

**Measuring the Effect of Electric Utility Deregulation on Residential Retail Prices in a
Midwestern State**

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Executive Summary

The deregulation of the electric utility industry is one of the largest deregulation efforts in U.S. history. Proponents argue that getting rid of the outdated utility model of regulated monopolies and introducing competitive markets will lower prices, increase efficiency, and result in a net benefit for the nation. Opponents, on the other hand, believe that both the tumultuous history of the electric utility industry and experiments with deregulation have shown that competitive markets for electricity are too open to manipulation and will result in increased prices for consumers and dangerous volatility in the provision of electricity. This paper will attempt to answer the question: does deregulation lower the price of electricity? The first section of this paper will detail technical and historical background information that is necessary to understand the debate surrounding the regulation of electric utilities. The second section will explore the relevant literature surrounding the empirical effects of deregulation. The third section will propose a method of testing the effect that deregulation has on the price of electricity by conducting a difference-in-difference analysis between Ohio (deregulated) and Indiana (regulated) pre and post deregulation. Results show that deregulation in Ohio has led to a modest decrease in retail prices for residential consumers relative to Indiana. This result was counter to the author's expectations, but is not completely unexpected as it aligns with some of the current literature, which generally shows small or no changes to residential retail prices.

Background

Structure of Electric Utilities

It is necessary to briefly describe the structure of electric utilities before discussing the consequences of regulation and deregulation. Electric utilities are generally broken down into three functions which are generation, transmission, and distribution. Generation is the physical creation of electricity at a power plant. Transmission is the conveyance of this electricity through power lines from the power plants to local utilities. Finally, distribution occurs when the local utilities transmit the electricity to the final consumer (Brennan et al., 2002).

Historically, public utilities have been characterized by vertical integration. This is when a single company runs two or more of the functions of a utility. Vertical integration has two main benefits for electric utilities. First, it allows utilities to take advantage of efficiency gains that come from controlling all three functions. These gains, in theory, will allow companies to produce, transmit, and distribute electricity with the lowest possible costs. Second, because electricity storage is quite difficult, electricity transmission requires a lot of coordination between generation and distribution to avoid waste. Vertical integration facilitates this coordination by having a single entity working both ends (Michaels, 2004).

The Era of Regulation

Electric utilities have been regulated in the United States for most of their history. However, this has not always been the case. Before the 1930s the electric industry was largely unregulated. The experiences of this era can shed light on the rationale behind regulation and the possible consequences of deregulation.

The first power plant was built by Thomas Edison in Manhattan in 1882 and by 1902 there were 3,620 power plants nationwide. These plants were almost exclusively owned by

private companies and were subject to no government oversight (Brennan et al., 1996). As the electric industry grew it came to be dominated by holding companies. These holding companies were characterized by a byzantine structure wherein a small group of investors owned many unrelated business ventures and investments. The electric utilities were particularly attractive as subsidiaries of these groups due to the nature of the industry, as electricity generation provided guaranteed revenue. The companies used this revenue in order to finance risky investments, which led them to having very large debts and relatively small assets. Holding companies in this era grew into massive organizations and quickly consolidated nearly the entire electric utility industry. In 1930 the 10 largest holding companies produced 75% of the nation's electricity (Mahoney, 2008).

When the Great Depression hit the United States holding companies were firmly in control of the electricity market. This led to disaster when banks decided to call in their loans to these holding companies. Due to their highly leveraged nature most of them could not pay back their loans and collapsed. This left the industry in shambles and investors, many of whom were average citizens who were told utilities were a safe investment, with nothing ("Public vs. Private Power", 2001). One of the most infamous cases involved Samuel Insull. As the head of Commonwealth Edison, Insull had pioneered both vertical integration in the electric industry and the industries use of holding companies. Insull presided over one of the largest holding companies in the nation which was operating in 30 states at its height ("Public Utility Holding Company Act", 1993). When the industry collapsed shares in his company dropped from \$570 to \$1.25 and 600,000 people lost their life savings. Insull, once a titan of industry on the level of John D. Rockefeller, was vilified by politicians and fled the country in disgrace (Munson, 2005).

