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Regulatory Implications of Utility Mergers on Market Competition and Consumer Pricing: Insights from the Duke-Progress Energy Merger

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Abstract
This paper analyzes the impact of the 2012 Duke Energy and Progress Energy merger on electricity rates in North Carolina and South Carolina. Using Difference-in-Differences and Synthetic Control Method analyses to find the effects on residential, commercial and industrial consumers, this study finds that the merger led to significant price reductions for residential and commercial consumers in North Carolina, where the market became more vertically integrated. In contrast, South Carolina, which remained fragmented among multiple electricity producers, experienced minimal or no beneficial pricing effects from the merger. The findings suggest that vertical integration in regulated, non-RTO states can yield consumer benefits through efficiencies and cost savings, provided effective regulatory oversight is in place. The study concludes by highlighting the critical role of regulation in noncompetitive markets and suggesting areas for future research, including extending the data timeline and comparative analyses with similar mergers.

Keywords: Energy Mergers, Merger Analysis, RTO, Regulation and Duke Energy

Introduction
Mergers in regulated utility markets can significantly affect market competition , regulatory oversight, and consumer pricing. In 2011, Duke Energy and Progress Energy announced their intention to merge, creating one of the largest electric utility companies in the United States under the name Duke Energy. This merger affected North Carolina and South Carolina (and parts of Florida), increasing single-firm market concentration to 96% in North Carolina and 42% in South Carolina in terms of total generation and distribution capacity. While the Department of Justice(DoJ) did not challenge the merger, the Federal Energy Regulatory Commission (FERC) assessed2 and eventually approved it with mitigating measures due to concerns about potential anti-competitive effects.

FERC's initial report highlighted three primary concerns: potential pressures on wholesale market prices, decreased access to transmission networks, and challenges in regulatory oversight stemming from the significant increase in market concentration. To evaluate these concerns post-merger, this paper examines the causal impact of the merger on consumer electricity prices in North Carolina and South Carolina.

Utilizing available data, I have modelled the pricing effects separately for three consumer groups – residential, commercial, and industrial. I have employed the Difference-in-Differences (DiD) method to quantify the merger's impact and used the Synthetic Control Method (SCM) to confirm my findings through an alternative analytical approach. My analysis is conducted at both the state level and the investor-owned utility (IOU) level to capture a comprehensive view of the merger's effects.

The rest of the paper is organized as follows: Section 1 provides detailed background on the merger and the associated regulatory concerns. Section 2 outlines the methodologies, underlying assumptions, and hypotheses used in the analysis. In Section 3, I present and discuss my findings. Section 4 explores the implications of these results, particularly the differences seen between North Carolina and South Carolina, and between the state-level and IOU level analyses. Section 5 delves into the policy implications of mergers in regulated environments, emphasizing the varying impacts across state lines. Section 6 suggests avenues for future research to enhance the generalizability of our study. Finally, Section 7 concludes the paper, summarizing the key insights and contributions.

Merger Between Duke Energy and Progress Energy

Mergers in regulated and vertically integrated states offer an opportunity to understand the effects of consolidation in regulatory environments and assess the efficacy of regulatory bodies in different states.

One such merger is the merger between Duke Energy Corporation (Duke Energy) and Progress Energy, Inc. (Progress Energy) that took place in 2011 and affected markets in North Carolina, South Carolina, and Florida .

Duke Energy filed a notice of merger application with the federal register in 2011 to acquire Progress Energy. At the time of announcement, Duke Energy and Progress Energy served 11 million and 3.1 million customers respectively in North Carolina, South Carolina, and Florida. Accounting for Duke Energy's operations in the Ohio and Indiana, the merger led to the creation of the largest electric utility company in the U.S., by enterprise value, market capitalization and generation assets and customers [3]. Following the notice of merger application, interventions were filed with FERC, concerning the JDA (Joint Dispatch Agreement) and Joint OATT (Open Access Transmission Tariff), by the Ohio Commission, North Carolina Commission, and Florida Commission . These notices of intervention focused on the potential impacts of the proposed merger on competition, market concentration, and regulatory oversight in the relevant markets, particularly in North Carolina, South Carolina, and Florida. Concerns were raised about the effects on wholesale energy markets, access to transmission networks, and the potential increase in market power, which could adversely affect customers and smaller utilities in these regions. Additionally, the interventions addressed the implications of the merger for state regulatory commissions' ability to oversee and manage electric utility operations within their jurisdictions.

FERC's Analysis of the Merger

Per Section 203(a)(4), FERC approves a transaction if it decides that it is consistent with the public interest. The analysis proposed in Section 203(a)(4) involves understanding the effect on competition, rates, and regulation. In the analysis presented by Duke Energy and Progress Energy to FERC, they acknowledged that there would be an increase in market concentration in the Carolinas, but they argued that the effect would be minimal and would not hurt competition. They employed the "Delivered Price Test" and market share analysis, which suggested the merger would not lead to significant harm to consumers or competition in the relevant markets.

The applicants (Duke Energy and Progress Energy) focused their analysis to the FERC on the impact on Available Economic Capacity (AEC) and indicated that depending on the assumptions used, the Herfindahl-Hirschman Index (HHI) would increase by 200 to 300 points [5]. The analysis included sub-analyses with different assumptions associated with rate pancaking . With rate pancaking, the HHI increased by one point to 1,126 in the Duke Energy Carolinas Balancing Authority Area (BAA) for the summer super-peak period and by 186 points to 1,336 in the Progress Energy Carolinas-East BAA for the summer off-peak period. Without rate pancaking, the HHI increased by 241 points to 1,073 in the Duke Energy Carolinas BAA and by 214 points to 1,364 in the Progress Energy Carolinas-East BAA during the summer off-peak period. Duke Energy and Progress Energy argued that eliminating rate pancaking, despite indicating higher market concentration, would ultimately benefit wholesale consumers by lowering delivered power costs through the removal of intermediary transmission rate charges [5]. FERC also asked that Duke Energy and Progress Energy provide a price sensitivity analysis for the Duke Energy Carolinas, Progress Energy Carolinas-East, and Progress Energy Carolinas-West BAAs. This analysis included scenarios with a 10% increase and decrease in price levels, as well as a short-term sensitivity analysis using delivered price data from the Electric Quarterly Reports (EQR). These analyses indicated that the electricity supply from both Duke Energy and Progress Energy relied on geographically proximate generation facilities, suggesting that any increase in generation costs would have a minimal impact during periods when power is sourced from remote generation [5].

In response, several intervenors, including state regulators, consumer advocacy groups, and market participants, highlighted three anti-competitive concerns associated with the merger. First, they specified that the merger would lead to the development of an area of overlap in operations in North Carolina and South Carolina where both have substantial generation and distribution facilities. These regions were in the Southeastern North Carolina and Northeastern South Carolina. Intervenors added that the merger would lead to a significant increase in horizontal market power not just in the overlapping regions but also statewide markets – which could potentially lead to higher electricity transmission costs and rates for end consumers. Secondly, intervenors marked that the merger would have negative wholesale market effects as both are major producers of electricity in North and South Carolina and could deploy monopolistic pricing strategies that would harm retailers and end-users. Last, state regulators (included in the list of Plaintiffs) shared concerns about the merger's impact on state-level competition and regulatory oversight Following a set of back and forth, protests and negotiations with the FERC, applicants accepted certain conditions imposed to address anticompetitive concerns. The measures included 'stub mitigation' and transmission reservations and rate increase embargoes. As a result, applicants had to set aside 104 MW additional transmission capacity from Duke's generation facilities in the Duke Energy Carolinas Balance Authority Area (BAA) for Progress Energy Carolinas East Balancing Authority Area and allow for reservation of capacity by transmission companies, not affiliated with Duke or Progress Energy [7]. The merged party was also required to join an RTO, have independent oversight of the transmission network through the establishment of an ICT

(Independent Coordinator of Transmission), divest certain generation assets, perform virtual divestitures and make significant investments to alleviate potential bottlenecks that could prevents entry of competitive market suppliers in the future [5]. Lastly, the merging parties agreed to "… commit for a period of five year to hold harmless wholesale requirements and transmission costs from the costs of the transaction." After receiving clearance for the merger, Duke Energy and Progress Energy merged on July 2nd, 2012.

Methods

This paper divides the analysis into two parts – first, examining the effect of the merger on average electricity rates across the state, and second, assessing its impact on rates charged by investor-owned utilities (IOUs). Both parts focus on end-user rates for three consumer categories: residential, commercial, and industrial. I develop a more comprehensive understanding by combining these two sets of regression results – statewide electricity rates and IOU-specific rates. This includes the impact on different consumer groups, the responses of downstream suppliers and competitors, and the influence of market concentration in electricity generation on pricing.

