Have Customers Benefited from Electricity Retail Competition?*

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Abstract

Compared to traditional cost-of-service (COS) regulation, electricity retail competition may lead to lower costs but higher markups. Thus, the net policy effect on the average electricity retail price is ambiguous. This paper uses a difference-in-difference approach to estimate the policy impact for U.S. states that restructured their electricity retail markets. The results suggest that in restructured states, only residential customers have benefited from significantly lower prices but not commercial or industrial customers. Furthermore, this benefit is transitory and disappears in the long run. Overall, retail competition does not seem to deliver lower electricity prices to retail customers across the board or over time.

Keywords: Electricity; restructuring; retail choice, retail competition; difference-in-difference.

JEL codes: L52, K23, Q48, D42, D43

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1 Introduction

In the 1990s, a number of U.S. states began restructuring their electricity retail markets and pursued retail competition as an alternative to traditional cost-of-service (COS) regulation. Direct rate regulation was eschewed in favor of access regulation, thereby opening the electricity market to alternative retail service providers (RSPs). These firms procure electricity from power producers and market it to final customers, using existing electricity network infrastructure owned by local utilities. It was hoped that, by restructuring the electricity retail market to allow for competition, electricity prices determined in the marketplace would decrease, and welfare would increase.

However, there is no guarantee that retail competition will ultimately lead to lower retail prices paid by customers. Two potentially opposing effects arise from the same market restructuring process: On the one hand, competitive pressure gives all firms a strong incentive to cut costs. On the other hand, the oligopoly markup rate determined through competition may well exceed the markup rate charged by previously rate-regulated monopolies. Thus, unlike the hypothetical benchmark of an unregulated monopoly—where the introduction of competition would reduce both costs and markups—replacing rate regulation with competition may or may not result in lower prices.

This paper empirically investigates the policy impact of retail competition, as currently practiced in the U.S., on average electricity retail prices. Using data obtained from the Energy Information Administration (EIA) covering the period from 1990 through 2011, we examine the effects of a state's decision to implement retail competition on the average prices paid by different segments of customers, allowing for potentially different policy effects at different stages after market restructuring. To identify a causal impact, we employ a difference-in-differences (DID) approach, exploiting the fact that some states implemented retail competition in different years, while others never pursued restructuring at all.

Our results paint a rich and interesting picture. First, we find that the policy impact differs across customer segments: In restructured states, only residential customers have benefited from significantly lower prices (with price reductions ranging from 0.54 to 0.71 ¢/kWh) but not commercial or industrial customers.[1] Second, the policy impact is different in the short run, defined as a transitional period that immediately follows restructuring and lasts for a limited duration, and the long run. For example, using a five-year window for the transitional period, we find that the price reduction for residential customers is much more pronounced in the transitional period (ranging from 0.94 to 1.21 ¢/kWh), but is not significantly different from zero in the post-transitional period. For commercial customers, we find a price reduction (albeit insignificant) in the transitional period (ranging from 0.31 to 0.35 ¢/kWh), followed by a price increase (also

[1] Residential customers are mainly regular, single-family households living in houses or apartments. Commercial customers include businesses, offices, restaurants, hotels, etc., and industrial customers are large manufacturing or processing plants.

insignificant) in the post-transitional period (ranging from 0.24 to 0.35 ¢/kWh). For industrial customers, the price change is not significantly different from zero in the transitional period, and is followed by a price increase in the post-transitional period (ranging from 0.40 to 0.57 ¢/kWh). Across all customer segments, there is generally a significant upward price jump when moving from the transitional to the post-transitional period.

These results may appear counterintuitive at first glance. One would expect that size differences across customer segments translate into differences in their bargaining power with RSPs, with residential customers having the least, and industrial customers the most, bargaining power. Indeed, industrial customers on average pay a lower price than commercial customers, who in turn pay a lower price than residential customers, under both COS regulation and retail competition. However, when focusing on the difference between the two regulatory regimes, it is residential customers that benefit from restructuring. Why does more bargaining power fail to generate larger benefits from retail competition? Similarly, one would expect that competition is not well established in the short run, and whatever efficiency gains that could potentially be achieved through competition have not fully materialized yet. On the other hand, in the long run, competition should be well established and cost reductions associated with competition built into operational processes. Why, then, do prices jump upward, instead of downward, between the transitional and post-transitional period?

Both puzzles can be understood when looking more closely at the details of the restructuring process. Anticipating that it takes time to establish competition, states that pursue market restructuring generally stipulate additional regulatory provisions for a certain time period following the opening of their retail markets. In particular, many restructuring states in the U.S. implemented a period of temporary rate freezes or rate reductions to ensure price stability while competition was being established. The transitional retail markets that result from such hybrid regimes—namely, incipient competition coupled with price controls—are quite attractive for customers, and especially so for customers that have relatively little bargaining power on their own. However, lifting these price controls at the end of the transitional period will result in a price increase unless the cost savings from fully established competition have made the price cap non-binding. The true difference between the two regulatory regimes is thus better captured by the post-transitional price impact. Our results suggest that retail competition, as currently practiced in the U.S., fails to deliver lower prices in the long run.

In light of the more favorable results we obtain for the transitional period, one may ask whether states could permanently adopt a hybrid regime, and thus enjoy cost savings and low markup rates indefinitely. Given firms' participation constraints, however, this seems problematic. The fact that prices increased in the post-transitional period indicates that cost savings achieved under competition were not significant enough to compensate firms for the imposition of price controls. But at the same time, it may not be possible to achieve larger cost savings precisely because price controls discourage firms from entering the market or aggressively competing for

market share. We perform an empirical test to illuminate this issue. In addition to measuring the impact of *nominal* policy changes, we also use realized penetration rates of restructured retail services as an indicator for the degree of *effective* retail competition in a state. Some states implemented retail competition but, for various reasons, saw little realized competition in their retail markets. In these states, restructuring nominally took place but did not have a real impact on market composition. Using alternative numerical penetration thresholds to determine whether a state has achieved a meaningful degree of retail competition, our results are even less favorable: Whenever the policy effect is significant, retail competition is associated with *higher* rather than lower average prices. Thus, retail competition *per se* does not appear to be the driving force behind any observed price reductions.

The rest of the paper is organized as follows. In Section 2 we provide some background concerning electricity market restructuring in the U.S., and link this paper to the existing literature on competition and regulation of electricity markets. We then present our econometric model and discuss our identification strategy in Section 3. Data used for the empirical analysis are described in Section 4, and estimation results are reported in Section 5. We conclude with a discussion of the results in Section 6. All tables are in the Appendix.

2 Background

2.1 Restructuring of the U.S. electricity market

The U.S. electricity industry can be divided into a wholesale sector and a retail sector. The wholesale sector generates bulk power in power plants and transports it through the high-voltage, long-distance transmission grid to load centers. The retail sector purchases bulk power from the wholesale sector and distributes power through low-voltage, local distribution networks to final customers. Wholesale operations typically involve interstate commerce and are thus subject to state and federal regulations. On the other hand, retail operations do not usually involve interstate commerce and are subject to state regulations only.

A traditional electric utility is a vertically integrated local monopoly in both wholesale and retail operations, regulated by both federal and state agencies. The predominant form of regulation of utilities used to be cost-of-service (COS) regulation, i.e., price regulation. However, the mid-1990s saw a paradigm shift in electricity industry regulation in the United States. With the mandate of the 1992 Federal Energy Act, the Federal Energy Regulatory Commission (FERC) issued a series of regulatory orders to promote wholesale competition through access regulation to the transmission grid.[2] The restructuring of the wholesale market replaced traditional COS regulation of wholesale operations with wholesale competition.

[2]See Federal Energy Regulatory Commission, Orders No. 888, No. 889, and No. 890.

Soon after the restructuring of the wholesale market, some states started to experiment with a similar restructuring of their retail markets. Traditional COS regulation of retail operations was replaced with retail competition, enabled by access regulation of distribution networks. Depending on the state, retail restructuring may be implemented through state legislation, regulatory orders, court decisions, or a combination of these actions. By the end of 2011, active retail competition exists for residential customers in 14 states, for commercial customers in 16 states, and for industrial customers in 18 states. Figure 1 is a snapshot of restructured states for the year 2011. Table 1 shows the evolution of the restructuring status across states from 1990 to 2011. The policy variation across states and over time will play an important role for the identification of the restructuring policy impact (discussed in detail later).

When a state restructures its retail market, competition does not happen overnight: It takes time for firms to enter the newly opened market, and for customers to understand and take advantage of the newly available choices. There is hence a transitional period after restructuring has commenced, but before competition is fully established, during which incumbent utilities face relatively little competitive pressure. Thus, additional regulatory measures are needed during the transition to competition, to prevent the abuse of market power. States almost invariably stipulate a rate freeze or a rate reduction for some time after the commencement of their restructuring policies.[3,4] The transitional period can therefore be regarded as a hybrid regime of cultivating retail competition with the safeguard of price controls, whereas the post-transitional period can be regarded as a relatively pure form of retail competition replacing traditional COS regulation.

2.2 Effects of restructuring on market outcomes

The policy changes in the electricity industry described above have spawned a growing literature that examines the impact of restructuring on market outcomes in the U.S.[5] Most of this literature focuses on the wholesale sector. It is nonetheless important in our context, as it examines the

[3]For example, in Illinois, House Bill 362, "The Electric Service Customer Choice and Rate Relief Act of 1997," stipulated a 15 percent rate reduction for residential customers by August 1998, and another 5 percent reduction in May 2002. In Massachusetts, House Bill 5117 required retail access by March 1998, rate cuts of 10 percent by March 1998 and another 5 percent cut 18 months later. In Ohio, Senate Bill 3 was signed into law in July 1999. It allowed retail customers to choose their energy suppliers beginning January 1, 2001. It also required a 5 percent residential rate reduction and a rate freeze for 5 years. In Texas, Senate Bill 7 was enacted in June 1999. The law required retail competition to begin by January 2002, rates to be frozen for 3 years, and then a 6 percent reduction for residential and small commercial consumers.