The disastrous effects of the unregulated utilities market led to the passage of the first strict federal utility regulations in the form of the Public Utilities Holding Companies Act of 1935 (PUHCA). This bill sought to address some of the largest drivers of the collapse of the early 1930s by strongly regulating holding companies. The act limited the geographic scope of public utilities, limited the amount of debt they could take on, and forbid the grouping of public utilities and other subsidiaries under one company (“Public Utility Holding Company Act”, 1993). The intent was to prevent the large concentration of power in a few companies and the use of utilities to finance risky investments. Under the act the SEC was given regulatory power over any interstate transmission of electricity and individual states were given power to regulate the utilities that operated within their borders. At the same time the Federal Water Power Act was amended to create the Federal Power Commission (FPC) which had power over interstate transmission of electricity and set the wholesale price of electricity (Brennan et al., 1996).

States reacted to their newfound powers of regulation by setting up utility commissions and establishing price controls on the retail price of electricity. These prices were based on the cost to produce electricity that producers incurred, with a reasonable bit of profit for the utility. The alternative to cost-based pricing is market pricing where the prices are set based on supply and demand in a competitive market. The states also required that producers get approval for rate increases and changes to terms and conditions. Increases had to be justified based on a rise in costs to the producer in order to be approved (Fox-Penner, 1994).

The next major development in the regulation of the electric industry came in the wake of the Northeast Blackout of 1965. On November 9, 1965 a faulty relay switch caused an overloading of the power system and resulted in a blackout that left 30 million people over 80,000 square miles without power (“Nov. 9, 1965”, 2011). In response to the blackout, the FPC

recommended the formation of a group that can help ensure the reliability of the electric grid in order to avoid another incident (“History of NERC”, 2013). This led to the formation of the North American Electric Reliability Council (NERC). The council divided the United States and Canada into coordinating zones. Each of these zones developed standards and practices for coordination and distribution of wholesale energy. The entire organization shared information, experiences and, though voluntary, encouraged uniform adoption of these standards (Brennan et al., 2002). In 2006 NERC gained federal authority to enforce their standards (“Frequently Asked Questions”, 2012).

Towards Deregulation

The first movement towards deregulation in the industry began with the energy crisis of the 1970s. The OPEC oil embargo and ensuing energy crisis in the 1970s caused a significant rise in the price of oil in the United States. The price for a barrel of oil rose from \$3.18 in 1970 to \$12.64 in 1979 (“Petroleum & Other Liquids”, 2016). This had two effects that helped fuel the movement towards deregulation.

The first effect was that the spike in oil prices had a direct effect on the input cost for electricity producers. In the 1950s and 1960s oil prices held steady at fairly low levels. This caused a large investment in oil fired power plants in the United States. Subsequently, the low price of oil meant that consumers enjoyed low, and often declining, prices for electricity. With the rise in oil prices the costs began to be passed on to consumers in the form of higher rates (Geddes, 1992).

The second effect that the energy crisis had is that it turned energy into a national security concern. Politicians decided that the United States needed to transition away from its heavy

reliance on foreign energy sources. This culminated in the passage of the Power Plant and Industrial Fuel Use Act of 1978 (PIFUA). This act restricted the use of oil burning power plants and incentivized the use of coal and nuclear power. By restricting the use of oil plants the government pushed the electricity industry, which was already moving in this direction due to increased oil prices, to construct new plants or to convert old plants from oil to coal. The cost of construction of these plants was passed on to consumers (Richardson and Nordhaus, 1995).