Market

Before the merger in 2011, Duke Energy operated in North Carolina, South Carolina, Florida, Indiana, Kentucky, and Ohio; while Progress Energy operated in parts of North Carolina, South Carolina, and Florida. Even though Florida is a common territory of operation in the merger, Duke Energy and Progress Energy did not have major areas of overlap, except Orlando [4]. Therefore, I focus my analysis on North Carolina and South Carolina only. In both of these markets, I have data available for four consumer groups – residential, commercial, industrial and transportation; however, I have not used 'transportation' data as a subset of my analysis due to low variability of consumption data between 2006 and 2020 and missingness of dependent variables for key control states.

Although the FERC highlighted the merger's anti-competitive effects on the wholesale electricity market, I have analyzed end-user electricity rates to understand its downstream impact on consumers . Given that Duke Energy Progress generates 96% of the electricity in North Carolina and 42% in South Carolina, I hypothesize that this high market concentration in the wholesale market leads to direct spill-over effects affecting downstream consumers [8].

Analytical Methodology

This paper attempts to infer causality by using two commonly used techniques for retroactive merger analysis – Difference-in-Differences (DiD) and Synthetic Control Method (SCM) [9]. First, I apply the DiD method to understand the ordinality and statistical significance of price changes due to the merger, followed by the application of the SCM to visualize the change in electricity rates compared to the control group. This paper exclusively uses publicly available data and exhibits some manipulation of variables while ensuring the preservation of their core properties (median, mean, IQR). I have discussed the selection and use of variables and their manipulations (if any) in the sub-sections below.

Selecting Independent Variables Affecting Electricity Price

Retail and wholesale electricity rates in the U.S. are dependent upon the nature of state-specific utility regulations . In states like North Carolina , electricity rates are approved by the utility commissions based on several factors. These factors include the cost of providing service (transmission, operations, and infrastructure), the cost of developing infrastructure (grid modernization and investments in renewable energy projects), and the cost of generating electricity (coal, natural gas, fuel costs, etc.).10 Under North Carolina general statutes 62-133.2, electric utilities are allowed to adjust electric rates based on changes in fuel costs [10]. This process is common in regulated states and is often called 'Fuel Adjustment Clause (FAC)' and allows for utility companies to pass through the cost of fuel directly to consumers.

Based on the above information about regulated states like North Carolina, I use different variables for each segment of our analysis. Since my goal is to infer causality of the merger on electricity rates, I control for variables that affect specific segment of the analysis.

Analysis on State-Wide Average Retail Electricity Rates

As discussed earlier, retail electricity rates are primarily determined by regulatory authorities. This makes it challenging to model price adjustments in regulated states. To address this, I have focused on variables that best represent the 'cost of providing service' and the 'cost of developing infrastructure'12.

Since I am working with state-wide averages, I account for the fact that vertically integrated electricity generation companies run alongside local distribution companies. While the rates set by these generation companies influence overall electricity rates, they do not entirely determine the changes or absolute values of average electricity rates within a state.

Therefore, I use the following variables to ensure that factors effecting electricity rates are controlled for –

• Variables standing for 'cost of providing service': Number of consumers by customer segmentation (residential, industrial, commercial) and Average electricity consumption by each customer

• Variables standing for 'cost of developing infrastructure' 14: Real Per Capita Income by state and Possibility of weather calamities that could damage infrastructure (binary)

Analysis on IOU-Specific Average Electricity Rates

In addition to the analysis mentioned above, I have isolated the pricing effect of the merger exclusively to IOUs (Investor-Owned Utilities). IOUs work with the goal of generating profits, unlike cooperatives and municipal electricity transmission organizations. Therefore, by performing the analysis on IOU-specific variables, I am able 12 I excluded variables related to the 'cost of generating electricity' because wholesale generators absorb these costs and adjust rates based on competitive market forces. These costs are not directly reflected in wholesale electricity distribution agreements or passed on to distributors. I performed two tests to ensure that excluding these variables does not result in omitted variable bias (OVB). First, the excluded variables showed no or extremely limited correlation with any other explanatory variables. Second, they explained little of the variance exhibited by the dependent variable in each respective model. In other words, the tests confirmed that the exclusion of these variables does not impact the fundamental structure of the model.

To isolate the profit-making motive of an IOU. However, this method results in a significant reduction in the number of customers included in the analysis. The variables used to control for ancillary factors are identical in both cases (stateaverage and IOU-specific pricing). Since IOUs are usually responsible for generation and transmission of electricity in vertically integrated, non-RTO states, lack of upward pricing pressures from generation facilities would imply that resource cost adjustments will be applied to consumers directly, while accounting for regulatory effects. Therefore, I have included variables that stand for the total spend associated with generating electricity i.e., total spend on acquisition of coal, natural gas, and fuel oil for electricity generation.

Performing Manipulation on Select Variables

My dataset is structured as a pooled dataset, where most variables have values for all states. However, some variables related to the cost of generating electricity – specifically coal, fuel oil, and natural gas costs – are missing for certain years and states. This is less than ideal, but the cost of generating electricity is an endogenous variable crucial to my IOU-specific model. Since these costs directly influence retail electricity rates, omitting them could lead to biased regression estimates. Therefore, addressing the missing data is essential to maintain the integrity of the analysis.

To manage this issue, I employed machine learning techniques to impute the missing values . Using scikit-learn's imputation function with the 'median' strategy, I filled in the gaps in the dataset. Specifically, I performed a linear regression that ranked fuel rates by state for each year and used the regression coefficients to estimate the missing values, incorporating historical data for each state. Post-imputation analysis showed that the statistical properties of the manipulated dataset - such as the median, interquartile range (IQR), maximum, and minimum values – remained similar to those of the original dataset, as proven by the boxplots in Appendix 1.

Theory of Analysis

As previously mentioned, I use the Synthetic Control Method (SCM) and Difference-in Differences (DiD) regression to understand the causal impact of the merger on retail electricity pricing. Both of these methods are applied for state- and IOU-level analysis, using variables mentioned in the last section. In Section 2.B, I justify the use of SCM and DiD due to their usage in earlier retroactive merger studies. In addition to their earlier academic usage, SCM and DiD help in controlling time-invariant variables that are specific to state entities

Difference-in-Difference

The application of DiD is similar to performing a regression but, with the addition of dummy variables that represent the treatment effect, post-treatment time-invariant effect and the interaction between these variables. The coefficient associated with the interaction term is theorized to be the causal effect of the treatment, controlling for other associated covariates.

Suppose Y , represents the retail electricity rates for each respective consumer group, j
i.e., residential, commercial and industrial consumers, δ is the measure of treatment effect on the merger and γ is a vector of k coefficients associated with the vector of k covariates(x ,). Using the variables mentioned in Section II.B.1, I ran the following regression

$$Y_{it,j} = \beta_{0,j} + \rho_{1,j}(treated) + \rho_{2,j}(after) + \delta_{1,j}(treated \times after) + \gamma_k x_{it,k} \quad \ldots (2)$$

Synthetic Control Method

For reference, SCM is designed to apply weights on control group covariates such that the mathematical manipulation generates a single synthetic control group. The synthetic control group is then plotted to compare the deviation of the dependent variable of the synthetic group from the dependent variable for the treatment group. The deviation generated, in theory, helps to understand the causal effect of the treatment. I have implemented the SCM for this analysis using calculations mentioned below.

Let, Y be the observed outcome variable i.e., cost per kilowatt-hour, in cents, for residential, industrial, or commercial use for unit i at time t. The goal is to estimate Y i.e., counterfactual outcome for our treatment group and treatment effect α for treatment states after the merger (treatment) is our variable of interest.

The relationship between these dependent variables for all units i is defined by:

$$Y_{it} = Y_{it}^N + \alpha_{it} D_{it}$$

such that,

$$D_{it} = \begin{cases} 1, & if\ i = 1\ and\ t > t_M \\ 0, & otherwise \end{cases}$$

$$Y_{it}^N \approx \sum_{j=2}^{I} W_j Y_{jt} \qquad \dots (1)$$

$$such\ that\ we\ min \sum_{t=1}^{t_M - 1} (Y_{1t} - \sum_{j=2}^{I} W_j Y_{jt})^2\ \ and\ \Sigma W_j = 1\ and\ W_j \geq 0$$

In other words, the weights $W = (W2, \dots, W1)$ are selected in such a way that they minimize the pre-treatment difference between the treatment group and the synthetic control group.

In some cases, SCM does not perfectly optimize the RMSE (Root Mean Squared Error). The lack of optimization is also seen in the statistical significance associated with the coefficient of the treatment effect. I have discussed these findings in later sections.

