U.S. Electric Utilities and Deregulation: Trends, States' Choice, and Political Environments

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Abstract

I investigate the conduct of electric utilities in the U.S. from 1990 to 2013. I document significant increases in executive salaries, distribution capital, operating expenses, and outages, as well as changes in retail electricity prices. These changes are largely associated with the wave of deregulation. However, the choice of individual states to deregulate their electricity industry had a relatively small impact. Nevertheless, individual states' political environment, specifically the ideological makeup of the states' public utility commissions, had an important role in determining the influence of the trend on key aspects of utilities' conduct.

Keywords: Electricity, Utilities, Deregulation, Political Ideology
JEL Classification: D72, L16, L43, M5

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1 Introduction

Deregulation was a prevalent phenomenon in many industries in the late 20th century, including energy, telecommunications, transportation, and finance. The U.S. electricity industry is one prominent example of an industry that experienced major deregulation. In this paper, I explore the conduct of investor-owner utilities from 1990 to 2013. This is the period during which the U.S. electricity industry experienced major deregulation due to the Energy Policy Act of 1992 and three subsequent changes it brought about: establishment of wholesale electricity markets, divestiture of generating plants from vertically integrated electric utilities, and the entry of retailers.

Although electric utilities remained as natural monopolies in local distribution and continued to be regulated, institutional changes and new competitions in related segments implied needs for utilities to adjust their behaviors in response to the changed environment. I analyze three key variables that capture main features of utility management – (1) executive salaries, (2) investments in distribution capital, (3) operation and maintenance (O&M) expenses – and two key variables that determine consumer welfare – (4) service quality (reliability of electric power distribution measured by infrequencies of outages) and (5) retail electricity prices. Executive salary is a variable that reflects recruitment of managerial talent necessitated by increased competition and risks associated with industry restructuring. O&M expenses and capital investments are two key managerial decisions made by utilities and regulated by state-level regulators. Reliability and retail electricity prices determine consumers' value of electricity consumption. Thus, these five variables together capture how industry-level and state-level market and regulatory forces influence of key features of utility management and consumer welfare.

I compare the magnitude of three different factors: industry trends, individual states' choice of deregulation, and the ideological makeup of the state public utility commissions (PUCs) that regulate electric utilities. Industry trends influence utility management by affecting their expectations of future restructuring as well as movements in input prices and demand conditions. Individual states' choice influence utility management through establishment of wholesale electricity markets, divestiture of generating plants from vertically integrated electric utilities, and the entry of retailers, as well as auxiliary features of deregulation such as transitory rate freezes and recovery of stranded costs. Ideological makeup of the state PUCs influences utility management because PUCs with a larger proportion of Republican commissioners tend to make regulatory decisions that are relatively more favorable to utility profits as opposed to consumer welfare and tend to be lax in monitoring utility behavior, as demonstrated by Lim and Yurukoglu (2016).

I use a panel data set on investor-owned electric utilities and state PUCs that includes detailed information on their behavior. The key variables I investigate demonstrate substantial changes associated with the industry trend of deregulation. Executive salaries, distribution capital, O&M expenses, and outages increased significantly for this period. Retail electricity prices also changed significantly. However, individual states' choice of deregulation only had a minimal impact. Rather, the key changes are mostly industry-wide trends. Nevertheless, the regulatory environment of individual states, specifically the ideological makeup of the state's PUC, significantly influenced the magnitude of the change. For example, the increase in executive salaries associated with the trend toward deregulation took place under the PUCs that had a large share of Republican commissioners, which implies lax oversight over compensation practices under regulators who were relatively friendly to utilities.

This study contributes to the large literature on the deregulation of the U.S. electricity industry, most recently reviewed by Borenstein and Bushnell (2015). Borenstein and Bushnell (2015) argue that the greatest political motivation for restructuring was rent shifting between utility and consumers rather than efficiency improvements. They also note that the key changes in retail electricity prices were driven largely by exogenous factors such as natural gas price rather than changes in the industry structure *per se*. Most importantly, their result shows that the price variation across restructuring status captured by the difference-in-difference approach is rather minimal. One of the key points of the present study, the discrepancy between the industry-wide trend and variation across deregulation status, is related to and inspired by their study. The present study differs from theirs in two ways, however. First, I document that the discrepancy between the industry-wide trend and variation across states due to deregulation status is a more general phenomenon that appears in many dimensions of utilities' conduct, including compensation, investment, O&M expenses, and reliability. Second, despite the minimal impact of individual states' choice of deregulation, I document that the ideological makeup of a given state's PUC played a significant role in utilities' conduct.

Other recent research in this literature focuses on the efficiency of generating plants (Cicala (2015), Davis and Wolfram (2012), Fabrizio et al. (2007)) and wholesale market efficiency (Borenstein et al. (2002), Bushnell et al. (2008), Hortacsu and Puller (2008)). Unlike research on generating plants that shows efficiency improvements following deregulation, research on utilities during the period of deregulation has been relatively scarce, evidently due to the fact that utilities continued to be regulated. Kwoka et al. (2010) is an exception and argues that distribution utilities, particularly those that experienced mandatory divestiture, had reduced efficiency after deregulation. Although utilities continued to be regulated, their management needed to adjust to the new competition with retailers as well as changes in their relationship with generating plants. Therefore, to fully understand deregulation and its impacts, understanding conduct by utilities is essential.

This study also contributes to the literature on the interaction between regulators and electric utilities.[1] Lim and Yurukoglu (2016) investigate how regulator ideology interacts with regulatory holdup and utilities' moral hazard in U.S. electric utility regulation. Abito (2014) also studies U.S. electric utilities, but with a primary focus on agency costs in pollution regulation. This study differs from Lim and Yurukoglu (2016) and Abito (2014) in two ways. First, it focuses on deregulation. Second, it includes an analysis of executive compensation, an important part of utility management.

Finally, this study is also related to the literature on executive compensation, most recently surveyed by Frydman and Jenter (2010). The rise in executive compensation has been salient in many industries and has been linked to various concurring phenomena such as the increase in firm size over time and deregulation. The existing literature focused on performance pay rather than salary because performance pay has been the main driver of increases in executive compensation while salary largely remained constant. The electricity industry is somewhat distinct in that it experienced a significant increase in both salary and performance pay.

Joskow et al. (1996) study executive compensation in U.S. electric utilities before deregulation, focusing on the influence of regulators' favorability toward consumers. Bryan et al. (2005) study changes in the executive compensation and operation of U.S. electric utilities following the Energy Policy Act of 1992. The present study differs from Bryan et al. (2005) in four ways. First, while they analyze the period 1990-2001, the present study covers 1990-2013. This is an important difference because some of the patterns observed in the 2000s documented in the present study are notably different from those in 1990s. Second, they focus on the difference between the periods before and after 1992, while I treat each state's decision to deregulate separately. Third, I analyze the influence of regulatory ideology, which they abstracted away from. Fourth, I analyze executive compensation in conjunction with utility performance such as reliability of electric power distribution which influences consumer welfare. Integrating utility performance into the analysis helps to draw more concrete implications from the changes to utility conduct.

The rest of the paper is organized as follows. Section 2 describes the institutional background of the energy industry and lays out a conceptual background. Section 3 introduces data. Section 4 presents findings. Section 5 concludes.

[1] The literature on utility-regulator interaction is sizable, and here I discuss only the most recent papers. See Lim and Yurukoglu (2016) for a richer discussion.

