopted. As regulators weigh the objectives of their office with the compliance-specific capabilities and strategies of those firms within their jurisdiction, I expect that the policy outcome would reflect the strategic potential of the regulated firms. Here I consider how the endowment of the relevant compliance-specific capabilities and market forces can be interpreted by a regulator that is responsible for setting an environmental policy that can vary in its degree of stringency.

3.3.1 Compliance-specific capabilities

The regulator is presented with a favorable position when a jurisdiction has firms capable of undertaking those actions necessary to comply with a particular policy type. The expected viability of market strategies post-regulation would be able to support a more demanding form of policy. The expected out-of-compliance costs would be mitigated as the likelihood would be greater that the firms would be able to redeploy their resources in a manner consistent with a policy designed with such aptitude taken into account.

The firms would have an incentive to work cooperatively with the regulator to prove the technical feasibility of a proposed policy type. In fact, the firms' collective input may help customize the demands of the policy to their distinctive characteristics and avoid a generic policy. These customized forms of regulatory policy breed more positive responses by firms as they are seen as more flexible and permit greater managerial discretion in compliance strategies (Majumdar & Marcus, 2001). Moreover, firms would have little incentive to challenge the policy in the courts or through political action. Rather a strong policy that set the bar high for the firms to meet would provide a value-enhancing opportunity that may have not previously been available (Porter and van der Linde, 1995). Hence:

Hypothesis 1: Ceteris paribus, the greater the endowment of compliance-specific capabilities among firms in a jurisdiction, increases the likelihood of a more demanding policy outcome versus no policy at all.

3.3.2 Role for a dominant and capability leading firm

Firms shape regulation by presenting a coherent plan for how they would be able to respond to increasingly demanding policy. This may be accomplished through explicit contact between management and regulators or more implicitly as regulators individually consider the likely response of their regulated firms. In either case, the market structure of the regulated setting would be important as the potential response of a market dominant firm, who controls a significant proportion of market share, would have a significant impact on the regulator's expectations of the out-of-compliance costs of a prospective policy. Recall that the out-of-compliance cost is that involved in determining the feasibility of a policy type, selling that policy to political overseers, and enforcing and monitoring compliance of the policy. Therefore, if a single firm controls a majority of an industry's sales in a jurisdiction it can have an inordinate impact on the regulator's perception of firm responses to increasingly stringent policy types. When a jurisdiction is populated by a dominant firm that not only has a significant market share but is also endowed with the requisite compliance-capabilities, the potential exists to reduce the regulator's out-of-compliance cost by aligning policy with the preference of that single firm.

The potential that the single largest firm within a jurisdiction has capabilities that are aligned with the interests of the public authorities comes from several sources. First, larger and more capable firms have the resources and organizational capacity to benefit from more efficient production (Cohen & Levinthal, 1990). Evidence shows that such firms have greater opportunity to develop economies of scale in their operations, which would be consistent with the public authorities' expectations (Delmas & Tokat, 2005). Second, the dominant firm in a jurisdiction requires more frequent interaction with the public authorities as its operations are not only larger but in most cases more complex. The extent of the regulatory issues within this relationship presents greater opportunity for deal brokering between the firm and the public authorities and the incentive for these firms to have developed compliance-specific capabilities as a prior negotiating tactic (Russo, 2001). Finally, the dominant firm would have the necessary resources and incentives to focus on research and development in operating technologies. As a result, this may alleviate the out-of-compliance cost of regulation since the public authority is not only responsible for monitoring and enforcement activities, but also confirming the feasibility of a new policy (Marcus & Geffen, 1998). If the dominant firm has been progressive and developed compliance-specific capabilities in the past, then it may positively contribute to the public authorities' assessment of the feasibility of an increasingly stringent policy. Hence:

Hypothesis 2a: Ceteris paribus, the presence of a market dominant firm that is endowed with the necessary compliance-specific capabilities in a jurisdiction, increases the likelihood of a more demanding policy outcome versus no policy at all.

Isolating the benefits of a policy for the interest of the market dominant and capable firm may be possible but politically challenging. A regulator must account for the interests of the pool of firms and could face a backlash if it appeared to provide preferential treatment by choosing a stringent policy that posed a compliance challenge for the smaller firms in the jurisdiction. The regulator may well recognize that a demanding policy would induce the appropriate market response by the key firm and this would have the greatest implications on managing the out-of-compliance cost. Nonetheless, the possibility that a group of firms would remain out of compliance and lack the appropriate market strategies to succeed following policy adoption may curb the regulator's enthusiasm for betting on the more demanding policy type. However, the story would be quite different if the jurisdiction has an overall group of firms that, like the market dominant firm, are endowed with the relevant capabilities to succeed under a demanding policy. The credible positions of the firms as a whole would breed greater confidence in the success of a policy that would require significant action without the concern that this policy would alter market forces. Firms with such market positions would induce the regulator to take on a more collaborative stance and use policy to build upon these strengths.

Strength and relative homogeneity among the capability endowments of market dominant and smaller firms within a jurisdiction may also serve to solve a collective action problem. The problem of free riding can make it difficult for groups of firms to collaborate in meeting a common goal (Olson, 1965). Therefore, without some form of leadership within the group of firms the viability of post-regulation policy compliance may go unrecognized. Using much of the same argument concerning market dominance that was made above, a dominant firm would have the necessary presence, ties, and resources to bring together the diverse interests within a jurisdiction to compose a common and mutually beneficial plan. Therefore, the role of a capable group of firms on the adoption of a stringent policy would be positively moderated by the presence of a dominant and capable firm as this big player would help solve the collective action issues. Hence:

Hypothesis 2b: Ceteris paribus, the greater the endowment of compliance-specific capabilities among firms in a jurisdiction that is market dominated by a firm endowed with these capabilities, increases the likelihood of a more demanding policy outcome versus no policy at all.

3.3.3 Jurisdictions with a dominant and capability lagging firm

The viability of market strategies following the enactment of a demanding policy becomes much less tenable when the dominant firm lacks the appropriate set of capabilities. Lacking the support of the key firm would make it politically challenging for a regulator to adopt such a policy and it would also significantly increase the monitoring and enforcement actions that would be necessary. As a result, despite the strength of the smaller firms in the jurisdiction, the regulator would encounter a significant out-of-compliance cost of choosing a demanding policy. In such a setting, the smaller firms have only limited success in overcoming the power and influence of the dominant firm, no matter how strong they may be in terms of their capabilities. Rather, the stronger that these smaller firms are, the less likely a demanding policy would be chosen as the dominant yet lagging firm would have a stronger incentive to ensure that its position is taken more seriously than others. This would especially be the case when a regulator is weighing different options with regards to a regulatory policy and would likely choose that which represents the greatest likelihood for firm success.

The literature on technological laggards has identified the differential behavior of such firms due to their limited absorptive capacity and tacit knowledge in technical matters (Berry, 2006). However, there is less understanding about the interactive impact of market dominance and technological competence. In particular, the case where the dominant yet technically lagging firm is competing for public policy with more capable yet minor firms. I predict that when weighing different policy alternatives the regulator is more likely to be risk averse and less willing to take a chance on those policy proposals that would be congruent with the capabilities of the smaller firms. Therefore, I present the pessimistic proposal that a dominant firm that lacks the appropriate capabilities will be successful at barring the introduction of a demanding policy which would otherwise be welfare enhancing, even in the presence of capable yet smaller firms.

Hypothesis 3: Ceteris paribus, the greater the endowment of compliance-specific capabilities among firms in a jurisdiction that also has a market dominant firm that lacks these capabilities, the lesser the likelihood of a more demanding policy outcome versus no policy at all.

3.4 Methodology

3.4.1 Empirical Setting

To test my predictions, I searched for an empirical setting where an environmental policy varied by stringency on a state-by-state basis within the same national boundary and there was sufficient variation on the distribution of capabilities among firms. Further, it was important that environmental performance was a key concern of firms and policy makers within the industry. I chose to focus on the renewable portfolio standard (RPS) in the U.S. electric utility industry. The electric utility sector has been targeted as a major contributor to global climate change due to emissions of greenhouse gases that result from energy generation. On a global basis, one third of total carbon dioxide emissions are produced by this industry (Friends of the Earth, 2006). In the U.S. electric generating plants account for 40% of such emissions. As concerns with climate change rise, firms in this sector will be under pressure to participate in the political process that determines new regulatory demands and respond with strategic actions. While limiting the study to only one industry can inhibit external validity, the impact of these firms on global climate change and the ability to more clearly identify the relationship between firms and regulators supports the appropriateness of the context.

Since the Clean Air Act Amendments of 1990, the electric utility sector has faced increasing pressure from all levels of government to better manage its pollutants.[12] The RPS has become the policy tool of choice at the state level and creates a statutory obligation for IOUs to include renewable power as part of the generation mix that it markets to final customers.[13] Renewable power includes electricity generated from wind, solar, biomass, refuse, geothermal and hydropower sources. By 2008 twenty-eight states had enacted RPS policies that together would increase the power generated from renewable sources from under 2,500 megawatts (MW) in 2000 to over 55,000 MW in 2020. However, wide variation persists in the demands of these policies as the proportion of renewable power required ranges from 2% of total megawatt hours (MwH) sold in Iowa to 30% in Maine and Minnesota. Similarly, variation exists on the number of years required to meet these objectives with stricter policies requiring more immediate action. Figure 1 depicts a map of the U.S. that demarcates states with strong, weak, and no policies as of 2007.

An additional feature of this context, which is important for my purpose, is that the firms have a close relationship with the regulator that is responsible for setting and enforcing the RPS. This ensures that the regulator has an understanding of the relative

[12] The EPA required state-level regulators to develop "state implementation plans" (SIPs) that explain how each they planned to enforce the Clean Air Act. A state implementation plan is a collection of the regulations a state will use to clean up polluted areas. The states are obligated to notify the public of these plans, through hearings that offer opportunities to comment in the development of the plan.

[13] Several attempts at mandating a national renewable portfolio standard in the U.S. have passed through the Senate but have failed to make it to the House of Representatives. The proposed national standards have ranged from 10%-15%.

capability endowment of the firms that they oversee. The state-level Public Utility Commissions (PUCs) are charged with overseeing the activities of utilities and abiding by the tenets of the Public Utility Regulatory Policy Act (PURPA). In general, this requires the PUC commissioners to be concerned with the reliability and price of power. Consequently, a firm's relationship with the PUC is of vital importance as the PUC is responsible for overseeing the rate review process and approving the firm's regulated activities. Recently, PUCs have taken on a growing concern with environmental issues (Dworkin, Farnsworth, Rich, & Klotz, 2005) and mandated polices such as the RPS to diversify power generation and induce environmentally responsible activities. Finally, the utilities are required to provide quarterly and annual statements of their activities and performance to both these state-level PUCs and the Federal Energy Regulatory Commission that acts as the national regulator. This provides a direct informational outlet that regulators may rely upon to identify the capability endowments and market share of the firms that they oversee despite remaining at a relative informational disadvantage to the firm.

3.5 Data

The sample consists of 144 Investor Owned Utilities operating in 48 states in the U.S. for the period of 1991 to 2006.[14] I limit the study to only IOUs as these are the major polluters in the industry and are the focus of the RPS policies. The sixteen year

[14] IOUs account for two-thirds of the power sold in U.S. with the remainder accounted for by municipalities, co-operatives, federal agencies and power marketers. Nebraska has been excluded from the study since no IOUs operate in the state and Alaska has been excluded due to missing data.

panel not only represents the period when the RPS policies were implemented but also follows the 1990 passage of the Clean Air Act Amendments that created additional pressure on state-level regulators to encourage emission reductions by utility firms and provides for a natural starting point for the analysis.

Firm specific information on these utilities is compiled annually by the Environmental Information Administration (EIA) and was obtained at both firm and generating plant level from Platts, an energy information provider. This data has been commonly used in both the management (Delmas et al., 2007; Delmas & Tokat, 2005; Russo, 1992) and economics (Kwoka, 2002; Lyon & Mayo, 2005) literature to study firm and regulatory behavior. Financial information on the bond ratings for these firms was obtained from Standard & Poors. As I am focused on the decision by regulatory bodies to pass more demanding environmental policies the level of analysis is at the state. Therefore, the capability measures that are predicted to influence policy stringency capture the average strength of the utilities that sell electricity within a state. This results in balanced panel of 768 state-year observations. Information on the state-level RPS policies was collected from individual state governments and from the Pew Center on Global Climate Change.

While prior studies of the renewable energy sector had focused solely on the generating capacity of IOUs (Delmas et al, 2007), I intend to introduce a novel dataset that identifies the procurement relationships between utilities and independent power producers. Purchased power agreements between IOUs and renewable power producers have become the norm in the industry and have begun to eclipse in-house generation of such power sources. This development within the industry was a result of earlier efforts to introduce third-party power generators following the passage of the Public Utility Regulatory Policies Act of 1978.[15]. The capability for utilities to not only develop their own renewable resources but enter such agreements and manage a diverse portfolio of energy types is crucial for complying with increasingly stringent RPS policies. Data on purchased power transactions were coded by hand to identify the type of power being provided (i.e. wind, solar, biomass, etc.) using information from various public sources, such as the federal Environmental Protection Agency's e-Grid database, and proprietary sources, such as Platts generators database, and datasets from two industry consulting companies, Energy and Environmental Analysis Inc. and Utilipoint International . Over the period of the sample the utilities had on average 28 trading partners per year who generally included independent power producers, power marketers, and other IOUs. However, this varied widely from a single trading firm to over 200 different arms-length-transactions for a utility firm in a year.

3.5.1 Dependent Variable

Consistent with the predictions set above, I develop a dependent variable (named RPS POLICY) that captures the stringency of an environmental policy as represented by the adoption of a state's initial RPS. Therefore, I create a trichotomous dependent variable that takes on a value of 1 when a state has adopted a less demanding RPS policy,

[15] See Russo (2001) for a thorough description of this process that forced utility firms to purchase power from third party generators.

2 for a more demanding RPS policy, and 0 when no policy has been mandated. As the demands of the policy would be increasing with the proportion of power that is required to be procured from renewable generation sources I chose to use the publicly-debated national target of 15% as the cutoff between the more and less demanding policy types.[16] This national target had passed through the Senate in the summer of 2007 but failed to be debated in the House of Representatives.[17] Therefore, states that chose a policy of 16% or above were coded as a 2 and states that chose a policy of 15% or below were coded as a 1. Finally, I lead this variable by a year so that it is being regressed on the covariates of the prior year in the panel.[18] I chose this leading structure since the regulator's decision making process would take into account the firms' prior capabilities when basing their expectations of the firms' future capacity to comply. This leading structure also helps to avoid concerns with the independence assumption that may arise from a contemporaneous correlation.

The argument for the 15% cutoff between more and less demanding policies is threefold. First, the national target passed by the senate acknowledged the availability of renewable power sources throughout the country and the potential for firms to efficiently procure such power at this level even if they are not geographically located in a high-

[16]A 1997 study by the Union for Concerned Scientists examined a national 10% non-hydro renewable energy standard. A 1998 Energy Information Administration (EIA) study examined the differential impact of varying national renewable energy standards. The 15% level was first discussed by politicians in 2001 in response to a letter written by Senator Frank Murkowski who was seeking further analysis from the Department of Energy on the implications of a renewable portfolio standard.

[17] Bill H.R. 6 passed the Senate by a vote of 65-27 on June 21, 2007.

[18] Lead structures of 2 and 3 years provided the same statistical support for the results.

yield locale. Therefore, it seems a logical starting point for considering a cutoff. Second, an independent study by the Union of Concerned Scientists contrasted the market dynamic of a national RPS set at 10% versus 20% with the status quo of no policy and identified the costs and benefits that would result from each (Union of Concerned Scientists, 2004). The logical middle ground of these two policy demands would be the 15% that I focus on as a cutoff. Finally, the average RPS requirement among the twenty-eight states that have already adopted such a policy is 15.08%. Therefore, it is logical that states that chose a policy above this level would be considered to have adopted a policy that is more demanding than the average.

3.5.2 Independent Variables

To capture the aptitude of firms and their credible positions vis-à-vis a novel environmental policy, i.e. the RPS, I created a series of time-varying state level measures that represents both the (a) operational expertise (FUEL DIVERSITY) and (b) financial capacity of firms (BOND RATING). The former embodies the viability of a post-regulation market strategy as represented by the relative ease by which the group of firms marketing power within a state would hold the requisite knowledge and technical capacity to manage a diverse portfolio of fuel generation types. The latter identifies whether the firms have the financial strength to construct new generation capacity at a reasonable cost or sign long-term contracts with IPPs to procure power generated from renewable sources. The decision as to how to operationalize these two constructs was developed through a thorough review of trade publications and interviews with senior executives at electric utilities.

The market potential of a more demanding RPS policy would likely be contingent on the operational aptitude and technological expertise that a firm has historically developed. Interviews with utility firm executives and regulators identified experience managing a diverse portfolio of energy types as a key capability that would be leveraged in a policy environment that compelled more renewable power to be sold. Managing a diverse energy portfolio can include, but is not limited to, understanding technical aspects related to the varying sources of power, transmitting and distributing power of different voltage, an aptitude at siting of different types of power plants and transmission lines, developing relationships with independent power producers, and scheduling intermittent power sources generated in-house or by arms-length suppliers.

To operationalize this measure I calculate the fuel diversity of each firm using a Hirschman-Herfindahl index (HHI) that is generally used to identify market concentration within an industry. I begin by taking the percentage of power that each utility firm generates and/or purchases from coal, oil, natural gas, nuclear, hydro, wind, biomass, geothermal, refuse, and solar sources. This data was obtained from Platts, a leading energy information provider, and supplemented with my own identification of the power procured in PPAs. I then use the HHI calculation, as depicted in equation 1, where 's_i' represents the percentage share of power type i and n is the number of power types used by a focal firm. I then average the HHI of each firm that operates within a state to get a single number out of 10,000 that represents the fuel diversity of the IOUs. [19] Therefore, a state with an HHI closer to 10,000 has utilities that operate with a concentrated fuel mix and as that figure decreases the fuel diversity among firms in a state and resultant capability to manage a more diverse portfolio increases. For instance, the utilities in Mississippi have historically only relied on coal for their power and as a result the average HHI for the state has been close to 10,000. In contrast, the utilities in Maine have generally been able to manage a very diverse portfolio of fuel types and have an average HHI near 3,000. Throughout the analysis this variable is referred to as fuel diversity and captures the technical aptitude of firms to meet the demands of an RPS.

$$H = \sum_{i=1}^{n} s_i^2 \qquad (1)$$

For the financial capacity measure I use the average bond rating for the utility firms operating within a state. Corporate bonds are a necessary element of the capital structure of utility firms and bond rating agencies cover the financial performance of these firms closely. This data was obtained from Standard & Poor's (S&P) who provides a quarterly assessment of utility firms. The data ranges from a rating of 'AAA' to 'D' and I coded the data ordinally from a 22 for the strongest rating to a 1 for the weakest. The average rating at the firm-level was 15.8 or equivalent to a rating of about a 'BBB+'. As

[19] A normalized HHI would range from 0 to 1.

long-term contracts [20] with IPPs have become the industry standard, concern has arisen by utility firms as to their accounting implications which are considered imputed debt by bond rating agencies (Tye & Hawthorne, 1997). This can result in a higher cost of capital for firms that choose this option over firm-owned generation. According to S&P,

"the rating criteria focuses on the utility rate base and the related earning capacity, both of which tend to diminish as purchased power increasingly replaces self-generated power. Next, the impact of purchased power contracts is assumed to increase operating leverage of a utility with its magnitude depending on the nature of the purchase contract. In S&P's view, the purchased power risk increases when a utility relies on nonutility generated power for more than 10 percent of its capacity needs. S&P collects information on purchased power from utilities on a confidential basis. It then computes the net present value of future annual capacity payments (discounted at 10 percent) as a potential debt equivalent." (S&P, 2007).