PIFUA was part of a larger package introduced by President Carter that aimed to reduce American reliance on foreign oil. This package also included the Public Utilities Regulatory Policies Act of 1979 (PURPA), which ended up being one of the most consequential pieces of legislation in the movement towards deregulation. PURPA incentivized a shift towards alternative energy by requiring producers to purchase energy from certain independent generators such as those that produced electricity with alternative energy (Ardoin and Grady, 2006). This broke the monopoly that the vertically integrated firms had held for decades. The experience showed that electricity producers could purchase electricity in the first stage, generation, from third party producers without causing a significant disruption in the market (Brennan et al., 2002).

Continued high electricity costs in the 1980s increased calls for action by proponents of deregulation. In the 1990s the FPC, now known as the Federal Energy Regulatory Commission (FERC), issued a series of orders that allowed deregulation to take place. These orders required vertically integrated firms to allow independent generators access to their transmission lines at a reasonable rate. In the past only certain qualifying facilities were given access to these transmission lines, with the FERC orders the floodgates were opened (Borenstein and Bushnell, 2015).

However, it was still up to individual states whether to allow market prices for electricity sales within their states. This allowed states to begin to experiment with deregulation, in some cases referred to as restructuring. Two of the first states to experiment with deregulation were California and Pennsylvania. Both states opened up retail sales to competition. They created a marketplace where consumers could choose between multiple electricity providers. These providers bought or generated electricity then paid for the use of transmission lines to bring electricity to consumers. Regulators in these states phased out price controls on retail electricity and slowly began the conversion to market pricing (Blumsack et al., 2005).

By the year 2000 there were 23 states that had passed bills to ease regulations in their electricity market. Following the energy crisis in California in 2000, which will be covered in detail later, the benefits of deregulation were called into question. By 2014, 16 states had deregulated markets, seven states have suspended deregulation, and the rest have never experimented with deregulation (“Electricity Deregulation Map”, 2014).

Proposed Benefits of Deregulation

Now that the historical context of deregulation in the United States has been explored, it is necessary to describe the theoretical benefits of deregulation that led to this push. The original rationale for the vertically integrated firm was that a monopoly was necessary to capture efficiency gains granted by a single firm being able to coordinate all aspects of electricity distribution. Furthermore, the high cost of constructing and maintaining plants required a monopolistic firm that could capture guaranteed profits to ensure a return on investment (Klitgaard and Reddy, 2000). Advances in both communication and generation technology, it was argued, rendered a large part of these advantages obsolete.

Competition would incentivize firms to engage in cost cutting through the implementation of more efficient generation methods. This would include moving away from old, inefficient plants which would have a side effect of lowering environmental damage. In addition to increasing efficiency, firms would be competing for customers which would lead to lower prices for all (Joskow, 1997). By opening up the production and distribution of electricity while maintaining the monopoly on transmission, made possible by FERC requiring utilities to allow third party transmission, proponents hoped to capture the most beneficial aspects of both competition and monopoly.

Literature Review

The California Crisis

Any examination of the literature surrounding the effects of deregulation must begin with the energy crisis in California in 2000. This was a watershed moment in the deregulation movement and spawned countless case studies and papers in an attempt to determine why the deregulation experiment in California failed.

California created both wholesale and retail sales markets when it deregulated its industry. They allowed wholesale prices to be determined by the market immediately, while they put a temporary cap on the price of retail electricity and limited the rate of price increases for four years. This was done in an effort to insulate consumers from price volatility that was expected to occur during the transition period. In addition to the creation of two new markets, lawmakers included subsidies for existing utilities to help them cover expenses for already built power plants and infrastructure. The bill was crafted in a manner that gave every stakeholder

something they wanted in an effort to attain broad support. The bill ended up passing unopposed (Munson, 2005).