2 Institutional and Conceptual Backgrounds

2.1 Institutional Background

The electricity industry is composed of three large segments – generation, transmission, and distribution – as illustrated in Figure 1. Generation is the process of transforming raw materials

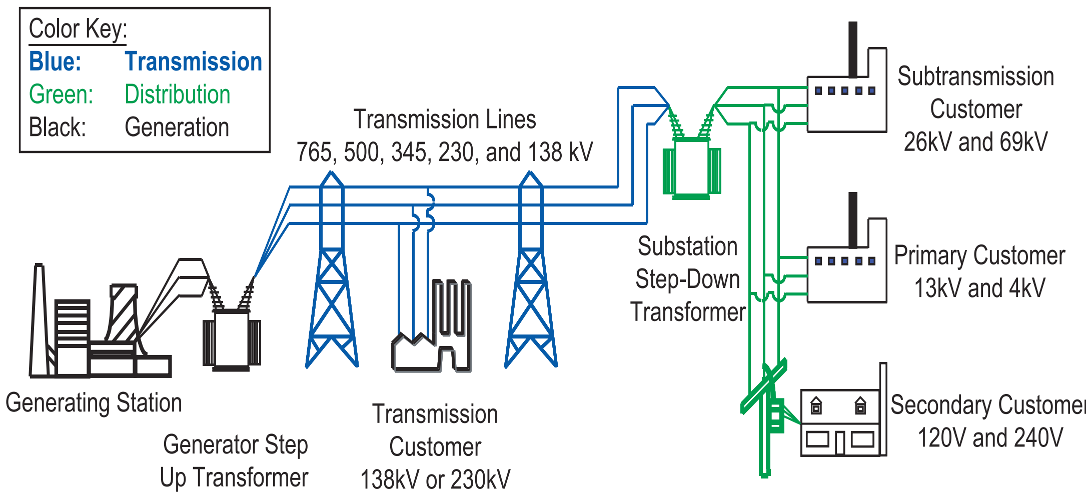


Figure 1: Electricity Industry

Source: U.S.-Canada Power System Outage Task Force (2004)

into electricity. Following generation, electricity reaches the transmission process, in which high-voltage electricity is delivered over long distances from generating plants to local substations. Once electricity reaches a local substation, it continues to the distribution process, in which low-voltage electricity is delivered over short distances from the local substation to final users. In about one third of the U.S. states, those that chose to open the final segment of the delivery process, there exist retailers, also known as power marketers, that procure electricity from wholesale power producers and deliver procured electricity to the final users by gaining access to the transmission and distribution systems owned by utilities.

2.1.1 Deregulation of the U.S. Electricity Industry

Historically in the U.S., electricity was provided by regulated, vertically integrated utilities that combined generation, transmission, and distribution functions. This structure changed fundamentally with the wave of deregulation in the 1990s, which began with the Energy Policy Act (EPAct) in 1992 and subsequent Federal Energy Regulatory Commission (FERC) orders 888 and 889 in

1996. EPAct, FERC orders, and legislation passed by individual states restructured the industry in three ways. First, it reorganized formerly balkanized transmission grids into regional grids managed by independent balancing authorities, Independent System Operators (ISOs) and Regional Transmission Organizations (RTOs), that coordinate the flow of electricity through transmission systems without owning them. Second, through divestiture, a large fraction of generating plants were transformed from parts of vertically integrated utilities into independent power producers that sell electricity by procurement and by participation in competitive wholesale markets. Third, about one third of the states opened the distribution system to retailers, who differentiated themselves from utilities in terms of electric power procurement and pricing.

Table A1 in the Appendix classifies states based on deregulation status. Throughout the mid-to-late 1990s, a large number of state governments conducted studies that assessed the costs and benefits of deregulation. Deregulation was a complex process that involved actions by state PUCs, legislatures, and governors. Twenty-two states and the District of Columbia legislated deregulation, which included the aforementioned features, such as divestiture of generation plants and retail competition. After the energy crisis in California in 2000 and 2001, seven states suspended deregulation. As of 2015, fifteen states and the District of Columbia are currently deregulated. These states are geographically clustered in the Northeast region, and those outside the Northeast are states with a large population such as California and Texas.

2.1.2 Regulatory Process for the Electric Utilities

Despite the wave of deregulation described above, a majority of the states kept the structure of regulated, vertically integrated electric utilities. Moreover, even in the states with major deregulation, distribution segments of the industry remain as local monopolies. Thus, electric utilities, whether traditional vertically integrated utilities or divested transmission and distribution utilities, continue to be regulated by state PUCs.

Each PUC, which is a part of the state government, is composed of three to seven members. Commissioners are appointed by the governor in about forty states and are directly elected by the voters in the remaining states. Each PUC regulates the conduct of utilities primarily through periodic rate reviews, often called "rate cases". The primary objective of the rate review is to set the "revenue requirement", the amount of revenue that the utility is allowed to recover from consumers. Combined with estimates of future electricity demand, the revenue requirement determines the electricity rate for subsequent years that allows utilities to recover their cost of service, composed of the costs of generating/purchasing electricity, appropriate operating costs, and fair return on their prudent investment. That is, the revenue requirement is:

$$pQ = C_f + C_{om} + rk$$

where p is the electricity price to be set, Q is the estimated electricity demand, C_f is the cost of generating or purchasing input electricity, C_{om} is O&M expenses, r is the rate of return, and k is the value of utility capital. Regulators influence pass-through of C_f to consumers, adjudicate the rate of return, r, approve the value of utility capital, k, and operating costs, C_{om}, which range from executive compensation to maintenance expenses for distribution systems that affect outages.

There is a set of regulatory principles that PUCs follow in their regulatory decisions.[2] For example, the rate of return on utility capital should be set comparable to that on other investments of similar risk. In addition, the value of capital, k, should include only the portion of capital that is actively used and useful for providing service to consumers. In practice, however, such principles have large room for discretion in their interpretation and implementation. This leads to an influence of regulator ideology on outcomes of rate reviews and on utility management, which I discuss below.

2.2 Conceptual Background

In this subsection, I lay out mechanisms through which industry trends, states' choice of deregulation, and the ideological makeup of PUCs influence the conduct of electric utilities. I discuss general features of those three factors first, then discuss each of the five outcome variables I investigate.

Industry Trends and States' Choice The data period that I investigate, 1990-2013, is a period of a large regime change toward electricity deregulation, its experimentation, controversies surrounding the California electricity crisis, then suspensions of deregulation. During this period, there were also other trends affecting the industry such as technology advances and large movements in natural gas prices. The industry also experienced a steady increase in the electricity demand. Per capita electricity consumption in the U.S. increased by 13% from 11713 kWh in 1990 to 13246 kWh to 2011.[3]

In theory, a large wave of deregulation brings two key forces into play: competition, in the states where deregulation is in place, and increased risks due to the uncertainty in future legislations and in the performance of the new regime. In deregulated states, electric distribution utilities faced

[2] Alt (2006) provides a comprehensive description of the regulatory process that state PUCs follow.
[3] See World Development Indicators by the World Bank: http://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC.

price competition with retailers.[4] New price competition has put pressure on utilities for better management and stronger cost-cutting efforts. Increased risks due to uncertainty lead to pressure on utilities for more scrutiny on investment decisions.[5] As is well-known, there were many crises and controversies regarding wholesale power markets in the early years of deregulation. Moreover, in deregulated markets, retailers use utilities' transmission and distribution systems, and retailers' customers pay distribution (delivery) charges to utilities.[6] The distribution charges are regulated and supposed to be set so that they cover fair return on utilities' investment and operating costs. Despite this regulatory principle, there is large room for regulators' discretion in determining a "fair" return. The newness of this practice, combined with regulatory discretion, was another source of uncertainty during the transition toward deregulation. These pressures on utility management for cost-cutting and more prudent investment decisions, in turn, are reflected in electricity prices.

Efforts for cost reduction and more scrutiny on investments also influence the reliability of electricity distribution. One of the key determinants of reliability is the age of the infrastructure for distribution. Utilities' capital investments, specifically the resources that utilities expend to improve the quality of distribution infrastructure (e.g., replacement of old equipments with new ones) have a first-order influence on reliability. Lim and Yurukoglu (2016) estimate that a 10% increase in the value of distribution capital reduces outages by about 5%. Therefore, a decrease in investments, if it occurs, would lead to an increase in outages.

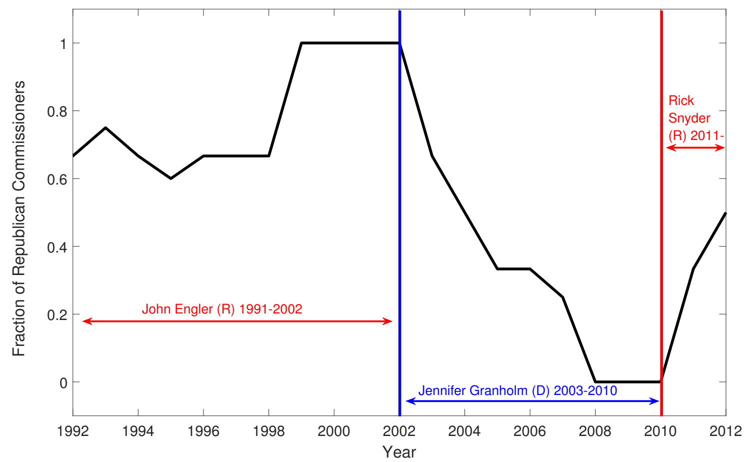
Other trends that concurred may countervail these forces of deregulation. For example, a constant growth of electricity demand requires investments in distribution capital, in the form of an increase in capacity. Which of these forces was dominant in practice is an empirical question that will be addressed in Section 4.