As a result, a pool of firms within a state that collectively have a stronger bond rating would not only have an easier time constructing their own renewable capacity but would attract IPPs into the state as the likelihood of successful arms-length contracting

[20] Purchase power agreements between utility firms and IPPs are generally contracted for a twenty to thirty year period so as to ensure complete cost recovery of the IPPs investment. The utility firm benefits from an ex ante contracted quantity of power for a pre-determined price per megawatt-hour (MwH). Furthermore, as Zelner (2001) identified firms may also choose this approach when it is less likely that their investments would be included within their regulated rate base that is used to determine a utility firm's allowed earnings.

would be greater.[21] Throughout the analysis I refer to this measure as bond rating and it is used to capture the financial competence to meet the demands of an RPS.

To identify states populated with a dominant and leading firm, I created a dummy variable that takes on 1 when there is a single firm that holds greater than 60% of market share and is in the top quartile nationally in the relevant capability (FUEL DIVERSITY or BOND RATING) for a given year.[22] This dummy is 0 otherwise. These variables are named DOMINANT & LEADING FUEL DIVERSITY and DOMINANT & LEADING BOND RATING, respectively. Similarly, when the dominant firm is lagging in these capabilities I use a comparable criterion but set the dummy to 1 when a state has a firm that holds greater than 60% of market share yet is in the bottom quartile nationally in the relevant capability for a given year. Again, the dummy is 0 otherwise. These variables are named DOMINANT & LAGGING FUEL DIVERSITY and DOMINANT & LAGGING BOND RATING These variables are interacted with the state-level capability measures in testing hypotheses 2b and 3.

3.5.3 Controls

In order to capture the dynamic element of the panel dataset and control for the prior endowment of renewable power I include a one-year lagged measure of the percentage of total renewable power that is sold in a state by utility firms (PERCENT

[21] Utility firms in Nevada had a difficult time attracting IPPs to contract with at the early stages of t its RPS since the IPPs questioned the financial integrity of the utility firms and were apprehensive in entering long term contracts that may not be honored (Wiser, Porter, Bolinger, & Raitt, 2005).

[22] Sensitivity was conducting using a market share figure of 50%, 70% and 80% and the statistical results remained the same.

$RENEWABLE_{t-1}$).[23] This identifies the degree to which the utility firms in a state have committed to renewable power prior to policy adoption and how the stringency of a policy may be impacted by this prior endowment.

A significant motivation for RPS policies is to reduce harmful carbon dioxide emissions. As a result, I include a measure for these emissions that the electric power industry emits using in metric tons of CO_2. This data was obtained from the EIA and standardized by state capita for ease of comparison (named CO^2). I would expect that states with electric utility sectors that are relatively larger polluters would have a stronger motivation to implement demanding RPS policies.

Public policy can be influenced by a variety of different interest groups which are active to varying degrees. This is especially the case when examining an environmental policy in the electric utility that not only has important environmental implications but could have an economic impact of particular industries or ratepayer classes. The extant literature in corporate environmentalism has focused on the interplay between these stakeholders and the choice by firms to embrace environmentally responsible alternatives (Henriques & Sadorsky, 1999; Bansal & Roth, 2000; Kassinis & Vafeas, 2006). As a result, I include Sierra Club membership per state capita to capture the strength of environmental groups in a state (SIERRA CLUB). This data was provided on annual basis from the Sierra Club which is globally recognized as a leading environmental group. While environmentalists support more stringent RPS policies, the coal and

[23] This includes both power generated by the utility firms and purchased from others.

manufacturing industries have fought their own campaigns to limit such policies. The U.S. coal industry would see the demand for its product reduced as regulators compel utility firms to choose cleaner technologies and as a result I include state employment in the coal industry per state capita to capture the state-level lobby which was obtained from the Energy Information Administration (COAL EMPLOYEES). The rationale would be that states that have a greater proportion of their residents employed in this industry would be less likely to adopt demanding RPS policies. The manufacturing industry would have a related concern in limiting the likelihood of a demanding RPS policy as their lobby would be interested in ensuring that the cost of power is kept low. The cost of renewable power can be 2X to 6X the cost of conventional coal generated power and this would have a serious impact on the American manufacturing industry that would bear the brunt of this cost (Bryner, 2007). Therefore, I include the proportion of gross state product per state capita that is allocated from the manufacturing sector (MANUFACTURERS). This data was obtained from the U.S. Bureau of Economic Analysis. Similarly, I include the average retail price of power in a state since I would expect that states with high priced electricity would be less likely to choose more costly renewable options, while states with firms that sell more reasonably priced power would have the capacity to bring on these costlier forms (AVERAGE RETAIL PRICE). This data was collected from the EIA and has also been used in economic analyses of RPS policies in the past (Lyon and Yin, 2008).

The predictions made above consider a cost-concerned regulator that is apprehensive to choose a policy that would leave firms out of compliance. This situation would mean that the regulator would need to dedicate greater resources to implementing and enforcing the policy. As a result, I include a number of factors that capture the variability in a regulator's resource base. First, I include the number of full-time employees at the PUC per state capita (PUC EMPLOYEES). I would expect that as the number of employees at the PUC increases there would be less concern with enacting a stringent policy as regulating out-of-compliance would be less of an issue for the regulator. This data was collected from the Book of States that is published by the Council for State Governments and has been used in the past to measure the resource base of utility commissions (Fremeth & Holburn, 2009). Second, using a similar rationale I include the total state budget per capita as resource-rich states may be more willing to dedicate resources to ensuring regulatory compliance of a demanding policy (STATE BUDGET). This data was collected from the National Association of State Budget Officers. Related to the total state budget, I also include the allocations to the state level environmental protection agency that were made by both the state government (STATE EPA BUDGET) and the by the Federal EPA (FEDERAL EPA DISBURSEMENTS). These two measures capture the relative concern with environmental issues within a state and were obtained from the Book of the States. They were standardized by state capita for ease of comparison between larger and smaller states.

To capture the political setting within a state I include two variables that would be particularly relevant. First, the tenure of the state governor may capture the relationship between the utility firms and the key political overseer (GOVERNOR TENURE). Governors who are longer tenured would have better developed relationships with utility firm executives who are often well represented by lobbyists in state capitals. The governor has final budgetary approval on bureaucratic resources and would be able to discipline a regulator that mandates a policy that is beyond the competence of the firms. A second measure is the degree of legislative rivalry in the state legislature (LEGISLATURE RIVALRY). When there is a slimmer majority held in the state legislature politicians may be more willing to take on consumer-friendly interests at the expense of the utility firms. In this case, I would expect that greater rivalry would be correlated with more demanding policy types. This variable was constructed using data on the party seats obtained in the most recent state legislature election using equation 2. Accordingly, higher values on each of these measures (maximum value equals one) reflect a slimmer overall majority by the dominant party.

$$\text{Legislature Rivalry}=1-\frac{(\text{Majority party seats in Legislature-Minortiy party seats in Legislature})}{\text{Total Seats in Legislature}} \quad (2)$$

A further institutional variant that can make a firm's position more credible for the adoption of a demanding RPS policy is membership in a regional transmission organization (RTO) or Independent Service Operator (ISO) (variable named TRANSMISSION PLANNING). There are 7 of these RTO/ISO organizations in the U.S.

who provide independent and non-discriminatory transmission service on a regional basis. Utility firms located in a RTO/ISO region have generally relinquished management of their transmission grid to these independent operators who facilitate competition among wholesale suppliers to improve transmission service and provide fair electricity price. Therefore, it is expected that firms which have greater access to independent markets for renewable power as a result of being in an RTO/ISO region would have a more viable plan to succeed under a demanding RPS policy. The data on RTO/ISO membership and when these organizations took on a transmission management capacity for member firms was obtained from FERC.

Finally, I include the average number of years since the firms' last rate review case to capture the potential lobbying relationship between the firms and the regulator in the state (YEARS SINCE LAST REVIEW). The rationale behind this measure is the more frequent the interaction between firms and regulators the more likely there has been explicit lobbying efforts on the firm's behalf. To capture the temporal element of the data I include a counter for years passed since the 1990 Clean Air Act Amendments (YEAR COUNTER).

Summary statistics and correlations are presented in tables 3.1 and 3.2.

3.5.4 Method

Because the dependent variable in this study takes on three categories and I have a panel dataset with time-varying covariates it is appropriate to estimate the model using a multinomial logit estimator in a discrete-time event history approach. While an ordered logistic regression may seem like a logical alternative, I argue that more and less demanding policy types represent distinctive policy choices rather than an ordered process. Therefore, I model the regulator's choice of a more or less demanding RPS policy versus no policy at all. Equations 3 and 4 depict the multinomial logit model where Prob(y_i=j) is the predicted probability that the regulator in state *i* chooses policy type *j*, which represents either a more or less demanding policy type, at time *t+1*. Recall that I chose a leading structure so that a policy at t+1 is regressed against covariates at t. X_{it} is a time varying vector of covariates of state *i* at time *t*. These covariates include the measures for compliance-specific capabilities, indicators for dominant leading/lagging firms, their interaction, and a series of control variables. The errors are clustered by state to account for potential serial correlation that would otherwise underestimate the standard errors and lead to overestimated t-stats.

$$\text{Prob}(y_{i,t+1}=j)=\frac{e^{\beta_j X_{i,t}}}{1+\sum_{j=1}^{J} e^{\beta_k X_{i,t}}} \quad \text{for } j=1,2 \tag{3}$$

and

$$\text{Prob}(y_{i,t+1}=j)=\frac{1}{1+\sum_{j=1}^{J} e^{\beta_k X_{i,t}}} \quad \text{for } j=0 \tag{4}$$

An important element of the design is the discrete-time event history approach which is a competing risks model that allows me to examine the propensity for a regulator to choose a particular policy type over time (Box-Steffensmeir & Jones, 2004). Such models are commonly used to examine policy adoption and changes in the economics and political science literatures (Clarke & Cull, 2002; Box-Steffensmeir & Jones, 1997). The model works by assuming that each state is at "risk" of adopting a policy in each year. Therefore, all 48 states enter the analysis in 1991. As states adopt a policy of either type they are then are no longer at risk. In the year following adoption they are not included in the analysis. As a result, the sample is reduced from 768 observations (48 states over 16 years) to 664 usable observations.

3.6. Results

The results of the multinomial logit regressions with estimates and standard errors are presented in Tables 3.3 through 3.6. Results are reported for the likelihood of observing the adoption of a strong policy (RPS of 16% and greater) and a weak policy (RPS of 15% and below) versus no policy at all. All models include the fourteen control variables described above and the standard errors clustered by state. Table 3.3 presents models with controls and the main effects of compliance-specific capabilities (fuel diversity and bond rating) to test hypothesis 1. **Model 1** on table 3.3 includes only the control variables, **Model 2** includes the fuel diversity measure as operationalized by the average HHI, and **Model 3** includes the average bond rating. In table 3.4 I test hypothesis

2a by introducing dummy variables that indicate the presence of a capability leading firm that holds a dominant position in a market. **Model 4** in this table includes this dominant leader variable in the case of fuel diversity and **Model 5** in the table does the same for bond rating. The main effects of fuel diversity and bond rating are also included. In table 3.5 I test hypothesis 2b by interacting the dummy variable for presence of a dominant leading firm with the compliance-specific main effects. In **Model 6** of this table I present the results of the interaction between the dummy variable and the fuel diversity measure and in **Model 7** I do the same with that dummy variable and the bond rating measure. All main effects are included in this model in order to properly assess the interaction. Finally, I test hypothesis 3 in table 3.6 where I change the dummy variable to represent a capability lagging, dominant firm rather than a leading, dominant firm. **Model 8** of this table reports the results for this interaction in the case of fuel diversity and **Model 9** does the same for bond rating. In all cases the models fit the data relatively well with a McFadden's pseudo-R^2 above 38% with log likelihoods decreasing as the variables of interest are included.

3.6.1 Interpretation of Main Results

Hypothesis 1 predicted that regulators enact demanding policies as they expect firms to be able to effectively respond in a manner that would mitigate out-of-compliance costs. The result in **Model 2** of Table 3.3 (which includes the controls and fuel diversity measure) does not support this hypothesis as states with firms that have managed a less diverse fuel mix as represented by a higher Herfindahl index face more demanding environmental policies. Therefore, regulators are choosing policies that compel firms to change their technical aptitude rather than taking advantage of the relative strength of the firms in a state. In fact, increasing the Herfindahl index of fuel diversity by a standard deviation from the mean (which would indicate greater concentration in firms' fuel mix) increases the probability of a strong RPS policy by approximately 2.5 times. For instance, as per my estimation, firms operating in Tennessee in 2006, which is at a standard deviation above the mean, were 2.5 times more likely to face a demanding policy than firms in Kansas, which was at the mean of the data. Therefore, states that are characterized by a series of atomistic firms that lack technical capability are much more likely to face a demanding environmental policy. However, in the case of the firms' financial capacity to increase renewable resources the story is less clear. In **Model 3** of Table 3.3 (which includes the controls and the bond rating measure) I identify that firms in states that had higher average bond ratings were less likely to face a weak policy but there was no significant correlation with the stronger policy type. Concordantly, while less financially-competent firms may be more likely to encounter a renewable energy policy it is not of the more demanding type. This may indicate a willingness of regulators to weigh technological and financial compliance-specific capabilities differently and consider that a downgraded bond rating, as a result of a demanding policy, will increase the utility firm's cost of capital and induce an increase to consumer rates.

Hypotheses 2a and 2b move beyond the atomistic environment and introduce the presence of a dominant and capable firm. In **Model 4 of** Table 3.4 (includes controls, the fuel diversity measure, and an indicator variable for the presence of a dominant and technically leading firm) I see that as hypothesized, states that have a single firm that controls greater than 60% of the market share and is in the top quartile in fuel diversity nationally (lower Herfindahl index) are more likely to have adopted a strong RPS policy. This provides support for hypothesis 2a. Further, the main effect remains significant despite the introduction of this dummy variable. However, in **Model 5** of Table 3.4 (includes the controls, the bond rating measure, and an indicator variable for the presence of a dominant and financially leading firm) the presence of a dominant firm that is in the top quartile nationally according to its bond rating has no significant correlation with the likelihood of a strong policy and actually reduces the likelihood of a weak policy. Therefore, we again see divergent results between the technological and financial compliance-specific capabilities. These correlations indicate that regulators may be willing to leverage the technological strength of the dominant and leading firm but are less likely to take advantage of a dominant firm that stands out for its financial strength.

The results of the interacted relationship between the presence of a dominant and capable firm and the compliance-specific capabilities of all firms in the state are presented in Table 3.5 in **Model 6** (includes the controls, the fuel diversity measure, the dummy variable, and the interaction between the fuel diversity measure and the dummy variable) and **Model 7** (includes the controls, the bond rating measure, the dummy variable, and the interaction between the bond rating measure and the dummy variable). However, as the coefficients and standard errors of interactions in non-linear models, such as a multinomial logit, create interpretive challenges (Ai & Norton, 2003) I apply a simulation based approach that presents the effect and significance of the interaction graphically. This simulation based approach developed by King, Tomz, and Wittenberg (2000) has several simplifying advantages over calculus based approaches and can easily be tailored to build confidence intervals around changes in the predicted probabilities that result from discrete changes to focal variables in the interaction (Zelner, 2009). The results of the change in the predicted probability when a dominant and capable firm is present in a state are presented in Figures 3.2 and 3.3. The x-axis in these diagrams present the range of the data for the compliance-specific capabilities of firms in a state and the y-axis is the change in predicted probability when the dummy variable changes from a 0 to a 1 indicating the effect of a dominant and capable firm. The shaded bars provide the 95% confidence intervals and in both diagrams they do not cross zero for most of the observed range of the data, thus indicating a statistically significant result. Both diagrams highlight that there is a greater probability of observing adoption of a strong RPS policy when a market dominant and capable firm is present as the total pool of firms in a state increase in their strength of compliance-specific capabilities. The non-linear effect in both interactions is clear as it shoots upwards in the latter half of the data. Furthermore, while the interaction is not significant in the case of a weak policy when the dominant firm is technically competent there is a negative and decreasing effect when that dominant firm has a strong bond rating. Therefore, I find support for hypothesis 2b as regulators are more likely to adopt strong policies when the pool of firms is endowed with the necessary compliance-specific capabilities and a dominant and capable firm is present.

In Table 3.6, I test the predictions of hypothesis 3. In **Model 8** (includes the controls, the fuel diversity measure, the dummy variable, and the interaction between the fuel diversity measure and the dummy variable) and **Model 9** (includes the controls, the bond rating measure, the dummy variable, and the interaction between the bond rating measure and the dummy variable) of this table the dummy variable indicates the presence of a market dominant yet lagging firm and graphical presentation of the results are in Figures 3.4 and 3.5. Interestingly, when the dominant firm is a technological laggard the probability of a demanding policy is decreasing as the capabilities of the firms in the state increases. This result is statistically significant over the range of the data but is not significant in the case of a regulator choosing a weak policy type. However, the result is divergent in the case of the dominant firm that has a poor bond rating. In this case the interaction demonstrates a positive and increasing relationship as the strength of the bond rating of the pool of firms in a state increases. Therefore, I find mixed support for hypothesis 3 as the technical and financial compliance-specific capabilities lead to different results when the dominant firm is a laggard.

3.6.2 Interpretation of Control Variables

The control variables included in the models provide some interesting contextual understanding to the adoption of RPS policies. In particular, coordinated environmental and manufacturing interests are correlated with a greater and lesser likelihood, respectively, of the adoption of a stringent renewable energy policy. This indicates that the regulator is sensitive to such interests in the case of a demanding policy, but the influence of such groups has less effect on the likelihood of a weak policy as only the Sierra Club variable is marginally significant and positive in that case. Similarly, states with larger budgets per capita were also more likely to adopt stringent policies with no significant result on the likelihood of a weak policy. Interestingly, the data highlights that states with longer tenured governors were more likely to adopt weaker policies and less likely to adopt stringent policies. This may highlight sensitivity among regulators to undertake potentially-costlier stringent policies when the probability of gubernatorial transition is higher due term limit restrictions. Finally, the dynamic measure that captures the percentage of renewable power sold by utilities in a state in the previous year is significant in almost all models and increases the likelihood of a strong policy and decreases the likelihood of a weak policy.

In summary, I find support for the theoretical prediction that firms' ability to comply influences the stringency of environmental policy. After controlling for the role of outside interests, the political environment and the bureaucratic resources available the policies chosen reflect a trade-off by a regulator that is concerned with compliance and the costs involved. The regulator can take an adversarial stance when it requires firms to develop the necessary technical capabilities. While this is counter to the expectations of hypothesis 1, it is consistent with the concept of a technology-forcing policy that compels firms to change and innovate to meet a demanding regulation (Yao, 1988). When the regulator's interests are compatible with those of the firm the regulator can choose to adopt a stringent policy that provides opportunity for firms to redeploy their compliance-specific capabilities. And the regulator can capitulate to a dominant firm when that firm lacks the necessary technical know-how. The results are somewhat consistent when the capability considered is financial capacity. The regulator, however, has additional factors to consider when leveraging the financial strength of firms as regulatory actions that unduly increase the firm's cost of capital can create an additional financial burden.

It is important to recognize the limitations to this study. Although the electric utility industry in the U.S. is a major emitter of greenhouse gases it is only one industry in one country. The RPS represents a command and control policy that compels firms to undertake particular actions, however environmental regulation in other countries and industries may be more collaborative or incentive based. Moreover, while the two compliance-specific capability measures that I use here were confirmed by industry insiders, they are specific to this setting and a more generalized account of this construct could provide a valuable contribution The external validity of this study could be reinforced with a cross-industry analysis that moves beyond the electric industry to consider how compliance-specific capabilities of firms in multiple industries can shape a common regulatory policy. Similarly, the well established relationship between utility firms and their regulators may induce particular behaviors by either party that may not be expected in less regulated settings.

Finally, it is an empirical challenge to rule out industry capture (Stigler, 1971) as an explanation for the observed policy outcomes. The capture hypothesis identifies that industry can use its informational advantage to sway regulatory decision making in its preferred direction. The difficulty in clearly measuring information flows between industry and the regulator make it a plausible alternative explanation for my results. Nevertheless, my ability to consider firm heterogeneity within and between regulated jurisdictions does make an empirical advance that offers a managerial lens on the primarily theoretical research on industry capture.