[4]Another provision in the transitional period is that incumbent utilities are allowed to recover "stranded costs," i.e., the difference between the net book value of a generating plant used for setting cost-based regulated prices and the market value of that plant if it were required to sell its output in a competitive market. In most states, such stranded cost recovery is achieved through some type of non-bypassable stranded cost charge that is assessed to all customers as a component of regulated monopoly distribution service. See Jaskow (2000) for a detailed discussion.

[5]For the restructuring experiences of other countries, see Green and Newberry (1992), Pollitt (1997), Newberry and Pollitt (1997), Newberry (1999, 2002), Hogan (2002), Al-Sunaidy and Green (2006), Joskow (2006, 2008), and Zhang *et al.* (2008), among others.

effects of restructuring on production efficiency and the exercise of market power—channels that are also relevant to the retail sector.

Kleit and Terrell (2001) estimate that gas-fired generation plants could reduce costs by up to 13% by eliminating production inefficiencies. Wholesale restructuring creates competition in the generation segment and gives plant operators an incentive to close this gap. Fabrizio *et al.* (2007) estimate that investor-owned fossil-fueled plants in states that restructured their wholesale markets reduced labor and nonfuel expenses by 3–5% relative to investor-owned plants in other states, and by 6–12% relative to government and cooperatively owned plants that were largely insulated from restructuring incentives. For nuclear-fueled plants, Zhang (2007) finds that restructuring is linked to a 5.5% increase in plant utilization, and to an 11% reduction in operating costs. Barmack *et al.* (2007) use plant level data from New England to simulate the social cost and benefit of restructuring. Compared to the counterfactual of continued direct regulation, restructuring led to a net social benefit of 2% of total wholesale costs.[6]

Whether such cost savings are passed on from the wholesale to the retail sector depends on each firm's market power. The literature finds less positive results on this issue. Borenstein and Bushnell (1999) use historical cost data to simulate California's electricity market after restructuring, and find potential for significant market power during high-demand hours. Using California post-restructuring data, Borenstein *et al.* (2002) find near-competitive pricing during low-demand months, but a significant departure from competitive pricing during high-demand summer months. Similarly, Wolak (2003) finds a significant increase in unilateral market power for each of the California's five large electricity suppliers, following restructuring.[7]

In contrast to what is known about wholesale markets, our understanding of the restructuring impact on electricity retail markets is still rather limited.[8] In states that restructured their electricity retail sectors, Apt (2005) compares the annual rates of change of electricity prices before and after restructuring, and argues that retail competition for industrial customers did not lead to lower

[6]Similar efficiency gains have been documented in other industries that have undergone a restructuring or deregulation process (e.g., Bailey 1986, Olley and Pakes 1996, Ng and Seabright 2001). In the context of electricity markets, reductions in production costs may be partly offset by increased environmental costs associated with power generation. Fowlie (2010) finds that deregulated power generation plants in restructured electricity markets are less likely to adopt more capital-intensive environmental compliance options, compared to physically similar plants that are either rate regulated or publicly owned.

[7]A different strand of the literature examines the role of vertical arrangements between the wholesale and retail sectors for price formation in electricity markets. Joskow (1997) and Borenstein (2002) emphasizes the importance of such vertical relationships for the success of electricity market restructuring. Bushnell (2007), Mansur (2007), and Bushnell *et al.* (2008) examine a number restructured electricity markets and demonstrate that the presence of long-term vertical arrangements between the wholesale and the retail sectors are generally important not only for maintaining price stability, but also for preventing anti-competitive practices.

[8]A unique feature of the retail market, as compared to the wholesale market, is that retail customers typically do not see real-time price changes and hence cannot adjust their consumption decisions accordingly. Bushnell and Mansur (2005) find that retail consumers respond more to lagged price increases from their past bills than current price information. Borenstein and Holland (2005) and Joskow and Tirole (2006, 2007) discuss the importance of replacing traditional electric meters with real-time meters to improve efficiency in the electricity retail market.

industrial electricity prices. However, the before-and-after comparison may be confounded by factors whose changes coincide with the restructuring. Fagan (2006) uses historical price data for 1990–1997 to forecast 2001–2003 prices, and then compares this forecast to actual prices in 2001–2003. He finds that, relative to their predicted values, prices for industrial customers in restructured states increased less than those in non-restructured states, but the difference is not statistically significant.[9]

Our paper fills a gap in this literature. Using a long panel dataset (1990–2011), we are able to exploit differences in electricity retail market restructuring status across states *and* over time, to estimate the impact of retail competition on average prices. We further allow for different policy impacts for residential, commercial, and industrial customers, as well as different policy impacts in the short run and long run. As we will demonstrate, the effect of retail competition on average prices depends crucially on both the customer segment and the time frame under consideration.

3 Empirical Approach

To answer the question of whether retail competition leads to lower electricity prices, compared to traditional COS regulation, we use the difference-in-difference (DID) approach. This method utilizes policy variations across both states and time periods for identification.

3.1 Econometric model

The basic, *uniform impact* model we estimate is the following:

$$y_{st} = \alpha_s + \beta_t + \gamma R_{st} + \theta X_{st} + \varepsilon_{st}. \tag{UI}$$

The dependent variable y_{st} is the average electricity retail price for state s in year t, calculated as the average revenue per unit of energy sales and services (¢/kWh).[10]

On the right hand side, α_s is the state fixed effect and β_t is the year fixed effect, allowing for a linear time trend as a special case. R_{st} is a dummy variable that takes on the value 1 if the retail market in state s has been restructured in year t, and 0 otherwise. (Two different approaches,

[9]Fagan (2006) author acknowledges that the result is preliminary as "the impact of restructuring on prices was still evolving in the post-restructuring period examined. Most states were (and still are) in the transition period where rates are set by a mix of competitive and regulatory forces."

[10]We focus on the average price instead of marginal price of retail electricity for several reasons. First, even if one can find the tariff schedules offered by retails service providers, the choice of the applicable tariff schedule is potentially endogenous and influenced by a customer's forecast of his own future demand, and customer-level data is not publicly available. Second, our analysis is at the state level. While it is easy to construct state-wide average price, it would be very difficult to construct state-wide marginal price even with customer-level data. Three, despite the potential efficiency reasons to install real-time meters, the majority of residential customers and small commercial customers still have conventional meters. Ito (2014) finds strong evidence that household consumers respond to average price rather than marginal price or expected marginal price in their electricity consumption.

document-based and data-based, will be used to determine a state's restructuring status in a given year. Both will be discussed in Section 4.2.) X_{st} is a vector of additional control variables that capture both supply and demand side factors for state s in year t. The residual term is ε_{st}. Our parameter of interest is γ, which measures the policy impact of retail restructuring, that is, the difference between the average electricity retail prices under retail competition and COS regulation.

In the uniform impact model (UI), the policy effect is assumed to be constant over the entire restructuring period. As outlined previously, this assumption neglects temporary regulatory measures, imposed by restructuring states, that are effective only during the transitional period. To better capture these policy differences between the short run and long run, we divide the policy impact into two parts: A transitional impact over a certain period following restructuring, and a post-transitional impact thereafter. Thus, we also estimate the following *differential impact* model:

$$y_{st} = \alpha_s + \beta_t + \gamma^{SR} R_{st}^{SR} + \gamma^{LR} R_{st}^{LR} + \theta X_{st} + \varepsilon_{st}. \qquad \text{(DI)}$$

In (DI), R_{st}^{SR} is a dummy variable equal to 1 if the retail market in state s has been restructured but remains in the transitional period in year t. R_{st}^{LR} is a dummy variable equal to 1 if the retail market in state s has been restructured and is in the post-transitional period in year t. (The construction of these indicators will be detailed in Section 4.2.) The coefficients γ^{SR} and γ^{LR} capture the short run and long run impacts, respectively, of switching from COS regulation to retail competition.

3.2 Identification

After controlling for observed heterogeneity through X_{st}, identification of γ (and γ^{SR}, γ^{LR}) rests on the following assumptions. First, systematic unobserved heterogeneity across states remains constant over time, so that it can be captured by the state fixed effects (α_s). Second, systematic unobserved heterogeneity over time remains constant across states, so that it can be captured by the year fixed effects (β_t). When these assumptions are satisfied, the patterns of price evolution over time are similar across states, so that γ can be identified through the following difference-in-difference method.

For state s that first implemented restructuring in year t, the observed year-over-year price difference $y(R_{st}=1) - y(R_{s,t-1}=0)$ captures the effect caused by moving from one regulatory regime to another, as well as other (policy-independent) factors that result in price changes between year $t-1$ and year t. The counterfactual benchmark is $y(R_{st}=0) - y(R_{s,t-1}=0)$, that is, the price difference that would obtain if state s had not implemented its restructuring policy. This counterfactual is not directly observable. However, it can be approximated by that of another state u that did not restructure its market in either year $t-1$ or year t. For this state, the observed price difference $y(R_{ut}=0) - y(R_{u,t-1}=0)$ captures only the policy-independent price evolution across the two years, under an unchanged regime of COS regulation. By netting out the difference across

the two years, the remaining difference can be solely attributed to the policy change from COS regulation to retail competition in state s. Thus, the parameter γ is identified by the difference in differences

$$\big[y(R_{st}=1)-y(R_{s,t-1}=0)\big] \;-\; \big[y(R_{ut}=0)-y(R_{u,t-1}=0)\big].$$

One may worry about the possibility that restructuring policies are endogenous. That is, a state's decision to adopt retail competition is not random but instead depends on the prevailing electricity prices in that state. Indeed, states that implemented restructuring tend to have had (and continue to have) higher electricity prices than states that decided against restructuring. Selection based on the level of prices does not bias our estimates of the restructuring impact, as level differences are readily accounted for by the inclusion of state fixed effects. On the other hand, selection based on different price trends would create a problem. For example, if state s adopted restructuring based on the observation that its retail prices had increased and were expected to continue to increase, while state u rejected restructuring based on the observation that its retail price had stayed flat and were expected to remain flat, the time-invariant state fixed effects α_s and α_u would fail to capture this trend difference. The observed price difference for state u would then underestimate the counterfactual price difference for state s, resulting in an upward bias in the estimated parameter γ.