Individual states' legislation and implementation of deregulation included several auxiliary features, such as temporary rate freezes and recovery of stranded costs during the transition period, in addition to the establishment of wholesale electricity markets, divestiture, and the entry of retailers. These were aimed at mitigating price volatilities during the transition period and help utilities recover costs of their past capital investments. Given that a political motivation behind these features was rent shifting between consumers and utilities, it is useful to consider how regulators'

[4] In the states with retail competition, the price of electricity supplied by retailers is unregulated and is heavily influenced by wholesale market price, while the price of electricity supplied by utilities is regulated. Thus, in case that utilities incur large capital investments and operating costs, the regulated price by utilities can be significantly higher than the unregulated price by retailers. Such discrepancy in prices may reduce the demand for electricity supplied by utilities over time through consumers' switch to retailers. This may necessitate a further increase in regulated electricity price for the recovery of fair return on investments, which may lead to an even larger reduction in demand.

[5] For a richer discussion on uncertainty and investment, see the literature cited in Bloom (2009).

[6] For components of electricity bills in deregulated markets, see the following example from Michigan: https://www.michigan.gov/documents/mpsc/electric_residential_bill_charges_final_318312_7.pdf.



Source: Lim and Yurukoglu (2016)

Figure 2: Fraction of Republicans on the PUC in Michigan

political ideology influences regulation and utility conduct which I turn to next.

Regulator Ideology PUCs have a direct influence over key components of utility management through rate reviews, as described above. PUC members are political actors appointed by elected officials or elected themselves. Thus, the ideological composition of PUCs is directly influenced by partisan tides of the state electorate and major government offices. And, PUCs with different ideological compositions make systematically different regulatory decisions.

Figure 2 illustrates how the state governor's party affiliation influences partisan composition of the PUC, with an example from the state of Michigan. Michigan had a Republican governor until 2002, which led to a high proportion of Republicans on the PUC throughout 1990s. Then, a Democratic governor was elected in 2002, which led to a steep decrease in the proportion of Republicans. PUCs typically have high turnover rates, with the average tenure of their members being under 5 years. This leads to frequent changes in the ideological composition of PUCs. Using cross-time variations, Lim and Yurukoglu (2016) document that PUCs with a larger proportion of Republicans adjudicate a higher rate of return and are associated with a stronger degree of operational inefficiency measured by energy loss. They interpret their results on energy loss as a result of lax monitoring of utility's managerial effort under conservative regulators. Their results demonstrate that conservative regulators tend to put a relatively larger weight on utility profits as opposed to consumer welfare, compared with liberal regulators. Now I turn to the discussion on how the main features of industry trends, states' choice of deregulation, and regulatory ideology affect the outcome variables I investigate.

Executive Compensation[7] The two key forces brought by deregulation, competition and increased risks, lead to the demand for better managerial skills. This, in turn, increases executive salaries necessary for recruiting and retaining executives with qualified managerial skills.

The ideological makeup of the PUCs can interact with the influence of industry trends on executive compensation through regulators' monitoring efforts. Executive compensation often reflects factors that are not directly related to executives' managerial skills. Bertrand and Mullainathan (2001) demonstrate that executives get rewarded for improvement in company earnings due to completely exogenous factors ("luck"), and the magnitude of such rewards is influenced by the quality of governance (monitoring by the board) measured by the presence of large shareholders. Similarly, executives of utilities can be rewarded for exogenous changes in earnings due to factors such as fluctuations in wholesale electricity prices. The influence of random factors on executive compensation in electric utilities can be mitigated by regulators' monitoring efforts. Exerting an effort in intense monitoring of utility management is costly for regulators, however. Moreover, the benefit from mitigating an increase in executive compensation is passed on to consumers in the form of lower electricity prices. Therefore, the degree to which regulators are willing to exert a monitoring effort to mitigate the increase in executive compensation unrelated to performance critically depends on the weight that regulators put on consumer welfare. Therefore, executive compensation would be relatively compressed under liberal regulators.

Investment[8] **and Operation and Maintenance Expenses** For investment, I focus on utilities' investments in distribution capital.[9] Focusing on distribution capital helps me focus on the comparison of management practices between utilities in deregulated and regulated states based on the type of assets that both groups own even after deregulation. As elaborated in the above discussion on industry trends and states' choice of deregulation, price competition and increased risks associated with deregulation put pressure on utility management for cost-cutting efforts and stronger

[7]It is useful to note that there has been an economy-wide increase in executive compensation as discussed in Frydman and Jenter (2010), independent of electricity industry deregulation. To the extent that managerial skills consist of components that are not industry-specific, an economy-wide increase in compensation may easily spill over to the electricity industry. The patterns of executive compensation that will be shown in Section 4 below are not simply a replica of the economy-wide trend, however. The increase in executive compensation in other industries was driven by performance pay components such as option grants, while the base salary remained relatively stagnant. In contrast, the base salary of utility executives has shown a significant increase for the same period.

[8]Deregulation also affected utilities' capital through the divestiture of generating plants. However, I abstract away from divestiture. While investment in distribution capital reflects utilities' managerial decisions motivated by prospects for future returns, divestiture is a large-scale breakup of a firm, a structural and discrete change determined by state governments' decisions. Therefore, even if divestiture has a direct influence on utilities' capital, it is of fundamentally different nature from utilities' investment in distribution capital.

[9]According to the Edison Electric Institute, distribution systems constitute approximately 25% of infrastructure spending by the electricity industry. See http://www.incontext.indiana.edu/2010/july-aug/article3.asp.

scrutiny on investment decisions. This, in turn, induces a decrease in investments. The same mechanism also applies to O&M expenses. However, as mentioned earlier, these forces of deregulation are countervailed by the forces of the increasing demand for electricity that occurred for the same period. An increasing demand necessitates an expansion of the capacity, which in turn leads to an increase in distribution capital and O&M expenses.

Let us now consider the potential influence of regulator ideology. Lim and Yurukoglu (2016) document that conservative regulators adjudicate a higher rate of return, which is in turn associated with more investment. Therefore, in the present study, I focus on the influence of regulator ideology on O&M expenses. There are two competing influences of regulator ideology on O&M expenses. On the one hand, liberal regulators, who put a relatively larger weight on consumer welfare, may engage in more intense auditing of utilities' O&M expenses. This mechanism, analogous to that laid out above for executive compensation, would lead to lower O&M expenses under liberal regulators. On the other hand, higher rates of return adjudicated by conservative regulators may increase electricity price significantly, if they are not compensated for by cost reductions elsewhere. Thus, if conservative regulators desire to increase utility shareholders' return without causing public outcry due to high electricity prices, they would need to induce utilities to reduce O&M expenses to compensate for high rates of return.[10]

Reliability Outages occur due to shortages of electricity supply or failures of transmission and distribution systems. The outages during the California energy crisis in 2000 and 2001 are good examples of those due to shortages of electricity supply. As is well known, the shortage of electricity supply in California was a rather unusual phenomenon due to wholesale market manipulation. Outages due to transmission and distribution systems are to a large extent influenced by capital investments, in the form of improvement in the age and quality of infrastructure, and to a smaller extent by maintenance efforts. Thus, forces that influence investment and O&M expenses discussed above would eventually have a long-run impact on reliability.

[10]Lim and Yurukoglu (2016) argue that conservative regulators tend to induce less efforts by utilities to reduce input electricity costs, which increases energy loss. The second influence of regulator ideology on O&M expenses proposed here may seem contradictory to their argument on energy loss. There are subtle differences between the two, however. The cost of input electricity is subject to full pass-through due to automatic adjustment clauses in most states. The increase in electricity price due to the pass-through of input electricity costs is reflected in surcharges, observed by consumers after consumption, rather than in base rates. Moreover, due to automatic adjustment clauses for input electricity cost, the audit costs that regulators have to bear for inducing utilities' effort to reduce energy loss may be significant. In contrast, O&M expenses are not subject to automatic pass-through, and the estimates of O&M expenses are reflected in the determination of the base rates of electricity. Thus, O&M expenses differ from energy loss in terms of the nature of regulator's discretion and the impact on electricity rates.