3.7 Discussion and Conclusion

Why are regulators so demanding? The findings of my analysis indicate that the answer is in how firm capabilities and market positions shape regulators expectations of policy effectiveness. As a result, firms are partially responsible for the strength of the policy demands that they encounter. Regulatory policies are not only designed to enhance public welfare, lessen externalities, or solve market failures but also to avoid the out-of-compliance costs that the regulator would otherwise face. Regulators act strategically to consider the plausible outcomes of their decisions and take bets on the expected actions of the pool of firms that they oversee. This can include compelling firms to adopt new practices, reinforcing activities that are already consistent with firm aptitude, or even forgoing policy altogether. The idea that a regulator could take on different positions vis-à-vis the regulated industry is not novel, however previous treatments often take extreme positions without considering that these different positions represent strategic choices rather than a maxim. My results indicate that the regulators' strategic posture is driven by the technological and financial strength of the firms and their relative market positions within a state.

For firms, these results highlight the strategic nature of the regulator. The compliance-specific capabilities that a firm develops can not only be used to meet its organizational objective but also that of the regulator that is responsible for overseeing its activities. Firms are at risk of facing new environmental regulations and these findings indicate that their own aptitude is a driver of more demanding policies. The potential for such capabilities to be leveraged to improve social welfare, as I find in the case when a dominant and capable firm is present, identifies how the strategic behavior of a regulator is a critical consideration in capability development by firms. The choice to invest in compliance-specific capabilities may introduce additional regulatory pressures rather than subdue them as regulators recognize an opportunity to leverage an organizational practice that could be mandated and strengthened across a regulated jurisdiction. Therefore, before investing in practices or capabilities that may induce further regulation firms must consider this explicit trade-off and question how far they would be willing to go in such efforts. The recent trend in self-mandated greenhouse gas emission reductions by firms may be appropriate considering the policy uncertainty that persists in the U.S. Firms, however, should be wary that these efforts may induce even more demanding policies once a state or federal policy has been enacted. Therefore, while such environmentally responsible actions may be desirable, due to stakeholder relations or corporate values, it may create a heavier regulatory burden in the future.

Forward looking performance implications of compliance-specific capabilities provide motivation to examine corporate environmentalism dynamically. Determining whether it ‘pays to be green’ is more complicated than generally considered if the firms are ‘policy-shapers’ rather than ‘policy-takers’ and the policy outcomes may not result for years. Many utility firms in the electric sector had developed the necessary capabilities ex ante to RPS adoption and had their technological strategies reinforced by favorable policy outcomes. Others were less fortunate and were compelled to undertake actions that were inconsistent with their technological aptitude. A firm’s ability to profit from environmental policy changes would only reveal itself over time as firms recognize profitable strategies which may involve redeploying the appropriate compliance-specific capabilities.

The insights developed here can also inform research in corporate political activity and non-market strategy. A firm’s likelihood to be politically active may be directly related to its stock of compliance-specific capabilities or those of other firms in the regulated jurisdiction. Understanding that a regulator may choose to take advantage of these resources to limit their exposure to the out-of-compliance cost may induce a firm to highlight or underplay these attributes as part of their political lobbying efforts. Baron

(1995) provided anecdotal evidence for an integrated approach to strategy that brings together market and non-market elements, but delineated between market and non-market resources. My results suggest that decoupling these resources may not be necessary as compliance-specific capabilities, which were historically developed with market intentions, can play an important role in non-market efforts to shape public policy. However, the value of such an approach is contingent on the strategic posture of the regulator and their likelihood to take account for compliance-specific capabilities in the determination of a policy outcome.

These results provide important implications for the design of environmental and regulatory policy. In particular, the tradeoff between federal and state level control should consider the capacity for a state-level regulator to more effectively account for the out-of-compliance cost that result from policies set at different stringency levels. The state level regulator can rely upon its specialized knowledge of the compliance-specific capabilities of firms in the state to better balance the inherent trade-offs. Federal environmental regulation would be more appropriate for settings where such an explicit calculation is either difficult or unnecessary or when a consideration of the out-of-compliance cost would obstruct essential welfare enhancing objectives. The recent federal initiative in the U.S. to implement a relatively weak renewable energy standard should take into consideration the 'building-blocks' that have been developed at the state level in more than half the country. A blanket policy that would push the firms in the remaining unregulated states to proactively acquire renewable power may effectively propel the advance of the American renewable energy market. Yet the practical implementation of such a policy would represent a considerable challenge as many of the firm or state specific issues would have not been adequately addressed.

The theoretical framework that I provide, which is supported empirically, offers a novel approach for understanding how firms shape public policy. The implications suggest that as firms develop compliance-specific capabilities and create an environment where they can effectively respond to policy they may, in fact, induce more demanding forms in the future. Identifying the strategic behavior of a regulator under a variety of conditions presents implications for particular forms of firm strategy that can be used to shape the institutional environment to their own advantage.

CHAPTER 4.

4.1 Introduction

Firm response to public policy is an important determinant of corporate environmental action. Since the 1970s, a complex series of policies at the national and sub-national levels have been developed that set goals, restrictions, and means for compliance with environmental objectives. As identified in the previous chapter, the types of policies that are set are a function of the interdependence that exists between regulatory agencies and the firms that they oversee. In sum, firms differ in their ability to respond to an environmental policy. With this in mind, I argue that firm response to a policy may not merely be an effort to comply with a standard, but an opportunity to gainfully redeploy capabilities and preempt future policy types. Within a competitive market environment or non-market environment for public policy this may provide firms with an advantage over others in the regulated jurisdiction.

The logic behind this position is that regulators can face increasing costs when firms are out of compliance. This can lead the regulator to act strategically and map the stringency of a policy on to the capabilities of the firms that they oversee. In this case, the consequence would be more stringent policies when the firms in the regulated jurisdiction are endowed with the capabilities that would allow them to be able to respond positively.

Should firms differ in the capabilities at meeting a demanding policy then the benefits of undertaking the necessary action should disproportionately accrue to the more competent firms that can more easily redeploy the appropriate capabilities from internal sources. Endowed firms would avoid capability development (Helfat and Peteraf, 2003; Gavetti, 2005) or accessing the market for such skills (Capron, Dussauge, and Mitchell, 1998) both of which can be costly and time intensive. In fact, these competent firms may well profit as less able competitors seek assistance from them in meeting the demands of the policy. For instance, this is a key mechanism in an emissions trading scheme, such as "cap and trade", where those firms with excess credits can sell them to those firms that require them. Therefore, the competent firms are likely to not only respond positively to the policy but take the opportunity to further ratchet up the standard as the regulator continues to observe firm competence. Such behavior would be consistent with the literature on raising rivals costs (Williamson, 1968; Salop and Scheffman, 1983; McWilliams, Van Fleet, and Cory, 2002).

To examine the impact of the interdependent relationship on firm strategy, I focus on recent growth of the alternative energy sector in the United States. Alternative energy production as both a means to reduce Greenhouse Gas (GHG) emission and as a catalyst for economic growth has received abundant, and sometimes sensationalized, attention in the popular press. However, the propensity for utility firms to diversify their portfolio of fuel technologies with renewable sources, such as wind, biomass, hydro, solar and geothermal, can present particular operational and managerial challenges. Many utility firms have entrenched operating practices and, in some cases, century old production plants and transmission lines. The distributed and intermittent nature of many alternative energy technologies is in stark contrast to the large-scale and centralized generating technologies that utility firms are accustomed to.[24] Some utility firms have been hesitant to embrace these environmentally responsible technologies, undertaking actions to question or even undermine their practicality.[25] Other utility firms have embraced the opportunity and recognize the inevitability of a national or transnational GHG emissions program.

The existing literature on business and the environment has presented a number of explanations for the growth of the alternative energy sectors. These include, but are not limited to, green consumerism (Byrnes, Jones, and Goodman, 1999), differentiation in response to a potentially deregulated environment (Delmas, Russo and Montes-Sancho, 2007), and the emergence of a new intermediary actor in the form of independent power producers (Russo, 2001; 2003). While identifying the role of policy makers as an exogenous stimulus, this work has generally underplayed the nuanced interrelationship between firms and regulators. This has been more thoroughly developed in the non-market strategy literature (Baron, 1995; Holburn and Vanden Bergh, 2008; Hillman and

[24] Senior utility executives have used the metaphor of a Naval Culture when referring to this position, where operating a boiler in power plant should be no different from operating a boiler on a battleship and any technology that is more complicated than that is superfluous. This reflects an older generation of utility leadership that was overrepresented by engineers, many of whom were trained on warships during the Second World War.

[25] For instance the "Clean Coal" marketing and lobbying campaign has attempted to position coal power as a technologically sound, clean alternative that would be preferable to renewable technologies and is financially supported by major electric utilities including: Duke Energy, American Electric Power, Southern Company, and FirstEnergy Corporation.

Hitt, 1999) that identifies firms as both policy takers and policy makers. Recognizing the firm's dual role is important for my purposes as the arguments hinge on public policy not being strictly exogenous, which is consistent with Berchicci and King's (2007) observation that business and environment scholarship needs to reconsider what is exogenous and endogenous.

My empirical examination focuses on the growth of renewable energy use by investor-owned utilities (IOUs) in the United States between 2001 and 2006. This is a setting where previous research in management and economics had identified how firm and institutional factors explained changes in renewable energy generation by IOUs. Although I take a similar approach, I also include the renewable energy purchases by these IOUs to create a more accurate depiction of the total fuel mix that utility firms are operating.[26] The environmental policy that I observe is a state-level Renewable Portfolio Standards (RPS) that mandates the use of renewable power used by IOUs. Interestingly, these policies vary widely on a state-by-state basis and in some cases vary within a state as regulators have chosen to intensify the demands on utility firms. I introduce fuel mix diversity as a measure of competence that captures the utility firm's aptitude at complying with an increasingly stringent RPS. I find that given an environmental policy those firms with the requisite compliance specific capabilities increase the renewable power that they market. In addition, as competitors' exposure to an RPS increase, a focal firm is likely to increase its own renewable power. However, when a state contiguous to

[26] In 2006, purchases of renewable power from 3rd party independent power producers comprised over 65% of the total renewable power sold by IOUs.

where a utility firm operates adopts an RPS, the utility firm's fuel mix is unaffected. When both measures are considered the competitive exposure to an RPS continues to increase a utility firm's use of renewable energy, but now the geographic factor leads utility firm's to reduce renewable energy use. Therefore, the decisions that firms make with regards to environmental performance is sensitive to the types of policies that are faced by other firms.

In the next section I will briefly highlight the literature that relates firms' strategy to environmental policy. I then set out a series of theoretical predictions that relate policy and firm capabilities with renewable energy choices. Subsequently, I discuss the sample and variables, the empirical approach, and the results. In the final section, I will conclude by offering implications for further research.

4.2 Firm Strategy and Environmental Policy Targets

A rich body of literature in management, economics, and political science has examined how firms respond to regulatory or deregulatory initiative by policy makers. Generally, this work highlights how attempts to improve public welfare, loosely defined, by government action can constrain or enhance firm choices. Within the sphere of corporate environmentalism, government has had an important, yet an underemphasized, role acting as a stimulus for firm action. While government policy has been identified as the *single* most important source of pressure on firms to consider environmental issues

(Henriques and Sadorsky, 1996; Rugman and Verbeke, 1998; Maxwell and Lyon, 2004; Vogel, 2006), the management literature has been focused on a "rules of riches" conundrum that questions whether it pays to be green (Berchicci and King, 2007; Etzion, 2007).

The debate has emphasized the potential importance and benefit of corporate environmentalism for profit-seeking firms. While noteworthy, the profit motives or even value-based normative explanations for why a firm may choose to limit environmental externalities are proving to be only a partial and perhaps temporary explanation for such behavior as firms rarely act out of benevolence and the "low hanging fruit" is quickly seized (Marcus, 2004). The corporation must act according to the rules of the game that are promulgated by the government. As a result, they will continue to be an important driver of environmental sustainability by firms. Consequently, how firms choose to operate within those rules, which includes their differing competence to comply and their efforts to preempt impending or modify existing policy, will provide a more complete explanation for corporate environmental efforts. Understanding how the heterogeneity among firms relates to public policy is essential for explaining both voluntary and involuntary corporate environmental initiatives. This should help contribute to a nascent literature that is shifting analysis to the conditions under which it can pay to be green (Marcus & Fremeth, 2009; Delmas et al, 2007) and the reasons why firms undertake environmental efforts (Easley & Lenox, 2006; Kassinis & Vafeas, 2006; Lyon, 2009).

4.2.1 Environmental Policy Targets and Firm Response

Pressure created by statutory targets can act as a stronger motivating factor than many of the other conventional stakeholders (Delmas and Toffel, 2004). For example, the Sierra Club may picket a firm's facilities or the news media may publicize its indiscretions but these groups are unable to independently shutter a firm's operation for questionable environmental performance. Karpoff, Lott, and Wehrly (2005) show that non-compliance with regulatory policy can impose a serious reputational cost that can be more severe than the penalties imposed on firms. Targets set by regulatory bodies (i.e. emissions reduction, quality standards, etc.) act as an anchoring mechanism that legitimizes conforming solutions that are developed within a firm (Tenbrunsel, Wade-Benzoni, Messick and Bazerman, 2000). Furthermore, the "teeth" that can come from possible sanctions or legal proceedings do make such policies a considerable threat. The "Risk Factors" that are listed in an electric utility firm's 10-K filing is riddled with regulatory concerns that could have a "material adverse effect on results"[27]. In the case of nuclear regulatory standards compliance and non-compliance with the Nuclear Regulatory Commission's (NRC), rules play a very important role on firm behavior as Feinstein (1989) and Marcus (1987) indicate. The shuttering of a nuclear power plant can be devastating for a firm as it would force them to not only pay fines and bring the plant into compliance but also locate alternative sources of electricity to provide its customers in the mean time.

[27] This was taken directly from Xcel Energy's 10-K in reference to the targets that they face from mandates to provides customer with clean energy, renewable energy and energy conservation offerings.

The stringency of targets set by government can have an important effect on firm decision making. Gray and Shadbegian (1998) identified how state level differences in an environmental policy in the pulp and paper sector impacted location choice of firm investment. In this case, firms that would face a greater cost of meeting compliance due to stringency choose to invest in less restricting jurisdictions.[28] Fuller (1987) identified how electric utility firms chose to either avoid or evade a state level emissions policy on both the stringency of policy (level of allowed suspended particulate matter) and the firm's distinct capabilities. Similarly, Majumdar and Marcus (2001) point to the differing types of government policies and how they impact firm capabilities. They illustrated how well designed regulatory regimes in the utility sector, which are stringent but provide for greater flexibility, can have a more positive effect on firm productivity. Therefore, it is fair to conclude that the strategic responses to regulation are idiosyncratic and depend on the organizational structures and capabilities of firms. Klassen and Whybark (1999) corroborate this conclusion by identifying how a firm's capability to implement pollution prevention technologies as a valuable strategic resource. Their study of the U.S. furniture industry emphasized the ineffectiveness of environmental policy when firms lack the requisite operational capabilities and knowledge resources.

As explained in the first chapter, the interdependence between firm competence and the behavior of regulators that oversee the industry can have an important role in determining the stringency of an environmental policy. Environmental standards can vary

[28] This would be consistent with the "Race to the Bottom" thesis that has been developed in the international trade literature

between countries, within country, and even within state or provincial borders when considering municipal law. As the complexities of firm operations increase and cross multiple jurisdictions become more prevalent, there can be an increasingly difficult series of regulatory hurdles that a firm needs to cross. For instance, the Dow Chemical Company, a leading multinational chemicals firm, operates manufacturing facilities in 35 countries and produces over 3,300 products. Table 3.1 highlights the interstate distribution of Dow's major production facilities. The diversity in the U.S. alone is remarkable with 42 plants located in 16 different states. The company's annual report recognizes the regulatory complications that this presents when it states early in the listing of risk factors that "[a]ctual or alleged violations of environmental laws or permit requirement could result in restrictions or prohibitions on plant operations, substantial civil or criminal sanctions, as well as the assessment of strict liability and/or joint and several liability" (Dow, 2008). In response to mounting environmental regulation throughout the world, Dow had reduced its absolute Greenhouse Gas emissions by more than 20% and achieved a 22% improvement in energy efficiency since 1994.

The diversity of policies that Dow must comply with can be quite different from other multinational chemical firms, such DuPont or Monsanto, which can have a different profile of regulated jurisdictions in which they operate. For instance, DuPont faces an even more diverse set of state-level policies than Dow as it operates 50 major facilities across 24 U.S. states. On the other side of the spectrum would be the scenario of a single-facility firm that only operates within one state. Not surprisingly, competing firms within the same industry may be subject to differing degrees of environmental standards. King & Shaver (2001) identified how the stringency of the environmental policy of a foreign firm's home country had no impact on how that firm operated in the U.S. This rebuked the "Porter Hypothesis" postulated by Porter & van der Linde (1995), which claimed that stringent environmental policy may induce comparative advantage for firms of that country. However, King & Shaver (2001) do find that managing facilities across an increasing number of states within the U.S. imposes difficulties for both domestic and foreign firms. While only a control variable in their study, the question remains as to how multi-jurisdictional exposure to differing environmental policies (stronger, weaker, or absent) may influence firm decision making and the resultant competitive dynamics that may ensue as firms interact with both one another and policy makers.

4.2.2 Preemption and Voluntary Firm Efforts

One manner by which firms interact with both each other and policy makers has been through preemptive or responsive voluntary efforts. Firms have the opportunity to develop self-regulatory standards when policy targets are absent or impending. This may be accomplished as part of an industry association or even in conjunction with a government agency. The literature on Industry Self Regulation (ISR) has identified how firms can organize their collective interests to solve industry-wide environmental or social ills and possibly preempt regulatory targets. Lyon and Maxwell (2004) provide a taxonomy of corporate approaches to shaping environmental policy. These include preemption, negotiated agreement, voluntary action to induce regulation, promoting public voluntary agreement, overcompliance to gain regulatory concessions, and voluntary action to influence future regulation.

The research that has examined elements of this taxonomy has highlighted why firms join self-regulatory initiatives (King & Lenox, 2000; Khanna & Damon, 1999), the role of stakeholders in influencing these decisions (Delmas, 2001; Maxwell, Lyon, & Hackett, 2000), and the preferences that firms hold make when encountering a variety of differing regulatory approaches (i.e. negotiated agreements vs. command and control) (Marcus & Geffen, 1998; Delmas & Marcus, 2003). However, the firm-specific factors that may explain their relative competence at meeting a self-regulatory, voluntary, or statutory policy has been generally overlooked. All of this is despite the fact that heterogeneous firm-specific characteristics can both explain environmental performance (King & Lenox, 2001; King & Shaver, 2001) and the cost of enforcement of environmental regulatory standards (Short and Toffel, 2008; Lyon & Maxwell, 2004). An interesting exception is a formal model presented by Maxwell and Decker (2000) which analyzes a firm's voluntary environmental investment conditioned on its relative compliance cost of meeting a prospective policy. It considers the regulator's strategic behavior to induce these voluntary investments by particular firms and the regulator's willingness to trade this for enforcement concessions. The anecdotal case that they provide is the U.S. Environmental Protection Agency's (EPA) StarTrack program that rewarded firms for being in compliance by making them a lower inspection priority. Nevertheless, the question of how firm competence at meeting an environmental policy--

voluntary or otherwise--can determine its likelihood to undertake greening activities remains unclear.

Academic and popular attention over the past decade has been increasingly focused on the cross-section of energy and the environment. The negative externalities that are created from energy production and electricity generation, in particular, have been well documented. In the U.S. the electric utility industry emits approximately 40% of the country's GHG emissions.