To determine whether such trend differences played an important role in the restructuring decisions across states, we look for both document evidence and empirical evidence. First, on the document side, a careful reading of the EIA reports documenting states' restructuring decisions indeed suggests that the level of electricity retail prices, rather than the trend of price changes, was the primary concern in the decision to adopt retail competition.[11]

Second, on the empirical side, we compare the price patterns from 1990 to 1996—before any restructuring policy was implemented—between the group of states that later pursued retail competition ($g_s = 1$) and the group of states that did not ($g_s = 0$). This comparison can reveal whether systematic differences exist between the two groups of states before the policy change. In particular, we estimate the following *pre-treatment* model:

$$y_{st} \;=\; \phi g_s + \beta_t + \delta(t \cdot g_s) + \theta X_{st} + \varepsilon_{st}. \qquad \text{(PRE)}$$

A significant estimate of ϕ would suggest a systematic difference in price level between the two groups, consistent with the document evidence, and this price level difference is readily accounted for in the subsequent DID analysis by the state fixed effects. On the other hand, a significant estimate of δ would indicate a systematic difference in trends between the two groups, thus raising concerns about the suitability of the DID approach.

[11] See Table 2 for the EIA report excerpts.

4 Data

To empirically estimate the regression models, we compiled a state-level panel dataset for the period 1990–2011.

4.1 Dependent variable

For the dependent variable, electricity retail sales data are obtained from the EIA website.[12] These are annual, state-aggregate data on electricity sales quantity and revenue. The data are separately reported for the three main customer segments: residential, commercial, and industrial. Within each customer segment, total sales are reported in terms of both revenue and quantity, and are further broken down into restructured services and full services. Restructured services refer to unbundled energy and delivery services, and full services to traditional bundled energy and delivery services. (Without retail competition, total sales consist of full services only.) Our focus is on the average price for all customers within the same segment, regardless of whether they choose restructured services or not, as competitive pressure acts upon all firms, including the incumbent utility. The average price y_{st} is thus calculated by dividing the total sales revenue by the total sales quantity.

Residential customers tend to be small, commercial customers medium-sized, and industrial customers large. Over our 22-year period, the nationwide annual electricity consumption of an average customer in each of these segments is 11, 71, and 1,576 MWh, respectively. These size differences translate into different outside options and, hence, different degrees of bargaining power with RSPs.[13] While industrial and large commercial customers may resort to on-site self generation of electricity, or decide to relocate to a different area when it is economical to do so, smaller commercial and residential customers typically cannot. Outside options place an upper limit on the price a customer is willing to pay for electricity retail services. In our sample, the national average retail prices paid by residential, commercial, and industrial customers were 10.9, 9.6, and 6.9 ¢/kWh, respectively (in 2009 dollars). Given the substantial price differences across customers, we estimate the model separately for the three segments to avoid potential confounding effects due to composition changes.

4.2 Restructuring status

Data on the restructuring status of electricity retail markets by state and year are obtained from EIA state restructuring documents. We record the effective dates of states' restructuring policies

[12] www.eia.gov/electricity/data.cfm.

[13] Besides their relative size, the three segments differ in other characteristics as well. For example, the load profile of residential customers tends to be more variable than that for industrial customers, thus requiring more ancillary services to meet reliability standards.

as applicable to each of the three customer segments.[14] Five states—Arkansas, Montana, New Mexico, Oklahoma, and West Virginia—pursued restructuring policies but subsequently repealed these policies before they became effective. Four states—Arizona, California, Delaware, and Virginia—suspended their restructuring policies after they had been in effect for some time. In addition to the customer-segment specific restructuring status, we also construct a common status variable called "full retail choice" that indicates whether retail competition applies to all customers in all three segments.[15] As shown in Table 1, the number of states (including the District of Columbia) with active retail competition for at least one customer segment gradually increases from zero in 1990–1996 to 21 during 2002–2004, and then decreases to 18 in 2011. The number of states with full retail choice increases from zero in 1990–1997 to 17 in 2004, and then decreases to 14 in 2011.

For each state, we also divide the entire restructuring period into a transitional and a post-transitional period. Recall from Section 2.1 that most restructuring states stipulate price controls during a transitional period from COS regulation to full retail competition. The actual length of the transitional period varies from state to state (and possibly from region to region within a state), and so does the magnitude of provisional rate reductions mandated during the transition. These stipulations are determined in the legislative and regulatory process associated with restructuring, and are influenced by various parties, including regulators, incumbent utilities, potential competitors, and consumer advocacy groups. As a summary measure, we declare the first T years after the introduction of retail competition the transitional period, and the years afterwards the post-transitional period. We consider two time windows, $T=3$ and $T=5$. Table 1 provides a breakdown of the number of observations that fall into the transitional and post-transitional period, respectively.

Finally, as an alternative indicator for a state's restructuring status we consider the realized level of competition in the retail market, measured by the penetration of restructured services as a percentage of total sales. Specifically, we consider a state having active retail competition if and only if its realized penetration of restructured services meets a threshold τ. Three numerical thresholds are considered, $\tau=1\%$, $\tau=5\%$, and $\tau=10\%$. Table 1 provides a breakdown of the number of observations whose realized penetration meets each of the thresholds. The effective penetration for residential customers is rather low: out of 193 observations that have nominally active restructured markets, only 35 observations (a mere 16%) have a penetration rate above the 10% threshold (by either revenue or quantity). In contrast, the effective penetration for

[14] In the case where retail competition is phased in, the effective date is recorded as that of the first phase. On the other hand, pilot programs are not considered official restructuring policies.

[15] This is a more restrictive measure of restructuring for two reasons. First, if a state implements retail competition for industrial or commercial customers before it does so for residential customers, or introduces retail competition in multiple phases, the effective date of full retail choice is that of the last phase for retail customers. Second, if a state suspends retail competition for residential customers while maintaining it for non-residential customers, we record this event as an end to full retail choice even though segment-specific restructuring continues.

commercial and industrial customers is relatively strong, in that over 50% of the observations from nominally restructured markets surpass the 10% threshold.

Both the document-based and the data-based measure of restructuring status are used in our empirical analysis. The former allows us to assess the price impact of nominal policy changes, while the latter allows us to assess the price impact of effective policy changes. The estimation results can thus shed light on the source of any identified policy impact—a regulatory regime switch toward competition *per se*, or market competition as a result of the regulation change.

4.3 Supply and demand controls

Electricity prices also depend on a number of other factors that affect market supply and demand. To control for supply side factors, we obtain EIA state level data on electricity generation capacity by primary fuel source (coal, natural gas, oil, nuclear, hydro, and other).[16] The portfolio of a state's generation capacity captures observed heterogeneity in supply conditions across states.[17] Moreover, generation capacity is a result of past investment decisions and is thus a predetermined factor not influenced by current retail market conditions. Actual generation quantity, on the other hand, is determined simultaneously with the electricity price as the market equilibrium outcome. In essence, we use generation capacity as an instrument for quantity.

We also want to control for demand side heterogeneity. For residential customers, electricity is used for final consumption, and we obtain state level aggregate personal income data from the Bureau of Labor Statistics (BLS) to control for income effects. For commercial and industrial customers, electricity is an intermediate input used in production of goods and services. Ideally, we would like to obtain state level GDP data to control for derived demand. However, due to changes in GDP reporting criteria during our data period this is problematic.[18] Instead, we use the same state level aggregate personal income data from the BLS as a proxy to control for derived demand, relying on the macroeconomic identity that aggregate production equals aggregate income.

[16] Other sources for electricity generation include wind, solar thermal, photovoltaic, geothermal, biomass, etc. Over the 22-year period, they account for 5.4% of total capacity.

[17] For example, within the sample period, coal is a low-cost fuel source compared to natural gas and oil, so states that rely heavily on coal for power generation tend to have low production costs.

[18] The Department of Commerce (DOC) switched its GDP reporting criteria from SIC to NAISC code in 1997, and cautioned that reported GDP data under these two codes are not directly comparable. In fact, in 1997, when GDP was reported under both codes, it differs substantially across reporting codes (both in aggregate and broken down by industry). DOC has done extensive work to harmonize reported GDP under the two codes at the national level; however, state level GDP data remain incomparable before and after 1997. Since the year 1997 also corresponds to the beginning of retail competition in the states, using state level GDP data would confound the interpretation of any estimation results (i.e., any discrete jump detected in the data could be attributed either to the change in GDP reporting or to the change of retail regulation).

4.4 Summary statistics

Our dataset is a balanced panel of 51 states (including the District of Columbia) over the period 1990–2011, resulting in 1,122 observations. Summary statistics are reported in Table 3.

Average revenue generated from residential customers per state, per year is 2.2 billion dollars, 1.5% of which comes from restructured services. For commercial and industrial customers, average revenue is $1.8 and 1.0 billion dollars, respectively, with restructured services accounting for 9% and 7%, respectively.[19] Similarly, for the three customer segments, the average sales quantity per state, per year are 24, 21, and 20 TWh (million MWh), with restructured services acounting for 1%, 7%, and 5%, respectively. Dividing revenue by quantity, the average prices for residential, commercial, and industrial customers are 11, 10, and 7 ¢/kWh, respectively (in 2009 dollars).

On the supply side, the average summer generation capacity per state, per year is 17 GW (thousand MW), translating into a national average of 872 GW.[20] Out of the generation portfolio, coal, natural gas, oil, nuclear, hydropower, and all other sources account for 36%, 31%, 7%, 11%, 9%, and 5%, respectively. On the demand side, the aggregate personal income per state, per year is 197 billion dollars, translating into a national average of 10 trillion dollars (in 2009 dollar).

5 Results

As both restructuring status (the policy variable) and average price (the outcome variable) are serially correlated, the difference-in-differences approach overestimates the significance of the policy impact unless the clustered error structure is properly corrected for (Bertrand *et al.* 2004). Here, all reported standard errors are clustered by states.