Selection of Treatment Year

Initially, I conducted preliminary analyses using 2012 and 2013 as the treatment years. The rationale for selecting 2012 was to capture the immediate retail pricing effects following the merger's completion. Drawing inspiration from Orley Ashenfelter, Daniel Hosken, and Matthew Weinberg's study on the merger between Maytag and Whirlpool, which found that competitors adjusted their rates in key markets upon merger announcements, I wanted to see if a similar pattern emerged with transmission companies. However, my tests revealed that merger approval protocols prevented companies from increasing retail electricity rates immediately after the merger announcement. As a result, 2012 was not a suitable treatment year. Similarly, I dismissed 2013 because it was challenging to justify an immediate spillover effect of the merger on retail pricing within that period.

Consequently, I selected 2016 as the treatment year, five years post-announcement, aligning with FERC's anticompetition mitigation measures18. This choice is supported by the typical duration of commercial utility Power Purchase Agreements (PPAs), which generally last around five years [15]. I hypothesize that by 2016, electricity agreements between Duke Energy Progress and their transmission partners would have undergone renegotiations, reflecting the behavioral remedies imposed by FERC. This timing allows for a more accurate assessment of the merger's impact on retail electricity rates after regulatory adjustments have taken effect.

In summary, by designating 2016 as the treatment year, the analysis balances regulatory considerations and data availability, providing a robust framework to assess the merger's impact on retail electricity pricing in North Carolina and South Carolina.

Selection of Treatment Group

In the introduction of this paper, I provided a brief overview of the U.S. electricity market's structure. While analyzing the market both state-wise and by investor-owned utilities (IOUs), I had the option to include all 50 states and their respective IOUs as control units. However, selecting the appropriate control group required a deeper understanding of the regulatory environments to accurately identify the treatment group.

(Figure 1)

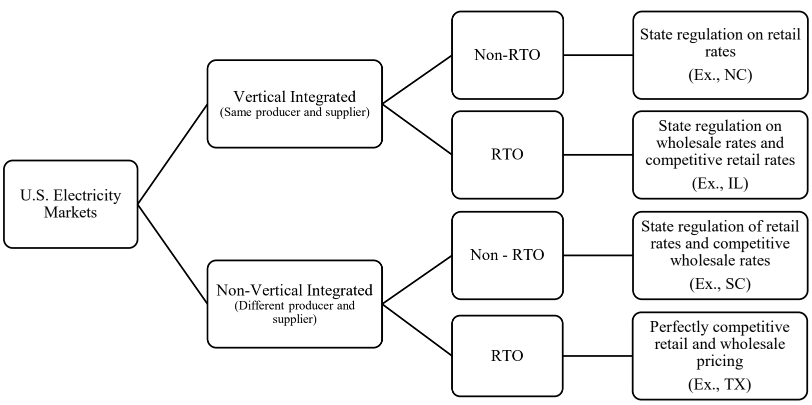

Figure 1

To visualize the electricity market, I created a (over)simplified diagram (see, 'Figure 1') that highlights the average differences in pricing dynamics across various market structures. In my dataset, I included a dummy variable to indicate which states operate under Regional Transmission Organizations (RTOs). For our Difference-in-Differences (DiD) and synthetic control analyses focusing on North Carolina and South Carolina (our treatment group), I decided to exclude states governed by RTOs. This decision is supported by the argument that RTOs introduce complexities that are not time-invariant within our observation period, making it difficult to isolate their effects using fixed-effect models.

RTO states typically feature more competitive retail pricing, which can lead to significant fluctuations in electricity rates – higher during adverse weather conditions and lower when grid utilization is low. Additionally, transmission companies in these markets can adjust rates to encourage consumers to switch suppliers. In contrast, non-RTO states, especially those with vertically integrated utilities, do not offer consumers the option to choose their electricity provider. These fundamental operational differences mean that the impact of RTOs cannot be assumed to be constant over time, justifying their exclusion to maintain the validity of our analysis. Although excluding RTO states reduces the variability of independent variables, it enhances the model's applicability to the pricing effects of the merger in North Carolina and South Carolina. Beyond excluding RTO states, I also omitted non-RTO states that experienced in-state utility consolidations .

One crucial assumption that validates the DiD observations is the parallel trends assumption. Based on filters identified above, I have included line graphs of electricity rates by state in appendix 2. Based on a visual inspection, as identified as a reliable method to prove the assumption, I argue that states like Hawaii, Louisiana and Nevada do not exhibit parallel pre-treatment trends to North Carolina or South Carolina. Therefore, for our regression on state-level variables, I will be excluding these states.

After these exclusions, the analysis focused on North Carolina and South Carolina as treatment states and 15 other states as control units. Additionally, I used data from 54 IOUs within these 15 control states to conduct both DiD and Synthetic Control Method (SCM) analyses (Additional information about these states and IOUs is mentioned in our Appendix 8). This approach ensures that our findings are robust and specifically reflect the impact of the merger on retail electricity pricing in the target states.

Results

Using the outline of techniques, manipulations, and filtering logic mentioned in previous sections, I first apply SCM using the state-level model for North Carolina and South Carolina, followed by the IOU-level model for Duke Energy Progress in North Carolina and South Carolina. For the purposes of this analysis, I limit the use of SCM to only understand the directional pricing effect of the merger. I then use DiD to understand the ordinal pricing effect and the associated statistical significance of the treatment. In this section, I iteratively refer to the results of both SCM and DiD for all state, IOU, and industry-specific analyses. Results from the DiD on state-level and IOU-level observations are presented in Table 1 and Table 2, respectively.

In the DiD model, my coefficient of importance is the coefficient associated with the interaction term i.e., δ , . I will be using 95% confidence interval (5% statistical significance) as my threshold for statistical significance. In other words, using a two-tailed statistical significance test and defining H as δ , = 0 and H : δ , ≠ 0, if δ , differs significantly from 0 within the 95% confidence interval, I have rejected H supporting evidence for a non-zero treatment effect .

State-Level Observations

	(NC.1) Residential	**(NC.2) Commercial**	**(NC.3) Industrial**	**(SC.4) Residential**	**(SC.5) Commercial**	**(SC.6) Industrial**
Customers (log)	0.130** (0.0406)	0.199** (0.108)	0.0201 (0.0865)	0.132** (0.0417)	0.196** (0.0650)	0.0181 (0.863)
Consumption (Log kWh)	-0.627** (0.205)	-0.621** (0.197)	-0.0235 (0.0750)	-0.665*** (0.201)	-0.639** (0.192)	-0.0272 (0.0749)
Weather risk (1 = True)	0.172 (0.115)	0.0280 (0.108)	0.00723 (0.105)	0.184 (0.116)	0.0327 (0.108)	0.00942 (0.105)
post16Xtreatment	-0.0709*** (0.0141)	-0.0698*** (0.0148)	0.0150 (0.0331)	-0.0167 (0.0165)	-0.0504* (0.0213)	0.0259 (0.0385)
post16 (1 = After 2015)	**0.0983*** (0.0128)**	**0.0720*** (0.0142)**	**0.00763 (0.0256)**	**0.0962*** (0.0128)**	**0.0708*** (0.0141)**	**0.00752 (0.0256)**
Treatment (1 = NC / SC)	-0.223* (0.104)	-0.352*** (0.0726)	-0.105 (0.0808)	0.0488 (0.0909)	-0.0896 (0.0582)	0.000134 (0.0934)
Per Capita Inc. (Log PCI)	0.483*** (0.110)	0.589*** (0.140)	0.637*** (0.172)	0.489*** (0.109)	0.600*** (0.138)	0.636*** (0.171)

Constant	-0.435 (2.166)	-1.224 (1.813)	-4.909* (2.241)	-0.271 (2.124)	-1.152 (1.788)	-4.847* (2.237)
N	225.000	225.000	225.000	225.000	225.000	225.000
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001						

Table 1: Difference in Difference Analysis on State-Level Variables

Pricing Effect of the Merger for Residential Consumers in North Carolina

The SCM analysis, shown in Appendix 5.1, indicates a net-negative effect of the merger on rates of electricity for residential consumers. Between 2006 and 2016, electricity rates for our treatment group and control group increased from roughly 9 cents / kWh to 11 cents / kWh. After the application of treatment effect in 2016, residential rates in our synthetic control state rose faster than in our treatment group. Electricity rates for residential consumers in our synthetic control state increased from just above 11 cents / kWh to nearly 12 cents / kWh. On the other hand, electricity rates for residential consumers in North Carolina increased from 11 cents to roughly 11.5 cents / KWH. In other words, electricity rates in North Carolina grew at 4.5%, compared to 9% in our synthetic control state – doubling the price change.