4.3 Theory and Hypotheses

The choices that firms make with respect to their environmental performance has been explained by both endogenous and exogenous forces that compel them to change current operating practices and undertake economic activity that has a positive environmental impact. Firms rarely act out of benevolence to undertake these activities (Marcus, 2004; Vogel, 2006; Portney, 2008); rather, they are commonly compelled to act due to both regulation and profit-seeking opportunity. The merits of both these motivating forces have often been considered separately. Firms either respond to an existing policy or undertake new activities irrespective of the presence of a statutory requirement. While voluntary, profit-seeking efforts can persist on their own. As argued in the previous chapter, environmental regulation and the varying demands that it places upon firms can be a function of the competence of those firms and the market structure that may further define firm-regulator interaction.

4.3.1 Influence of Public Policy

Regulators have an incentive to set policies that map onto the particular strengths of the firms that they oversee in an effort to avoid the costs of monitoring firms that are out of compliance. Therefore, regulators can choose policy that is violation minimizing rather than social welfare maximizing (Garvey & Keeler, 1994). By acting strategically, a regulator may be able to induce positive environmental response while avoiding unwanted political or public attention. Therefore, regulations designed with goals that are ambitious enough to stretch firms beyond their current practices yet provide certainty and predictability are more likely to be successful (Majumdar & Marcus, 2001; Sharma & Vredenburg, 1998). The costs that a regulator would face if a policy fails due to an unrealistic expectation of firm competence can dissuade a regulator from adopting that choice in favor of a moderate alternative. One implication of this relationship, where both the firms and regulators are interacting as strategic actors, is that the degree of firm compliance is likely to be an increasing function of the stringency of the policy that has been set. In other words, firms are not necessarily responding to meet the demands of a policy, but rather their response is the result of well-intentioned planning on the part of a regulator.

As a mechanism that creates predictability for firms, regulatory policy acts as an objective institutional pressure that not only directs but also legitimizes particular activities (Delmas & Toffel, 2004; Scott, 1995). An activity that may have previously been considered as imprudent may now be favorable as policy makers deem it appropriate. For instance, renewed interest in nuclear power generation in the United States in the late 2000s came not only from GHG emission concerns, but from the fact that the Nuclear Regulatory Commission had recently approved four new power plant designs submitted by General Electric and Westinghouse and four more are still pending (NRC, 2009). Further, regulatory rules can be vague and leave much room for interpretation in compliance. As a result, policy goals can lead firms to search and develop novel operating practices that help solve market failures or inefficiencies (Dobbin & Sutton, 1998; Wholey & Sanchez, 1991). Therefore, I would expect more stringent environmental policies to be an important driver of firm decisions to improve their environmental performance.

Hypothesis 1: Ceteris paribus, the stringency of an environmental policy is positively related to changes in firm environmental performance.

4.3.2 Role of Firm Competence

The decision to improve environmental performance has been attributed to firm level differences (Lenox & King, 2001). These differences can stem from a firm's technical capabilities, individual preferences, and competitive positioning. As a result, firms distinguish alternative responses to environmental concerns based on their own attributes and competences. Firms endowed with the necessary capabilities to more efficiently transform inputs into profitable, yet environmentally sustainable, outputs can be more likely to undertake such activities (Dutta, Narasimhan, & Rajiv, 2005). Seizing this opportunity to redeploy such capabilities can allow the firm to meet both internally and externally established objectives. This latter point is essential as the vast literature on firm capabilities differs in many ways (Teece, 2007; Nelson & Winter, 1982) but generally shares one common idea: firm competences meet a particular purpose or objective and preferably do so in a manner that is superior to other firms (McGrath, MacMillan & Venkataraman, 1995).

Capabilities that support environmentally sustainable objectives can be developed through purposeful action, as in the case of environmental management systems and ISO 14001 accreditation (Potoski & Pakash, 2005; King, Lenox, & Terlaak, 2005). Nonetheless, the competences to undertake these activities may parallel those already established within the firm and require little further development. In other words, capabilities need to be redeployed to different yet related activities to meet a new objective. For instance, the institutional structure of the U.S. electric utility sector over the past 20 years has favored the growth of small-scale energy generation by Independent Power Producers (IPP) that distributing IOUs must contract with to source a supply of power (Russo, 2003). Delmas and Tokat (2005) identified how the design, negotiation, and enforcement of long term contracts within this industry can be expensive, time consuming, and difficult. Further, the technical aspects of scheduling these purchases and managing a wider portfolio of energy types that can result can present a particular challenge to IOUs (Hyman, Hyman, & Hyman, 2005). Argyres & Mayer (2007) add to this discussion by arguing that contracting can be a capability that is heterogeneously distributed among firms and a source of potential competitive advantage. Therefore, IOUs that have developed a wider mix of power in the past through relationships with IPPs may have developed a capability at long-term contracting that can be redeployed to source renewable power in the future. This redeployability argument contrasts the traditional view in the literature that 'environmental capabilities' generates broader 'organizational capabilities' (Russo & Fouts, 1997; Klassen & Whybark, 1999; Delmas & Toffel, 2004; Sharma & Vredenburg, 1998). This traditional approach claims that the same processes that confer environmental advantages can create operational advantages that have a positive impact to financial performance.

The opportunity to use incumbent capabilities to meet newly formed objectives can create incentive for firms to undertake environmentally sustainable efforts. A newly formed organizational objective that is focused on environmental sustainability could initiate the appropriate capability redeployability. Such an objective may be internally determined due to managerial preference or externally induced from stakeholder pressure. The roles of such pressures have been well documented within the domain of business and the natural environment (Kassinis & Vafeas, 2006; Bansal & Roth, 2000), yet they generally have overlooked the heterogeneity in firm capabilities that can act as a prerequisite for environmental sustainable activities. Newly formed objectives may act as a sufficient condition for such activities, but by themselves does not necessitate action. The research on 'greenwash' has highlighted how some firms adopt organizational objectives that preach environmental performance but do not act upon them (Ramus & Montiel, 2005; Lyon & Maxwell, 2006). Alternatively, increased popular attention from an ongoing public policy discussion or broader public debate can induce firms to adopt a new objective. In this case, firms may be anticipating a potential regulatory policy that would compel them to adopt this externally induced objective. For instance, the continued uncertainty of carbon-pricing policy in the U.S.in the 2000s led many firms to reduce their carbon footprint in anticipation of pending policy change (Hoffman, 2007). As a result, when firms have already invested in developing a particular competence that would allow them to meet this new objective they would be forgoing a profitable opportunity if they chose not to take advantage by redeploying these competences.

Hypothesis 2: Ceteris paribus, firm competence at meeting the demands of an environmental policy is positively related to changes in firm environmental performance.

4.3.3 Contingent Relationship

When firm capabilities provide distinctive benefits what is done with them can be contingent on the demands of the external environment. Even when an industry already has high institutional pressures we still see firms exercise different strategic choices in response to public policy (Sharma, 2000). The internal organization of a firm matters as it channels how pressures are received and attended to (Delmas & Toffel, 2004). Few industries face as much regulation as the electric utility industry. The majority of investor-owned utilities in the U.S. have their prices, production, and environmental concerns heavily regulated by local, state, and national regulators. Nonetheless, there is an intra-industry variation in approaches to managing environmentally sensitive generation resources. A cadre of large firms has backed the technically-unproven "Clean Coal Technology[29]", while others have chosen to adopt currently available renewable energy technologies. This variation in preferences and resultant firm strategy is indicative of competences that firms have developed.

The strategic interaction between firms and regulators can often lead to more optimal environmental results (Palmer, Oates, and Portney, 1995). In creating a standard that firms are required to comply with, regulatory policy plays a key, if not definitive, role in the objective setting discussed above. The president of a major IOU in the U.S. made this clear when he bluntly stated that the "regulator has helped us determine our strategic initiatives with their policies" (Sparby, 2008). Similarly, Marcus and Geffen (1998) highlight how firms are able to seize opportunities when presented options by governments. These options can be mapped onto the particular competence of the firms by a regulator that acts strategically to leverage industrial strength. More stringent

[29] This technology is more aptly called Carbon Capture and Storage (CCS), which theoretically would prevent Carbon Dioxide from being emitted from coal power plants and store it underground in mine shafts using a series of subterranean pipelines. While research on CCS ensues the technology is not expected to be available at a utility scale until after 2025. Yet a number of small scale projects are being experimented upon around the world.

policies would polarize to more competent firms, as represented by the capabilities that would allow them to more robustly comply.

Firms recognize strategic alternatives differently based on their own attributes and the regulatory policies that they encounter (Fuller, 1987). The choices that they select will include (1) efforts to comply with the policy and (2) a newly legitimized form of growth. This would especially be the case in an industry that has a regulator with a mandate that covers both pricing and environmental concerns. Such is the case of the electric utility industry in the U.S. and elsewhere (Dworkin, Farnsoworth, Rich, & Klotz, 2006). In this setting a stringent environmental standard established by a regulator, such as a Public Utility Commission or other policy making body, can create an implicit arrangement where investments by regulated utility firms in environmentally sustainable facilities will be deemed prudent and included within the firm's rate base. For instance, many states have abandoned the 'certificate of need' procedure for renewable generating facilities in an effort to fast track investment into such technologies. When presented with the opportunity to redeploy capabilities that not only ensure statutory compliance but also present revenue generating possibilities, firms would be judicious to embrace activities that can improve their environmental performance. In other words, environmental performance would be jointly determined by the endowment of firm capabilities needed to respond to an environmental policy and the stringency of that policy.

Hypothesis 3: Ceteris paribus, the joint effect of the stringency of an environmental policy with firm competence at meeting the demands of that policy is positively related to changes in firm environmental performance.

4.3.4 Competitor's Policy Exposure

The statutory objectives that are created by a novel environmental policy in a specific jurisdiction generally apply to all firms that operate in that market. However, firms differ in both their relative competence to comply and the variation in policies that they must abide when operating across multiple jurisdictions. For instance, Avista Electric, a large U.S. IOU, operates in Idaho, Washington, and Montana and as of 2006 it was statutorily required to include renewable power as 15% of its fuel mix in the latter two states by a Renewable Portfolio Standard (RPS). This contrasts with the other major IOU in the state, Idaho Power, which had 99% of its sales in the state of Idaho and did not face the requirements of a RPS. Cross-jurisdictional differences in environmental policies can lead firms to make very different decisions on the environmental performance. King & Shaver (2001) highlight the complexities of operating across multiple jurisdictions and how this can create further challenges for environmental management. Such complexities can lead firms to re-consider the impact of how peer firms are regulated elsewhere. Therefore, I propose that there may be a 'peer effect' that induces firms to invest in environmental sustainable assets if their competitors are required to comply with increasingly stringent policy elsewhere.

The competitive dynamic that may ensue from a setting where firms vary in their regulated environmental requirements can play out in both the market and non-market arenas and influence a firm's environmental performance. In other words, there could be implications that result from the interaction between firms and also from the interaction between firms and regulators. As explained in the previous chapter, regulators have a vested interest in the competence of firms to comply with regulatory standards and this aptitude can be developed elsewhere if a firm faces related regulation in another jurisdiction.

First, competent firms, those endowed with the requisite capabilities, may profit as other firms in a common jurisdiction face more stringent policies elsewhere. Those burdened with more stringent regulation may choose to seek assistance in meeting such stringent environmental requirements. Profitable opportunities for other firms may present themselves in providing technical or operational direction, undertaking the required environmental actions for the competing firms, providing the environmental good through an arms-length transaction, or selling environmental credits to the other firm (i.e. carbon certificates in a cap and trade markets or Renewable Energy Certificates in the energy market).

Second, the variation of policies that firms encounter elsewhere can provide a strategic regulator in a focal jurisdiction with policy options. As motivated earlier, a regulator has an incentive to choose a policy that balances their mandate with out-of-compliance costs. Weighing between policies of varying strengths, the regulator may choose to not only map their policy to the competence of the firms but also to account for whether the firms have the requisite experience with similar policies in other jurisdictions. This reflects the case of Avista and Idaho Power highlighted above. Consequently, a firm that recognizes that a competitor may instigate the direction of an eventual policy can preempt this regulatory effort in the focal state to claim its own preferred position. This approach would be consistent with formal and anecdotal evidence that has been developed on this subject (Maxwell & Decker, 2004; Maxwell and Lyon, 2004). However, unlike the prior work that generally equates preemption with preventing legal binds, I contend that preemption may not simply displace more stringent policy types, but can also supplant weaker policy types as well. Therefore, firms that identify revenue generating opportunities from improved environmental performance and prefer stringent policy, to both legitimize and sustain this opportunity, would improve their environmental performance prior to policy adoption but following such policies being levied on competing firms in other jurisdictions. By expressing their eagerness for policy to a regulator, such a firm may be able to raise the intensity of an environmental policy to a point that may be well above the capacity of the other firms in the jurisdiction and in a manner that could substantially raise their competitors costs (Williamson, 1968; Salop and Scheffman, 1983; McWilliams, Van Fleet, and Cory, 2002).

As a result of both these market and non-market explanations I propose that,

Hypothesis 4: Ceteris paribus, the competitive pressure created by the stringency of environmental policy faced by a competing firm is positively related to changes in firm environmental performance.

In a similar argument to that which theoretically motivated the prior hypothesis, a regulator may also choose to harmonize their chosen policy with that of neighboring jurisdictions. Environmental concerns and natural resources may have important similarities within a particular geographic region. Similarly the network of policy makers within a region can help spread a policy across jurisdictions. This is the case for the Midwestern Governors Association that is "a nonprofit, nonpartisan organization that brings together the Midwestern governors of states to work cooperatively on public policy issues of significance to the region" (Midwestern Governors Association, 2009). This organization brings together state executives in the U.S. and Canada to discuss key policy issues.[30] Therefore, membership in such organizations or simply being connected territorially with another jurisdiction can lead to expansive policy making where an initiative catches on throughout a region.

[30] On environmental issues this group has played an important role in the U.S. by establishing regional working groups that have jointly developed initiatives on energy, GHG emissions, climate change, and transportation. However, it should be noted that agreement is not always unanimous among this group of states. In the case of the GHG Reduction Accord of 2007 half the member states chose not to get involved and did not sign the accord that recognized climate change and set GHG reduction targets, established a cap-and-trade system, and track emissions.

Firms that recognize the potential for a foreign policy from a jurisdiction where they do not operate to be introduced within their own market can, once again, undertake efforts to preempt the policy. This would not only allow them to be prepared for the introduction of this initiative but also allow them to offer a more stringent choice that may be preferable. By increasing their environmental performance in response to an outside policy, a focal firm can influence the regulator's calculus. As a result, I would expect that the policies adopted in contiguous jurisdictions to where a firm operates can initiate improved environmental performance by that focal firm.

Hypothesis 5: Ceteris paribus, the stringency of an environmental policy in a contiguous state that the firm does not operate within will be positively related to changes in firm environmental performance.

4.4 Methodology

4.4.1 Empirical Analysis

To test the hypotheses that I have proposed I examine the decisions of firms to change their environmental performance as a result of firm competence and regulatory stringency. Environmental performance can encapsulate many things. The U.N.'s Brundtland Report presents one of the most widely accepted definitions in stating that such efforts should "meet the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987)". The U.S.

EPA recognizes many categories of potential environmental improvements, including energy use, water use, discharges to water, air emissions, waste generation, conservation or preservation, and product performance (EPA, 2008). As a result, efforts to improve environmental performance can include, but are not limited to, reducing harmful emissions, improving waste management, and adopting technologies that improve the efficiency of inputs used. I require an industry where I am able to observe not only changes in environmental performance, but also variation in regulated policies and the competences of firms. This can be both within state, as in the case of differing state or provincial policies, and across countries, in a transnational context.

The empirical setting for my analysis is the U.S. electric utility sector. Within this industry, firms have taken different approaches to managing environmental performance on a number of dimensions and states have adopted policies of varying strengths to induce environmentally sustainable action. I focus on the decisions by Investor Owned Utilities to increase the proportion of renewable power that they include in the mix of power that they distribute to customers between 2001 and 2006. Renewable generating technologies include biomass, waste, geothermal, hydroelectric, solar, and wind. These sustainable approaches substitute for traditional energy generating technologies, such as fossil fuel combustion, that have a significant negative impact on the natural environment. The seven year panel covers the period in which the U.S. renewable energy sector has undergone its most significant growth and when new RPS policies were adopted by state level regulators and debated federally. Over this period renewable power increased by about 35%, yet this only comprises a small proportion of the overall portfolio of the American power production on an aggregate level. See Table 4.2 for a breakdown of renewable power over this period by generating technology and Figure 4.1 for a glimpse of renewable energy's role in the total energy supply in the U.S.

A number of prior studies have examined the development of the renewable energy sector. Delmas et al. (2007) analyzed the potential for market deregulation as an opportunity for product differentiation into renewable energy generation by IOUs. However, this analysis was conducted prior to the significant growth of the renewable sector and is limited by its focus on renewable generation by IOUs and not the broader renewable supply that can include both generation and purchases that are made by the IOUs. In fact, renewable purchases by IOUs from independent power producers comprise about 65% of the renewable power that is supplied to end users. Therefore, including this measure in an analysis of the renewable sector and environmental performance can be important. On this point, Russo (2001; 2003), and Sine, David & Mitsuhashi (2007) study the growth and development of the independent power producer industry through an institutional lens. Together this work highlights the growth of a nascent sector and the factors that led renewable energy projects to locate in particular regions. From more of a policy perspective, Holburn, Lui, & Mornad (2009) provide a thorough analysis of the renewable energy sector in Canadian province of Ontario. This work highlights how uncertainty, informal policy making, and bureaucratic turnover have prevented IPPs from investing in the province.

To develop a sample to test my hypotheses, I focus my analysis on the major IOUs in the U.S. These electric utilities both generate and/or purchase power that provides the country with about 85% of the total electricity. This is a stable industry with incumbent firms that, in many cases, date back to the historical roots of electrification of the country during the late 19th century. The sample consists of 127 IOU's that operate in United States. Almost 25% of the IOU's included in the sample operate across multiple states. Neither Alaska nor Nebraska have IOUs, but rather are serviced for electricity by public authorities and rural cooperatives. Further, I had to eliminate the IOUs in Texas as data on their mix of energy types was unavailable.

I utilized a series of databases, both private and publicly available, to construct the requisite variables. A primary source was a dataset provided by Platts, an electric industry consulting firm, which included firm generation statistics and the details of their purchase contracts with IPPs. The generating data could have been easily sourced from the Federal Energy Regulatory Commission's (FERC) or the Department of Energy's Environmental Information Administration, but due to inconsistencies in that data is was preferable to use the a pre-handled source for the information. Platts is a leader in this industry and has many IOUs, institutional investors, and banks as clients. Using the Platts data on contracted power arrangements I then coded the type of generating technology (i.e. wind, natural gas, biomass, etc.) that the IPP was using in its sale of power. Data on IPPs was gathered from the U.S. Environmental Information Administration, the FERC

Form 1 dataset, Utilipoint (another electric industry consulting firm), the database of Combined Heat and Power sources that is maintained by Energy and Environmental Analysis (another consulting company), the American Wind Energy Association, and when necessary queries with a internet search engine. Furthermore, access to SNL Financial's (the 2^{nd} largest private provider of industry-specific data) electric utility dataset was provided through the Office of the President at Xcel Energy that allowed me to access further firm specific variables that complemented the generating and purchases variables made available from Platts. Information on state level renewable energy policies was taken from the U.S. Department of Energy's office of Energy Efficiency and Renewable Energy. Other state variables were sourced from the Book of the States, the U.S. Bureau of Economic Analysis, the Sierra Club of America, and the Department of Energy.

4.4.2 Dependent Variable

My predictions are about a firm's environmental performance. Since I am examining the electric utility sector, a reasonable approach is to observe how IOUs differ in the choices that they make with respect to renewable power. Renewable technologies rely on fuel types that create little to no negative environmental externality in the generating process and can be constantly replenished. While renewably generated electricity could never act as an absolute substitute for the traditional forms of energy generation, it is projected that in the U.S. their use can increase to 638.67 billion KwH by 2030 or about 12% of total demand. While other more optimistic predictions expect renewable technology to make up 20% to 45% of energy demanded (Interlaboratory Working Group, 2000). As more power plants in the U.S. approach the end of their useful life and demand for electricity continues to grow, renewable options may be an attractive choice.[31] Furthermore, national and international policy agendas may catalyze renewable technology adoption as concern with the GHG emissions of fossil fuels escalates.