Electricity Price There are both theoretical and institutional reasons for the influence of deregulation on electricity prices. Theoretically, forces of competition brought by deregulation induce efficiency improvements in all segments of the industry. Indeed, many studies on generating plants, mentioned in Section 1, find evidence on efficiency improvements. Efficiency improvements in any segment of the supply chain would eventually be reflected in the price to final users. In addition, state-level implementation of deregulation included auxiliary features such as rate freezes and recovery of stranded costs, as discussed above.[11] This led to electricity prices that were not in accordance with market equilibria during the transition period. These institutional features can also function as mechanisms through which regulator ideology influences electricity prices. To the extent that rent-shifting between consumers and utilities as a political motivation for deregulation, as noted by Borenstein and Bushnell (2015), is reflected in the legislation of deregulation, liberal regulators who give a relatively larger weight to consumer welfare are more likely to keep electricity prices low.

3 Data

The data consists of 139 utilities for the period of 1990-2013. It has seven key components: (1) executive salaries, (2) value of the distribution plant, (3) O&M expenses, (4) service quality (reliability of electricity distribution), (5) electricity price, (6) proportion of Republicans on the PUC, and (7) deregulation status. Since utilities often cross state boundaries, the main unit of observation is utility-state-year rather than utility-year. The unit of observation for the electricity price, the proportion of Republicans on the PUC, and deregulation status is state-year. The data has 183 utility-state units and their yearly observations for the key variables.

Executive salaries, the value of the distribution plant, and O&M expenses are obtained from the FERC Form 1 annual filings. Executive salary is the base salary of the CEO reported on the form.[12] The value of the distribution plant is used to investigate utilities' investment behavior.[13] O&M expenses include a wide range of non-capital expenses ranging from personnel costs to maintenance expenses for distribution systems. Reliability of electricity distribution is measured by the System Average Interruption Duration Index (SAIDI). SAIDI measures the average duration

[11] Kwoka (2008) provides a richer discussion on how these features affected the dynamics of electricity prices.

[12] A large number of studies in the literature on executive compensation use data from ExecuComp database, which includes various other components of compensation such as cash bonuses and option grants. Unfortunately, only a small number of electric utilities are included in the ExecuComp, which makes it unsuitable for this study.

[13] Capital investment is an important determinant of the reliability of electricity distribution according to Lim and Yurukoglu (2016).

of outages in minutes per customer-year.[14] Large value for SAIDI implies low reliability. The data for SAIDI was obtained from various sources, including PUC archives and the EIA. Electricity price is available from the Energy Information Administration (EIA)-Form 861.

For the proportion of Republicans on each state's PUC, I use the "All Commissioners Data" developed by Janice Beecher and the Institute of Public Utilities Policy Research and Education at Michigan State University (Beecher (2013)), which contains information on the party affiliation of commissioners. I use the proportion of Republicans on each state's PUC, which I label as *Republican Influence*, as a measure of regulator ideology. Table 1 presents summary statistics.

Table 1: Summary Statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Panel A: Utility Conduct					
Salary ($)	857094	917625	25401	25168598	2415
Log (Salary)	13.37	0.76	10.14	17.04	2415
O&M Expenses ($1000)	117834	133811	0	886392	3863
Net Distribution Plant ($1000)[a]	1369775	1650640	0	14075832	3843
SAIDI	136	123	1	3909	1949
Panel B: Deregulation, Political Environments, and Electricity Price					
Deregulation	0.26	0.44	0	1	1198
Republican Influence	0.44	0.32	0	1	1145
Residential Price (¢/kWh)	12.5	3.6	7.1	38.5	1196
Average Price (¢/kWh)	10.5	3.4	5.5	35.1	1196

Note 1: In Panel A, the unit of observation is utility-state-year. In Panel B, it is state-year.
Note 2: All the values in dollar term are in 2014 dollars.
[a] 'Net distribution plant' means the value of distribution plants net of depreciation.

The coding of deregulation status is based on individual states' history of major government actions, available from the EIA. Specifically, the timing of deregulation is determined by legislation and regulatory actions that involve key features of deregulation, such as retail competition and divestiture of generating plants. It has been noted in the literature (e.g., Borenstein and Bushnell (2015), Kwoka (2008)) that coding of deregulation is not straightforward because deregulation in practice involved gradual implementations of a bundle of policy instruments that include auxiliary

[14] SAIDI is defined as the sum of all customer interruption durations divided by the total number of customers. There also exist alternative measures such as System Average Interruption Frequency Index (SAIFI) and Customer Average Interruption Duration Index (CAIDI). SAIFI is the total number of interruptions experienced by customers divided by the number of customers. CAIDI is defined as SAIDI divided by SAIFI. It measures the average duration conditional on having an interruption. I use SAIDI to measure reliability because it includes both frequency and duration across all customers.

features such as rate freezes and recovery of stranded costs. There is also a wide variation in the penetration of retail competition, measured by the market share of retailers, even among deregulated states. Thus, precisely how deregulation should be coded depends very much on the specific purposes of a given study. In the present study, I use binary classification of deregulation, despite its caveat of over-simplification, because I investigate many different dimensions of utility conduct in the same framework.

4 Findings

In this section, I present the results in the following order: (1) executive (CEO) salary, (2) investment, (3) O&M expenses, (4) reliability of electricity distribution, and (5) electricity price.

4.1 Executive Salary

Let us first look at key patterns of the mean CEO salary over time in Figure 3. There has been a notable surge in executive salary from the mid-1990s to mid-2000s. The mean executive salary rose from about 670,000 dollars in 1994 to about one million dollars in 2007. The trend came to a halt in the late 2000s and there has been a decrease since the late 2000s.[15] Given that electricity

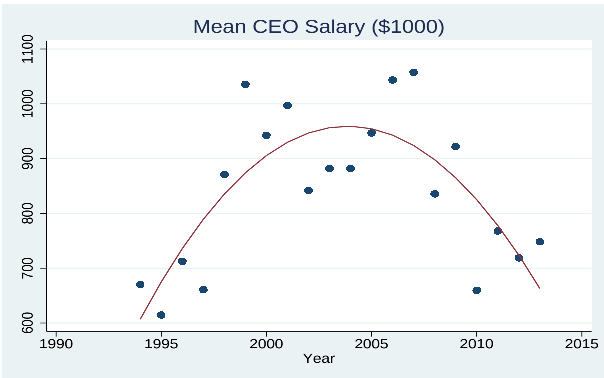


Figure 3: Mean CEO Salary Over Time

industry deregulation spread over the period of the mid- to late-1990s to early 2000s and that many states suspended the deregulation process by the mid-2000s, it shows a clear time-series association between the increase in executive salary and the wave of deregulation.

However, if we look at the difference across states over time, the appearance of the relationship between industry deregulation and executive salary becomes much weaker. Figure 4 shows the

[15]The key patterns are robust to exclusion of outlier observations of executive salary.

mean executive salary and its fractional polynomial fit separately for the states that experienced deregulation during the period of 1990-2013 and those that never experienced deregulation. That is, I classify states based on the entire history of deregulation for the period of 1990-2013. Thus, the set of states in each figure is held constant across different years. Both panels show that the cross-time difference in the cross-sectional difference across deregulation status (difference-in-differences) is small compared with the overall trend. That is, similar trends in executive salary took place regardless of individual states' deregulation decision.[16]

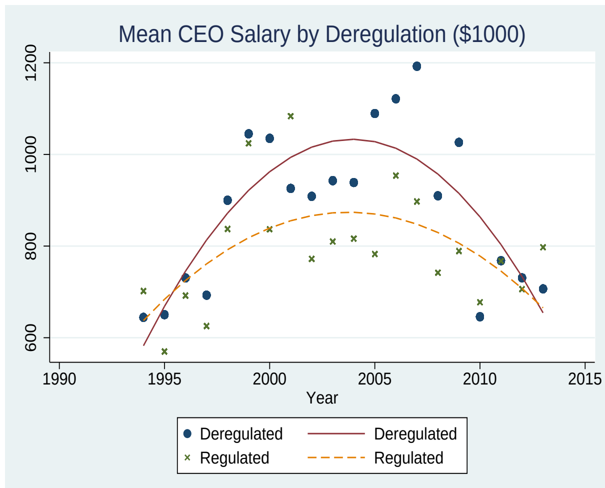


Figure 4: Mean CEO Salary Over Time by Deregulation Status

Table 2 organizes the key points from Figure 4 quantitatively by contrasting the results from before-after estimation with those from difference-in-difference (DD) estimation. The DD estimation, presented in Column (3) (and in (6) with logged salary) follows a specification of the following form:

$$salary_{it} = \beta_0 + \beta_1 Deregulation_{it} + \gamma_i + \delta_t + \varepsilon_{it},$$

in which γ_i is utility-state fixed effect, and δ_t is year fixed effect.