5.1 Pre-treatment price patterns

Our first analysis compares pre-treatment prices in states that pursued restructuring—regardless of whether the restructuring policy was subsequently repealed, suspended, or carried out as planned—to those in states that never pursued restructuring (see regression (PRE)). This categorization captures states' intent to restructure their retail markets, despite the possibility that eventual restructuring outcomes may be different based on future market developments. Since information about market developments during the treatment period was not available in the pre-treatment period 1990–1996, it could not have influenced the original policy deliberations.

[19] Thus, restructured services account for a relatively small share of revenue in our dataset. Keep in mind, however, that for states without a restructuring policy in a given year, restructured revenue is necessarily zero. Conditional on having restructuring policies, restructured revenue from residential, commercial, and industrial customers accounts for 5.5%, 23%, and 25% of total revenue.

[20] If all generation capacity were used at 100%, 7,600 TWh of power could be produced in a year. The actual output is 3,300 TWh, implying an average capacity utilization rate of 43%.

Table 4 reports the estimation results for all three customer segments. Recall that year fixed effects allow for a linear time trend as a special case. For each customer segment, column (1) allows for different intercepts but requires the same trend, while column (2) allows for both different intercepts and different trends across the two groups. The results are revealing. As expected, the two groups of states do exhibit noticeable level differences. The level difference is significant for residential customers: on average, residential customers in states that later pursued restructuring paid 1.6 ¢/kWh more than those in states that did not pursue restructuring. All other control variables, when significant, are of the expected signs. Adding a different time trend reduces the estimate for the level difference to 1.4 ¢/kWh without affecting its significance level, while the trend difference itself is insignificant. Similarly, the trend difference is insignificant for commercial and industrial customers. Furthermore, allowing for different time trends has only a negligible impact on the explanatory power of the model, as can be seen in the reported R^2.

Next, recall that five states repealed their restructuring policies and, despite their initial intent, never actually implemented retail competition. As a robustness check, we exclude these states from the pre-treatment analysis. The estimation results are reported in columns (3) and (4). After excluding the five states, the level difference estimates are significantly positive for all three customer segments. This is not surprising. States that repealed restructuring tend to have had lower prices than states that followed through. In fact, their low prices (and hence lack of perceived benefits) were an important reason why these states eventually decided against restructuring. On the other hand, the trend difference estimates remain insignificant for all customer segments, and allowing for different time trends has only a negligible impact on R^2. These results offer us some reassurance that restructuring states did not experience price patterns that were significantly different from the non-restructuring states.

While our pre-treatment analysis addresses the potential endogeneity of the adoption of restructuring policies, it does not address the potential endogeneity of the suspension of restructuring policies. Recall that four states suspended retail competition after having implemented it for a period of time, and the decision to suspend restructuring likely depended on the actual policy experiences in these states. For example, if restructuring was accompanied by significant price increases or other market disruptions, a state may have reacted by suspending retail competition. To ensure that our results are not sensitive to events in states that either repealed or suspended their restructuring policies, our subsequent DID regressions are performed both with and without these states.

5.2 Uniform policy impact

We now turn to our difference-in-differences analysis to estimate the restructuring policy impact on average electricity retail prices. Table 5 reports estimation results for the uniform impact model (UI), using the document-based restructuring status. For each of the three customer segments, we

estimate the model four times by increasingly restricting our sample: Column (1) uses all 51 states, including the District of Columbia; column (2) uses only the 48 continental states; column (3) further excludes the five states that repealed their restructuring policies; and column (4) excludes the additional four states that suspended their restructuring policies after implementation. At the expense of losing observations, the control group and the treated group of states arguably become more homogeneous when moving from column (1) to column (4). State and year fixed effects are included in all estimations but are not reported.

For residential customers, retail competition leads to a price decrease ranging from 0.5 ¢/kWh (column)) to 0.7 ¢/kWh (column 4). The estimates are significant at least at the 10% level. Given an average price of 11 ¢/kWh, these estimates translate into a price reduction of 5–7%, which is also economically significant. For commercial customers, we find no significant policy impact on price, as the point estimates are essentially zero. For industrial customers, retail competition leads to a price increase ranging from 0.1 ¢/kWh (column 3) to 0.3 ¢/kWh (column 4). However, these price increases are not statistically significant.[21]

These results may appear counterintuitive. Residential customers have little bargaining power with RSPs due to their small size, volatile load profile, and lack of outside options, and the opposite is true for industrial customers. Yet the data suggest that residential customers benefited from retail competition while industrial customers did not. Why does more bargaining power fail to translate into larger benefits associated with retail competition? We investigate this issue in the next section.

5.3 Short run vs. long run policy impact

As discussed in Section 2.1, many restructuring states stipulated various temporary safeguard measures during the transition from COS regulation to retail competition. The short run impact of restructuring during the transitional period may very well be different from its long run impact in the post-transitional period: The former captures the difference between COS regulation and a hybrid regime consisting of both direct price control and incipient retail competition, while the latter represents the difference between COS regulation and a relatively pure form of retail competition. Table 6 reports estimation results for the differential impact model (DI). Panel A uses a three-year window for the transitional period, and panel B uses a five-year window. (The general pattern is robust when alternative choices for the length of the transitional period are considered.)

For residential customers, retail competition leads to a short-run price decrease ranging from 0.9 ¢/kWh (column 1) to 1.1 ¢/kWh (column 4) in the three-year transitional window, and from

[21] With both state and year fixed effects, most of the control variables become insignificant. In fact, inclusion of these variables has only a neglible impact on the explanatory power of the model or on the estimation of the policy impact (see the robustness check results reported at the bottom of Table 5).

0.9 ¢/kWh (column 1) to 1.2 ¢/kWh (column 4) in the five-year window. The short-run policy impact is highly significant at the 1% level. In contrast, the post-transitional price benefit is much smaller. This price decrease ranges from 0.4 ¢/kWh to 0.50 ¢/kWh after the first three years, and from 0.03 ¢/kWh to 0.2 ¢/kWh after the first five years, and is statistically insignificant. Thus, the price benefit found in the uniform policy impact model appears to be largely driven by measures adopted during the transitional period, such as mandated rate freezes or rate reductions, while retail competition *per se* seems to offer little long-term benefits to residential customers. Furthermore, in all but one case, the upward price jump from the transitional to post-transitional period is significant.

For commercial customers, retail competition leads to a price decrease of 0.3–0.4 ¢/kWh within the transitional period, and to a price increase that ranges from 0.1 ¢/kWh to 0.2 ¢/kWh after the first three years, and from 0.2 to 0.4 ¢/kWh after the first five years. These estimates are insignificant in themselves, but their differences—that is, the upward price jump between the transitional and the post-transitional period—is significant in four of the eight cases. Thus, the zero impact found in the uniform policy impact model appears to be the result of a short-run price reduction that is later offset by a long-run price increase.

Finally, for industrial customers the short-run policy impact is essentially zero, but retail competition leads to a long-run price increase of 0.3–0.4 ¢/kWh after the first three years, and 0.4–0.6 ¢/kWh after the first five years. The long-run price increase is significant in three of the eight cases, and so is the upward price jump from the transitional to the post-transitional period.

As a sensitivity test, we also consider a linear trend for the policy impact using a "year since restructuring" variable, allowing the average price to change depending on the number of years since a state began retail competition. The estimation results are reported in panel C of Table 6. Consistent with the differences between the short-run and long-run policy impact, we find that for residential customers, retail competition leads to an immediate price decrease of 1.1–1.5 ¢/kWh, followed by an increasing price trend of 0.11–0.14 ¢/kWh per year. In other words, any price benefit disappears entirely in no more than eleven years after introduction of retail competition. Similarly, for commercial customers, the price benefit, if any, disappears entirely in no more than seven years; and for industrial customers in no more than four years.

Overall, a common pattern emerges for all three customer segments: If restructuring has any significant benefit at all, the benefit (in terms of lower prices) is front-loaded and driven by aggressive price controls adopted as a temporary measure in the transitional period. It appears that retail competition, in itself, fails to deliver long-lasting price benefits.

5.4 Effective penetration of restructured services

Not all states made the same progress in their restructuring efforts. Depending on how aggressive the temporary price control measures were during the transitional period, electricity retailers

may face different incentives to enter or expand in a certain market. Furthermore, even where alternative retail choices are available and potentially appealing, customers may be reluctant to switch their services due to misinformation and other search frictions (Wilson and Price 2010, Hortaçsu *et al.* 2012). Thus, the prevalence of restructured services may vary across customer segments and across states, despite nominally active retail competition.

Thus, we also estimate the policy impact of restructuring using a data-based measure for each state's restructuring status. A state is considered to have achieved *effective restructuring* when the realized penetration rate of restructured services surpasses a given threshold. One may be concerned about the potential endogeneity of realized penetration. For example, if the regulator stipulates a below-market "price to beat" for a default RSP—typically the incumbent utility—for customers that do not make an explicit choice of retailer, there may be little penetration of restructured services, reversing the direction of causality between prices and competition. To address this potential endogeneity, we use one-year lagged penetration instead of contemporaneous penetration as our indicator for restructuring. Since competition in the previous year is predetermined in the current year, it is influenced by the average price in the current year. At the expense of losing observations, we can interpret the estimated coefficient as the effect of past competition on current price (in the sense of Granger causality).

Table 7 reports our estimation results using 1%, 5%, and 10% thresholds.[22] Panel A uses one-year lagged penetration of restructured sales quantity as the indicator for restructuring. For residential customers, past competition has no significant impact on current average prices. This could be due to the limited number of observations whose penetration rates manage to meet even the 1% threshold. That is, despite nominally active retail competition, restructured services remain a very small share of the residential market in most cases. In the few cases where restructured services have taken hold, competition does not lead to significantly lower prices. The results are similar for commercial customers. For industrial customers, the results are even less favorable. For example, using the 10% threshold, retail competition in the previous year actually leads to significantly higher price in the current year, ranging from 0.4 to 0.7 ¢/kWh.

In addition to the penetration of restructured sales quantity, we also consider the penetration of restructured sales revenue (lagged by one year) as an indicator for restructuring. The estimation results are reported in panel B of Table 7. The main patterns are similar to those in panel A. For residential and commercial customers, past competition has no significant impact on current average price. For industrial customers, retail competition actually results in significantly higher prices in more than half of the reported cases. Overall, then, it appears again that retail competition *per se* is not the main driver behind any observed benefit (in terms of low prices) associated with restructuring.