In the construction of the dependent variable I take an approach similar to Delmas et al. (2007), but rather than focus on the generation of renewable power by IOUs I examine the total renewable power that they distribute to the end consumer. This includes both renewable power generated and purchased. The aim of this comprehensive framework is to provide a more representative depiction of the renewable power sector in the U.S. than has been previously examined.[32] As a result, the dependent variable is the renewable power as a percentage of the IOUs total energy sold (PERCENT RENEWABLES). I calculate this measure for each year from 2000 to 2006. This extra year allows me to include a lagged measure in my model since changes in the proportion of renewable power sold will be highly determined by the renewable power provided in the prior year. This allows me to test my hypotheses as a dynamic model that takes further use of the panel design.

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[31] The EIA projects energy demand to increase by 320,000 MW and that 70,000 MW of current generating capacity will have to be replaced by 2020. In fact, a May 2001 statement by Vice President Dick Cheney identified how at that point the U.S. would need 1,300 new 300 MW power plants or the equivalent of more than one a week for the following 20 years.

[32] According to the Manager of Data Services at Platts, that consulting firm had abandoned a similar effort due to the time intensive requirements involved.

4.4.3 Independent Variables

In order to identify the effect of varying policy demands, I use information on the stringency of a RPS policy that an IOU must comply with (RPS POLICY). An RPS compels IOUs to include a specified percentage of renewable power in their mix of energy generation technologies. It is necessary to note that these policies are developed at the state level in the U.S. by the state Public Utility Commission in conjunction with policy makers. On a state by state basis these policies can vary significantly in the amount of renewable power that must be included in the mix of fuel types. This includes Arizona that has a policy at about 1.1% to Minnesota with 30%. Furthermore, as of 2006, 29 states didn't have a RPS policy at all so that the utilities in those states had no statutory requirement to include renewable power. Delmas et al. (2007) included an indicator variable for the presence of an RPS in a state, but found no significant relationship between it and changes in renewable power. However, this is understandable when you consider that only four states had adopted such a policy over the period that they studied. As I expect a more active response by firms that face more demanding RPS policies I operationalize this variable as a continuous measure so that I am able to identify those firms that face more demanding policies.[33] This variable takes on the percentage of renewable power of an RPS' final objective. Considering that a quarter of the firms in the sample operate across state borders, I weighted this variable by the

[33] Expectations of a non-linear effect in the first chapter led me to operationalize this variable using a trichotomous measure rather than the continuous measure that is used here. Using this trichotomous measure for the analysis in the current study did not quantitatively alter the results but would make interpretation more of a challenge. As a result, the results presented below are using the continuous measure of a RPS policy.

percentage of electricity sold within each state by the utility firm. Firms that face no policy are coded with a zero.

To capture the competence of firms in responding to an environmental policy, i.e. the RPS, I created a time-varying firm level measure that represents the operational expertise of a firm to manage a diverse fuel mix (FUEL DIVERSITY). This is similar to what was constructed in the last chapter but now at the firm level. This measure identifies the relative competence by which a firm would hold the requisite knowledge and technical capacity to manage a diverse portfolio of fuel types. The decision as to how to operationalize this construct was developed through a thorough review of trade publications and interviews with senior executives at electric utilities. As per hypothesis 2 I would expect that firms that have greater technical aptitude to manage a variety of technologies from their prior experience would have already developed the necessary organizational routines and practices to do so in the future. These firms would most likely adopt new technologies and increase their reliance on renewable technologies as market and non-market environments demand. The potential for a firm to respond actively to an RPS would likely be contingent on the operational aptitude and technological expertise that it has historically developed. Interviews with utility firm executives and regulators had identified experience managing a diverse portfolio of energy types as a key capability. Managing a diverse energy portfolio can include, but is not limited to, understanding technical aspects related to the varying sources of power, transmitting and distributing power of different voltage, an aptitude at siting of different types of power plants and transmission lines, scheduling intermittent power sources, creating back up sources when power plants are inactive, and developing arms-length contracting relationships with independent power producers. To operationalize this measure, I calculate the fuel diversity of a firm using a Hirschman-Herfindahl index (HHI).

The HHI is generally used for measuring market concentration within an industry, but if interpreted in the opposite direction it can also identify breadth of diversity. I begin by taking the percentage of power for each utility firm from coal, oil, natural gas, nuclear, hydro, wind, biomass, geothermal, waste, and solar sources. This data was obtained from Platts and supplemented with my own identification of the power procured from IPPs. I then use the HHI calculation, as depicted in equation 5, where 's_i' represents the percentage share of power type *i* and *n* is the number of power types used by a focal firm. [34] I then rescale this variable by dividing it by a thousand for ease of interpretation. Therefore, a firm with an HHI closer to 10 has operations that are concentrated in a single fuel type. As that figure decreases the fuel diversity managed by a firm and capability to manage a more diverse portfolio in the future increases. For instance, the utilities in Mississippi have historically relied almost exclusively on coal for their power and as a result the average HHI for the state has been close to 10. In contrast, the utilities in Maine have generally been able to manage a very diverse portfolio of fuel types and have an average HHI near 3. For ease of interpretation this variable is multiplied by negative one so that increases in the variable are interpreted as improved fuel diversity rather than further concentration.

[34] A normalized HHI would range from 0 to 1.

$$H = \sum_{i=1}^{n} s_i^2 \tag{5}$$

The competitors' exposure to an environmental policy can play a key role in a firm's decisions surrounding its own environmental performance. To capture this I include the average RPS objective faced by other utility firms that operate in the same state(s) as a focal firm. I examine (1) the average RPS exposure of all competing utilities and also (2) the average RPS exposure of competing utilities that actually face the demands of a RPS. I name them COMPETITOR RPS1 and COMPETITOR RPS2, respectively.

I proposed that the policy environment in bordering states can influence a firm's choice to modify its environmental performance. To measure this relationship I include a variable that identifies the stringency of the RPS policies in the states contiguous to where a focal utility firm operates. This variable is the average RPS objective of the contiguous states where a focal utility firm does not have any operations. For some multi-state utility firms this can be upwards of 12 states. For a further test of this relationship, I re-operationalize this variable as the average RPS objectives of only those states contiguous to the state where a focal utility firm has more than 50% of its retail sales. The logic here is that firms would be most sensitive to outside pressures when their key market is most impacted. I name the CONTIGUOUS RPS1 and CONTIGUOUS RPS2, respectively.

4.4.4 Control Variables

As many factors can determine a utility firm's choice to modify its environmental performance it is important to include a series of control variables that capture alternative explanations for changes in the use of renewable power.

First, I include a lagged measure (t-1) of the PERCENT RENEWABLES, the dependent variable. Prior investments in renewable energy can be an important driver of future dependence on such technologies. These prior choices may only be realized in future time periods when utility firms improve their productivity, embrace them with greater commitment, or complete multi-stage investment projects.[35]

The extant literature provides a number of other factors that can be important to include when examining energy production and renewable power generation more specifically. One argument is that residential customers tend to be more receptive to environmentally responsible products and in many cases are willing to pay a premium for such products (Delmas, Montes, & Shimshack, 2009). Alternatively, renewable power can be significantly more expensive that traditionally generated power and firms may avoid such choices if it means that they have to work through the regulatory process to have residential power prices increased. I include the RESIDENTIAL SALES, which is the percentage of a utility firm's sales that are made to residential customers as a percentage of the firm's total sales. I hesitate to make a prediction on how it would be

[35] Many renewable energy generating technologies involve multi-stage investments where a proportion of the generation will come online each year for two or three years. For instance, utility-scale wind farms generally have two or three stages that are completed over a period of time.

related to changes in a firm's use of renewable power. Industrial customers may be even more sensitive to increased energy prices from renewable power as energy is often one of the most intensively used inputs in the industrial production process. Therefore, I also include INDUSTRIAL SALES, the percentage of a utility firm's sales that are made to industrial customers as a percentage of the firm's total sales. In both cases this data comes from the EIA's Form 861 database. To further evaluate the industrial concern with higher priced power, I include the percentage of the state Gross State Product (GSP) that comes from the manufacturing sector weighted by the utility firm's state sales. The data for the MANUFACTURERS variable comes from the U.S. Bureau of Economic Analysis. I would expect both the industrial sales and Manufacturers variables to be negatively related to changes in renewable energy by a utility firm.

Firm size can be an important determinant the choices available to technology firms. I use the total sales in MegawattHours by a utility firm that comes from the EIA's form 861 database. This variable is named TOTAL SALES and I would expect it to be positively related to changes in renewable power.

Market deregulation in a state can create pressure on utility firms to differentiate their product, which can potentially result in increasing the market potential for renewable power (Delmas et al., 2007). While deregulation in the U.S. came to a halt shortly after its debut, 16 states have restructured some aspect (i.e. residential, commercial, industrial) of their retail market to a particular degree. Migration from incumbent producers has generally not exceeded the 5% threshold, with some exception most notably in Texas[36], but market choices can create demand for renewable power. I have included an indicator variable for whether a utility firm operates in a state that has undergone market deregulation. This variable is weighted based on the percentage of sales in each state. Prior theory and empirical analysis would lead me to expect this variable to be positively related to changes in renewable power. This variable came from the EIA's report on the overview of market deregulation and the variable is named DEREGULATION.

The information that is available concerning a utility firm's operations can both embolden opposing groups and also provide public relations opportunity for the firms. Information can be disseminated voluntarily by the firm or through mandated disclosure programs. Utility firms in the U.S. undertake both to varying degrees. The U.S. DOE's 1605b program allows firms to voluntarily report their GHG emissions. Participation is completely voluntary and there is no verification procedure. I identified utility firms that participated in the program with a "1" if they participated and "0" otherwise. The variable is named VOLUNTARY REPORTING and was obtained on annual basis from the DOE. Some states have adopted a mandatory disclosure policy that compels utility firms to reveal on an annual or quarterly basis the types of generating technologies that consist of their fuel mix. These come in the form similar to nutritional label that you would see on food products and are distributed in customer bills. This variable was

[36] This explains why Texas has been excluded from the sample, as the IOUs in that state are no longer required to report their purchases and alternative means to tracking fuel mix diversity were unavailable for the period of study.

named INVOLUNTARY REPORTING and was coded as a “1” in states where such disclosure was required and “0” if otherwise. It was then weighted by the percentage of sales in each state to capture the differential exposure for multi-state utility firms. The data was obtained from the DOE’s office of Energy Efficiency and Renewable Energy. Since disclosure can provide external stakeholders with information concerning the utility firms operations then I would expect both these variables to be positively related to changes in renewable power.

As the change in renewable energy is used as a measure for environmental performance it is important to be able to account for the negative environmental externalities that the electric utility industry produces. For this purpose I include the carbon dioxide emissions in metric tons per state capita. This measure is weighted by a utility firm’s state sales to account for multi-state utilities. The variable is named CO^2 and its source is the EIA. I would expect that firms in ‘dirtier’ states would feel greater pressure to change their operating practices and adopt renewable power. The presence of environmentalist groups in a state can also be an important factor that shapes firm behavior. I include the membership in the Sierra Club per state capita to try and evaluate the influence of the environmental lobby. This variable is then weighted by a utility’s state sales to capture the effect on multi-state utility firms. The Sierra Club is one of the most prominent environmental groups in the U.S. and has effectively worked with government, industry associations, and firms to improve private environmental performance.[37] This variable is named SIERRA CLUB and was sourced directly from their national headquarters. I would expect firms that operate in states with a more prominent environmental lobby would be more likely to increase their use of renewable power. I also used an indicator variable to capture whether a state had imposed a moratorium on new nuclear power plants. This can proxy for a state's concern with the choices that utility firms make in new generating plant construction. The variable NUCLEAR MORATORIUM was collected from Herbst and Hopley (2007) and was weighted by state sales. I would expect this variable to be positively related with changes in renewable generation.

The theoretical predictions that I make concerning firm behavior and environmental performance specifically are contingent on the interrelationship that exists between firms and regulatory (or policy makers). As a result, I include a number of institutional factors that are related to state specific policy making. I try to capture the political leaning of a state that a utility firm operates within by including an indicator variable that identifies if the state government is dominated by Democratic Party members. A state is coded as a 1 if the Democrats hold both a majority in the legislature and control the governor's office. This variable is weighted by a utility firm's state sales. Democrats are often characterized as placing greater concern to environmental matters and as a result I would expect the DEMOCRATS variable to be positively related to changes in renewable power by a utility firm. This variable came from election results

[37] I tried to gain access to the membership from other environmental groups but the data was either entirely absent, not at the state level, or unavailable for the 6 year period that I study.

that were available in The Council of State Governments annual publication, the Book of the States. I include the state budget in millions per capita to try and capture the richness of a state government. This variable named STATE BUDGET again came from the Book of the States and was weighted by a utility's state sales. More affluent states would probably be able to both afford to make more stringent renewable energy policy and pay the premium for such power. The state Public Utility Commission is responsible for much of the research and implementation of the RPS policies so I have included two variables that capture their preferences and competences. First, I have included the tenure of the PUC Commissioners. In another paper, I have shown that more tenured commissioners are more likely to adopt consumer friendly policies (Fremeth & Holburn, 2009). As a result, I include the average years of experience of the commissions that a utility firm must interact with. This PUC TENURE variable is weighted by utility firm sales and the data comes from Regulatory Research Associates, a private consulting arm of the data provider SNL Financial. Second, I used an indicator variable that identifies PUC's that are directly elected by the public. Research has identified that PUCs that are directly elected are more responsive to consumer interests (Zelner, 2001; Bonardi, Holburn, & Vanden Bergh, 2006) This variable is named ELECT PUC and is weighted by utility firm state sales. The source for this variable was the Book of the States. Table 3.3 lists the descriptive statistics and Table 3.4 provides the correlation matrix for these variables.

4.4.5 Estimation

My predictions pertaining to changes in a utility firm's amount of renewable power are tested using a dynamic panel estimator. I chose this approach because I have a panel with few years (6 years) but many firms (137 firms), predict linear relationships, have a dependent variable that is dependent on its own past realizations (i.e. current proportion of renewable power is contingent on past proportion of renewable power), include independent variables that are possibly correlated with past and current realizations of the error term (i.e. fuel mix diversity is predetermined and not strictly exogenous), require firm fixed effects, and are concerned with heteroscedasticity and autocorrelation in the panel. These econometric issues are addressed by using the Arellano-Bond (1991) general methods of moments (GMM) estimator. The equation that will be estimated is:

$$Y_{it}=\beta_1 Y_{it-1} + \beta_2 C_{it} + \beta_3 X_{it} + \mu_{it} \qquad (6)$$

$$\mu_{it} = v_{it} + e_{it} \qquad (7)$$

In this equation Y_{it} is the percentage of renewable power for firm i at time t and Y_{it-1} is a one year lagged value of this measure. C_{it} is the matrix of key independent variables, including Compliance Capability, RPS exposure, the interaction of Compliance Capability and RPS exposure, the competitor's RPS exposure and the contiguous RPS exposure for firm i at time t. X_{it} represents the control variables that are included in the model. μ_{it} consists of the unobserved firm-specific effects, v_{it}, and the observation specific error, e_{it}. Estimating this model presents particular econometric problems. First, the firm specific variables in C_{it} and X_{it} can be assumed to be endogenous. For instance, fuel mix diversity is likely to be correlated to the error term when predicting changes in renewable power for a utility firm. Second, firm specific effects, such as geographic location or managerial preferences, may be correlated with the explanatory variables. The fixed effects are contained in the error term in equation (1). Third, a lagged dependent variable, Y_{it-1}, can introduce issues with autocorrelation and its correlation to the fixed effects in the error would also create a concern with "dynamic panel bias". Further, the short time dimension (T=6) raises greater concern over the significant correlation of the lagged dependent variable with the error term. This would not necessarily be the case in a longer panel as the impact would dwindle over a longer period.

The Arellano-Bond difference GMM estimator corrects these concerns through a couple approaches. First, it first differences the equation so to purge the firm fixed effect and the resultant "dynamic panel bias". However, this transformation then makes the differenced lagged dependent variable endogenous to the differenced error term. The problem of endogenous variables also would remain and may now be further complicated as predetermined variables that are not strictly exogenous are now likely to be correlated with the differenced error term. To correct for the endogeneity the Arellano-Bond estimator uses an instrumental variable approach by using lagged measures of the endogenous variables as instruments (Holtz-Eakin, Newey, & Rosen, 1988). Roodman (2009) recommends putting every regressor in the instrument matrix in some form, either lagged or not. Like other instrumental variable approaches it is important to ensure the validity of the instrument set. In this case it would be to use the Sargan/Hansen test to examine whether the instruments as group are exogenous. If the instruments are endogenous and a significant result is found in the specification test then the moment conditions of the GMM estimator are not valid. A further assumption of this estimator is that lagged values of the dependent variable and the error term are uncorrelated. Therefore, it is necessary to examine for higher order autocorrelation (i.e. AR(2)). First order autocorrelation is expected and does not signify improper model specification. The results of both tests are reported with the results.

I use the XTABOND2 program in STATA to employ this approach. All firm-specific variables are entered as endogenous while the state-specific are entered as exogenous. The instruments used are the second lag of the endogenous variables and the own values for the exogenous variables. According Roodman (2009) this is the standard treatment for instrumental variables in the differences GMM approach. The number of instruments used is listed with the results. Year dummies are included to not only control for a temporal effect but also to ensure that there is no correlation across firms in the error term, which is necessary for the autocorrelation test (Roodman, 2009). Further, I focus on the results using the two-step robust estimator that corrects panel-specific autocorrelation and heteroscedasticity as developed by Windmeijer (2005). I do provide the result from the one-step approach in **Model 1** of Table 3.5 to highlight the robustness of the results to the less efficient approach.

4.5 Results

4.5.1 Interpretation of Main Effects

Tables 4.5, 4.6 and 4.7 present the results of the empirical analysis. All models include the fourteen control variables described above and the lagged dependent variable. I will begin with a discussion of the hypothesized relationships and then comment on the control variables.

Model 2 on Table 4.5 presents the difference GMM regression analysis with the two-step estimator that assesses changes in renewable power use by IOUs between 2001 and 2006. This model includes all the controls, the lagged dependent variable and RPS Policy, Fuel Diversity, and their interaction. First, I find that the lagged dependent variable is positive and significantly related to growth in renewable power in the current year. This result holds for all the models and lends support to the idea that current increases in renewable power are based past levels of renewable power. Therefore, if this dynamic process continues for the average utility firm, then my model predicts an increase to 10% renewable power in about a 16-year period. The positive and significant effect (1.648, $p<0.01$) on the RPS variable supports my prediction in hypothesis 1 that a more stringent public policy leads to increases in environmental performance. Similarly, a significant and positive effect is also found for the role of compliance specific capabilities (7.279, $p<0.01$), which is consistent with hypothesis 2. Therefore, firms that are more likely to be able to meet the demands of an RPS are actively redeploying their firm-specific attributes in a manner that improves their environmental performance.

However, as the coefficient on the interaction is significant and positive (0.178, $p<0.01$) as predicted by hypothesis 3, there is a moderating effect that the RPS policy is creating. The interpretation of these effects must account for the interdependence of the stringency of RPS policy and compliance specific capabilities on each other.

To correctly assess the estimates I examine the marginal effects using values of the variables from the data. Using the coefficients from **Model 2** in Table 4.5 I can determine that the marginal effect of an RPS policy on renewable power ranges from -0.13% when the compliance capability measure is at the minimum (i.e. least fuel diversity) to 1.06% when at its maximum. In fact, for the firm that is at a standard deviation above the average firm a unit increase in an RPS policy would lead them to increase its renewable power by 0.4% in that year. The contingent relationship has a similarly important role when looking at the marginal effect of the compliance capability measure. Increasing the compliance capability measure for a firm that faces an RPS policy of 15% is likely to increase its renewable power by about 9.9%. This increases to 12.6% for a firm facing a policy of 30%. Therefore, firms that are more likely to be able to meet the demands of an RPS are actively redeploying their firm-specific attributes in a manner that improves their environmental performance. The size of this result is greater than what I expected and possibly a result of the interdependent relationship that may drive a regulator to act strategically when setting policy.