Columns (1), (2), (4), and (5) in Table 3 show that deregulation is associated with a significant (approximately 15% or more) increase in executive salary if it captures the trend. Whether I include the utility-state fixed effects or not makes little difference, suggesting the dominance of cross-time variation relative to cross-sectional differences in the relationship between deregulation and

[16]If I separately look at the states that still have active deregulated markets and those that eventually suspended deregulation, the difference between the two is similar to the difference between deregulated and regulated states in Figure 4. Further, the quadratic shape of the overall trend also appears in a large number of states when I look at the trend state by state. That is, the overall trend is not driven by a small number of large states or outliers.

Table 2: Executive Salary and Deregulation

Dependent Variable: CEO Salary ($)

	Dependent Variable					
	CEO Salary			Log CEO Salary		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	193,814*	222,911**	106,657	0.146*	0.154*	0.051
	(102,377)	(108,282)	(118,078)	(0.080)	(0.080)	(0.079)
Constant	773,466***	779,376***	715,184***	13.283***	13.312***	13.222***
	(35,277)	(37,753)	(53,344)	(0.052)	(0.028)	(0.053)
Observations	2,415	2,415	2,415	2,415	2,415	2,415
R-squared	0.01	0.01	0.03	0.00	0.01	0.05
Number of Utility-States	166	166	166	166	166	166
Utility-State FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Note: Unit of observation is utility-state-year. Columns (1) and (4) present results from random effect GLS regressions. Robust standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1

executive salary. The dominance of cross-time variation becomes more clear when the results from Columns (1), (2), (4), and (5) are compared with those in Columns (3) and (6), which include year fixed effects. The coefficient estimates from DD estimation in Columns (3) and (6) are far smaller than before-after estimation (at around five percent), and they have no statistical significance.

In the next step, I investigate the extent to which the industry-wide trend of the increase in executive salary interacts with the ideological makeup of the PUCs. Table 3 presents regressions that include *Republican Influence*, i.e., the proportion of Republicans on the PUC, and its interaction with deregulation. The full specification is of the following form:

$$\begin{aligned} salary_{it} &= \beta_0 + \beta_1 Deregulation_{it} + \beta_2 Republican\ Influence_{it} \\ &\quad + \beta_3 Deregulation * Republican\ Influence_{it} + \gamma_i + \delta_t + \varepsilon_{it}, \end{aligned}$$

in which γ_i is a utility-state fixed effect, and δ_t is a year fixed effect.

Table 3 shows that the extent to which deregulation is associated with an increase in executive compensation critically depends on *Republican Influence*. While deregulation is not associated with an increase in executive salary under the most liberal PUC (with no Republicans), it is associated with around a 20% increase in executive salary under the most conservative PUC (with all Republicans).

Table 3: Executive Salary, Deregulation, and PUC Ideological Makeup

	Dependent Variable: CEO Salary					
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	192,256*	-107,881	229,152**	-60,666	109,253	-191,442
	(102,792)	(151,014)	(110,145)	(166,951)	(117,478)	(167,367)
Republican Influence	37,700	-165,777	-50,579	-235,575*	-91,730	-280,400***
	(122,440)	(111,549)	(133,922)	(121,085)	(129,423)	(102,616)
Deregulation		586,452**		559,655**		592,690**
* Republican Influence		(240,161)		(243,598)		(235,885)
Constant	761,040***	860,383***	807,836***	900,716***	718,819***	812,769***
	(70,246)	(71,866)	(69,188)	(57,190)	(106,066)	(85,217)
Observations	2,331	2,331	2,331	2,331	2,331	2,331
R-squared	0.01	0.02	0.01	0.02	0.03	0.04
Number of Utility-States	166	166	166	166	166	166
Utility-State FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	Yes	Yes

	Dependent Variable: Log CEO Salary					
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	0.143*	-0.066	0.151*	-0.048	0.052	-0.150
	(0.081)	(0.111)	(0.081)	(0.112)	(0.078)	(0.104)
Republican Influence	0.100	-0.035	0.082	-0.045	0.047	-0.080
	(0.089)	(0.085)	(0.089)	(0.084)	(0.078)	(0.065)
Deregulation		0.405***		0.385***		0.398***
*Republican Influence		(0.141)		(0.136)		(0.122)
Constant	13.240***	13.306***	13.275***	13.339***	13.141***	13.204***
	(0.057)	(0.061)	(0.047)	(0.042)	(0.079)	(0.069)
Observations	2,331	2,331	2,331	2,331	2,331	2,331
R-squared	0.02	0.03	0.01	0.02	0.05	0.06
Number of Utility-States	166	166	166	166	166	166
Utility-State FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	Yes	Yes

Note: Unit of observation is utility-state-year. Columns (1) and (2) in each panel present results from random effect GLS regressions. Robust standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1

4.2 Investment

In this subsection, I investigate utilities' investment, by documenting key patterns in the net value of the distribution plant. Figure 5 shows the mean net value of the distribution plant over time. It shows a clear increase from the mid-1990s, which generates an appearance of the relationship between the trend of deregulation and investments. However, looking at the difference across

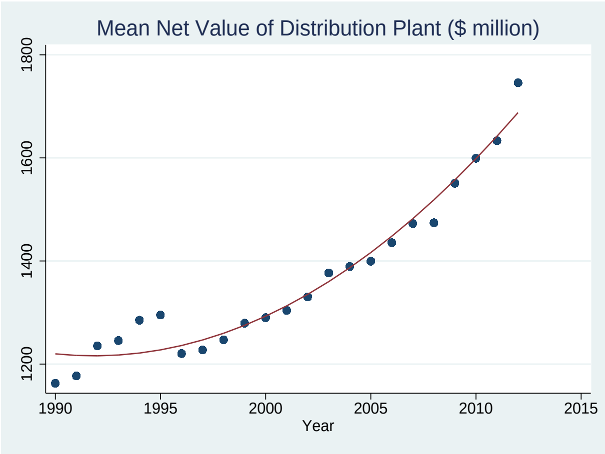


Figure 5: Mean Distribution Plant Over Time

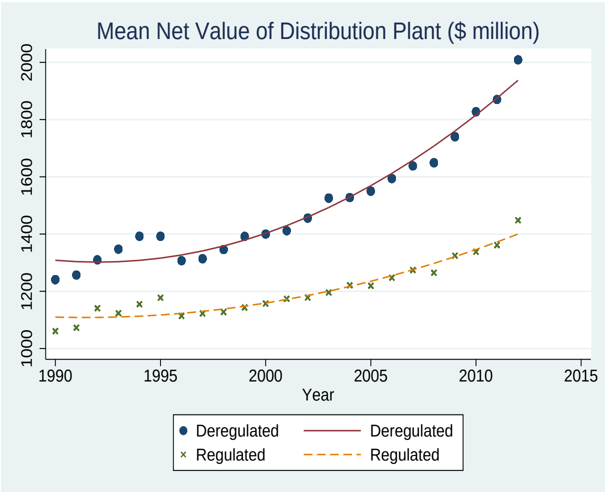


Figure 6: Mean Distribution Plant Over Time By Deregulation

states over time renders a very different conclusion. Figure 6 shows the mean net value of distribution plants over time, separately for states that have experienced deregulation for the period of 1990-2013 and those that have not. The comparison of the two groups renders a conclusion that the increase in the net value of the distribution plant over time is a rather common phenomenon, not strongly driven by deregulation. The two groups differ in overall gradients, but the difference is relatively small compared with the changes over time.