The relative deviation of growth in electricity rates for North Carolina's residential consumers is also reflected in the DiD regression analysis. Here, the coefficient of the interaction term, δ , is -0.0709, with a standard error of 0.014. In other words, controlling for other variables, the impact of the merger on electricity rates in North Carolina is statistically significant and is associated with a 7.1 percentage point decrease in electricity rates, when compared to control states. Given that the annual average residential electricity consumption in North Carolina is 13,334 KWH, the coefficient suggests that the merger is associated with annual savings of $101 per household per year or, 7.1% reduction in annual electricity bill.

Pricing Effect of the Merger for Commercial Consumers in North Carolina

Unlike residential consumers, SCM analysis does not yield an observed effect due to the merger. This is because regressors used in the model failed to effectively minimize pre-treatment trends. Consequently, post-treatment deviation of the treatment group from the control group renders inconclusive results.

Results from our DiD analysis generate a negative and statistically significant coefficient for our interaction term i.e., δ , = -0.0698, with a standard error of 0.014. In other words, the merger is associated with a nearly 7 percentage point decrease in electricity rates for commercial consumers in North Carolina. Commercial consumers spend over $592K annually in North Carolina on electricity and therefore, the merger was associated with a relative savings of $41,311.

Pricing Effect of the Merger for Industrial Consumers in North Carolina

Similar to residential consumers, relative growth of electricity rates for industrial consumers in North Carolina was less than the synthetic control state. Interestingly, electricity rates experienced a decline in electricity rates, while the synthetic control group's electricity price increased between 2016 and 2018 before reverting to their 2016-level in 2020. Between 2016 and 2020, North Carolina's industrial electricity rates reduced from 6.4 cents / kWh to 6.3 cents / kWh, while the synthetic control group's industrial electricity rates remained constant at 6.4 cents / kWh.

In table 1, the coefficient associated with interaction term for industrial consumers is positive and not statistically significant. Although the SCM analysis shows pre-treatment alignment between the treatment and synthetic control groups' electricity rates, the DiD results are not statistically significant at the 5% level, preventing confirmation of the merger's impact.

Pricing Effect of the Merger for Residential Consumers in South Carolina

The SCM analysis (Appendix 5.2) suggests a minimal but positive pricing effect on residential electricity rates in South Carolina post-merger. Prior to 2016, both treatment and synthetic control groups saw a gradual rise in rates from approximately 9 cents to 12 cents per kWh. Following the merger in 2016, residential rates in the synthetic control group increased slightly more than those in South Carolina. Specifically, while the synthetic control group saw an increase to around 12.5 cents per kWh, South Carolina's rates remained more stable, averaging just above 12 cents per kWh. This indicates a moderate price effect due to the merger. The DiD regression analysis indicates a rather subdued observation, showing an interaction term, δ , of -0.0167 with a standard error of 0.0165, suggesting an insignificant effect on household bills.

Pricing Effect of the Merger for Commercial Consumers in South Carolina

Similar to commercial electricity rates for North Carolina, SCM analysis is unable to generate a synthetic control group that effectively minimizes RMSE; however, coefficient generated from DiD analysis is negative and statistically significant at 5%.

The DiD regression coefficient for the commercial segment, δ , is -0.0504 with a standard error of 0.0213. On average commercial consumers in South Carolina spend approximately $581K annually on electricity bills. Based on observations from the DiD analysis, the merger is associated with 5% or, $29,296 in annual savings.

Pricing Effect of the Merger for Industrial Consumers in South Carolina

The industrial sector reveals an insignificant price increase in South Carolina relative to the synthetic control group. Post-merger, industrial electricity rates in South Carolina remained relatively constant at around 6 cents per kWh, while the synthetic control saw a slight rise before reverting to pre-2016 levels. The interaction term, ☐ , for industrial rates is estimated at 0.0259 with a standard error of 0.0385, indicating an inconclusive impact of the merger on industrial electricity rates.

In conclusion, analysis of the merger's impact on electricity pricing reveals divergent outcomes between North Carolina and South Carolina across consumer categories. For North Carolina, the merger was associated with significant savings for residential and commercial consumers, as evidenced by lower relative price growth compared to the synthetic control group. In contrast, South Carolina showed no statistically significant pricing impact for residential or industrial sectors, with electricity rates remaining largely consistent with the synthetic control post-merger. These findings suggest that while the merger brought measurable benefits to North Carolina's residential and commercial consumers and South Carolina's commercial consumers, its effects on South Carolina's electricity market were minimal, indicating potentially varying regional outcomes of the merger.

IOU-Level Observations

Table 2: Difference in Difference Analysis on Iou-Level Variables

	(NC.4) Residential	(NC.5) Commercial	(NC.6) Industrial	(SC.4) Residential	(SC.5) Commercial	(SC.6) Industrial
Customers (Log)	0.00918 (0.0101)	-0.0150 (0.0185)	-0.0395 0.0278	0.00923 (0.0101)	-0.0148 (0.0185)	-0.0396 (0.0279)
Per Capita Inc. (Log PCI)	0.577*** (3.55)	0.578*** (4.00)	0.676*** (4.68)	0.582*** (3.56)	0.582*** (4.02)	0.680*** (4.71)
Consumption (Log kWh)	0.0260* (0.0107)	0.0284 (0.0106)	0.0113 (0.0143)	0.0259* (0.0107)	0.0287** (0.0107)	0.0114 (0.0144
Weather Risk (1 = True)	0.118 (0.104)	0.165 (0.126)	0.210 (0.163)	0.119 (0.104)	0.164 (0.126)	0.212 (0.163)
post16 (1 = After 2015)	0.0896*** (0.0191)	0.0890*** (0.0175)	0.0859*** (0.0239)	0.0895*** (0.0193)	0.0882*** (0.0177)	0.0857*** (0.0242)
Treatment (1 = NC / SC)	-0.153 (0.0929)	-0.244* (0.116)	-0.176 (0.140)	-0.293** (0.0998)	-0.304* (0.119)	-0.327* (0.143)
post16X treatment	**-0.103*** (0.0312)**	**-0.152*** (0.0258)**	**-0.116** (0.0375)**	**0.0681*** (0.0175)**	**0.0207 (0.0158)**	**-0.0602** (0.0203)**
Coal Spending ($ Bn)	-1.179** (0.394)	-0.952** (0.331)	-0.108 (0.444)	-1.182** (0.404)	-0.980** (0.341)	-0.111 (0.462)
Fuel Spending ($ Bn)	0.578 (0.327)	0.456 (0.292)	0.498 (0.292)	0.577 (0.327)	0.456 (0.291)	0.498 (0.292)
Gas Spending ($ Bn)	-0.000559 (0.0177)	0.0286 (0.0166)	0.0474** (0.0177)	-0.00134 (0.0179)	0.0285 (0.0168)	0.0466** (0.0178)
Constant	2.227*** (0.129)	2.243*** (0.160)	1.940*** (0.258)	2.227*** (0.129)	2.243*** (0.160)	1.940*** (0.259)
N	728.000	728.000	728.000	728.000	728.000	728.000
Standard errors in parentheses * p<0.05, ** p<0.01, *** p<0.001						

Pricing Effect of Merger for Residential Consumers in North Carolina

Compared to the SCM analysis for state-level observations, there is a strong deviation in posttreatment electricity rates for IOUs. Before 2016, electricity rates for both North Carolina and the synthetic control group increased from roughly 8 cents per kWh to nearly 11 cents per kWh. After 2016, electricity rates for residential Duke Energy Progress consumers declined to a little above 10 cents per kWh before rebounding to their pre-2016 levels in 2020. In contrast, electricity rates for the synthetic control group continued to increase, reaching nearly 12 cents per kWh by 2020. According to the SCM analysis, residential electricity rates for Duke Energy Progress in North Carolina were roughly 0.5 cents per kWh cheaper than comparable IOUs.

Observations from the SCM are supported by the coefficient of the interaction term in the DiD model. In our DiD model, δ , = -0.103 with a standard error of 0.031. This indicates that, controlling for other associated variables, the merger was associated with a 10.3 p.p. decline in electricity rates for Duke Energy Progress's residential consumers in North Carolina. To put it in perspective, the merger is theorized to reduce the annual residential electricity bill by approximately $141.38 per consumer per year.

Pricing Effect of Merger for Commercial Consumers in North Carolina

SCM analysis for commercial consumers of Duke Energy Progress does not yield a definitive post-treatment electricity price deviation due to our model's inability to minimize and converge RMSE; however, the DiD analysis provides statistically significant insights. In our DiD model, δ , = -0.152 with a standard error of 0.026. Therefore, controlling for other associated variables, the merger was associated with a 15.2 percentage point decrease in electricity rates for commercial consumers in North Carolina. In other words, the merger is statistically associated with a $1,136 relative decrease in spending on electricity for commercial consumers compared to comparable IOUs.