The specification tests for the GMM estimator support the appropriateness of its use. The Sargan-Hansen test is not significant, which supports the exogeneity of the instruments. Further, the difference in Hansen tests of exogeneity, also referred to as the C statistic, was not significant. This compares full and restricted models to assess the orthogonality of the instruments. This not significant result further supports the instrumental variable approach adopted. Finally, the test for autocorrelation in the error structure is not significant for AR(1) and more importantly for AR(2), so I retain the null. Altogether, the results in table 5 lend support to the idea that firm efforts to improve environmental performance can not only result from the strength of public policy, but also a firm's differential ability to respond to such policy.

Table 4.6 and Table 4.7 introduces specifications that include the role of the RPS policies faced by (1) competing firms and (2) in states contiguous to where a utility firm operates. The effects described above are robust to the inclusion of these variables in **Models 3-8** and are reported in similar magnitudes. **Models 3 and 4** of Table 4.6 (includes all controls, lagged dependent variable, RPS POLICY, FUEL DIVERSITY, their interaction and measures for competitor RPS exposure) identify the positive and significant coefficients on the COMPETITOR RPS1 (0.219, $p<0.01$) and COMPETITOR RPS2 (0.140, $p<0.01$) that support my prediction in hypothesis 4. The more stringent the policies that are faced by other utility firms that operate in the same U.S. state leads to an increase in the amount of renewable power used by a focal firm. In **Model 5 and 6** of table 4.6 (includes all controls, lagged dependent variable, RPS POLICY, FUEL

DIVERSITY, their interaction and measures for contiguous state RPS exposure) I do not find support for hypothesis 5 as neither the CONTIGUOUS RPS1 nor CONTIGUOUS RPS2 variables are statistically significant. However, when I include both the COMPETITOR RPS1 variable with the CONTIGUOUS RPS1 or CONTIGUOUS RPS2 in the same specification in **Models 7 and 8** of Table 4.7, the effect persists on the Competitor variables but now the Contiguous variables are negative and significant (-0.054, $p<0.05$; -0.049, $p<0.05$). This result is opposite of what I had predicted since I expected there to be a positive peer effect that would cross state borders, which could act as a substitute to the competitors' exposure.

The negative effect would mean that as bordering states adopt an RPS policy firms actually reduce the amount of renewable energy they use, after holding the competitors' policy exposure constant. The change in statistical significance is interesting, since when entered on its own the contiguous states' policy plays no role but after controlling for the influence of competitors exposure to policy it now has this dampening effect on renewable energy use. The competitors' RPS policy and contiguous states' RPS policy variables are correlated at about .40, so leaving either variable outside the model can lead to an omitted variable bias. One possible explanation for the negative coefficient is that as neighboring states adopt an environmental policy firms may anticipate changes in their own states and reduce the renewable energy they use with the knowledge that they can easily increase it in the future when needed. It is technically feasible for utility firms to switch between different power technologies as they shift their purchases between different suppliers or reduce reliance on their hydro or biomass plants. This anticipatory approach would better position a firm to be in compliance in the future. As a result, there seems to be a peer effect but not as I had previously expected. This contrasts with the role played by competitor's exposure to an RPS policy which has a positive impact on a focal utility firm's environmental performance and would have a more direct impact on a regulator's future actions in that common jurisdiction.

A possible alternative explanation may be that the sources for renewable energy are scarce. As states contiguous to a firm adopt an RPS the focal utility firm may face growing demand for either the renewable power that it generates or the renewable power it sources from independent power producers. This may lead that utility firm to reduce it use of renewable power voluntarily as it sells it to IOUs in those neighboring states or involuntarily as the firm gets bid out of another producer's available supply. In either case the firm would reduce the proportion that renewable power makes up of its total energy mix.

As in the prior models, the necessary specification tests support the validity of the instruments (Sargan-Hansen test and C statistic) and the lack of autocorrelation in the errors for both AR(1) and AR(2).

4.5.2 Interpretation of Control Variables

A number of the control variables have statistically significant results that are worth noting. The proportion of utility firms' sales to residential customers was negative and significant. Therefore, firms that have greater ties to residential customers use less renewable power, which tends to be more expensive on a Kilowatt Hour basis. Surprisingly, however, neither the industrial sales variable nor the Manufacturers' share of GSP was significant. Larger utility firms were also correlated with lesser renewable energy. While the resources available to larger firms may provide them with a greater potential to explore the use of alternative energy forms, they are also tied to the larger base load plants (i.e. nuclear and coal) that could make it less necessary to do so. Consistent with the findings of Delmas et al. (2007), I find that deregulation is positive and significantly related to use of renewable power. In fact, IOUs that operate in deregulated states tend to use approximately 5% more renewable power. Interestingly, the economic significance that I identify is almost identical to that found by Delmas et al. (2007) for a slightly earlier time period. Finally, I find that utility firms that operate in states with greater membership in the Sierra Club are likely to increase the use of renewable power. Year dummies were also included in all the models, although not reported in the tables, and I do identify a positive and significant effect at the 1% level for the year 2005.

4.6 Discussion and Conclusion

Prior research on organizations and the natural environment has recognized that regulatory policy is an important driver of corporate environmental performance. The relative competence of firms to meet such policy has generally been overlooked. I argue that firm response to a policy may not merely be an effort to comply with a standard, but an opportunity to gainfully redeploy capabilities and preempt future policy types. The way that firms differ in their propensity to comply can not only shape their actions but the actions of the regulators that determine the policy. This can provide firms with an advantage over others in the regulated jurisdiction. The empirical relationships that I identify here are consistent with this argument since I find that increases in renewable power is not solely related to regulatory policy that compels such action, but is contingent on the firm aptitude at being able to comply. The contingent nature of these compliance-specific capabilities provides an alternative explanation for why firms would choose to improve their environmental performance. Stringent regulatory policies that compel environmental action can be differentially seized upon by firms seeking to redeploy the requisite but heterogeneously endowed technical or operational competences to take advantage of profitable opportunities. As firm-specific explanations for corporate environmentalism have tended to overlook the role of public policy the findings that I present here begin to identify how firm strategy and public policy can jointly determine environmental performance. This has implications for both firm strategy and public policy.

I find that firms in the U.S. electric utility industry increase their use of renewable power not only when they are statutorily required to do so but also when it is consistent with their technical and operational capabilities. In addition, as the stringency of a renewable portfolio standard increases, the more competent a firm is at managing a wide variety of energy types escalates the likelihood that it will increase the amount of renewable power that it uses. This result brings together the economic work on environmental policy design that often does not distinguish firms from the broader industry with that of strategic management that is focused on how firms differ.

In theory, the success of a regulatory policy, statutorily or voluntarily determined, will not depend solely on the tenets of the policy or the enforcement mechanism that is provided but also the competence of firms to meet the policy. This is at the center of the problem of how governments are able to pick "winners and losers" when developing public policy. Those firms that are competent and have the requisite capabilities that can be redeployed in a profitable manner are likely to succeed while those firms that do not have such capabilities, yet must meet the same standard, will languish. Firms that would unduly suffer under a policy can create cost concerns for regulators, which may ease the demands of the policy. This latter point is particularly relevant to policies that vary by jurisdiction, as in the case of the RPS in the energy industry.

When both the policy can vary on a state-by-state basis and the competence of the firms vary within a state, the resultant action that firms undertake will embody elements of both market and non-market competition. As I demonstrated, firms that share a jurisdiction with other firms that face more stringent standards elsewhere are likely to increase their renewable power beyond the impact of their own statutory requirements. This result identifies that firms incorporate information regarding the broader regulatory environment and specifically the demands placed upon competitors. It may also indicate how firms can try to preempt future changes to policy that can be induced directly by other firms in the same jurisdiction. This has important implications to the research in non-market strategy that examines how firms shape their policy environment. The unexpected result for the role of a policy in a contiguous state suggests a distinct mechanism for the anticipation of jurisdictional harmonization and environmental performance. Examining another empirical setting, perhaps between multiple countries, may provide for an interesting avenue to examine this issue further.

The theoretical predictions and empirical support that I develop in this chapter identifies the next stage of the interdependent relationship that exists between firms and regulators. Not only can firms influence the stringency of an environmental policy by their relative ability to comply, but these competences are in fact used once a policy has been enacted. Furthermore, firms are not only aware of the policies that they are currently straddled with, but also of the policies that can potentially arise in the future. Firm strategies to anticipate future environmental regulation is a rather salient concern as the debate over a national and possibly global carbon policy is looming. For instance, the Kyoto Protocol was initially signed in 1997 and the choices that firms have made to improve their compliance specific capabilities over this span will be an important indicator of future environmental performance.

CHAPTER 5.

5.1 Conclusion

This dissertation has argued that the (1) stringency of environmental policy and (2) environmental performance by firms – specifically increased use of renewable power – are the result of the interdependence of firm capabilities and a regulator's incentive to mitigate out-of-compliance costs. Evidence from the U.S. electric utility sector supports this argument. Regulated jurisdictions, populated with firms that have the requisite compliance-specific capabilities and/or market strength that would reduce a regulator's out-of-compliance costs, are more likely to face environmental policies that place greater demands on them relative to the policies set in other jurisdictions. Therefore, the policies that are set by regulators may not be seen as stringent for the firms involved, rather they would be seen as such when compared to similar policies set elsewhere. Firms that can gainfully redeploy the necessary capabilities to adopt more renewable power in their mix of energy types are more likely to do so when this more demanding policy has been levied on them.

Underlying both elements of this dissertation is not just this interrelationship between firms and regulators but how such relationship is nested within the competitive environment between firms within a state or with those in neighboring states. In the first analysis this dynamic played out to explain how the dominant firm, either leading or lagging in a particular capability, was able to have discretion over the stringency of the

RPS policy that is adopted. Novel in this finding is how elements of a particular firm's strategy through its technology choices is able to influence policy making decisions. This passive mechanism that a firm is able to use to improve its competitive positioning is quite different from the much more explicit approaches to influencing policy that have been considered in the past. Similarly, in the second analysis there is again a very important role for firm strategy as firms alter their use of renewable power based on the policy constraints that are faced by others, either in their own state or in neighboring states. The posturing among firms is due to number of reasons. First, there is a limited supply of locally generated renewable power and as more firms are subject to RPS policies the demand for this power will only increase. This can compel some firms to both increase their use of renewable power but also decrease their own use of this power as they now have a new market to sell such electricity to instead of using it themselves. Second, firms may see policies elsewhere as a sign for times to come in their own state. An interview with one senior utility executive exemplified this fact as he claimed that the states surrounding his own state had a history of following his state's regulation and that they can expect policy to be soon adopted in these bordering states. The "bleeding" of both policies and firm strategies across state borders induces external pressures on firms to respond. An important implication of this is that firms will need to recognize that a shifting regulatory environment may be externally induced. Furthermore, that there are limitations to sub-national policy and as policy spreads across a country firms must anticipate forthcoming national or even international policy. Capabilities developed to deal with a sub-national policy can be leveraged by regulatory bodies in higher forums.

For research, this dissertation provides some important implications. I identify a regulator or public policy making body as a strategic actor that takes account of the heterogeneity in firm capabilities. Viewing the regulator as acting strategically is not novel, but the role played by internal firm characteristics and their ability to reduce the regulators costs, under certain circumstance, offers a new perspective on the issue. This mechanism provides a link between market and non-market issues and more accurately depicts the regulator as having interests that can be in-line with the regulated firms. Therefore, the general assumption that increasingly stringent regulatory policy is hostile to firm interests must be reconsidered. Stringent policy can help set and legitimize internal objectives that are not only achievable, but can be rewarding to both the natural environment and firm performance.

The idea of a compliance-specific capability could be further developed to better understand where such capabilities come from. While beyond the purview of this dissertation, it is interesting to understand what would drive a firm to have historically developed an aptitude at managing a diverse mix of energy types. Linking this concept to the research on industry architecture that has examined industry disintegration may provide a route to understand the origin of compliance-specific capabilities.

The question of whether or not a particular investment “pays”, green or otherwise, remains a key research question. While my dissertation did not address this issue it does present some interesting implications for this line of research. In particular, the longitudinal nature of my study and its focus on the heterogeneous characteristics of firms highlight that it may pay for some firms to invest in green resources at some times. But that this may not be true in all cases for all firms given their competitive and policy environment. Furthermore, a choice by a firm to voluntarily develop a particular competence may be leveraged in the future by a regulator acting strategically to take advantage of the firms that they oversee. As a result, what may pay today may not pay tomorrow and future research that examines this question should examine these temporal elements as they relate to the constraints of varying policy regimes.

Furthermore, future research in management and corporate environmentalism must rethink what is exogenous and endogenous. Firms do not just take policy but shape policy and this latter process does not only come from heavy-handed lobbying and private politics but the inherent motivations that underlie the actions of key non-firm actors. In the case of corporate environmentalism these non-firm actors are essential as management of public goods introduces various governmental and nongovernmental actors to the competitive landscape. The actions of these players, or lack thereof, are not accidental nor can they be considered unidirectional. Future research should try to better understand the motivations and decision making processes of these players and how they influence firm decision making.

For managers the implications of this research is that they must plan for how a regulator may leverage their capabilities or the capabilities of other firms in a common jurisdiction. As firm capabilities can provide options for a regulator acting strategically then managers must be prepared for the statutorily defined objectives that result. However, a decision to invest or develop a capability can have ramifications in the different jurisdictions that the firm operates within. Additionally, the shifting regulatory environment may depend on your own actions or also the actions of your competitors. Recognizing how closely aligned your competitors are with the regulators incentive structure may be a worthwhile activity as it may predict the onset of future regulatory policy. However, if a regulator has no motivation to act strategically then such concerns are moot. Therefore, understanding the individual motivation for leadership at the policy making body can help determine whether a firm is likely to face increasingly stringent policy in the future.

The implications for policymakers are that understanding the internal competences of the firms that are overseen can be a very important activity as capabilities are heterogeneously distributed and can be an important determinant of the success of a policy. Leveraging these competences through more stringent policy leads to improved environmental performance by regulated firms. Therefore, collecting information on not just what firms are doing but what they are likely capable of can be a useful activity. This may also involve spending resources on trying to understand how firms are regulated in other jurisdictions and whether this may help or hinder how a particular policy may be received in a focal jurisdiction. Furthermore, policymakers have an important role to play in providing the necessary leadership and stability in the implementation stage of a policy. Firm competence and desire to redeploy compliance-specific capabilities can be wasted if uncertainty or obstacles remain. Enthusing confidence among all parties, firm and non-firm, and being seen as a source of direction is key to realizing the greatest environmental benefit among the firms in a regulated jurisdiction.

CHAPTER 6.

6.1 References

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TABLES AND FIGURES

Table 3.1: Summary Statistics

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
RPS Policy	0.060	0.314	0	2
Fuel Diversity	8831.425	1367.805	3685.297	10000
Dominant & Leading Fuel Diversity	0.119	0.324	0	1
Dominant & Lagging Fuel Diversity	0.03	0.183	0	1
Bond Rating	15.924	1.716	10.2	19.6
Dominant & Leading Bond Rating	0.083	0.275	0	1
Dominant & Lagging Bond Rating	0.090	0.286	0	1
Percent Renewable $_{t-1}$	8.559	12.259	0	70.497
Sierra Club	0.002	0.003	0.00003	0.02730
Coal Employees	0.0007	0.0021	0	0.0157
State Budget	0.0017	0.0025	0.000071	0.0216
PUC Employees	0.00004	0.00005	0.000003	0.0004
State EPA Budget	0.0355	0.0367	0.0031	0.1861
Federal EPA Disbursements	0.027	0.048	0.001	0.529
CO^2	13.564	18.561	0.014	115.157
Average Retail Price	0.068	0.019	0.033	0.144
Manufacturers	0.006	0.011	0.0001	0.105
Governor Tenure	3.353	2.839	0	16
Legislature Rivalry	0.743	0.196	0.184	1
Transmission Planning	0.265	0.441	0	1
Year Counter	6.748	4.423	1	15
Years since last review	6.231	3.853	0	24

Table 3.2: Correlation Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1 RPS Policy																					
2 Fuel Diversity	-0.06																				
3 Dominant & Leading Fuel Diversity	0.06	-0.33																			
4 Dominant & Lagging Fuel Diversity	0.04	0.16	-0.07																		
5 Bond Rating	-0.16	0.09	-0.08	0.14																	
6 Dominant & Leading Bond Rating	-0.02	0.04	0.18	0.33	0.17																
7 Dominant & Lagging Bond Rating	0.12	-0.14	0.48	-0.03	-0.19	-0.09															
8 Percent Renewable (t-1)	0.06	-0.65	0.31	-0.13	-0.08	-0.04	0.13														
9 Sierra Club	0.07	-0.15	-0.08	-0.01	-0.05	-0.07	-0.01	0.12													
10 Coal Employees	-0.06	0.12	0.09	-0.06	-0.05	-0.03	-0.05	-0.11	-0.12												
11 State Budget	0.01	0.06	-0.08	0.03	-0.01	-0.01	-0.03	-0.08	0.81	-0.05											
12 PUC Employees	-0.02	0.10	-0.11	-0.03	-0.02	-0.09	-0.04	-0.09	0.68	0.14	0.67										
13 State EPA Budget	0.02	-0.21	0.11	0.30	-0.10	0.05	0.03	0.19	0.29	0.26	0.30	0.22									
14 Federal EPA Disbursements	0.01	0.02	-0.07	0.02	0.00	-0.01	-0.05	-0.03	0.85	0.00	0.82	0.65	0.39								
15 CO^2	-0.07	0.15	0.10	-0.09	0.00	-0.04	-0.08	-0.15	0.39	0.59	0.45	0.38	0.56	0.59							
16 Average Retail Price	0.06	0.08	0.02	0.15	-0.08	0.19	0.13	-0.12	0.03	-0.20	0.07	0.01	-0.02	0.02	-0.14						
17 Manufacturers	-0.02	0.09	-0.08	-0.03	0.05	-0.04	-0.07	-0.10	0.84	-0.08	0.79	0.60	0.25	0.91	0.55	-0.02					
18 Governor Tenure	-0.03	-0.05	-0.08	-0.02	0.10	-0.08	-0.08	0.04	0.04	-0.06	0.06	0.02	0.08	0.06	-0.01	-0.06	0.03				
19 Legislature Rivalry	0.06	-0.07	-0.16	-0.19	-0.04	-0.17	-0.02	0.06	0.16	-0.22	0.08	0.03	-0.21	0.07	-0.07	-0.21	0.16	0.00			
20 Transmission Planning	0.12	0.20	-0.06	0.17	-0.34	0.03	-0.01	-0.19	-0.10	-0.02	-0.04	0.04	0.00	-0.02	-0.06	0.10	-0.07	-0.02	0.02		
21 Year Counter	0.21	0.05	-0.07	0.02	-0.40	0.19	-0.09	-0.08	0.03	0.03	0.08	-0.07	0.17	0.10	0.12	0.04	0.06	0.00	0.07	0.50	
22 Years since last review	0.05	0.06	0.08	-0.04	-0.02	0.22	-0.02	-0.07	-0.05	-0.05	0.04	-0.12	0.06	0.04	0.08	0.14	0.09	-0.05	0.00	0.11	0.44

Table 3.3: Multinomial Logit Results for Main Effects

	Model 1		Model 2		Model 3	
	Weak Policy	Strong Policy	Weak Policy	Strong Policy	Weak Policy	Strong Policy
Fuel Diversity (HHI)			**-0.001 (0.019)**	**0.002** (.001)**		
Bond Rating					**-0.398** (.155)**	**-0.422 (.292)**
Percent $Renewable_{t-1}$	-0.171** (.051)	.070** (.031)	-0.213 (.191)	0.236*** (0.085)	-0.203*** (.052)	0.062** (.029)
Sierra Club	344.728 (227.836)	578.839** (243.918)	329.806 (274.512)	872.291*** (267.769)	277.621 (219.720)	589.930** (230.699)
Coal Employees	-959.083 (1167.123)	-889.413 (2376.867)	-897.735 (1185.171)	-519.014 (1167.934)	-2307.635* (1302.535)	-751.062 (2393.622)
State Budget	-79.087 (191.864)	313.416** (123.868)	-81.669 (180.435)	391.142** (173.941)	-129.604 (173.974)	376.556** (150.376)
PUC Employees	-17106.140 (10574.690)	-11112.950 (13374.470)	-16631.13* (9969.652)	-8188.576 (15061.76)	-17812.770 (12186.120)	-13128.480 (14344.270)
State EPA Budget	11.271 (13.094)	-13.126 (14.228)	11.372 (13.058)	-9.534 (10.581)	9.758 (13.878)	-9/851 (14.446)
Federal EPA Disbursements	-3.281 (35.117)	-3.035 (40.852)	-3.161 (35.227)	-22.774 (37.471)	8.264 (37.635)	-16.829 (46.924)
CO^2	-0.224* (.121)	.001 (.085)	-0.221* (.117)	-0.001 (.063)	-0.271* (.139)	-0.007 (.091)
Average Retail Price	22.574 (15.014)	18.376 (11.447)	22.252 (14.873)	14.014 (10.140)	17.515 (12.994)	15.217 (10.816)
Manufacturers	191.798 (123.079)	-789.646*** (262.784)	191.788 (123.828)	-755.571*** (200.505)	217.877* (128.105)	-777.565*** (240.075)
Governor Tenure	0.234** (.106)	-.301* (.177)	0.235** (.106)	-0.341* (.181)	0.277** (.129)	-0.296 (.195)
Legislature Rivalry	5.189* (3.125)	0.749 (3.006)	5.054 (3.250)	0.919 (2.451)	5.558 (3.594)	0.127 (3.107)
Transmission Planning	-0.163 (0.981)	1.668* (0.948)	-0.203 (1.037)	1.571** (.786)	-0.318 (.937)	1.522 (.999)
Years since last review	-.252 (.076)	0.068 (.091)	-0.247*** (.076)	0.041 (.090)	-0.235** (.093)	0.104 (.106)
Year Count	-0.291*** (.109)	0.603*** (.112)	0.291** (.112)	0.695*** (.158)	0.226** (.106)	0.621*** (.155)
Constant	-10.092** (4.236)	-11.216 (2.629)	-7.094 (15.649)	-30.307*** (10.133)	-3.019 (5.485)	-4.547 (3.869)
McFadden's Pseudo R^2	0.38		0.40		0.41	
Observations	664		664		664	

*p<0.10; **p<0.05; ***p<0.01 (Two-tailed tests)
Standard Errors in parentheses are clustered by States.