Table 4 organizes key features of Figure 6. The DD estimation, presented in Column (3) (and

Table 4: Investment and Deregulation

Dependent Variable: Net Distribution Plant ($1000)

	Dependent Variable					
	Net Distribution Plant			Log Net Distribution Plant		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	174,578***	174,421***	-42,280	0.115***	0.115***	-0.039*
	(63,801)	(63,781)	(70,811)	(0.028)	(0.028)	(0.020)
Constant	1,255,121***	1,315,856***	1,061,136***	13.297***	13.452***	13.280***
	(150,284)	(19,717)	(41,991)	(0.143)	(0.009)	(0.015)
Observations	3,843	3,843	3,843	3,838	3,838	3,838
R-squared	0.00	0.03	0.25	0.00	0.05	0.50
Number of Utility-States	182	182	182	182	182	182
Utility-State FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Note: Unit of observation is utility-state-year. Columns (1) and (4) present results from random effect GLS regressions. Robust standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1

in (6) with logged distribution plant), follows a specification of the following form:

$$Net\ Distribution\ Plant_{it} = \beta_0 + \beta_1 Deregulation_{it} + \gamma_i + \delta_t + \varepsilon_{it}.$$

Columns (4) and (5) show that deregulation is associated with about 11% investment in the net value of distribution plants over time, while the DD estimate shows a negative association between deregulation and the net value of distribution plants.

In sum, individual states' decision to deregulate the industry had a small and negative influence on investment, if any. This is consistent with the conceptual background laid out in Section 2.2. It is also useful to note that there had been a steady increase in the electricity consumption for the data period as well as for the period of the wave of deregulation as discussed in Section 2.2. An increase in electricity consumption by itself can drive an investment in the distribution plant as well as an increase in O&M expenses, which will be analyzed below in Section 4.3.

4.3 Operation and Maintenance Expenses

In this subsection, I investigate O&M expenses incurred by utilities. Figure 7 shows the mean yearly O&M expenses. The overall pattern is similar to that of distribution plants. There is a salient increase from the mid-1990s, which renders an appearance of the association between deregulation and an increase in O&M expenses. In Figure 8, I look at the difference across states over time by

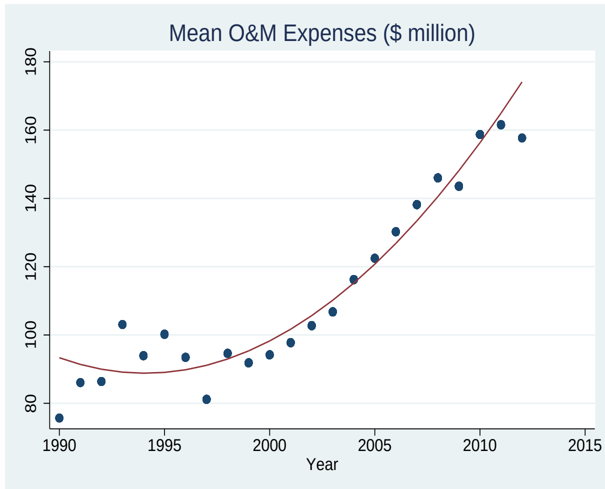


Figure 7: Mean Distribution Plant Over Time

classifying states based on whether they have ever had deregulation for the period of 1990-2013 or not. As in the case of investments, states experienced similar trends regardless of they chose

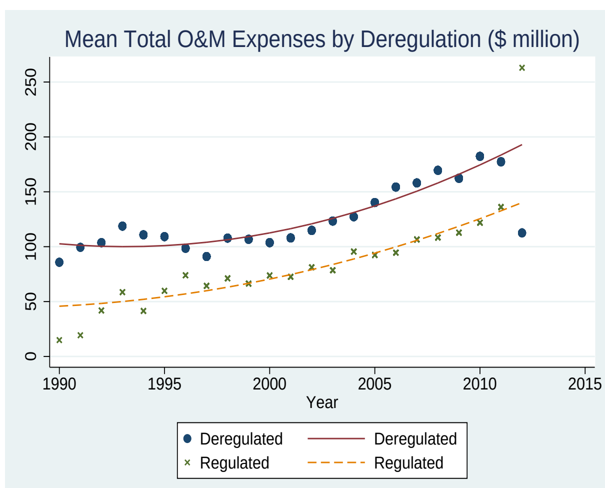


Figure 8: Mean (log) Distribution Plant Over Time by Deregulation

to deregulate their market or not. These trends are also in accordance with the steady increase in electricity consumption for the same period, mentioned in Section 4.2.

Table 5 organizes key features of the above Figure 8. The DD estimation, presented in Column

Table 5: O&M Expenses and Deregulation

Dependent Variable: O&M Expenses ($1000)

	Dependent Variable					
	O&M Expenses			Log O&M Expenses		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	24,988***	24,848**	5,655	0.157**	0.157**	-0.002
	(9,416)	(9,450)	(10,326)	(0.064)	(0.064)	(0.053)
Constant	105,646***	110,128***	96,489***	10.862***	11.012***	10.912***
	(11,397)	(2,931)	(4,470)	(0.129)	(0.020)	(0.027)
Observations	3,863	3,863	3,863	3,862	3,862	3,862
R-squared	0.02	0.04	0.24	0.01	0.03	0.30
Number of comp	183	183	183	183	183	183
Utility-State FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Note: Unit of observation is utility-state-year. Columns (1) and (4) present results from random effect GLS regressions. Robust standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1

(3) (and in (6) with log O&M expenses) is based on a specification of the following form:

$$O\&M\ Expenses_{it} = \beta_0 + \beta_1 Deregulation_{it} + \gamma_i + \delta_t + \varepsilon_{it}.$$

Columns (4) and (5) show that deregulation is associated with about a 16% increase in O&M expenses over time. However, the DD estimate shows essentially no relationship between the two.

In the next step, I investigate the extent to which the ideological makeup of the PUCs influences O&M expenses. Table 6 presents regressions that include *Republican Influence* and its interaction with deregulation. The full specification is of the following form:

$$\begin{aligned} O\&M\ Expenses_{it} &= \beta_0 + \beta_1 Deregulation_{it} + \beta_2 Republican\ Influence_{it} \\ &\quad + \beta_3 Deregulation_{it} * Republican\ Influence_{it} + \gamma_i + \delta_t + \varepsilon_{it}. \end{aligned}$$

The results in the top panel show a reduction in O&M expenses under conservative regulators that is both statistically and quantitatively significant. The bottom panel, using log O&M expenses, shows weaker results suggesting that the reduction in O&M expenses shown in the top panel took place mainly in large utilities. Nevertheless, the coefficient estimate in Column (6) of the bottom panel shows a 11-12% reduction in O&M expenses under the most conservative regulators relative to the most liberal ones.

Table 6: O&M Expenses, Deregulation, and the PUC Ideological Makeup

	Dependent Variable: O&M Expenses ($1000)					
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	28,250***	37,555**	28,175***	37,824**	6,794	7,064
	(9,222)	(16,372)	(9,237)	(16,368)	(9,274)	(14,360)
Republican Influence	-35,444**	-29,227*	-36,014**	-29,575*	-26,920***	-26,747**
	(14,134)	(14,915)	(14,183)	(15,011)	(9,960)	(11,066)
Deregulation		-19,366		-20,089		-563
*Republican Influence		(18,978)		(18,799)		(12,863)
Constant	121,284***	118,583***	126,156***	123,310***	106,618***	106,551***
	(15,159)	(15,842)	(6,614)	(7,699)	(3,400)	(3,912)
Observations	3,853	3,853	3,853	3,853	3,853	3,853
R-squared	0.01	0.01	0.07	0.08	0.26	0.26
Number of comp	183	183	183	183	183	183
Utility-State FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	Yes	Yes
	Dependent Variable: Log O&M Expenses					
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	0.173***	0.215**	0.173***	0.216**	0.002	-0.029
	(0.064)	(0.098)	(0.064)	(0.098)	(0.052)	(0.068)
Republican Influence	-0.175*	-0.147	-0.177*	-0.148	-0.095	-0.115**
	(0.103)	(0.115)	(0.103)	(0.115)	(0.057)	(0.057)
Deregulation		-0.087		-0.089		0.064
*Republican Influence		(0.161)		(0.161)		(0.091)
Constant	10.940***	10.927***	11.091***	11.078***	10.948***	10.956***
	(0.125)	(0.126)	(0.049)	(0.054)	(0.032)	(0.030)
Observations	3,852	3,852	3,852	3,852	3,852	3,852
R-squared	0.00	0.00	0.05	0.05	0.30	0.30
Number of comp	183	183	183	183	183	183
Utility-State FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	Yes	Yes

Note: Unit of observation is utility-state-year. Columns (1) and (2) in each panel present results from random effect GLS regressions. Robust standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1

4.4 Reliability

In this subsection, I investigate key patterns of SAIDI, the outage measure. Let us first look at the overall trend of SAIDI, presented in Figure 9. SAIDI has gradually increased over time from the mean SAIDI of around 100 in the early 1990s to the mean SAIDI of around 150 in the mid-2000s. As in the case of executive salary, the increasing trend came to a halt around the mid-2000s and there was a slight decrease at the end of the data period. Considering the fact that deregulation spread in the late 1990s and that the process was suspended by the mid-2000s, it gives a time-series association between deterioration in reliability (increase in the SAIDI) over time and deregulation.