Pricing Effect of Merger for Industrial Consumers in North Carolina

SCM and DiD results for industrial Duke Energy Progress consumers are similar to those observed for residential consumers in North Carolina. In the SCM, post-treatment generates a significant divergence in electricity rates for industrial consumers, with a delta of roughly 0.6 cents per kWh.

For reference, industrial electricity rates reduced from 6.4 cents per kWh to 6.2 cents per kWh for Duke Energy Progress consumers, while industrial electricity rates increased from 6.4 cents per kWh to 6.8 cents per kWh for our synthetic control group consumers. This deviation is supported by our DiD analysis, where δ , = -0.116 with a standard error of 0.038. In other words, the merger is statistically significant and is estimated to be associated with a reduction in electricity rates for industrial consumers by 11.6 p.p. when compared to the synthetic control group, or about $26,297 per consumer per year.

Pricing Effect of Merger for Residential Consumers in South Carolina

According to SCM analysis, residential electricity rates for Duke Energy Progress in South Carolina closely followed the synthetic control group's rates up to 2015, with both gradually increasing. After 2015, Duke's actual residential rates began to rise steadily, surpassing the synthetic model. This divergence suggests that post-merger, residential electricity rates for Duke in South Carolina increased more than expected when compared to similar IOUs.

This observation is supported by the DiD analysis, where δ , = 0.068 with a standard error of 0.018. In other words, controlling for other associated variables, the merger was associated with a 6.8 percentage point increase in electricity rates for residential consumers of Duke Energy Progress in South Carolina or, $545 increase in annual spending on electricity for residential consumers compared to comparable IOUs.

Pricing Effect of Merger for Commercial Consumers In South Carolina

SCM analysis for commercial consumers of Duke Energy Progress in South Carolina shows that both actual and synthetic control rates trended upward from 2006 to 2015, with Duke's actual rates displaying more fluctuation. Post-2015, Duke's commercial rates continued to increase but at a slower rate than the synthetic control, with a notable peak around 2017. However, due to higher RMSE and lack of model fit, the SCM results for commercial consumers are inconclusive.

DiD analysis yield an interaction term δ , = 0.021 with a standard error of 0.016. This suggests a slight increase in electricity rates for commercial consumers, but the coefficient is not statistically significant at conventional levels. Therefore, I cannot conclusively determine the merger's impact on commercial electricity rates for Duke Energy Progress consumers in South Carolina. The observed trends may be influenced by other factors such as local market conditions or regulatory changes that are not fully captured by the models. As a result, the merger's effect on commercial electricity pricing in South Carolina remains uncertain based on the available data.

Pricing Effect of Merger for Industrial Consumers in South Carolina

Similar to the case for commercial Duke Energy Progress consumers in North Carolina, the SCM fails to converge and minimize the RMSE, offering inconclusive evidence for the pricing effect of the merger compared to the synthetic control group. Therefore, I rely on the results of the DiD analysis, where the coefficient of the interaction term δ , = -0.06 with a standard error of 0.02. Controlling for other variables, electricity rates for industrial consumers are roughly 6.02 p.p. less than the control group. In terms of annual savings, the merger is associated with a $12,592 decrease in the annual electricity bill for industrial consumers of Duke Energy Progress in South Carolina.

The analysis of the merger's impact on IOU-specific electricity pricing shows distinct regional outcomes across consumers for Duke Energy Progress in North Carolina and South Carolina. In North Carolina, the merger led to modest savings for consumers in all industries, reflected in lower relative price growth compared to the synthetic control group. Conversely, South Carolina exhibited price increases for residential consumers, no statistically significant price change for commercial consumers and price decreases for industrial consumers. These results indicate that while North Carolina consumers experienced measurable benefits, the merger had mixed effects on South Carolina's electricity market, highlighting potential regional variations in merger impacts. I have discussed possible explanations for these differences in the following section.

Intuition

The observations made above are useful in understanding the impact of the merger on electricity pricing for consumers in North Carolina and South Carolina. However, across both sets of analyses – state-level and IOU-level observations –

there are differences in the effect of the merger on each treatment group. For reference, in the last section I mention that consumers in North Carolina, compared to consumers in South Carolina, have lower electricity rates due to the merger between Duke Energy and Progress Energy.

This section explores the reasons behind the differing effects of the merger in North Carolina and South Carolina and hypothesizes why the magnitude of the coefficients differs in IOU-level observations between the states. Finally, I compare the reasons associated with divergence of results between IOU-level and state-level observations.

In this analysis, I have used only the coefficients from the DiD analysis. While SCM visualizations are powerful for confirming the fulfillment of the parallel trends assumption, they do not help in understanding the statistical significance of the divergence between treatment and control group variables upon enactment of the treatment. Therefore, it becomes challenging to draw conclusive arguments for or against a specific narrative using observations from the SCM model.

Comparing the Effect of the Merger Between North Carolina and South Carolina

Table 1 presented in Section III(A) provides the coefficients generated from the DiD regression, first using North Carolina as the treatment group, and then using South Carolina as the treatment group. As a recap, in the setup of the analysis, I mentioned that the control group comprises states that are representative of the regulatory environments in North Carolina and South Carolina, respectively, excluding any state that has experienced a merger between IOU companies operating in that state. Since I have used the logarithmic form of the dependent variable, the coefficient associated with the interaction term represents the average percentage point change in electricity rates for consumers in the treatment group states, compared to the average percentage point change in electricity rates for consumers in the control group states .

Regulatory Differences

While there are several factors that could contribute to the divergence in the impact of the merger, there are some facets that might be more relevant than others. These include regulatory frameworks, market structures, and state-specific policies. In terms of the regulatory framework, the North Carolina Utilities Commission (NCUC) has historically been more proactive than other states in safeguarding consumer interests. For example, in 2012, the NCUC required that the merger between Duke Energy and Progress Energy include rate freeze agreements and transfer cost savings to consumers [5]. On the other hand, the Public Service Commission of South Carolina (PSCSC) did not exercise strict demands during the review process of the merger in 2011.

Fuel Cost Adjustment Differences Due to Energy Mix

In 2016, Duke Energy Progress (the merged entity) issued fuel cost adjustments that benefited consumers in North Carolina more than those in South Carolina. Duke Energy Progress announced a rate reduction of 6.5% for North Carolina and 0.9% for South Carolina. They attributed this price adjustment to the lower cost of natural gas and operational efficiencies [16]. While both states benefited from nearly identical cost efficiencies from the reduction in natural gas rates, North Carolina experienced higher benefits due to existing infrastructure for a diverse energy mix and reliance on the use of natural gas. On the other hand, South Carolina relied on traditional energy sources like coal and nuclear. Due to a lack of available infrastructure to take advantage of lower generation costs, electricity rates in North Carolina dropped faster than in South Carolina [17].

Difference in Market Structure

Lastly, differences in the allocation of merger-related costs and savings between the states could have played a role. Duke Energy Progress may have allocated a larger portion of the merger's operational efficiencies and cost savings to North Carolina due to its larger market share and strategic importance. This allocation would result in more pronounced price reductions for North Carolina consumers while leaving South Carolina consumers with negligible effects. Such corporate strategies are often influenced by regulatory environments, market potential, and the companies' long-term objectives in each state.

Comparing the Effect of the Merger Between Iou-Level Variables

I have used observations from specifications NC.4, NC.5, and NC.6 for North Carolina, and SC.4, SC.5, and SC.6 for South Carolina. In this section, I will compare the consumer group-specific coefficients and explore potential reasons for their differences across state lines. While it would be ideal to compare all consumer groups, I am restricted to using only those coefficients that are statistically significant. Therefore, I have compared the coefficients of the interaction terms for NC.4 with SC.4 (residential IOU) and NC.6 with SC.6 (industrial IOU).

Duke Energy Progress's residential and industrial consumers in North Carolina experienced declines in electricity rates of 10.3 p.p. and 11.6 p.p., respectively. In contrast, their residential and industrial consumers in South Carolina experienced a 6.8 p.p. increase and a 6.02 p.p. decrease in electricity rates, respectively. Hypothetically, indexing Duke Energy Progress's residential and industrial electricity rates in North Carolina and South Carolina to 100, North Carolina's residential electricity rates would be 17.1 p.p. less than South Carolina's residential electricity rates. On the other hand, the difference in industrial rates would be less pronounced at 5.6 p.p.

Benefits of Vertically Integrated Electricity Market

North Carolina is more vertically integrated than South Carolina. In North Carolina, Duke Energy Progress generates 96% of the electricity, indicating an elevated level of vertical integration. This means the company controls a sizable portion of the supply chain, from generation to distribution. In contrast, in South Carolina, Duke Energy Progress generates only 42% of the electricity, suggesting a more fragmented market with multiple players involved in generation and distribution.