[22]The main results are robust when other threshold values are used.

5.5 Sensitivity tests

To check the robustness of our main results, we perform the following sensitivity tests. First, instead of using restructuring status that is specific to each customer segment, we use the status of "full retail choice" common to all three customer segments. The estimation results are reported in Table 8. Using this more restrictive measure of restructuring, we find qualitatively similar policy impacts. In the uniform impact model (panel A), only residential customers experience significant benefits from restructuring, but not commercial or industrial customers. Allowing differential policy impacts (panels B and C), the benefit is front-loaded but disappears for all customers in the long run.

Interestingly, using the full-retail-choice status variable, even industrial customers enjoy significant price reductions in the short run, unlike the previous findings using segment-specific status. To explain this change, recall that the primary reason for regulators to stipulate price control measures during the transitional period is to protect consumer welfare, i.e., the welfare of residential customers. If retail competition is first introduced for industrial customers only, few safeguards are generally put in place to control the prices these large customers pay. However, when retail competition is later introduced for residential customers, temporary price controls usually become effective and it is possible that these measures create spillover benefits to industrial customers.

Next, because states vary substantially by the size of their economies, we estimate the restructuring policy impact using state aggregate income as weights. The results are in Table 9. The overall pattern remains robust. In the uniform policy impact model (panel A), residential customers experience a price reduction of 0.4–0.7 ¢/kWh; however, this reduction is statistically significant in only one out of four cases. Commercial and industrial customers see no significant change in their prices. Allowing for a differential policy impact (panels B and C), we again find a transitory benefit that disappears in the long run.

Finally, we consider a log-linear specification of the model, so that the policy impact is estimated as a percentage change in the average retail price.[23] The results are in Table 10, and the overall pattern remains robust once again. In the uniform impact model (panel A), residential customers experience a price reduction of 4% (which is similar to the $5--7\%$ estimates we computed in the linear model), but the price reduction is only significant in two of the four cases. Allowing for a differential policy impact (panels B and C), the benefit for residential customers is front-loaded. We find no evidence that restructuring delivers benefits to any customer segment in the long run.

[23] For our supply side control variables, a $\ln 0$-problem arises due to the fact that not all states have all six categories of generation capacity installed. To circumvent this problem, we use the logarithm of state total generation capacity, together with the percentages of the individual generation categories in total capacity, as supply side control variables.

6 Discussion

It has been over a decade since some states in the U.S. implemented retail competition in their electricity markets. This paper is the first to use state-level panel data to estimate the policy impact of retail competition on electricity retail prices. The results are mixed and, generally, less favorable than what was perhaps hoped for by policy makers in restructured states. Across the three customer segments, only residential customers can be said to have benefited in a significant fashion from retail competition. Even so, the benefit appears front-loaded and mainly driven by aggressive price controls imposed during a transitional period from COS regulation to competition. We find no evidence of a long-term benefit for either residential, commercial, or industrial customers.

These findings deserve some discussion. Given that our most favorable estimates are short-run policy impacts, one may be tempted to ask whether regulators could prolong the "transitional period" indefinitely, thus extending the short-run policy impact into the long run. In other words, could regulators maintain aggressive price controls in an otherwise open retail market? This approach may not be sustainable. Regulators cannot force local utilities or RSPs to operate at or below costs. These firms can always exit retail operations if they earn less than a normal profit. They may accept price controls during the transition to open markets as an investment, exchanging lower profits in the short run for the opportunity to earn higher profits in the long run. However, unless the market-wide normal profit level decreases drastically, or technological innovations reduce operational costs significantly, it is unlikely that firms will accept permanently lower price levels and still remain in the electricity retail business.

One may also ask why restructuring and deregulation in other industries (e.g., airlines, telecommunications) have delivered significant price reductions, but not in the electricity retail sector. For residential and small commercial customers, a possible explanation is the presence of search frictions. At the U.S. income level, household expenditure on electricity is only a small fraction of total household budget. Thus, the perceived benefits from identifying the optimal choice of electricity retailer may be small relative to the associated search costs. It may be a daunting task for small customers to gather information from multiple RSPs, forecast their future load demand, and determine which contract delivers the best cost/risk combination. If these search costs are sufficiently high, consumers may exhibit a preference for the status quo (i.e., their incumbent utility as default retailer), which in turn diminishes the incentive of retail firms to enter, and compete aggressively, in the market.

References

[1] Al-Sunaidy, A. and R. Green. "Electricity Deregulation in OECD (Organization for Economic Cooperation and Development) Countries." *Energy* 31, 2006, pp. 769–787.

[2] Apt, Jay. "Competition Has Not Lowered U.S. Industrial Electricity Prices." *Electricity Journal* 18 (2), 2005, pp. 52–61.

[3] Bailey, Elizabeth. "Price and Productivity Change Following Deregulation: The U.S. Experience." *Economic Journal* 96 (381), 1986, pp. 1–17.

[4] Barmack, Matthew, Edward Kahn, and Susan Tierney. "A Cost-Benefit Assessment of Wholesale Electricity Restructuring and Competition in New England." *Journal of regulatory Economics* 31, 2007, pp. 151–184.

[5] Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. "How Much Should we Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics* 119 (1), 2004, pp. 249–275.

[6] Borenstein, Severin. "The Trouble with Electricity Markets: Understanding California's Restructuring Disaster."*Journal of Economic Perspectives* 16 (1), 2002, pp. 191–211.

[7] Borenstein, Severin and Stephen Holland. "On the Efficiency of Competitive Electricity Markets with Time-Invariant Retail Prices." *RAND Journal of Economics* 36 (3), 2005, pp. 469–493.

[8] Borenstein, Severin and James Bushnell. "An Empirical Analysis of the Potential for Market Power in California's Electricity Industry." *Journal of Industrial Economics* 47 (3), 1999, pp. 285–323.

[9] Borenstein, Severin, James Bushnell, and Frank Wolak. "Measuring Market Inefficiencies in California's Restructured Wholesale Electricity Market." *American Economic Review* 92 (5), 2002, pp. 1376–1405.

[10] Bushnell, James. "Oligopoly Equilibria in Electricity Contract Markets." *Journal of Regulatory Economics* 32, 2007, pp. 225–245.

[11] Bushnell, James and Erin Mansur. "Consumption Under Noisy Price Signals: A Study of Electricity Retail Rate Deregulation in San Diego." *Journal of Industrial Economics* 53 (4), 2005, pp. 493–513.

[12] Bushnell, James, Erin Mansur, and Celeste Saravia. "Vertical Arrangements, Market Structure, and Competition: An Analysis of Restructured U.S. Electricity Markets." *American Economic Review* 98 (1), 2008, pp. 237–266.

[13] Fabrizio, Kira, Nancy Rose, and Catherine Wolfram. "Do Markets Reduce Costs? Assessing the Impact of Regulatory Restructuring on US Electric Generation Efficiency." *American Economic Review* 97 (4), 2007, pp. 1250–1277.

[14] Fagan, Mark. "Measuring and Explaining Electricity Price Changes in Restructured States." *Electricity Journal* 19 (5), 2006, pp. 35–42.

[15] Fowlie, Meredith. "Emissions Trading, Electricity Restructuring, and Investment in Pollution Abatement." *American Economic Review* 100 (3), 2010, pp. 837–869.

[16] Green, Richard and David Newbery. "Competition in the British Electricity Spot Market." *Journal of Political Economy* 100 (5), 1992, pp. 929–953.

[17] Hogan, William. "Electricity Market Restructuring: Reforms of Reforms." *Journal of Regulatory Economics* 21(1), 2002, pp. 103–132.

[18] Hortaçsu, Ali, Seyed Ali Madanizadeh, and Steven L. Puller. "Power to Choose? An Analysis of Choice Frictions in the Residential Electricity Market." Mimeo, 2012.

[19] Ito, Koichiro. "Do Consumers Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing." *American Economic Review*, 2014, 104(2), pp. 537-563.

[20] Joskow, Paul. "Restructuring, Competition and Regulatory Reform in the U.S. Electricity Sector." *Journal of Economic Perspectives* 11 (3), 1997, pp. 119–138.

[21] Joskow, Paul. "Deregulation and Regulatory Reform in the U.S. Electric Power Sector." Sam Peltzman and Clifford Winston, eds.: *Deregulation of Network Industries: What's Next?*, 2000, pp. 113–54.

[22] Joskow, Paul. "Introduction to Electricity Sector Liberalization: Lessons Learned From Cross Country Studies." Fereidoon Sioshansi and Wolfgang Pfaffenberger, eds.: *Electricity Market Reform: An International Perspective*, 2006, pp. 1–32.

[23] Joskow, Paul. "Lessons Learned From Electricity Market Liberalization." *Energy Journal* 29 (Special Issue #2), 2008, pp. 9–42.

[24] Joskow, Paul and Jean Tirole. "Retail Electricity Competition." *RAND Journal of Economics* 37 (4), 2006, pp. 799–815.

[25] Joskow, Paul and Jean Tirole. "Reliability and Competitive Electricity Markets." *RAND Journal of Economics* 38 (1), 2007, pp. 60–84.

[26] Kleit, Andrew and Dek Terrell. "Measuring Potential Efficiency Gains From Deregulation of Electricity Generation: A Bayesian Approach." *Review of Economics and Statistics* 83 (3), 2001, pp. 523–530.

[27] Mansur, Erin. "Upstream Competition and Vertical Integration in Electricity Markets." *Journal of Law and Economics* 50 (1), 2007, pp. 125–156.

[28] Newberry, David. *Privatization, Restructuring, and Regulation of Network Utilities*. Cambridge: MIT Press, 1999.

[29] Newberry, Paul. "Problems of Liberalizing the Electricity Industry." *European Economic Review* 46, 2002, pp. 919–927.