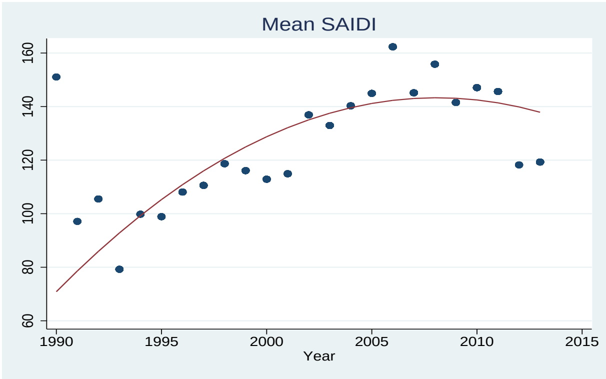


Figure 9: Mean SAIDI Over Time

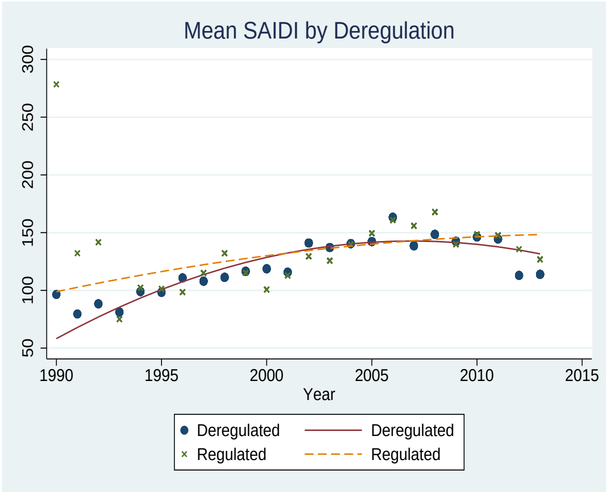


Figure 10: Mean SAIDI Over Time by Deregulation

However, as in the case of other variables analyzed above, looking at the difference across states over time renders a different conclusion. Figure 10 shows the yearly mean SAIDI over time, separately for states that have experienced deregulation for the period of 1990-2013 and those that have not, which shows very similar trends for the two groups. Overall, the magnitude of the difference in differences between the two groups is much smaller than the trend.

Table 7: Reliability and Deregulation

	Dependent Variable					
	SAIDI			log(SAIDI)		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	18.835**	21.330***	16.250*	0.158***	0.177**	0.068
	(8.500)	(7.745)	(9.079)	(0.060)	(0.067)	(0.066)
Constant	133.650***	125.749***	159.529***	4.678***	4.631***	4.712***
	(8.764)	(3.704)	(43.114)	(0.060)	(0.032)	(0.238)
Observations	1,949	1,949	1,949	1,949	1,949	1,949
R-squared	0.00	0.00	0.04	0.00	0.01	0.11
Number of Utility-States	164	164	164	164	164	164
Utility-State FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Note: Unit of observation is utility-state-year. Columns (1) and (4) present results from random effect GLS regressions. Robust standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1

Table 7 organizes the key points from Figure 10 quantitatively by contrasting the results from before-after estimation with those from the DD estimation. The DD estimation, presented in Column (3) (and in (6) with logged SAIDI), follows a specification of the following form:

$$SAIDI_{it} = \beta_0 + \beta_1 Deregulation_{it} + \gamma_i + \delta_t + \varepsilon_{it},$$

in which γ_i is utility-state fixed effect, δ_t is year fixed effect.

Estimates in Columns (1), (2), (4), and (5) show that deregulation is associated with a significant increase in SAIDI (around 15-18%) over time. As in the case of other variables above, whether utility-state fixed effects is included or not makes almost no difference to the estimates, indicating the dominance of the trend compared with cross-sectional differences. DD estimates in Column (6) shows a magnitude that is only about a third of the estimates in specifications without year fixed effects. This demonstrates the smallness, if any, of the impact of individual states' restructuring decision on reliability.

4.5 Electricity Price

In this section, I investigate fluctuations in electricity prices. Borenstein and Bushnell (2015) argue that fluctuations in electricity prices were primarily influenced by exogenous factors such as natural gas prices. The point of the documentation of price fluctuations in this subsection is to use it as a basis for further analysis – the influence of regulatory ideology on electricity prices.

Figure 11 shows the fluctuation of the electricity price averaged across customer classes (left panel) and residential electricity price (right panel). Electricity prices had a decrease from early

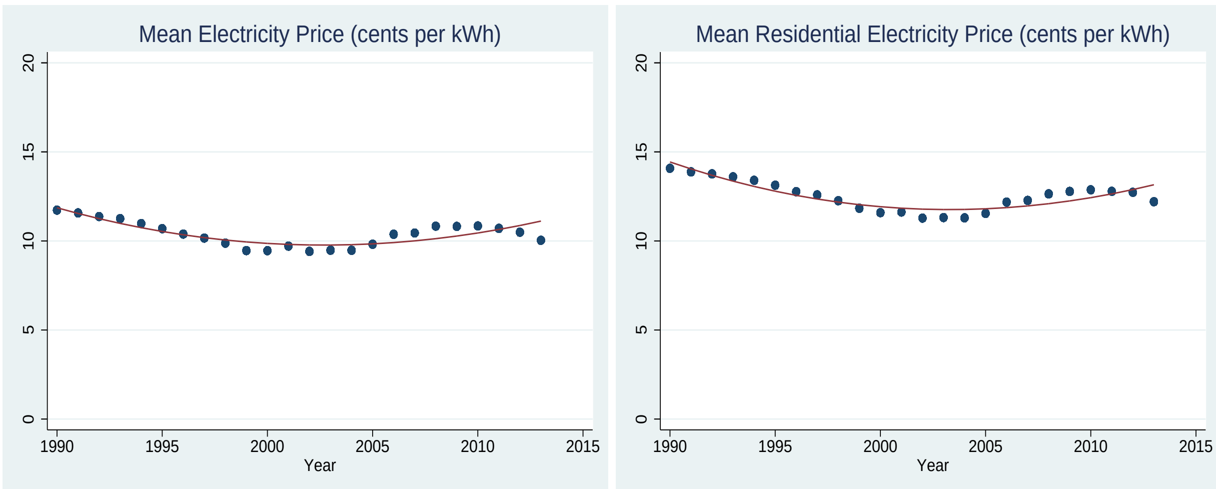


Figure 11: Mean Electricity Price Over Time (cents per kWh)

1990s, even before active deregulation of the industry. The trend of the drop in prices continued throughout the late 1990s, which was the period of deregulation. Then, around 2005-2010, there was a period of high electricity prices.

Figure 12 shows electricity prices by two different groups of states based on whether they have ever had deregulation for the period of 1990-2013. It shows that patterns in the two groups are almost parallel across the entire data period.