California experienced disaster shortly after implementation. The state dealt with rolling blackouts and soaring electricity prices throughout 2000 and 2001. “Californians’ electricity bills went from \$7.25 billion for all of 1999 to \$7.5 billion for just the first six weeks of 2001” (Munson, 2005). The system experienced extreme volatility; on December 14, 2002 the average price for a megawatt hour spiked from \$30 to \$1400 (Trebing, 2008). Furthermore, there was rampant market manipulation by new entrants to the electricity market. Wholesale companies, Enron being the most famous example, would shut down power plants or book transmission lines in an effort to throttle supply during peak load times. This allowed these companies to then charge exorbitant prices to “fix” the problem (Trebing, 2008). Finally, the caps set on retail prices but not on wholesale prices caused large discrepancies in prices which many utilities could not afford. In effect the utilities were paying high prices on the wholesale market and being forced to sell electricity at a loss. This caused several large utilities to file for bankruptcy (Sexton, 2001). In 2002, California suspended their deregulation efforts and rolled back reforms (Munson, 2005).

Many studies have attempted to determine what exactly caused the energy crisis in California. The public policy implications are vastly different depending on if the root cause was the method by which California attempted deregulation or if it was deregulation itself. A fairly large amount of literature places the blame at the feet of the method of deregulation. This school of thought argues that political pressure to ensure broad support caused the bill to contain many aspects that came to a head and caused disaster. Chief among these issues was the fact that wholesale prices were to be based on market rates while retail prices would be fixed for a period

of years. This was based on the assumption that retail prices would remain higher than wholesale prices, as had been the case historically (Sexton, 2001). When wholesale prices rose above the fixed retail prices utilities were forced into bankruptcy and could not facilitate the amount of energy the state needed. In San Diego, where the local utility had been able to buyout the retail freeze and thus set their own rates, retail prices tripled (Cudahy, 2002). Numerous studies have come to the conclusion that the structure of Californian deregulation was the issue (Bhagwat, 2003; Congressional Budget Office, 2001; Cudahy, 2002; Joskow, 2001; Munson, 2005; Sexton, 2001).

The second school of thought believes that the crisis was caused by flaws inherent to any deregulation effort. The market for electricity is simply unable to efficiently function without oversight and regulation. In the absence of regulation the market is prone to both inefficient market domination by large firms and manipulation by firms. This will drive prices up, increase volatility, and lead to sub-standard provision of power (Borenstein et al., 2002; Brennen, 2002; Puller, 2007; Trebing, 2008). Furthermore, electricity markets have a fundamental problem wherein “demand is difficult to forecast and is almost completely insensitive to price fluctuations, while supply faces binding constraints at peak times, and storage is prohibitively costly” (Borenstein, 2002).

Effects of Deregulation on Retail Prices

Regardless of the cause, the failure in California had a chilling effect on deregulation efforts nationwide. However, there is a strong possibility that under the right circumstances, and with the proper policy, deregulation can be implemented without causing a disaster. In fact, many states have implemented deregulation programs without a resultant catastrophe. With that

in mind it becomes necessary to look at the broader literature that examines the effect of deregulation on the retail price of electricity. Even if deregulation efforts don't result in an energy crisis they may not be worth the effort if they do not result in lower prices.

Quite a few studies have examined the effect of deregulation on retail prices. Rose (2007) found that between 2002 and 2007 regulated states had prices increase by an average of 19.4%, while deregulated states saw prices increase by an average of 39.7%. A study that used a simple plot of retail prices between 1990 and 2014 in regulation, deregulation, and suspended states found that there has been very little effect on prices from deregulation (Morey and Kirsch, 2016).

A series of studies using more advanced statistical techniques have found varying results. A regression analysis of the early effects of deregulation using state-level panel data found that it had resulted in lower prices for industrial and residential consumers (Joskow, 2006). One recent study that used a difference-in-difference method, averaging regulated and deregulated states found that retail customers enjoyed short-term price benefits but that in the long run deregulation has not lowered prices (Su, 2015). Two studies used regression analysis to analyze the effects of deregulation in Texas, finding that prices increased for both residential (Zarnikau and Whitworth, 2006) and commercial (Zarnikau et al., 2007) customers. A final study, which estimated the price markup effects on both producers and consumers, found that producers in deregulated states had higher profits while consumers in deregulated states had higher prices than those in regulated states (Blumsack et al., 2008).