[30] Newberry, Paul and Michael Pollitt. "The Restructuring and Privatisation of Britain's CEGB—Was It Worth It?" *Journal of Industrial Economics* 45 (3), 1997, pp. 269–303.

[31] Ng, Charles and Paul Seabright. "Competition, Privatisation and Productive Efficiency: Evidence From the Airline Industry." *Economic Journal* 111 (473), 2001, pp. 591–619.

[32] Olley, Steven and Ariel Pakes. "The Dynamics of Productivity in the Telecommunications Equipment Industry." *Econometrica* 64 (6), 1996, pp. 1263–1297.

[33] Pollitt, Michael. "The Impact of Liberalization on the Performance of the Electricity Supply Industry: An International Survey." *Journal of Energy Literature* 3 (2), 1997, pp. 3–31.

[34] Wilson, Chris M., and Catherine Waddams Price. "Do Consumers Switch to the Best Supplier?" *Oxford Economic Papers* 62 (4), 2010: pp. 647–668.

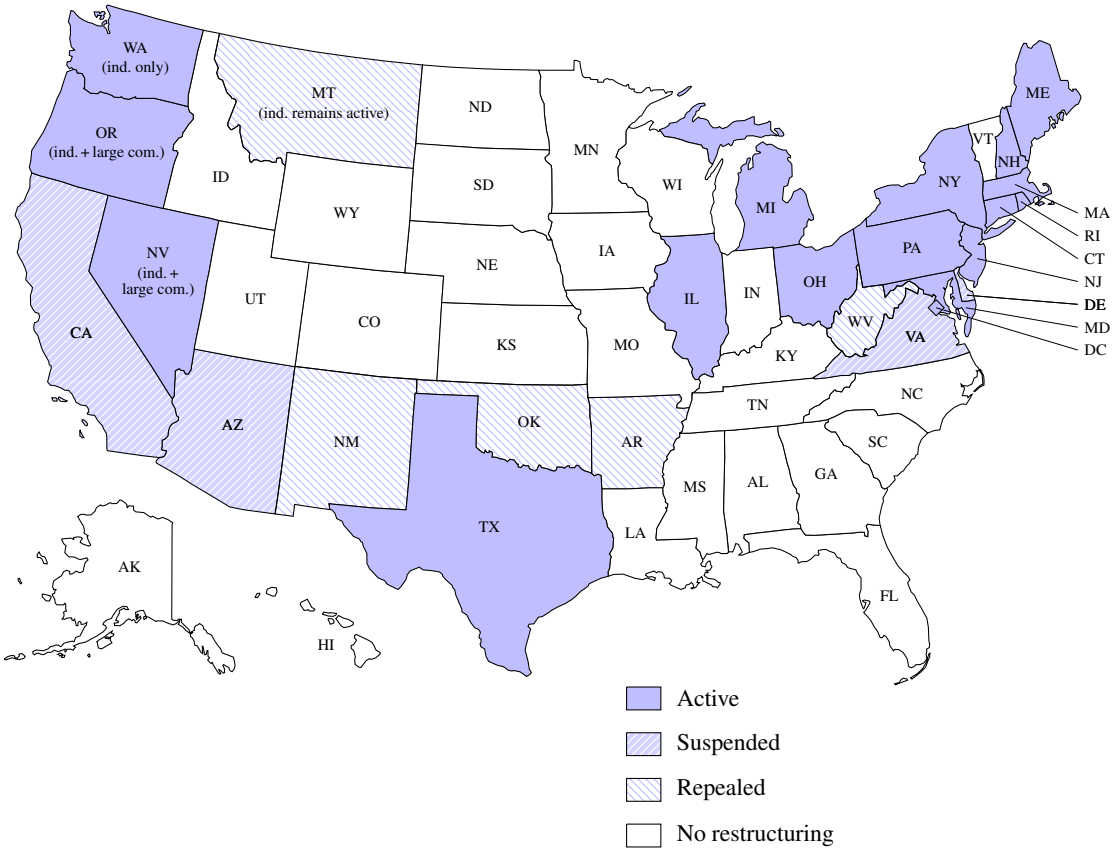
[35] Wolak, Frank. "Measuring Unilateral Market Power in Wholesale Electricity Markets: The California Market, 1998–2000." *American Economic Review (Papers & Proceedings)* 93 (2), 2003, pp. 425–430.

[36] Zhang, Fan. "Does Electricity Restructuring Work? Evidence From the U.S. Nuclear Energy Industry." *Journal of Industrial Economics* 55 (3), 2007, pp. 397–418.

[37] Zhang, Yin-Fang, David Parker, and Collin Kirkpatrick. "Electricity Sector Reform in Developing Countries: An Econometric Assessment of the Effects of Privatization, Competition and Regulation." *Journal of Regulatory Economics* 33 (2), 2008, pp. 159–178.

Appendix

Figure 1: State electricity retail market restructuring status, 2011



Source: Energy Information Administration

Table 1: State restructuring status

Year	Residential	Commercial	Industrial	Full retail choice
	Number of restructuring states by year			
1990–1996	0	0	0	0
1997	1	1	1	0
1998	5	5	6	3
1999	7	9	10	4
2000	11	12	13	7
2001	15	17	19	13
2002	17	19	21	16
2003	17	19	21	16
2004	17	19	21	17
2005	16	18	20	16
2006	16	18	20	16
2007	15	17	19	15
2008	14	16	18	14
2009	14	16	18	14
2010	14	16	18	14
2011	14	16	18	14
Total observations	**193**	**218**	**243**	**179**
Observations in transitional/post-transitional period				
First 3 years	54	60	66	54
After first 3 years	139	158	177	125
First 5 years	89	99	109	87
After first 5 years	104	119	134	92
Observations with effective retail competition				
Revenue penetration $\geq 1\%$	104	193	230	n.a.
Revenue penetration $\geq 5\%$	56	161	201	n.a.
Revenue penetration $\geq 10\%$	35	130	172	n.a.
Quantity penetration $\geq 1\%$	103	194	237	n.a.
Quantity penetration $\geq 5\%$	56	160	207	n.a.
Quantity penetration $\geq 10\%$	35	138	160	n.a.

Table 2: State deliberations and restructuring decisions (EIA excerpts)

Retail competition adopted	Retail competition rejected
"In 1996, the average revenue per kilowatt hour (which is used as a proxy for price) of electricity sold in **California** was 9.48 cents, the tenth highest rate among the 50 States and the District of Columbia. This rate was one factor leading Governor Pete Wilson to sign Assembly Bill 1890 (AB1890) on September 23, 1996. [...] To implement it, **retail competition**, allowing customers to choose their electricity, began on March 31, 1998." [a]	"There is no compelling reason at this time for **Kentucky** to move quickly to restructure. [...] Representatives from other States that have restructured as well as experts in the field of electricity restructuring indicate that Kentucky is in a unique position because of its existing low electricity rates, which currently are the lowest east of the Rocky Mountains. Most of Kentucky's generation is coal-fired and its generators are close to coal fields which are among the cheapest fuel sources." [a]
"On November 27, 1997, HB 5117, the Electric Utility Restructuring Act, was signed by Governor Paul Cellucci to restructure the industry in **Massachusetts**. [...] **Retail access** was required by March 1998. [...] In 1996, Massachusetts had the eighth highest electricity rates in the Nation, which were most certainly a consideration in enacting the legislation the following year." [a]	"The Legislative Council Committee on Electric Utilities Restructuring issued its final report. The report recommended a slow approach to retail competition. **Idaho** was a low cost state for electricity and concerned about prices rising under a competitive market." [b]
"In both years (1996 and 1998), **Pennsylvania** had the eleventh highest average electricity price among the 50 States and the District of Columbia. Like California and Massachusetts, Pennsylvania falls into the camp of relatively high-priced States that have been somewhat aggressive in pursuing restructuring. [...] Governor Tom Ridge signed the Electricity Generation Customer Choice and Competition Act into law on December 3, 1996. [...] The law called for a phase-in of **retail choice** with one-third eligible to choose by January 1998, another third by January 1999, and the remaining third by January 2000." [a]	"In light of the low cost of electricity in **West Virginia** and the price spikes experienced this past summer in other States that have restructured retail markets, lawmakers seem to need to be convinced that restructuring will benefit West Virginia consumers. [...] Most concerns center on protecting small (residential) consumers from price increases." [c]

(a) www.eia.gov/cneaf/electricity/chg_stru_update/chapter8.html

(b) www.eia.gov/cneaf/electricity/page/restructuring/idaho.html

(c) www.eia.gov/cneaf/electricity/page/restructuring/west_virginia.html

Table 3: Summary statistics

Variable			**Mean**	**Std. Dev.**	**Min.**	**Max.**
Total revenue	($mil.)	Residential	2,181	2,549	90	16,649
		Commercial	1,781	2,379	97	16,251
		Industrial	1,045	1,099	11	9,301
Restructured revenue	($mil.)	Residential	32	152	0	1,644
		Commercial	162	668	0	7,228
		Industrial	74	267	0	3,247
Total sales	(GWh)	Residential	23,385	23,641	1,480	145,654
		Commercial	20,889	22,234	1,450	128,214
		Industrial	19,672	18,916	216	108,300
Restructured sales	(GWH)	Residential	233	1,072	0	14,763
		Commercial	1,438	5,244	0	47,974
		Industrial	989	3,582	0	43,102
Average price	(¢/kWh)	Residential	10.92	3.17	6.27	33.61
		Commercial	9.56	2.86	5.17	31.37
		Industrial	6.88	2.69	3.17	27.52
Summer generation capacity	(GW)	Coal	6.13	6.01	0	23.51
		Natural gas	5.31	9.82	0	73.22
		Oil	1.25	2.18	0	14.80
		Nuclear	1.95	2.49	0	12.61
		Hydro	1.53	3.39	0	21.58
		Other	0.92	1.62	0	11.57
		All sources	17.10	16.31	0.56	109.18
Personal income	($bil.)		197	239	12	1,623

Note: Price and income figures are in 2009 dollars.