Table 8 organizes key patterns in Figure 12. The DD estimation, presented in Columns (3) and (6) show results from specifications of the following form:

$$Price_{it} = \beta_0 + \beta_1 Deregulation_{it} + \gamma_i + \delta_t + \varepsilon_{it},$$

where $Price_{it}$ is electricity price in state i in year t, γ_i is a state fixed effect, and δ_t is a year fixed effect. For both total and residential electricity prices, the DD estimates of the association between prices and deregulation, in Column (3) and (6), are negligible compared with estimates in Columns (1), (2), (4), and (5) that capture the movement due to the trend. The smallness of difference-in-

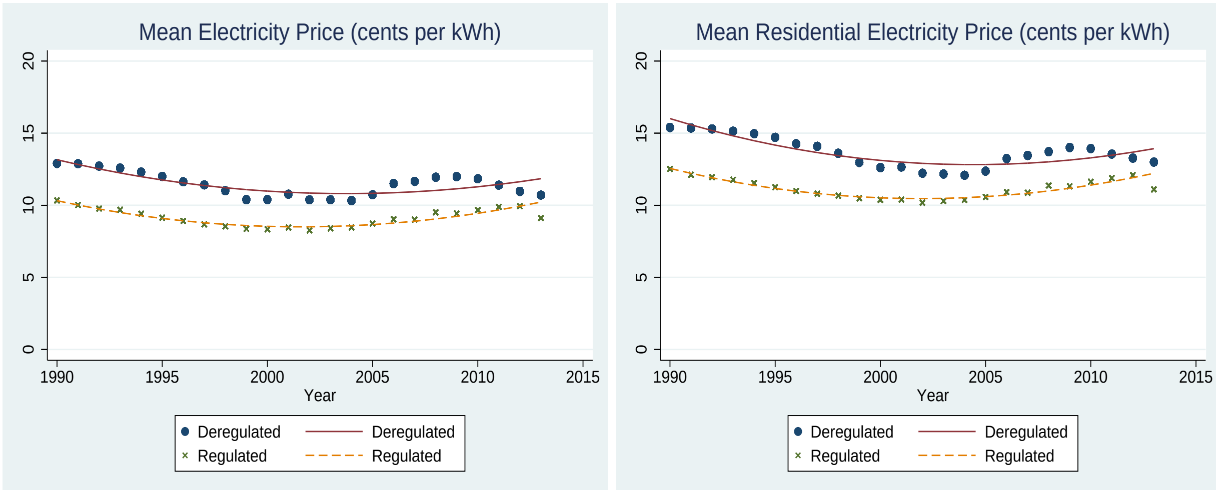


Figure 12: Mean Electricity Price Over Time by Deregulation

differences association between deregulation and electricity prices largely confirms the argument of Borenstein and Bushnell (2015).

In the next step, I investigate the role of regulator ideology, measured by the proportion of Republicans on the state PUC (*Republican Influence*). Full specifications of Table 9, in Column (6) of each panel, are based on the following equation:

$$\begin{aligned} Price_{it} &= \beta_0 + \beta_1 Deregulation_{it} + \beta_2 Republican\ Influence_{it} \\ &\quad \beta_3 Deregulation_{it} * Republican\ Influence_{it} + \gamma_i + \delta_t + \varepsilon_{it}. \end{aligned}$$

In Columns (5) of each panel, the estimates show that *Republican Influence* significantly increases electricity prices. And, the magnitude of the relationship is significantly larger than the DD estimate of the relationship between deregulation and the decrease in prices. Column (6) of each panel shows positive coefficient estimates for $Deregulation * Republican\ Influence$ although they are not statistically significant. In sum, electricity prices are significantly associated with regulator ideology in both deregulated and regulated states, with a stronger relationship in deregulated states.

These results are consistent with the conceptual background laid out in Section 2.2 as well as findings in Lim and Yurukoglu (2016). That is, if rent-shifting between consumers and utilities was an important motivation for deregulation, regulator ideology may easily be reflected in the process of setting rate freezes and recovery of stranded costs. On the other hand, Lim and Yurukoglu (2016) find two alternative mechanisms, unrelated to deregulation, through which conservative regulator ideology would be associated with higher electricity prices. First, conservative regulators tend to adjudicate a higher rate of return on utilities' capital in rate cases. Second, utilities tend to incur more energy loss under conservative regulators. Both high rates of return and larger energy loss are

Table 8: Electricity Price and Deregulation

Dependent Variable: Electricity Price (cents per kWh)

	Dependent Variable					
	Total Price			Residential Price		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	-0.926***	-0.973***	-0.088	-1.286***	-1.342***	-0.275**
	(0.121)	(0.121)	(0.126)	(0.133)	(0.133)	(0.138)
Constant	10.744***	10.750***	11.752***	12.850***	12.858***	13.924***
	(0.407)	(0.049)	(0.165)	(0.431)	(0.054)	(0.182)
Observations	1,196	1,196	1,196	1,196	1,196	1,196
R-squared	0.05	0.05	0.28	0.04	0.08	0.30
Number of State	50	50	50	50	50	50
State FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Note: Unit of observation is utility-state-year. Columns (1) and (4) present results from random effect GLS regressions. Robust standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1

factors that increase electricity prices under conservative regulators in deregulated and regulated states alike.

5 Conclusion

This study documents changes in the conduct of regulated electric utilities for the past two decades. Most of the key dimensions of conduct, including executive compensation, investment in distribution capital, O&M expenses, reliability, and pricing, demonstrate significant changes associated with the wave of deregulation. The impact of individual states' choice of deregulation was small, however, in all dimensions investigated. Rather, the influence of regulator ideology is more notable.

Future research could go in two directions. First, more detailed research is needed to further understand patterns in executive compensation, investments and operations, and reliability. Natural gas price, which is the exogenous factor that influences fluctuations in pricing, is not likely to explain changes in other aspects of conduct mentioned above. Moreover, for those other dimensions, there might have been significant spill-over across states and utilities rather than a single exogenous factor that influences the industry as a whole.

Second, it would be useful to conduct a study on relative impacts of trends, individual states' choice, and political environments on environmental regulation that influences the electricity in-

Table 9: Electricity Price, Deregulation, and Regulator Ideology

	Dependent Variable: Total Price (cents per kWh)					
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	-0.919***	-0.835***	-0.969***	-0.870***	-0.068	-0.108
	(0.125)	(0.193)	(0.124)	(0.192)	(0.128)	(0.183)
Republican Influence	-0.139	-0.089	-0.111	-0.051	0.346**	0.323*
	(0.173)	(0.195)	(0.173)	(0.194)	(0.154)	(0.172)
Deregulation		-0.193		-0.230		0.092
* Republican Influence		(0.340)		(0.338)		(0.300)
Constant	10.799***	10.778***	10.784***	10.759***	11.617***	11.626***
	(0.414)	(0.412)	(0.089)	(0.096)	(0.175)	(0.178)
Observations	1,145	1,145	1,145	1,145	1,145	1,145
R-squared			0.05	0.05	0.29	0.29
Number of state	50	50	50	50	50	50
State FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	Yes	Yes

	Dependent Variable: Residential Price (cents per kWh)					
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deregulation	-1.297***	-1.312***	-1.357***	-1.355***	-0.266*	-0.361*
	(0.137)	(0.211)	(0.136)	(0.210)	(0.141)	(0.201)
Republican Influence	-0.063	-0.075	-0.029	-0.028	0.425**	0.369*
	(0.190)	(0.213)	(0.189)	(0.212)	(0.169)	(0.189)
Deregulation		0.040		-0.004		0.220
* Republican Influence		(0.373)		(0.370)		(0.330)
Constant	12.872***	12.877***	12.857***	12.857***	13.760***	13.780***
	(0.438)	(0.435)	(0.097)	(0.106)	(0.193)	(0.195)
Observations	1,145	1,145	1,145	1,145	1,145	1,145
R-squared			0.08	0.08	0.31	0.31
Number of State	50	50	50	50	50	50
State FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	Yes	Yes

Note: Unit of observation is utility-state-year. Columns (1) and (2) present results from random effect GLS regressions. Robust standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1

dustry. For example, the process in which renewable portfolio standards (RPS) were diffused across states in the late 2000s is similar to that of deregulation in the 1990s. There was a wave of legislation and implementation of RPS, with the lead of liberal, large, and urban states, which subsequently influenced the entry of new firms and the conduct of existing energy firms. Such research would enhance our understanding of the functioning of regulatory policies.

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Table A1: Deregulation of the U.S. Electricity Industry

Deregulation Status	States
Deregulated, Currently Active	Connecticut, Delaware, District of Columbia, Illinois, Massachusetts, Maine, Maryland, Michigan, New Hampshire, New York, New Jersey, Ohio, Oregon, Pennsylvania, Rhode Island, Texas
Deregulated, Suspended	Arizona, Arkansas, California, Montana, Nevada, New Mexico, Virginia
Regulated	Alabama, Alaska, Colorado, Florida, Georgia, Hawaii, Iowa, Idaho, Indiana, Kansas, Kentucky, Louisiana, Minnesota, Missouri, Mississippi, Nebraska, North Carolina, North Dakota, Oklahoma, South Carolina, South Dakota, Tennessee, Utah, Vermont, Washington, West Virginia, Wisconsin, Wyoming

Source: U.S. Energy Information Adminstration.
Note: Classification in this table is based on states' legislation of deregulation. 'Deregulated, Currently Active' category means states that currently have divested utilities and retail competition. 'Deregulated, Suspended' category means states that had legislated deregulation (and implemented it in many cases) and subsequently repealed it. 'Regulated' category means states that never had any legislations of deregulation.