Research Design

The lack of consensus concerning the effects of deregulation on retail electricity prices shows the need for further research in this area. In order to develop a hypothesis it is necessary to apply the lessons from both the history of electric utilities and the empirical studies that have already been conducted. History shows that an unregulated electricity market lends itself to market manipulation and poor business practices. This has been seen time and again throughout history. It was seen pre-1935 during the era of large holding companies and again during the California electricity crisis. The large gap in time between the two events suggests that market manipulation is a feature of the system rather than a bug. This market manipulation has the effect of either directly raising electricity costs, as seen in California, or of introducing volatility into the system which can cause higher prices or a complete market crash. Due to the disputes over the cause of the crisis in California it will be helpful to examine a state in another part of the country that deregulated in a different fashion.

Turning to the empirical studies presents a less clear picture. This is because the price of electricity is influenced by such a vast array of factors that it is difficult to pinpoint the effect deregulation has had. Furthermore, many of the states that have introduced deregulation did so in response to already having higher than average electricity prices. This makes it difficult to determine a counterfactual level of electricity prices absent deregulation. However, a close look at the more sophisticated studies that have been conducted implies that there is a strong likelihood that deregulation has had either a negative impact or no net impact. Furthermore, price volatility and increases will theoretically be most likely during the first few years of implementation as consumers and industry adjust to the new scheme.

The historical experiences and empirical results lead to two hypotheses:

Hypothesis 1: *deregulation will cause retail electricity prices in a state to increase.*

Hypothesis 2: *price increases in Ohio will be most substantial in the first years of implementation, followed by less substantial price increases as the program ages.*

In order to test this I use the difference-in-difference (DD) method to study the effect of deregulation. The DD method will allow me to examine the effects by comparing a treatment and a control group in time periods before and after deregulation. This method attempts to replicate a randomized experiment in the wild. DD will help control for any price fluctuations that may occur due to differences between the two states other than the policy change and for any price fluctuations that occur throughout time for electricity prices in Ohio and Indiana. I believe that this method is superior to a regression analysis in this context due to the large number of extraneous factors that may influence the price of electricity. By selecting treatment and control groups that are similar to each other in most respects other than deregulation, the level of bias in the results will be lower than it would be using a regression.

To this end, I will look at Ohio and Indiana before and after Ohio's deregulation efforts took effect in 2001. Ohio passed a bill to introduce electric utility deregulation, SB 3, in 1999. Effective January 1, 2001, this law allowed consumers to choose between any of the electric providers in their area. SB 3 was similar to most other deregulation schemes in that it continued the regulation of the transmission stage, but opened up generation and distribution to competition (Thomas et al., 2014). Ohio and Indiana are remarkably similar in many respects. **Table 1** shows a few statistics that illustrate their similarity. I believe that the nature of their demographic and economic similarities means that they are affected by many of the same factors and thus make a good comparison group.

Table 1

	Indiana	Ohio
Population, 2014	6,596,855	11,594,163
White alone, percent, 2013	86.30%	83.20%
Black or African American alone, percent, 2013	9.50%	12.50%
Bachelor's degree or higher, percent of persons age 25+, 2009-2013	23.20%	25.20%
Homeownership rate, 2009-2013	70.00%	67.50%
Median household income, 2009-2013	\$48,248	\$48,308
Persons below poverty level, percent, 2009-2013	15.40%	15.80%