There are three potential reasons that can be attributed to the difference in the price effect of the merger across these two states:

- **Streamlined Negotiations:** When a state negotiates with a single dominant company, the negotiation process becomes more straightforward. The utility commission can focus its efforts on one entity, making it easier to present arguments and push for favorable terms
- **Regulatory efficiencies:** Regulating one major company is less complex than overseeing multiple smaller ones. This allows for more effective monitoring and enforcement of regulations, ensuring that the utility operates in the public's best interest.
- **Integrated Planning:** A single company overseeing generation and distribution can plan more effectively for infrastructure investments and maintenance, potentially leading to improved service reliability and efficiency.

Consequently, while the benefit of increased vertical integration is not the sole reason associated with the difference in the price impact of the merger, it represents a key factor in the transfer of benefits from the merger to the consumers. It is also important to note that this situation can have negative impacts. For example, if negotiations between state regulators and the utility company in North Carolina fail, it could result in a gridlock leading to significant economic damage. However, since the supply of electricity is inelastic due to the high capital costs associated with generation and distribution, it is unlikely that an IOU would risk forfeiting potential revenues over marginal changes in profitability and revenue gains. Historically, there have been no instances of such occurrences, so it is safe to say that this is unlikely to happen.

Economies of Scale

Academic research suggests that economies of scale have a significant impact on the cost of electricity generation and distribution. Based on the market share distributions mentioned earlier, Duke Energy Progress's North Carolina operations would be categorized in the top quintile, while its South Carolina operations would be categorized in the fourth quintile. According to the authors, electricity rates for companies in the top quintile are 17.6% lower than those in the fourth quintile [18]. While this research output is not directly applicable to our analysis – since it generates an absolute difference between two market structures without taking regulatory structures into account – it supports the points mentioned in the previous section.

Furthermore, it helps confirm that the consolidation in North Carolina – from two firms to one, resulting in a combined firm generating 96% of the electricity – has more significant pricing effects than the consolidation in South Carolina, where the merger reduced the number of firms from four to three, with the combined firm generating only 42% of all electricity. This indicates that pricing effects from the merger are likely to be different and stronger in favor of consumers in North Carolina, as it exhibits greater economies of scale from the merger.

Reasons Parallel to State-Level Pricing Effect

In Section IV(A), I mentioned that the difference in the price effect of the merger on state-level pricing was potentially due to differences in regulations, fuel mix, and market structure. These differences have more pronounced trickle-down effects. For example, compared to their operations in South Carolina, Duke Energy Progress in North Carolina is likely to:

- Procure higher quantities of raw materials to activate scaled discounts
- Have access to a larger market for skilled workers
- Strategize and negotiate with the state to define optimal terms
- Mobilize disaster management efforts in a more speedy and efficient manner

Consequently, when an already consolidated market exhibits increased levels of consolidation, the benefits generated from synergies will increase. Since IOUs usually operate with a return-on capital clause on their spending, increased efficiency is likely to result in increased benefit transfers to consumers.

Comparing the Inter-State Effect of the Merger Between State-Level and Iou-Level Variables

This section extends the previous two subsections by comparing the coefficients associated with interaction terms for consumer groups across state- and IOU-level umbrella Difference-in-Differences (DiD) models. Specifically, regression outputs from Table 1 are compared with those from Table 2, such that Specification 1 is compared to Specification 4, Specification 2 to Specification 5, and Specification 3 to Specification 6. Because statistically significant comparable values for South Carolina are lacking, this analysis focuses solely on regression outputs for North Carolina.

Narrowness of IOU-Level Analysis

North Carolina's Duke Energy Progress's residential and commercial consumers experienced a reduction in electricity rates post-merger of 10.3 and 15.2 percentage points, respectively. Conversely, state-level electricity rates post-merger reduced by 7.1 p.p. for residential and 6.9 p.p. for commercial consumers. This indicates a 3.2 percentage point and

8.3 percentage point relative increase in rates for non-Duke Energy Progress residential and commercial consumers in North Carolina.

As mentioned in the introduction, retail electricity rates are regulated by the state, with variations in generation costs grandfathered in. However, the cost of electricity for retail distributors is defined through private contracts with electricity generation companies. In North Carolina, while Duke Energy Progress generates 96% of the state's electricity, 38.4% of residential and 32.6% of commercial consumers receive electricity through cooperatives and localized distribution companies. These entities maintain distribution lines from a certain point to the location of utilization. Although rates are established by the state, these transmission companies negotiate with the state to align on distribution charges levied onto consumers. Since Duke Energy Progress is both the producer and distributor for 61.6% of residential and 67.4% of commercial consumers, the associated distribution costs are relatively limited compared to companies that must first purchase wholesale electricity from Duke Energy Progress and then distribute it to end-users.

Although industrial consumers are excluded from the preceding analysis, it is important to understand the post-merger variations in electricity rates for these consumers. There are several reasons for this:

- **Different Pricing Structures:** Industrial consumers often have distinct pricing structures compared to residential and commercial consumers. They typically consume electricity at much higher volumes and may have direct contracts with electricity generators at negotiated rates less influenced by market fluctuations [19]. Therefore, the merger may not have significantly altered their existing contract terms or rates.
- **Greater Bargaining Power:** Due to their large consumption volumes, industrial consumers possess greater bargaining power and can negotiate more favorable rates that are less sensitive to market structure changes [20].
- **Cost-Reflective Tariffs:** Industrial tariffs are often designed to be more cost-reflective, including components like demand charges and time-of-use rates, which can dilute the impact of wholesale electricity price changes [21].

Thus, the merger's effect on industrial consumers' electricity rates may be less pronounced or statistically insignificant in the analyses conducted.

Wholesale V. Retail Pricing Dynamics

The differences observed between the IOU-level and state-level analyses can be attributed to distinctions between wholesale and retail electricity rates. The merger between Duke Energy and Progress Energy primarily affected the wholesale market by consolidating generation assets and potentially altering market power dynamics in electricity generation. This consolidation can lead to changes in wholesale electricity rates, directly impacting costs for distribution companies purchasing electricity from generators [22].

For non-Duke Energy Progress distribution companies in North Carolina, which serve approximately 38.4% of residential and 32.6% of commercial consumers, the merger could have led to higher wholesale rates due to reduced competition in the generation market [23]. These companies purchase electricity at wholesale rates from Duke Energy Progress and then supply it to end-users. If the merger resulted in increased wholesale rates, these costs might be passed on to consumers as higher retail rates or limit potential retail price reductions.

Conversely, Duke Energy Progress, being both a generator and distributor for a sizable portion of consumers, may have leveraged efficiency and cost savings from the merger to reduce retail rates for its customers. The vertical integration of generation and distribution allows Duke Energy Progress to internalize cost reductions and streamline operations, leading to lower retail rates for its consumers [24].

Therefore, the disparities between the IOU-level and state-level effects highlight the merger's impact on different market segments. While Duke Energy Progress's consumers benefited from reduced retail rates due to gained efficiencies, other distribution companies may have faced higher wholesale costs, negating potential savings at the retail level.

Policy Implications

Non-Rto States are Better Vertically Integrated

The analysis in this paper reveals significant differences in the impact of the Duke Energy and Progress Energy merger on North Carolina and South Carolina. Following the merger, North Carolina became more vertically integrated, with Duke Energy serving as the predominant utility in both electricity generation and distribution. In contrast, South Carolina remains fragmented among three major electricity producers. Despite this increased competition in South Carolina, the merger did not lead to lower price effects for consumers compared to North Carolina.

On average, residential and commercial electricity rates in North Carolina were approximately 1 cent per kWh higher than those in South Carolina (see Appendix 3). However, industrial electricity rates were lower in South Carolina compared to North Carolina. This discrepancy suggests that South Carolina may have incentive structures favoring lower industrial electricity pricing or disincentive structures leading to higher residential and commercial pricing. Notably, Duke Energy Progress supplies electricity to 52.6% of industrial consumers in South Carolina – the highest market share across all consumer categories – despite generating only 42% of the state's electricity. This indicates that economies of scale from the merger may have particularly benefited industrial consumers in South Carolina.

The key argument is that in states regulated by state bodies and not operating under RTOs, retail electricity rates are determined through negotiations between state regulators and utilities. Given the highly inelastic nature of electricity supply, full vertical integration in regulated markets is unlikely to harm consumers and may, in fact, benefit them through improved efficiencies and cost savings [25]. Vertical integration can reduce transaction costs, streamline operations, and eliminate duplication of services, potentially leading to lower rates for consumers [26].

However, the benefits of vertical integration must be balanced against potential risks. Without competitive pressures, monopolistic utilities may have less incentive to operate efficiently or innovate, potentially leading to higher long-term costs for consumers. Effective regulatory oversight is therefore essential to ensure that the efficiencies gained from vertical integration are passed on to consumers rather than retained as excess profits by the utility companies.