Table 3.4: Multinomial Logit Results including the Leading Firm Variable

	Model 4		Model 5	
	Weak Policy	Strong Policy	Weak Policy	Strong Policy
Fuel Diversity (HHI)	**-0.001 (0.001)**	**0.003*** (0.001)**		
Bond Rating			**-0.329** (0.155)**	**-0.440 (0.276)**
Dominant Leader Dummy	**1.409 (1.315)**	**2.896** (1.253)**	**-35.837*** (1.114)**	**0.561 (1.669)**
Percent $Renewable_{t-1}$	-0.186 (0.173)	0.258*** (0.084)	-0.215*** (0.058)	0.063** (0.029)
Sierra Club membership	366.828 (285.461)	1,156.345*** (277.927)	275.125 (220.672)	617.131** (265.039)
Coal Employees	-933.359 (1,169.035)	-1,133.762 (2,876.013)	-1,949.410 (1,264.284)	-1,100.819 (3,335.917)
State Budget	-105.994 (156.965)	483.654*** (175.599)	-98.186 (183.306)	378.806** (157.934)
PUC Employees	-16,564.776 (10,557.575)	-7,660.351 (19,381.518)	-19,983.720 (13,631.061)	-12,066.203 (14,692.002)
State EPA Budget	11.333 (13.555)	-15.099 (13.248)	11.980 (12.619)	-10.411 (14.971)
Federal EPA Disbursements	-0.526 (35.683)	-6.060 (59.900)	9.670 (33.689)	-15.469 (52.842)
CO^2	-0.207 (0.126)	0.003 (0.101)	-0.292* (0.160)	0.003 (0.109)
Average Retail Price	21.578 (14.807)	20.896 (14.368)	16.876 (13.427)	15.373 (10.645)
Manufacturers	161.689 (117.200)	-571.720*** (184.359)	234.728 (152.516)	-823.461*** (300.305)
Governor Tenure	0.259** (0.126)	-0.278 (0.205)	0.262** (0.127)	-0.288 (0.197)
Legislature Rivalry	5.325 (3.594)	2.429 (3.146)	4.837 (4.401)	0.376 (2.807)
Transmission Planning	-0.238 (1.032)	1.026 (0.889)	-0.365 (1.005)	1.557 (1.032)
Years since last review	0.305*** (0.113)	0.670*** (0.143)	0.251** (0.118)	0.632*** (0.160)
Year	-0.243*** (0.073)	0.005 (0.073)	-0.249** (0.111)	0.110 (0.106)
Constant	-10.422 (15.796)	-40.199*** (10.145)	-3.371 (5.544)	-4.734 (3.931)
McFadden's Pseudo R^2	0.42		0.41	
Observations	664		664	

*p<0.10; **p<0.05; ***p<0.01 (Two-tailed tests)
Standard Errors in parentheses are clustered by States.

Table 3.5: Multinomial Logit Results including the Dominant & Leading Firm Interactions

	Model 6		Model 7	
	Weak Policy	Strong Policy	Weak Policy	Strong Policy
Fuel Diversity (HHI)	**-0.001 (0.001)**	**0.003** (0.001)**		
Bond Rating			**-0.333** (0.157)**	**-0.540* (0.295)**
Dominant Leader Dummy	**22.037** (9.290)**	**18.316*** (6.598)**	**-31.546** (12.395)**	**-46.411*** (13.262)**
Fuel Diversity X Dominant Leader	**-0.003** (0.001)**	**-0.002** (0.001)**		
Bond Rating X Dominant Leader			**-0.077 (0.780)**	**2.886*** (0.792)**
Percent $Renewable_{t-1}$	-0.288 (0.263)	0.172 (0.105)	-0.217*** (0.058)	0.075** (0.032)
Sierra Club	495.032 (339.166)	1,582.536*** (486.952)	277.881 (221.094)	660.608*** (254.829)
Coal Employees	-1,481.754 (1,111.532)	-785.991 (3,714.600)	-1,949.341 (1,268.641)	-575.388 (1,219.499)
State Budget	-162.065 (171.764)	745.897** (319.047)	-99.229 (184.449)	444.240*** (159.532)
PUC Employees	-21,933.024 (13,999.732)	7,907.461 (22,531.312)	-20,141.479 (13,680.138)	-13,084.616 (13,005.155)
State EPA Budget	11.678 (14.321)	-10.646 (14.643)	11.853 (12.661)	-13.639 (14.558)
Federal EPA Disbursements	2.692 (42.129)	-23.698 (76.526)	9.857 (33.829)	-27.080 (34.594)
CO^2	-0.257** (0.130)	-0.094 (0.143)	-0.294* (0.162)	0.001 (0.071)
Average Retail Price	17.044 (13.918)	-7.620 (18.453)	16.431 (13.335)	9.258 (11.306)
Manufacturers	182.269 (122.502)	-843.051*** (227.094)	235.696 (153.040)	-922.043*** (268.039)
Governor Tenure	0.244* (0.127)	-0.249 (0.209)	0.262** (0.128)	-0.306 (0.197)
Legislature Rivalry	5.927 (3.720)	2.895 (2.741)	4.846 (4.419)	0.068 (2.046)
Transmission Planning	-0.293 (1.088)	0.803 (1.115)	-0.365 (1.007)	1.849* (0.956)
Years since last review	0.324** (0.126)	0.865*** (0.289)	0.252** (0.118)	0.719*** (0.199)
Year	-0.267*** (0.078)	0.050 (0.076)	-0.251** (0.112)	0.085 (0.103)
Constant	-7.222 (19.676)	-41.288*** (-3.371)	-3.273 (5.571)	-3.276 (3.904)
McFadden's Pseudo R^2	0.44		0.43	
Observations	664		664	

*p<0.10; **p<0.05; ***p<0.01 (Two-tailed tests)
Standard Errors in parentheses are clustered by States.

Table 3.6: Multinomial Logit Results including the Dominant & Lagging Firm Interactions

	Model 8		Model 9	
	Weak Policy	Strong Policy	Weak Policy	Strong Policy
Fuel Diversity (HHI)	**1.043*** (0.001)**	**0.168*** (0.001)**		
Bond Rating			**-0.293 (0.598)**	**0.032 (1.343)**
Dominant Laggard Dummy	**-0.001 (0.002)**	**0.002* (0.001)**	**-0.368** (0.169)**	**-0.457 (0.377)**
Fuel Diversity X Dominant Laggard	**-5.485 (9.316)**	**-9.193 (16.448)**		
Bond Rating X Dominant Laggard			**4.518 (8.403)**	**1.865 (19.319)**
Percent Renewable$_{t-1}$	-0.216 (0.195)	0.239*** (0.092)	-0.209*** (0.054)	0.063* (0.038)
Sierra Club	314.111 (279.463)	938.093*** (300.634)	292.380 (225.807)	717.419** (306.379)
Coal Employees	-762.844 (1,208.214)	-470.262 (581.800)	-2,341.204* (1,330.729)	-2,299.645 (4,508.859)
State Budget	-95.078 (167.688)	352.638** (159.486)	-156.010 (178.502)	480.556** (217.523)
PUC Employees	-15,810.010 (10,659.415)	-8,395.083 (14,023.974)	-17,314.641 (12,898.240)	-19,072.006 (24,644.574)
State EPA Budget	9.097 (11.494)	-21.765* (12.968)	9.757 (14.163)	-14.328 (17.123)
Federal EPA Disbursements	-5.381 (36.422)	-26.002 (34.129)	9.271 (37.790)	-5.839 (73.536)
CO^2	-0.223* (0.116)	0.034 (0.052)	-0.269* (0.144)	0.025 (0.134)
Average Retail Price	22.888 (14.907)	16.074 (10.183)	14.497 (13.496)	6.982 (17.759)
Manufacturers	210.023* (126.643)	-891.239*** (221.303)	208.639 (128.194)	-699.128** (284.905)
Governor Tenure	0.231** (0.108)	-0.336* (0.183)	0.276** (0.132)	-0.303 (0.275)
Legislature Rivalry	4.849 (3.363)	1.653 (1.931)	5.419 (3.614)	-1.168 (3.911)
Transmission Planning	-0.304 (1.124)	1.812** (0.832)	-0.365 (0.971)	1.307 (1.216)
Years since last review	0.297** (0.123)	0.732*** (0.166)	0.242** (0.118)	0.713*** (0.232)
Year	-0.261*** (0.077)	0.026 (0.099)	-0.237*** (0.092)	0.122 (0.116)
Constant	-6.035 (16.132)	-29.837*** (11.411)	-3.2468 (5.749)	-5.0159 (4.448)
McFadden's Pseudo R^2	0.41		0.43	
Observations	664		664	

*p<0.10; **p<0.05; ***p<0.01 (Two-tailed tests)
Standard Errors in parentheses are clustered by States.

Table 4.1: Dow Chemical Major Production Sites

Location	Distribution of Plants
United States	42 plants in 16 states
Canada	6 plants in 3 provinces
Europe	48 plants in 16 countries
Latin America	26 plants in 5 countries
Asia Pacific	23 plants in 8 countries
India, Middle East, and Africa	5 plants in 4 countries

Source: Dow Chemical 10-K, 2008

Table 4.2: Breakdown of Renewable Energy Generation in U.S. (Thousand MegawattHours)

	2001	2002	2003	2004	2005	2006
Waste	14,548	15,044	15,812	15,421	15,420	16,099
Biomass	35,200	38,665	37,529	38,117	38,856	38,762
Geothermal	13,741	14,491	14,424	14,811	14,692	14,568
Hydro	216,961	264,329	275,806	268,417	270,321	289,246
Solar	543	555	534	575	550	508
Wind	6,737	10,354	11,187	14,144	17,811	26,589
Total	**287,730**	**343,438**	**355,292**	**351,485**	**357,650**	**385,772**

Source: EIA, 2008

Table 4.3: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Percent Renewable$_t$	6.44	11.43	0	72.00
Percent Renewable$_{t-1}$	6.06	11.26	0	72.00
RPS Policy	4.78	8.15	0	30
Fuel Diversity	-9.02	-1.48	-3.95	-10.00
Competitor RPS1	4.62	7.48	0	30
Competitor RPS2	5.52	7.56	0	30
Contiguous RPS1	3.27	4.66	0	21
Contiguous RPS2	3.32	4.81	0	21
Residential Sales	0.34	0.08	0.01	0.54
Industrial Sales	0.30	0.15	0.00	0.99
Manufacturers	0.007	0.009	0.000	0.092
Total Sales	19	20	0.061	104
Deregulation	0.45	0.49	0	1
Voluntary Reporting	0.63	0.48	0	1
Involuntary Reporting	0.57	0.47	0	1
CO^2	11.34	10.99	0.02	102.57
Sierra Club	20.16	29.35	0.71	198.59
Nuclear Moratorium	0.35	0.46	0.00	1.00
Democrats	0.34	0.45	0.00	1.00
State Budget	0.003	0.004	0.000	0.024
PUC Tenure	4.16	2.43	0.33	14.67
Elected PUC	0.13	0.32	0	1

Table 4.4: Correlation Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1 Percent Renewable$_t$																					
2 Percent Renewable$_{t-1}$	0.94																				
3 RPS Policy	0.26	0.28																			
4 Fuel Diversity	0.57	0.52	0.31																		
5 Competitor RPS1	0.29	0.31	0.75	0.32																	
6 Competitor RPS2	0.28	0.29	0.69	0.31	0.96																
7 Contiguous RPS1	0.10	0.07	0.38	0.12	0.40	0.39															
8 Contiguous RPS2	0.06	0.03	0.39	0.09	0.41	0.41	0.97														
9 Residential Sales	0.05	0.05	0.06	0.03	0.06	0.05	0.17	0.16													
10 Industrial Sales	-0.03	-0.03	-0.18	-0.03	-0.18	-0.15	-0.28	-0.26	-0.61												
11 Manufacturers	-0.09	-0.09	-0.05	-0.08	-0.04	-0.06	0.07	0.06	0.03	-0.03											
12 Total Sales	-0.04	-0.05	-0.06	-0.02	-0.07	-0.05	-0.06	-0.05	0.09	-0.12	0.14										
13 Deregulation	-0.08	-0.06	0.27	-0.07	0.30	0.26	0.40	0.41	0.18	-0.23	0.03	-0.02									
14 Voluntary Reporting	-0.31	-0.32	-0.17	-0.31	-0.19	-0.18	-0.06	-0.05	0.04	0.02	0.14	0.34	0.02								
15 Involuntary Reporting	0.14	0.14	0.33	0.16	0.31	0.27	0.28	0.30	0.26	-0.27	-0.03	0.11	0.68	-0.02							
16 CO^2	-0.24	-0.24	-0.22	-0.25	-0.20	-0.17	-0.17	-0.16	-0.09	0.18	0.67	0.07	-0.28	0.13	-0.37						
17 Sierra Club	0.16	0.14	0.28	0.21	0.22	0.22	0.13	0.13	0.08	-0.19	-0.03	0.37	0.11	0.03	0.38	-0.23					
18 Nuclear Moratorium	0.21	0.22	0.24	0.24	0.25	0.25	0.11	0.10	0.01	-0.10	0.05	-0.13	0.14	-0.16	0.14	-0.03	0.17				
19 Democrats	0.09	0.08	0.25	0.10	0.23	0.23	0.11	0.11	0.06	-0.09	0.00	0.01	0.05	0.05	0.00	-0.05	0.14	0.43			
20 State Budget	-0.05	-0.05	0.14	-0.03	0.14	0.11	0.28	0.27	0.13	-0.20	0.80	0.05	0.19	0.13	0.14	0.36	0.02	0.28	0.14		
21 PUC Tenure	0.04	0.05	-0.14	0.01	-0.12	-0.14	-0.05	-0.05	0.00	0.08	-0.08	0.08	-0.03	0.02	-0.09	0.00	-0.16	-0.27	0.02	-0.14	
22 Elected PUC	-0.10	-0.10	-0.16	-0.11	-0.15	-0.16	-0.08	-0.08	-0.02	-0.01	-0.11	0.02	-0.27	0.09	-0.34	0.11	-0.19	-0.23	0.19	-0.12	0.41

Table 4.5: GMM Regression Results for Main Effects

	Model 1	Model 2
Percent Renewable$_{t-1}$	0.262*** (0.089)	0.224*** (0.030)
RPS Policy	1.919** (0.787)	1.648*** (0.200)
Fuel Diversity	6.661*** (1.273)	7.279*** (0.444)
RPS Policy X Fuel Diversity	0.209** (0.085)	0.178*** (0.022)
Residential Sales	-67.827 (66.283)	-59.639** (24.145)
Industrial Sales	-14.470 (18.791)	-7.052 (8.280)
Manufacturers	-54.529 (143.302)	7.605 75.429
Total Sales	-0.846 (1.910)	-0.180** (8.97)
Deregulation	4.479* (2.781)	4.762*** (1.503)
Voluntary Reporting	-2.834 (3.905)	-1.249 (1.275)
Involuntary Reporting	-0.395 (0.751)	-0.172 (0.402)
CO^2	0.371 (0.122)	-0.008 (0.068)
Sierra Club	0.128 (0.086)	0.102*** (0.278)
Nuclear Moratorium	11.485 (11.736)	9.535 (6.892)
Democrats	0.509 (0.810)	0.241 (0.253)
State Budget	22.239 (29.080)	-13.875 (16.538)
PUC Tenure	-0.061 (0.066)	-0.029 (0.027)
Elected PUC	11.977 (35.001)	-3.322 (20.046)
Chi-Square	247.10***	8363.04***
Instruments	54	54
Sargan-Hansen Statistic	24.67	24.67
Difference in Hansen Test (C Stat)	18.63	18.63
AR (1)	0.243	0.177
AR (2)	0.935	0.815
Two Step Robust Standard Errors	No	Yes

n=762
Coefficients for Year effects omitted.
*P<0.1, **P<0.05, ***P<0.01

Table 4.6: GMM Regression Results including Competitor and Contiguous Variables

	Model 3	Model 4	Model 5	Model 6
Percent Renewable$_{t-1}$	0.239*** (0.032)	0.222*** (0.032)	0.225*** (0.030)	0.225*** (0.030)
RPS Policy	1.532*** (0.193)	1.162*** (0.225)	1.671*** (0.201)	1.684*** (0.204)
Fuel Diversity	7.043*** (0.464)	7.197*** (0.460)	7.278*** (0.437)	7.244*** (0.431)
RPS Policy X Fuel Diversity	0.185*** (0.023)	0.186*** (0.026)	0.179*** (0.022)	0.181*** (0.022)
Competitor RPS 1	0.219*** (0.070)			
Competitor RPS 2		0.140*** (0.037)		
Contiguous RPS 1			-0.010 (0.025)	
Contiguous RPS 2				-0.0187 (0.028)
Residential Sales	-43.480* (22.684)	-57.514** (25.456)	-59.809** (24.267)	-60.000** (24.194)
Industrial Sales	-6.349 (8.219)	-7.313 (9.235)	-6.954 (8.231)	-6.992 (8.186)
Manufacturers	-10.163 (78.126)	-3.272 (80.989)	2.606 (75.826)	2.089 (75.895)
Total Sales	-0.142* (0.086)	-0.169* (0.098)	-0.180* (0.089)	-0.178** (0.086)
Deregulation	4.854*** (1.493)	4.798*** (1.399)	4.847*** (1.483)	4.807*** (1.489)
Voluntary Reporting	-1.295 (1.259)	-1.383 (1.318)	-1.298 (1.253)	-1.233 (1.237)
Involuntary Reporting	-0.163 (0.418)	-0.192 (0.417)	-0.181 (0.399)	-0.176 (0.399)
CO^2	0.007 (0.070)	-0.003 (0.072)	-0.003 (0.068)	-0.002 (0.069)
Sierra Club	0.073*** (0.028)	0.049 (0.034)	0.105*** (0.028)	0.108*** (0.028)
Nuclear Moratorium	7.919 (6.233)	11.705* (6.751)	9.471 (6.932)	9.488 (6.954)
Democrats	0.408 (0.252)	0.353 (0.266)	0.256 (0.239)	0.282 (0.233)
State Budget	-1.857 (13.992)	-6.484 (14.398)	-14.039 (16.548)	-13.903 (16.508)
PUC Tenure	-0.011 (0.027)	-0.003 (0.029)	-0.029 (0.027)	-0.028 (0.027)
Elected PUC	0.508 (25.109)	1.138 (25.485)	-2.019 (20.369)	-2.886 (19.728)
Chi-Square	8953.48***	8931.40***	8428.13***	8492.34***
Instruments	55	55	55	55
Sargan-Hansen Statistic	25.70	24.20	24.88	24.96
Difference in Hansen Test (C Stat)	19.98	18.61	19.08	19.06
AR (1)	0.164	0.172	0.177	0.176
AR (2)	0.985	0.852	0.811	0.816

n=762
Coefficients for Year effects omitted.
Two-Step robust standard errors are presented in parentheses.
*P<0.1, **P<0.05, ***P<0.01