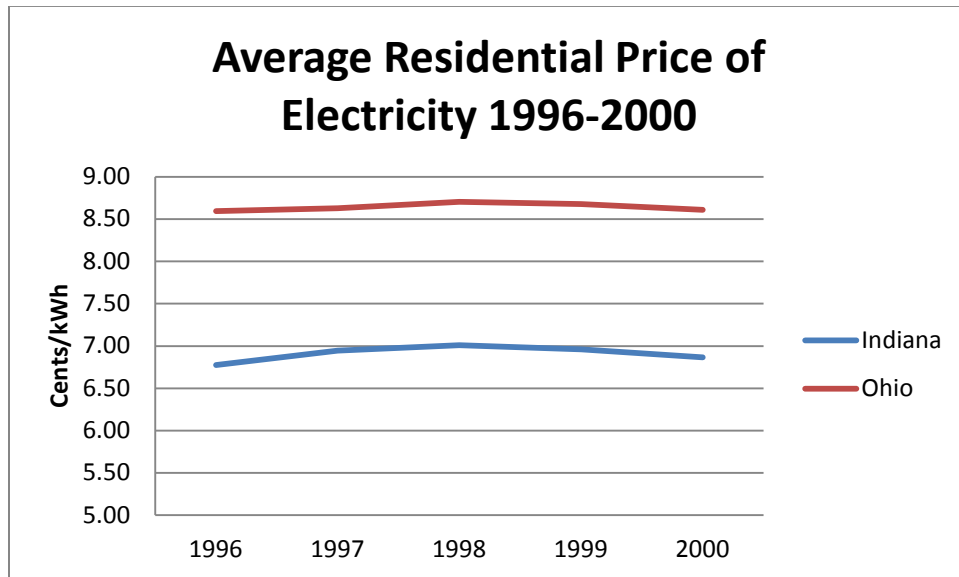
Source: U.S. Census Bureau

However, with a difference-in-difference, it is necessary to select two states that exhibit parallel trends before implementation in order to mitigate potential sources of bias. If the control and treatment groups are exhibiting different behavior pre-treatment it will be difficult to argue that any changes post-treatment are due to the treatment. In this case, the residential price of electricity before deregulation was trending in the same direction for both states with rates in Ohio being about 20% higher, on average, for the years 1996-2000 (**Figure 1**).

Three difference-in-difference estimates will be gathered for different time intervals. As stated above, there may be a period of adjustment during which prices become more volatile and

possibly increase. I predict that after time consumers and the industry will become familiar with the new system and prices will decrease, while still remaining high relative to Indiana. For this reason one year, four year, and eight year estimates will be conducted. The farther out from the time of treatment the less reliable the estimation becomes. This is because as we progress away from treatment the possibility of other changes or policies influencing the price of electricity increases. With the possible exception of the eight year estimate, the time horizons chosen for this study are relatively short and will still give us telling details about the effects of deregulation.

Figure 1



Source: Energy Information Administration

Data concerning the average retail price of residential electricity has been gathered from the Energy Information Agency, which compiles state-level, monthly figures for the average residential and industrial price of electricity in terms of cents per kilowatt hour (kWh).

Results

Results for the difference-in-difference estimation are presented in **Table 2**. All estimates are reported as cents per kWh. The results of the estimation show a consistent price decrease across the first two time horizons. The one year estimate is significant to the .05 level while the four year estimate is significant to the .01 level. The results of the eight year estimate are not significant so we cannot reject the null hypothesis and thus do not have evidence that Indiana and Ohio are statistically different after eight years. The estimated price decrease in the first year of deregulation is .29 cents. These savings increase to .44 cents four years after implementation. In percentages, the price decrease estimated to be attributed to deregulation was 3.42% in the one year estimate, 5.24% in the four year estimate.

Table 2 – Average Retail Price of Residential Electricity (per kWh) before and after deregulation in Ohio

	1 year estimate			4 year estimate			8 year estimate		
	Post Treatment	Pre Treatment	Difference, Post-Pre	Post Treatment	Pre Treatment	Difference, Post-Pre	Post Treatment	Pre Treatment	Difference, Post-Pre
Treatment (Ohio)	8.37	8.64	-0.27	8.33	8.64	-0.31	8.85	8.64	0.21
Control (Indiana)	6.92	6.91	0.01	7.04	6.91	0.13	7.63	6.91	0.72
Difference, Ohio - Indiana	1.45	1.73	-0.29** (0.113)	1.29	1.73	-0.44*** (0.105)	1.22	1.73	-0.51 (0.463)