Importance of Effective Regulation in Non-Competitive Markets

Electricity pricing in both North Carolina and South Carolina is closely monitored by their respective regulatory bodies. Despite similar regulatory frameworks, the two states experienced different pricing effects from the merger, highlighting the critical role of effective regulation in protecting consumers in noncompetitive markets.

In markets where electricity supply is inelastic and competition is limited, the negotiation between state regulators and utility companies becomes of utmost importance. A lack of balanced negotiation that benefits all parties can have long-term consequences. For example, if regulators refuse to permit warranted rate adjustments, utilities may become disincentivized to invest in necessary infrastructure improvements, leading to a reduction in Available Economic Capacity (AEC). This can result in supply constraints and potentially higher rates in the long term due to insufficient generation capacity to meet demand.

During the Duke Energy and Progress Energy merger proceedings, the FERC expressed concerns about the potential reduction of AEC due to the elimination of overlapping facilities. To address such concerns, implementing rigorous AEC tests can ensure that mergers in regulated, non-competitive markets lead to positive supply-side effects without compromising market efficiency or consumer welfare.

Therefore, non-competitive pricing states should rely on well-negotiated regulations that balance the need for utilities to recover costs and invest in infrastructure with the protection of consumer interests. Effective regulatory frameworks can mitigate the risks associated with vertical integration and market consolidation by:

- **Enforcing Transparency:**
Requiring utilities to provide detailed cost and operational data to regulators ensures that rate adjustments are justified.
- **Preventing Anti-Competitive Practices:**
Monitoring and regulating potential abuses of market power can prevent unfair pricing strategies.
- **Ensuring Fair Pricing Mechanisms:**
Implementing cost-reflective tariffs and rate structures that promote efficiency and equity among consumer classes.

By fostering a regulatory environment that encourages utilities to operate efficiently while safeguarding consumer interests, states can harness the benefits of vertical integration without exposing consumers to undue risks.

Additional Discussions

Updating and Checking Validity of Findings by Extending Data to Late-2020s

Future research could enhance the validity of the findings by incorporating panel data extending into the late 2020s. By redefining the treatment year as 2021, a decade after the merger, researchers could assess long-term effects and account for delayed impacts on pricing, market dynamics, and regulatory responses. This extended timeline would provide a more comprehensive view of the merger's consequences on the electricity market.

Checking for Generalizability by Assessing Other Similar Mergers

Cross-referencing the coefficients and findings with similar consolidations in other states or regions could offer valuable insights. By examining localized mergers involving only one state or specific regions, researchers can identify patterns, validate the uniqueness of the Duke-Progress merger effects, and strengthen the generalizability of the conclusions drawn. This comparative analysis would also help in understanding how different regulatory environments influence the outcomes of utility mergers.

Summary

This paper investigates the impact of the 2012 merger between Duke Energy and Progress Energy on electricity rates in North Carolina and South Carolina, utilizing DiD and SCM analyses. The findings reveal that in North Carolina, where the market became more vertically integrated post-merger, residential and commercial consumers experienced significant price reductions. Conversely, South Carolina, which remained more fragmented with multiple electricity producers, saw minimal to no beneficial pricing effects from the merger.

The study suggests that vertical integration in non-RTO, regulated states like North Carolina can lead to efficiencies and cost savings that benefit consumers, provided there is effective regulatory oversight. It emphasizes the importance of well-negotiated regulations in non-competitive markets to ensure that monopolistic entities do not exploit their position.

In conclusion, the paper underscores the nuanced effects of utility mergers on different states, shaped by regulatory frameworks, market structures, and the degree of vertical integration. It calls for careful consideration of these factors in future mergers and suggests areas for further research, including extending the data timeline and comparing similar mergers in other regions to enhance understanding of the long-term implications on the electricity market.

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Appendix

A. Appendix 1

Below are eight boxplots that represent imputed and non-imputed values associated with the costs of electricity generating raw materials. I have scaled the Y-axis to accurately represent the variation in imputed and non-imputed true values.

B. Appendix 2 – Electricity Rates by State and Industry

1. Residential

2. Commercial

3. Industrial

C. Appendix 3 – Summary Statistics for North Carolina and South Carolina

STATE	Variable	Mean	SD	N
North Carolina	KWH_res	1112.66	47.93	14.00
	Cust_Res	4315217.33	200899.55	14.00
	CPKWH_res	10.57	0.77	14.00
	Cust_com	662735.60	24962.07	14.00
	KWH_com	5942.35	179.97	14.00
	CPKWH_com	8.30	0.54	14.00
	Cust_indus	10447.67	465.41	14.00
	KWH_indus	217212.60	12564.11	14.00
	CPKWH_indus	6.12	0.40	14.00
South Carolina	KWH_res	1165.45	59.70	14.00
	Cust_Res	2161301.80	111681.16	14.00
	CPKWH_res	11.52	1.39	14.00
	Cust_com	355299.47	19810.36	14.00
	KWH_com	5093.54	269.62	14.00
	CPKWH_com	9.51	1.00	14.00
	Cust_indus	4360.33	304.44	14.00
	KWH_indus	537718.54	34047.92	14.00
	CPKWH_indus	5.81	0.48	14.00

D. Appendix 4 – Summary Statistics for Duke Energy Progress in North Carolina and South Carolina

State of operation	Variable	Mean	SD	N
North Carolina	KWH_res	1152.02	44.73	14.00
	Cust_Res	2659486.36	343538.70	14.00
	CPKWH_res	9.93	0.90	14.00
	Cust_com	446728.50	57048.72	14.00
	KWH_com	8518.44	329.93	14.00
	CPKWH_com	7.85	0.58	14.00
	Cust_indus	8474.07	988.64	14.00
	KWH_indus	337011.50	13390.95	14.00
	CPKWH_indus	5.99	0.46	14.00
South Carolina	KWH_res	1264.23	51.12	14.00
	Cust_Res	590729.64	47508.62	14.00
	CPKWH_res	9.82	1.22	14.00
	Cust_com	118748.14	9986.36	14.00
	KWH_com	6344.32	251.34	14.00
	CPKWH_com	8.32	0.83	14.00
	Cust_indus	2295.57	213.57	14.00

	KWH_indus	750684.31	30658.73	14.00
	CPKWH_indus	5.45	0.41	14.00

E. Appendix 5 – Synthetic Control Method visualization for North Carolina

1. State-level

a) State-Level Weights

State	Residential	Commercial	Industrial
AK	0	0	0
AL	0	.214	.047
AZ	0	.028	0
CO	0	0	.076
GA	.832	0	.08
HI	.001	0	0
IN	0	.471	.363
KY	0	0	0
LA	0	0	0
MS	0	0	0
MT	.061	0	0
ND	.106	.287	.073
NM	0	0	0
NV	0	0	0
SD	0	0	0
TN	0	0	0
WI	0	0	0

b) Synthetic Treatment Values

	Residential	Commercial	Industrial
Coal Spending($B)	1.63e+08	1.63e+08	1.63e+08
Fuel Spending($B)	2.06e+07	2.06e+07	2.06e+07
Natural Gas Spending($B)	1.72e+08	1.72e+08	1.72e+08
Customers (log)*	15.24917	9.276513	13.3815
Average kWh Usage (log)*	7.0297	12.2674	8.701408
Per Capita Income (log)	10.84504	10.84504	10.84504
Weather Risk (1=True)	1	1	1
*For Residential, Industrial, and Commercial Customers and Average kWh Usage, respective sector-specific variables are provided			

2. IOU-Level

a) IOU-Level Weights

	Residential	Industrial	Commercial
Average kWh Usage (log)*	7.025662	12.35676	896.1852
Customers (log)*	13.23543	7.675115	11.78322
Coal Spending($B)	1.56e+08	1.49e+08	1.63e+08
Fuel Spending($B)	2.11e+07	2.09e+07	2.64e+07
Natural Gas Spending($B)	1.57e+09	1.46e+09	1.23e+09
Weather Risk (1=True)	0.415	0.448	0.344
Per Capita Income (log)	12.45066	12.55644	12.76942

b) IOU Treatment Values

Company (State)	Residential	Industrial	Commercial
Alabama Power Co (AL)	0.415	0.344	0.046
Georgia Power Co (GA)	-	0.104	0.298

Indiana Michigan Power Co (IN)	-	-	0.423
Indianapolis Power & Light Co (IN)	0.354	0.275	-
Kingsport Power Co (TN)	0.107	0.277	-
Otter Tail Power Co (ND)	0.007	-	-
Public Service Co of CO (CO)	0.116	-	0.233
*Footnote: • Residential segment: **47 IOUs** have zero weights. • Industrial segment: **50 IOUs** have zero weights. • Commercial segment: **49 IOUs** have zero weights.			