Table 4: Pre-treatment price patterns

	Residential				Commercial				Industrial			
Average price	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
$I(g_s = 1)$	1.618	1.418	2.252	1.932	0.939	0.818	1.321	1.163	0.850	0.914	1.363	1.451
	(0.63)**	(0.59)**	(0.77)***	(0.71)***	(0.57)	(0.55)	(0.69)*	(0.65)*	(0.55)	(0.53)*	(0.65)**	(0.62)**
$t \cdot I(g_s = 1)$		0.067		0.108		0.041		0.053		−0.021		−0.030
		(0.06)		(0.07)		(0.04)		(0.05)		(0.04)		(0.04)
Real income	1.251	1.244	1.000	0.987	0.978	0.974	0.805	0.799	0.709	0.711	0.530	0.534
	(0.33)***	(0.33)***	(0.36)***	(0.37)**	(0.38)**	(0.39)**	(0.41)*	(0.41)*	(0.33)**	(0.33)**	(0.36)	(0.36)
Coal	−0.264	−0.264	−0.237	−0.236	−0.219	−0.219	−0.202	0.202	−0.218	−0.218	−0.202	−0.202
	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***
Natural gas	−0.083	−0.083	−0.069	−0.068	−0.063	−0.063	−0.052	−0.051	−0.057	−0.057	−0.045	−0.045
	(0.03)***	(0.03)***	(0.02)***	(0.02)***	(0.03)**	(0.03)*	(0.03)*	(0.03)*	(0.03)**	(0.03)**	(0.02)**	(0.02)**
Oil	−0.021	−0.018	0.004	0.009	−0.024	−0.023	−0.007	−0.004	0.002	0.001	0.007	0.006
	(0.13)	(0.13)	(0.11)	(0.11)	(0.15)	(0.16)	(0.14)	(0.14)	(0.10)	(0.10)	(0.09)	(0.09)
Nuclear	0.168	0.168	0.118	0.117	0.108	0.108	0.081	0.081	0.079	0.079	0.038	0.038
	(0.08)**	(0.08)**	(0.07)	(0.07)	(0.10)	(0.10)	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	(0.08)
Hydro	−0.352	−0.351	−0.314	−0.312	−0.300	−0.300	−0.279	−0.279	−0.320	−0.320	−0.324	−0.324
	(0.07)***	(0.07)***	(0.06)***	(0.06)***	(0.08)***	(0.08)***	(0.07)***	(0.07)***	(0.06)***	(0.06)***	(0.06)***	(0.06)***
Other	−0.453	−0.450	−0.348	−0.342	−0.190	−0.188	−0.113	−0.110	−0.119	−0.120	−0.028	−0.029
	(0.24)*	(0.24)*	(0.27)	(0.28)	(0.29)	(0.29)	(0.31)	(0.31)	(0.27)	(0.27)	(0.30)	(0.30)
N	357	357	322	322	357	357	322	322	357	357	322	322
R^2	0.561	0.562	0.585	0.586	0.471	0.472	0.482	0.483	0.436	0.436	0.467	0.467

Notes: 1. Standard errors are clustered by states and reported in parantheses.
2. Stars denote statistical significance: * significant at 10%; ** significant at 5%; *** significant at 1%.
3. Year fixed effects are used for estimation but omitted from reporting in the table.

Table 5: Uniform policy impact for the entire restructured period

	Residential				Commercial				Industrial			
Average price	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Restructured	−0.537	−0.560	−0.635	−0.714	−0.012	0.002	−0.058	−0.060	0.197	0.218	0.146	0.262
	(0.30)*	(0.26)**	(0.27)**	(0.29)**	(0.28)	(0.24)	(0.24)	(0.28)	(0.26)	(0.21)	(0.22)	(0.23)
Real income	0.039	0.046	−0.014	0.263	0.233	0.235	0.193	0.611	0.235	0.227	0.224	0.432
	(0.14)	(0.15)	(0.13)	(0.23)	(0.16)	(0.17)	(0.15)	(0.21)***	(0.11)**	(0.11)**	(0.11)**	(0.22)*
Coal	−0.309	−0.293	−0.308	−0.235	−0.075	−0.057	−0.073	0.009	−0.139	−0.130	−0.125	−0.080
	(0.15)**	(0.14)**	(0.14)**	(0.14)	(0.14)	(0.12)	(0.12)	(0.13)	(0.11)	(0.09)	(0.09)	(0.09)
Natural gas	−0.039	−0.004	−0.002	−0.005	−0.057	−0.024	−0.022	−0.036	−0.049	−0.012	−0.011	−0.013
	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)	(0.03)	(0.04)	(0.03)
Oil	0.122	0.044	0.049	0.086	0.151	0.082	0.078	0.126	0.241	0.173	0.168	0.213
	(0.14)	(0.12)	(0.13)	(0.13)	(0.14)	(0.11)	(0.11)	(0.11)	(0.15)	(0.12)	(0.13)	(0.13)
Nuclear	0.057	0.064	0.075	0.032	−0.195	−0.178	−0.172	−0.230	−0.203	−0.172	−0.184	−0.201
	(0.45)	(0.51)	(0.51)	(0.55)	(0.23)	(0.26)	(0.26)	(0.30)	(0.23)	(0.24)	(0.24)	(0.28)
Hydro	0.238	0.222	0.248	0.143	0.404	0.379	0.370	0.213	0.371	0.299	0.294	0.266
	(0.25)	(0.29)	(0.26)	(0.27)	(0.31)	(0.33)	(0.32)	(0.31)	(0.33)	(0.31)	(0.31)	(0.33)
Other	−0.001	0.061	0.065	−0.012	−0.133	−0.075	−0.069	−0.164	−0.104	−0.057	−0.063	−0.106
	(0.15)	(0.11)	(0.11)	(0.11)	(0.12)	(0.08)	(0.08)	(0.08)**	(0.11)	(0.07)	(0.07)	(0.08)
N	1,122	1,056	946	858	1,122	1,056	946	858	1,122	1,056	946	858
R^2	0.892	0.918	0.922	0.924	0.885	0.911	0.916	0.922	0.859	0.905	0.909	0.916
Robustness check. Only state and year fixed effects, no other control variables												
Restructured	−0.552	−0.505	−0.586	−0.611	−0.036	0.026	−0.038	0.061	0.187	0.239	0.164	0.342
	(0.33)*	(0.29)*	(0.29)**	(0.35)*	(0.28)	(0.24)	(0.24)	(0.28)	(0.27)	(0.21)	(0.22)	(0.24)
R^2	0.890	0.917	0.921	0.922	0.882	0.909	0.914	0.918	0.855	0.903	0.906	0.912

Notes: 1. Standard errors are clustered by states and reported in parantheses.
2. Stars denote statistical significance: * significant at 10%; ** significant at 5%; *** significant at 1%.
3. State and year fixed effects are used for estimation but omitted from reporting in the table.

Table 6: Differential policy impacts for the transitional and post-transitional periods

	Residential				Commercial				Industrial			
Average price	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
A. Use 3-year transitional window												
Transitional	−0.855	−0.930	−0.964	−1.125	−0.348	−0.359	−0.378	−0.380	−0.094	−0.120	−0.136	0.002
	(0.20)***	(0.19)***	(0.19)***	(0.21)***	(0.26)	(0.27)	(0.27)	(0.34)	(0.24)	(0.24)	(0.25)	(0.30)
Post-transitional	−0.365	−0.357	−0.451	−0.504	0.166	0.194	0.117	0.105	0.355	0.404	0.304	0.405
	(0.40)	(0.34)	(0.35)	(0.38)	(0.35)	(0.29)	(0.29)	(0.31)	(0.33)	(0.24)	(0.25)	(0.26)*
Difference	0.490	0.573	0.512	0.620	0.515	0.553	0.495	0.486	0.449	0.524	0.440	0.404
	(0.32)	(0.30)*	(0.30)*	(0.32)*	(0.32)	(0.30)*	(0.30)	(0.32)	(0.31)	(0.26)**	(0.27)	(0.29)
B. Use 5-year transitional window												
Transitional	−0.941	−1.009	−1.053	−1.213	−0.307	−0.314	−0.346	−0.346	0.013	−0.068	−0.131	−0.005
	(0.23)***	(0.21)***	(0.21)***	(0.23)***	(0.25)	(0.24)	(0.24)	(0.31)	(0.25)	(0.23)	(0.24)	(0.28)
Post-transitional	−0.071	−0.033	−0.141	−0.192	0.314	0.354	0.266	0.242	0.403	0.542	0.467	0.566
	(0.47)	(0.42)	(0.42)	(0.46)	(0.41)	(0.34)	(0.34)	(0.36)	(0.37)	(0.28)*	(0.30)	(0.31)*
Difference	0.870	0.976	0.912	1.021	0.621	0.669	0.611	0.589	0.390	0.610	0.599	0.571
	(0.39)**	(0.37)**	(0.37)**	(0.40)**	(0.37)*	(0.33)**	(0.33)*	(0.35)	(0.34)	(0.30)*	(0.32)*	(0.35)
C. Use linear trend in restructured period												
Restructured	−1.142	−1.277	−1.302	−1.530	−0.407	−0.486	−0.500	−0.487	−0.010	−0.232	−0.283	−0.180
	(0.25)***	(0.23)***	(0.24)***	(0.27)***	(0.28)	(0.29)*	(0.29)*	(0.38)	(0.30)	(0.27)	(0.27)	(0.36)
Year since restructuring	0.113	0.134	0.125	0.143	0.073	0.090	0.082	0.075	0.038	0.083	0.080	0.081
	(0.06)*	(0.05)**	(0.05)**	(0.06)**	(0.06)	(0.05)*	(0.05)	(0.05)	(0.05)	(0.04)*	(0.05)*	(0.05)

Notes: 1. Standard errors are clustered by states and reported in parantheses.
2. Stars denote statistical significance: * significant at 10%; ** significant at 5%; *** significant at 1%.
3. State and year fixed effects, and additional control variables are used for estimation but omitted from reporting in the table.