Standard Errors in parenthesis

*** p < 0.01; ** p < 0.05; * p < 0.1

Discussion

The results differ from expectations across the board. Each period shows an unexpected decrease in prices. In terms of **hypothesis 1**, which predicts that prices will increase, it is clear that this study does not support this hypothesis. Prices decreased in every period studied in both raw cents and percentages. While perhaps less of a decrease than what proponents estimated, a price savings of 3.42%-5.24% in electricity costs would be very valuable to residents, especially those in poverty. This hypothesis was based on two possibilities. First, the assumption that firms may engage in collusion, price gouging, and other manipulative practices seen in California. This would be due to the high cost of entry into the market which would lead to a small number of firms being able to dominate the market. Second, due to factors such as lack of information, apathy, and confusion, consumers may not seek out their optimal electricity provider. The evidence suggests that these events did not occur at a significant level.

Hypothesis 2 stated that the price increases would be highest in the first year and would subsequently decrease as the market adjusted. At first glance it appears that this hypothesis is not supported by the results, as prices decrease in each of the estimated time periods. However, there appears to be support for the broader theory that greater price savings will occur in time periods further from implementation (in this case it is simply continued price decreases rather than a slowing of price increases). The four year interval shows an additional .15 cents in savings compared to the prices one year after implementation.

One possible explanation is that as consumers and producers become accustomed to the system consumers continue to shop for the best deal they can get while producers continue to introduce efficiencies in order to gain more customers through lower prices. If that were the case we would expect to see further decreases throughout the time studied, and this is what occurs.

The non-significance of the eight year estimate somewhat clouds the picture as we cannot say there is a difference between Indiana and Ohio after eight years. This suggests either the savings experienced in the first years of deregulation evaporate over time or the difference-in-difference estimation is a poor estimator over this long time horizon.

Conclusion

An important limitation to this research is that the reliability of the difference-in-difference estimate diminishes as the time from treatment increases. There could have been exogenous changes in Ohio that affected the price of electricity in the eight years studied. This is one possible explanation for the lack of statistical significance in the eight year estimate. However, if we accept the results that there is no evidence of a statistical difference between Indiana and Ohio after eight years there is still evidence to support deregulation. In this case it simply means that deregulation led to a short term price savings. For this reason, it is worth comparing these longer estimates to the experiences of other states to determine if the cost savings really disappear after a number of years.

One related area where long term study is needed is the interaction between the percentage of savings consumers experience and the cost of electricity. If savings do not keep pace with electricity prices in the long run, then the short-term effects may be negated. If this is the case deregulation may not be as beneficial as it appears from this study. Future studies should attempt to replicate these results with similar and longer time horizons to determine if the trends found in Ohio are consistent with other states.

The central place that electricity has in all of our lives and the proper functioning of the economy mean that it is important to study the effects of reforms in the industry. This is vital to producing the best possible outcome for the nation. While the price of electricity is the focus of this paper it is important to remember that it is not the only important outcome. In the future, further research needs to be conducted concerning the effect of deregulation on generating capacity, alternative energy sources, and grid reliability, among a host of other variables. I believe that this paper can serve as a template with which to conduct these studies, as the subject currently has very few studies that use difference-in-difference estimation.

In terms of a policy recommendation I think that states with high levels prices relative to neighboring areas have reasonable evidence that a deregulation effort could help residents of their state. Ohio shows that, if properly enacted, these policies can introduce modest cost savings. However, legislators should be cautious as California provides an example of deregulation gone awry. It is important that any state contemplating deregulation weighs the potential benefits with the potential costs.

Overall, this study provides some evidence that deregulation can have a positive effect on a state. In Ohio, it appears to have led to a modest decrease in residential retail electricity prices. On the whole the literature is still quite mixed, with many studies showing no change or a slight change in either direction. My work is firmly in line with the general consensus of modest to no change, but helps support the body of work showing that the modest change will be towards price decreases.

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