Table 4.7: GMM Regression Results Competitive Exposure and Contiguous Exposure Combined

	Model 7	Model 8
Percent Renewable$_{t-1}$	0.239*** (0.031)	0.240*** (0.031)
RPS Policy	1.594*** (0.198)	1.583*** (0.195)
Fuel Diversity	6.987*** (0.443)	7.014*** (0.450)
RPS Policy X Fuel Diversity	0.192*** (0.024)	0.192*** (0.024)
Competitor RPS 1	0.242*** (0.745)	0.243*** (0.074)
Competitor RPS 2		
Contiguous RPS 1	-0.054** (0.026)	
Contiguous RPS 2		-0.049** (0.023)
Residential Sales	-44.081* (23.150)	-43.093* (23.187)
Industrial Sales	-5.767 (7.991)	-6.117 (8.068)
Manufacturers	-23.376 (80.909)	-23.605 (80.602)
Total Sales	-0.142* (0.085)	-0.138* (0.081)
Deregulation	4.736*** (1.478)	4.781*** (1.457)
Voluntary Reporting	-1.317 (1.229)	-1.367 (1.251)
Involuntary Reporting	-0.130 (0.414)	-0.122 (0.414)
CO^2	0.020 (0.073)	0.020 (0.072)
Sierra Club	0.084*** (0.029)	0.082*** (0.028)
Nuclear Moratorium	7.831 (6.256)	7.614 (6.206)
Democrats	0.509** (0.234)	0.504** (0.242)
State Budget	-0.455 (14.065)	-0.626 (14.127)
PUC Tenure	-0.006 (0.027)	-0.005 (0.027)
Elected PUC	0.104 (23.976)	3.022 (25.230)
Chi-Square	9352.00***	9322.01***
Instruments	56	56
Sargan-Hansen Statistic	26.87	26.69
Difference in Hansen Test (C Stat)	21.22	21.10
AR (1)	0.162	0.163
AR (2)	0.989	0.988

n=762 ; Coefficients for Year effects omitted.
Two-Step robust standard errors are presented in parentheses.
*P<0.1, **P<0.05, ***P<0.01

Figure 2.1: Global Renewable Energy Adoption – Growth Rate in KwH for 1997-2006

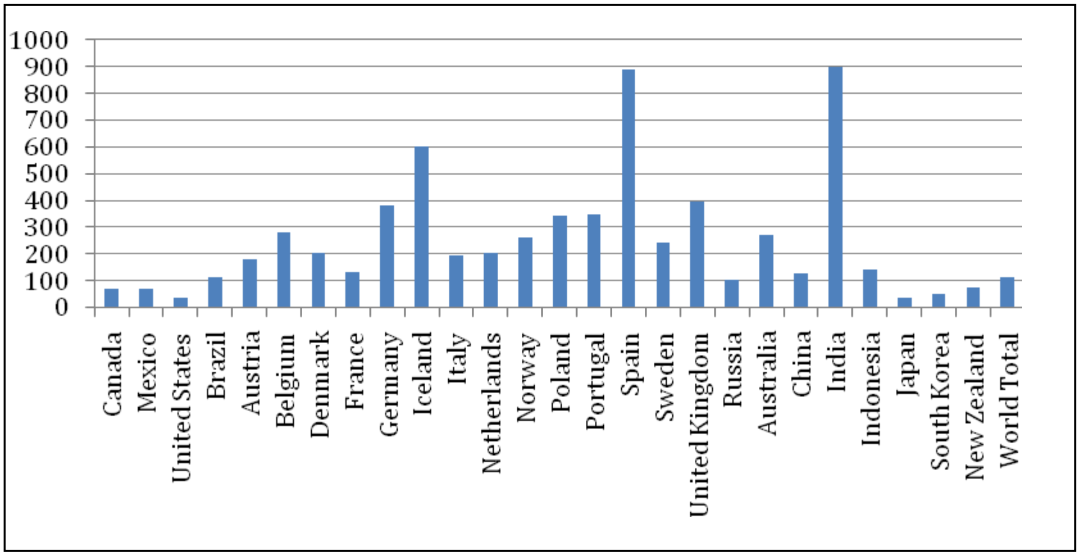

Figure 3.1: Map of Renewable Portfolio Standards in the United States

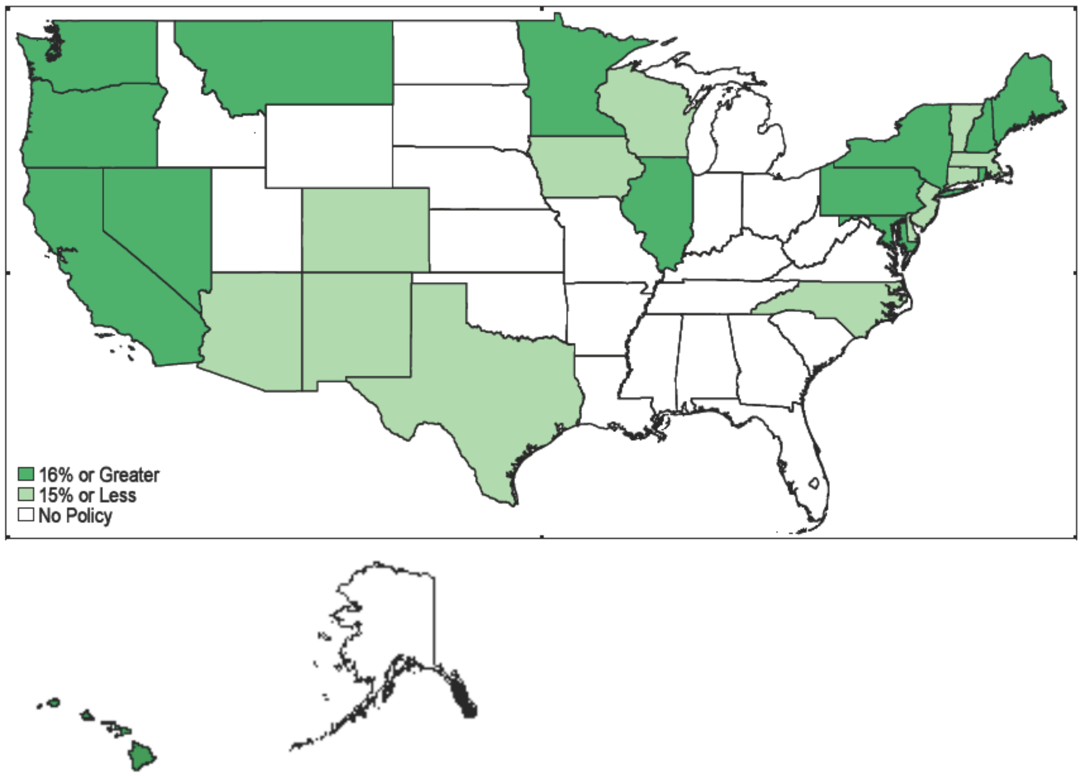

Figure 3.2: Change in probability of a strong policy with a dominant and technically leading firm

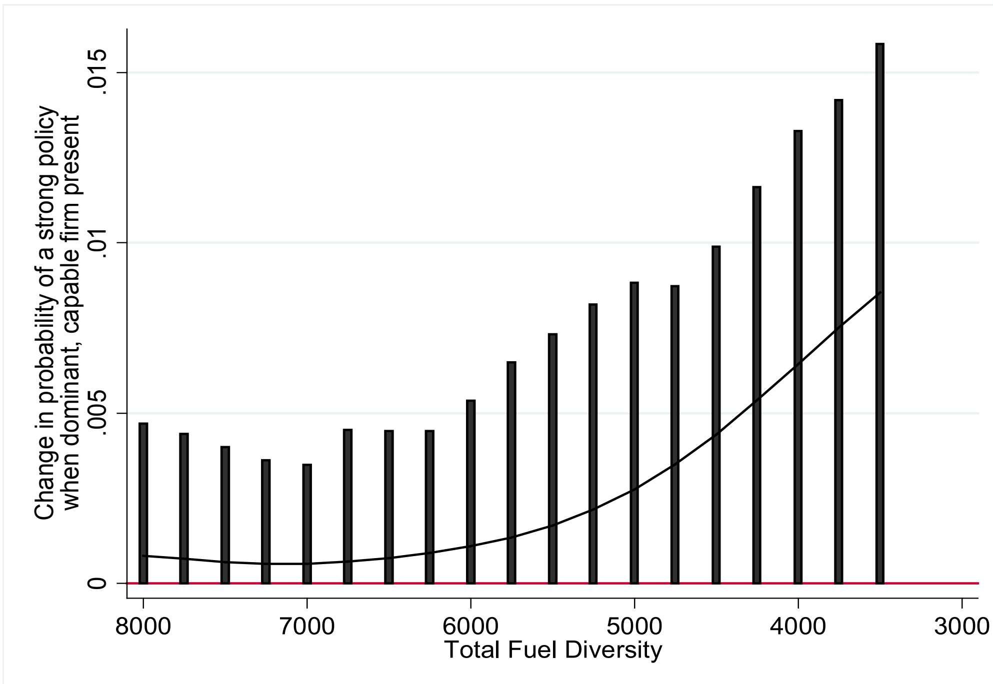

Figure 3.3: Change in probability of a strong policy with a dominant and financially leading firm

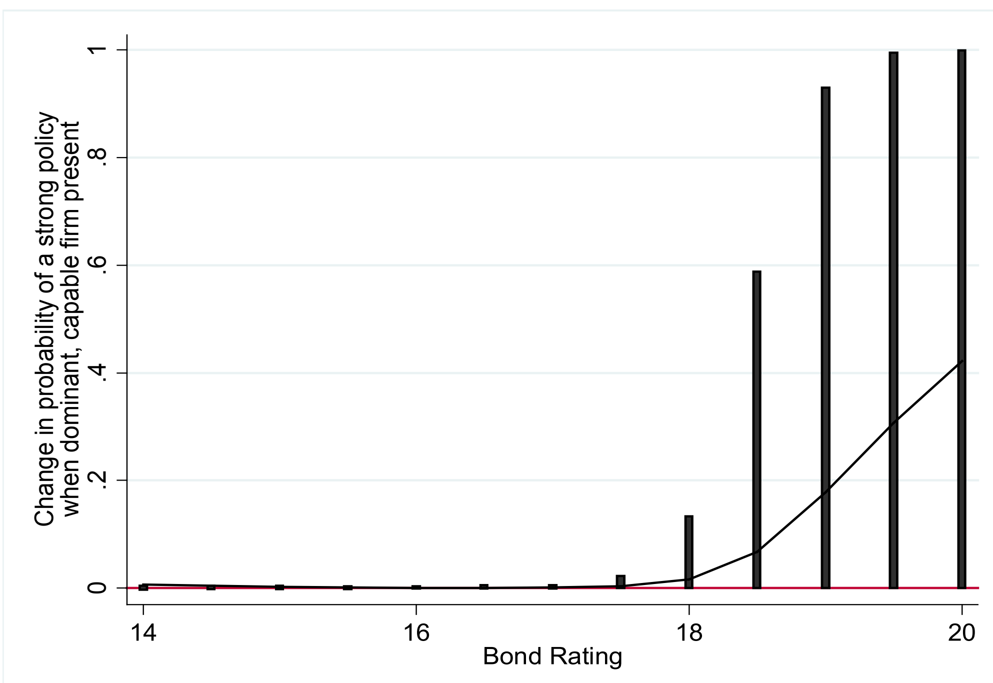

Figure 3.4: Change in probability of a weak policy with a dominant and financially leading firm

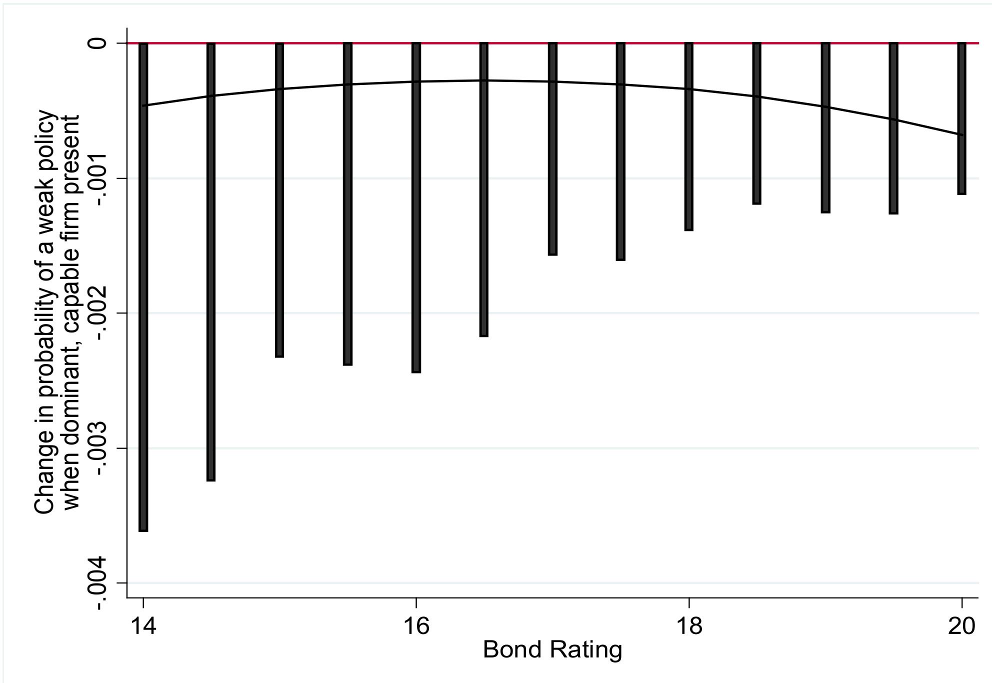

Figure 3.5: Change in probability of a strong policy with a dominant and technically lagging firm

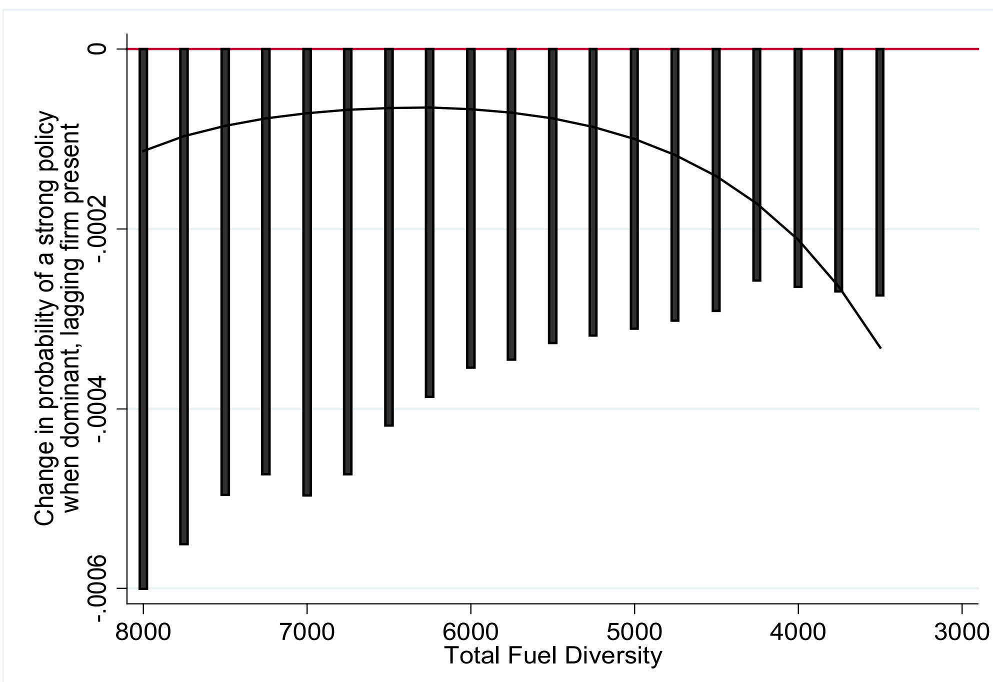

Figure 3.6: Change in probability of a strong policy with a dominant and financially lagging firm

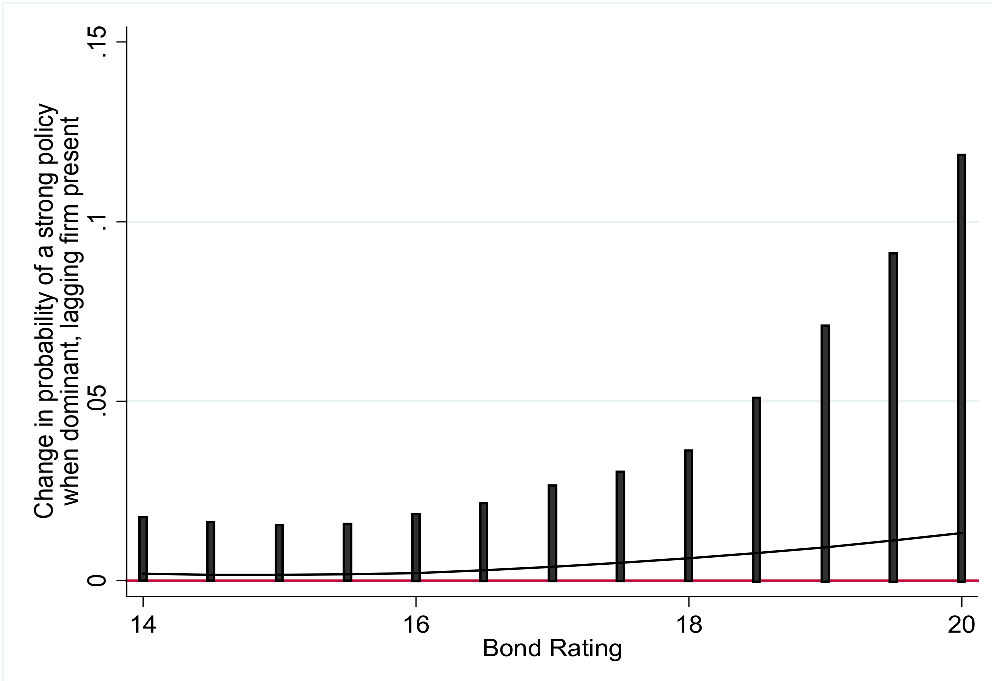

Figure 4.1: The Role of Renewable Energy Consumption in the U.S. Energy Supply, 2007