Table 7: Policy impact estimates based on effective penetration of restructured services

	Residential				Commercial				Industrial			
Average price	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
A. Restructured sales quantity penetration, one-year lag												
Penetration rate $\geq 1\%$	0.036	0.283	0.228	0.036	0.162	0.287	0.117	−0.090	0.361	0.417	0.328	0.213
	(0.44)	(0.45)	(0.45)	(0.51)	(0.36)	(0.30)	(0.30)	(0.31)	(0.33)	(0.23)*	(0.23)	(0.23)
Penetration rate $\geq 5\%$	0.318	0.577	0.529	0.510	0.333	0.432	0.319	0.176	0.481	0.537	0.453	0.283
	(0.48)	(0.52)	(0.51)	(0.52)	(0.38)	(0.34)	(0.36)	(0.37)	(0.35)	(0.26)**	(0.26)*	(0.25)
Penetration rate $\geq 10\%$	−0.336	−0.113	−0.168	−0.191	0.462	0.563	0.487	0.186	0.639	0.688	0.595	0.449
	(0.29)	(0.29)	(0.28)	(0.29)	(0.36)	(0.32)*	(0.33)	(0.33)	(0.34)*	(0.26)**	(0.27)**	(0.26)*
B. Restructured sales revenue penetration, one-year lag												
Penetration rate $\geq 1\%$	0.194	0.290	0.230	0.010	0.162	0.288	0.116	−0.094	0.359	0.429	0.338	0.226
	(0.48)	(0.47)	(0.47)	(0.53)	(0.36)	(0.31)	(0.32)	(0.31)	(0.34)	(0.23)*	(0.24)	(0.23)
Penetration rate $\geq 5\%$	0.238	0.484	0.431	0.408	0.310	0.406	0.286	0.137	0.486	0.555	0.466	0.336
	(0.49)	(0.54)	(0.53)	(0.54)	(0.38)	(0.34)	(0.36)	(0.37)	(0.35)	(0.25)**	(0.26)*	(0.25)
Penetration rate $\geq 10\%$	−0.336	−0.113	−0.168	−0.191	0.395	0.509	0.431	0.162	0.633	0.688	0.596	0.465
	(0.29)	(0.29)	(0.28)	(0.29)	(0.37)	(0.33)	(0.34)	(0.33)	(0.34)*	(0.25)***	(0.26)**	(0.25)*

Notes: 1. Standard errors are clustered by states and reported in parantheses.
2. Stars denote statistical significance: * significant at 10%; ** significant at 5%; *** significant at 1%.
3. State and year fixed effects, and additional control variables are used for estimation but omitted from reporting in the table.

Table 8: Policy impacts – restructuring measured as full retail choice for all three customer segments

	Residential				Commercial				Industrial			
Average price	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
A. Uniform policy impact for the entire restructuring period												
Restructured	−0.517	−0.538	−0.618	−0.664	−0.147	−0.176	−0.243	−0.297	0.071	0.011	0.001	0.050
	(0.31)	(0.27)*	(0.28)**	(0.30)**	(0.27)	(0.23)	(0.24)	(0.24)	(0.27)	(0.22)	(0.23)	(0.24)
B. Differential policy impact using the 3-year transitional window												
Transitional	−0.910	−0.993	−1.028	−1.128	−0.573	−0.631	−0.664	−0.684	−0.414	−0.499	−0.478	−0.426
	(0.20)***	(0.18)***	(0.18)***	(0.22)***	(0.19)***	(0.18)***	(0.18)***	(0.22)***	(0.18)**	(0.17)***	(0.18)***	(0.19)**
Post-transitional	−0.275	−0.250	−0.352	−0.420	0.116	0.112	0.028	−0.094	0.370	0.334	0.311	0.300
	(0.43)	(0.38)	(0.39)	(0.40)	(0.39)	(0.34)	(0.34)	(0.34)	(0.38)	(0.30)	(0.31)	(0.32)
Difference	0.635	0.743	0.676	0.708	0.689	0.743	0.692	0.590	0.785	0.833	0.789	0.726
	(0.35)*	(0.33)**	(0.32)**	(0.34)**	(0.37)*	(0.34)**	(0.34)**	(0.35)	(0.34)**	(0.26)***	(0.26)***	(0.26)***
C. Differential policy impact using the 5-year transitional window												
Transitional	−0.966	−1.034	−1.082	−1.190	−0.533	−0.575	−0.618	−0.670	−0.282	−0.417	−0.404	−0.397
	(0.24)***	(0.21)***	(0.22)***	(0.25)***	(0.20)**	(0.20)***	(0.20)***	(0.24)***	(0.22)	(0.19)**	(0.20)**	(0.23)*
Post-transitional	0.077	0.136	0.020	−0.086	0.363	0.366	0.270	0.112	0.537	0.593	0.558	0.541
	(0.51)	(0.46)	(0.47)	(0.48)	(0.46)	(0.39)	(0.39)	(0.38)	(0.41)	(0.34)*	(0.34)	(0.34)
Difference	1.043	1.170	1.101	1.104	0.896	0.941	0.888	0.783	0.820	1.010	0.962	0.938
	(0.43)**	(0.41)***	(0.41)**	(0.42)**	(0.40)**	(0.35)**	(0.35)**	(0.36)**	(0.33)**	(0.28)***	(0.29)***	(0.28)**

Notes: 1. Standard errors are clustered by states and reported in parantheses.
2. Stars denote statistical significance: * significant at 10%; ** significant at 5%; *** significant at 1%.
3. State and year fixed effects, and additional control variables are used for estimation but omitted from reporting in the table.

Table 9: Policy impacts – using state aggregate income as regression weights

	Residential				Commercial				Industrial			
Average price	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
A. Uniform policy impact for the entire restructuring period												
Restructured	−0.453	−0.433	−0.460	−0.665	−0.161	−0.141	−0.172	−0.361	−0.060	−0.036	−0.048	−0.016
	(0.28)	(0.28)	(0.28)	(0.36)*	(0.22)	(0.22)	(0.22)	(0.28)	(0.23)	(0.22)	(0.23)	(0.29)
B. Differential policy impact using the 3-year transitional window												
Transitional	−0.730	−0.733	−0.743	−0.882	−0.534	−0.531	−0.543	−0.526	−0.394	−0.393	−0.391	−0.162
	(0.18)***	(0.18)***	(0.19)***	(0.23)***	(0.23)**	(0.23)**	(0.24)**	(0.24)**	(0.28)	(0.28)	(0.28)	(0.27)
Post-transitional	−0.256	−0.219	−0.255	−0.504	0.087	0.119	0.081	−0.256	0.171	0.212	0.195	0.084
	(0.39)	(0.38)	(0.39)	(0.48)	(0.31)	(0.31)	(0.31)	(0.35)	(0.30)	(0.29)	(0.30)	(0.35)
Difference	0.474	0.514	0.488	0.378	0.621	0.650	0.623	0.270	0.565	0.605	0.585	0.246
	(0.30)	(0.30)*	(0.30)	(0.33)	(0.36)*	(0.35)*	(0.36)*	(0.28)	(0.37)	(0.37)	(0.38)	(0.30)
C. Differential policy impact using the 5-year transitional window												
Transitional	−0.743	−0.743	−0.756	−0.973	−0.436	−0.434	−0.451	−0.497	−0.331	−0.338	−0.342	−0.203
	(0.22)***	(0.22)***	(0.22)***	(0.29)***	(0.19)**	(0.18)**	(0.19)**	(0.22)**	(0.24)	(0.24)	(0.24)	(0.31)
Post-transitional	0.005	0.058	0.017	−0.242	0.231	0.278	0.235	−0.197	0.344	0.416	0.402	0.232
	(0.46)	(0.45)	(0.46)	(0.53)	(0.40)	(0.39)	(0.39)	(0.42)	(0.37)	(0.36)	(0.37)	(0.40)
Difference	0.748	0.801	0.773	0.732	0.666	0.712	0.686	0.300	0.675	0.754	0.744	0.435
	(0.35)**	(0.35)**	(0.35)**	(0.40)*	(0.39)*	(0.39)*	(0.39)*	(0.33)	(0.41)	(0.41)*	(0.41)*	(0.42)

Notes: 1. Standard errors are clustered by states and reported in parantheses.
2. Stars denote statistical significance: * significant at 10%; ** significant at 5%; *** significant at 1%.
3. State and year fixed effects, and additional control variables are used for estimation but omitted from reporting in the table.

Table 10: Policy impacts – log-linear models

	Residential				Commercial				Industrial			
Average price	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
A. Uniform policy impact for the entire restructuring period												
Restructured	−0.042	−0.037	−0.042	−0.038	0.006	0.009	0.005	0.022	0.038	0.044	0.033	0.070
	(0.02)*	(0.02)	(0.02)*	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)*
B. Differential policy impact using the 3-year transitional window												
Transitional	−0.057	−0.058	−0.060	−0.064	−0.014	−0.011	−0.013	0.003	0.019	0.022	0.021	0.062
	(0.02)***	(0.02)***	(0.02)***	(0.02)**	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.05)
Post-transitional	−0.032	−0.023	−0.029	−0.020	0.017	0.021	0.016	0.033	0.049	0.058	0.040	0.074
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)*
Difference	0.025	0.036	0.032	0.044	0.030	0.032	0.029	0.031	0.030	0.036	0.019	0.012
	(0.02)	(0.02)	(0.02)	(0.02)*	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
C. Differential policy impact using the 5-year transitional window												
Transitional	−0.064	−0.063	−0.066	−0.066	−0.010	−0.007	−0.010	0.006	0.031	0.029	0.021	0.059
	(0.02)***	(0.02)***	(0.02)***	(0.03)**	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Post-transitional	−0.011	0.002	−0.005	0.004	0.024	0.030	0.024	0.042	0.046	0.063	0.049	0.082
	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)*
Difference	0.052	0.065	0.061	0.071	0.034	0.037	0.034	0.035	0.016	0.034	0.028	0.023
	(0.03)*	(0.03)**	(0.03)**	(0.03)**	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.05)

Notes: 1. Standard errors are clustered by states and reported in parantheses.
2. Stars denote statistical significance: * significant at 10%; ** significant at 5%; *** significant at 1%.
3. State and year fixed effects, and additional control variables are used for estimation but omitted from reporting in the table.