F. Appendix 6 – Synthetic Control Method visualization for South Carolina 1. State-level

1. State-level

a) State Level Weights

State	Residential	Commercial	Industrial
AK	0	0	0
AL	0	0	0
AZ	0	0	0
CO	0	0	0
GA	0.418	0.56	0
HI	0.05	0.02	0
IN	0	0	0
KY	0	0	0.185
LA	0	0	0
MS	0	0.038	0.242
MT	0	0	0.381
ND	0	0	0
NM	0	0	0
NV	0	0	0
SD	0.532	0.382	0
TN	0	0	0.191
WI	0	0	0

b) Synthetic Treatment Values

	Residential	Industrial	Commercial
Coal Spending($B)	6.56e+07	6.56e+07	6.56e+07
Fuel Spending($B)	1.36e+07	1.36e+07	1.36e+07
Natural Gas Spending($B)	1.15e+08	1.15e+08	1.15e+08
Customers (log)*	14.55521	8.410945	12.74516
Average kWh Usage (log)*	7.08086	13.1862	8.564121
Per Capita Income (log)	10.64707	10.64707	10.64707
Weather Risk (1=True)	1	1	1
*For Residential, Industrial, and Commercial Customers and Average kWh Usage, respective sector-specific variables are provided.			

2. IOU-level

a) IOU-Level Weights

	Residential	Industrial	Commercial
Average kWh Usage (log)*	4.775988	11.00986	6.373196
Customers (log)*	13.26014	7.754254	11.65575
Coal Spending($B)	6.50e+07	6.50e+07	6.50e+07
Fuel Spending($B)	1.38e+07	1.38e+07	1.38e+07
Natural Gas Spending($B)	8.25e+08	8.25e+08	8.25e+08
Weather Risk (1=True)	1	1	1
Per Capita Income (log)	12.18656	12.18656	12.18656

b) IOU Treatment Values

Company (State)	Residential	Industrial	Commercial
Entergy Mississippi Inc (MS)	0.111	-	0.205
Georgia Power Co (GA)	0.155	0.393	-
Hawaiian Electric Co Inc (HI)	0.007	-	-
Kingsport Power Co (TN)	0.280	0.342	0.338
Lockhart Power Co (SC)	0.216	-	0.214
Northwestern Energy (SD)	0.102	0.241	0.084
Otter Tail Power Co (ND)	0.129	-	-
Consolidated Water Power Co (WI)	-	-	0.159

G. Appendix 7

H. Appendix 8

State of operation	Variable	Mean	SD
AK	KWH_res	620.65	40.78
	Cust_Res	279230.00	12941.50
	CPKWH_res	18.77	2.62
AL	KWH_res	1239.49	64.70
	Cust_Res	2167645.20	59402.60
	CPKWH_res	11.24	1.14
AZ	KWH_res	1060.98	39.02
	Cust_Res	2651620.13	134704.51
	CPKWH_res	11.41	1.04
CO	KWH_res	696.12	12.61
	Cust_Res	2202617.73	108079.03
	CPKWH_res	11.29	1.14
GA	KWH_res	1137.56	49.17
	Cust_Res	4161626.80	163452.22
	CPKWH_res	10.91	1.02
IN	KWH_res	997.00	40.05
	Cust_Res	2789000.27	64030.84
	CPKWH_res	10.72	1.56
KY	KWH_res	1148.97	52.55
	Cust_Res	1945765.20	31135.23
	CPKWH_res	9.45	1.31
MS	KWH_res	1227.06	52.40
	Cust_Res	1261971.80	26197.29
	CPKWH_res	10.56	0.64
MT	KWH_res	844.77	18.75
	Cust_Res	483190.00	22453.93
	CPKWH_res	10.05	0.98
NC	KWH_res	1112.66	47.93
	Cust_Res	4315217.33	200899.55
	CPKWH_res	10.57	0.77
ND	KWH_res	1112.82	55.44
	Cust_Res	350568.20	28680.03
	CPKWH_res	8.98	1.20
NM	KWH_res	642.05	17.02
	Cust_Res	863800.73	24495.01
	CPKWH_res	11.37	1.34

SC	KWH_res	1165.45	59.70
	Cust_Res	2161301.80	111681.16
	CPKWH_res	11.52	1.39
SD	KWH_res	1013.58	32.54
	Cust_Res	381332.33	16836.83
	CPKWH_res	10.07	1.46
TN	KWH_res	1264.32	64.68
	Cust_Res	2762430.00	96631.98
	CPKWH_res	9.81	1.01
WI	KWH_res	695.55	18.46
	Cust_Res	2633529.33	57314.45
	CPKWH_res	13.06	1.29
* Footnote: • Residential segment: **49 IOUs** have zero weights. • Industrial segment: **52 IOUs** have zero weights. • Commercial segment: **51 IOUs** have zero weights.			

I. Merger Review with Respect to 2023 Merger Guidelines:

Approved in 2012 without Department of Justice (DoJ) intervention, the merger between Duke Energy and Progress Energy was evaluated under the 2010 merger guidelines. These guidelines concentrated on "unilateral" monopolistic effects, and concerns were mitigated due to the oversight of state regulators on pricing and business decisions. In this section, I briefly re-examine the merger through the lens of the 2023 merger guidelines to speculate on the qualitative likelihood of DoJ intervention under the updated framework. This preliminary analysis primarily explores the surface-level implications of the merger in light of the 2023 guidelines and lays the groundwork for potential further research that could be developed into a separate paper.

It is important to note that the Parker immunity doctrine will likely apply in this situation [27]. Since the merger exhibits anticompetitive behavior but operates under state regulation, it is presented in the literature as an act of the government. In other words, state regulation provides immunity from federal antitrust laws, effectively reducing the probability of intervention.

However, as noted, in exceptional circumstances, the doctrine may be overruled as a basis for intervention.

1. Mergers Involving Multi-Sided Platforms

Guideline 10 addresses mergers involving multi-sided platforms – entities that provide various products or services to two or more distinct groups and facilitate interactions between them. Duke Energy and Progress Energy can be considered multi-sided platforms as they serve electricity consumers and state authorities, operate generation and distribution networks, and have participants on each side. The network effects, while not immediately apparent, become significant when considering that a substantial shift by consumers to alternative energy sources (e.g., solar panels) could disrupt the utilities' ability to maintain reasonable rates due to decreased economies of scale.

Furthermore, the vertically integrated nature of these companies presents a conflict of interest, especially in negotiations with other distributors for wholesale supply. The 2023 guidelines emphasize protecting competition in any market interacting with the platform. By viewing the state as one side of the platform, the merger could be seen as substantially lessening competition, limiting the state's ability to negotiate effectively with the merged entity.

However, applying Guideline 10 to this merger faces challenges for two primary reasons: first, the static nature of electricity consumption and the limited operational overlap between Duke Energy and Progress Energy before 2011; second, the weak correspondence to the definition of a 'platform'. Regarding the first point, the lack of significant pre-merger competition might weaken the argument that the merger substantially lessened competition. Nonetheless, the merged entity's enhanced market dominance and its potential to diminish the state's negotiating power could still render Guideline 10 applicable Concerning the second point, Duke Energy and Progress Energy are not prototypical 'platforms' as commonly defined. Platforms are generally businesses that facilitate interactions between two or more interdependent groups [28, 29]. In merger reviews, a related concept is 'clustering', where a company aggregates resources or services to create value. The pertinent question is whether an energy generation company that integrates resources and supplies electricity directly to retail distributors or consumers can be considered a clustering operation akin to Amazon. If so, this analogy could support applying Guideline 10 to assess the merger's competitive effects.

2. Elimination of Competition for Workers or Other Sellers

Guideline 11 focuses on mergers that lead to undue concentration of buyers, which can harm competition for workers or other sellers. The consolidation of the electricity generation market could limit employment options for specialized workers, effectively making Duke Energy Progress the sole major employer for certain skill sets within the region. This reduction in competition for labor could suppress wages and limit career opportunities, adversely affecting the labor market.

Applying this guideline, the DoJ might have raised concerns about the merger's impact on workers, similar to issues observed in other industries facing consolidation. While South Carolina has other electricity producers, the significant market share held by Duke Energy Progress postmerger could still raise red flags regarding decreased competition for workers in both states.

However, this argument also has weaknesses. For instance, in the Kroger-Albertsons merger case, a common counterargument against claims of competitive harm to workers was that workers are a mobile factor of production [30-38]. While certain segments of the labor force might become unemployed due to redundancies absorbed by the merger, it would be difficult to justify a merger injunction based on a relatively small percentage of the workforce [39-51. Given that the premerger operational overlap between Duke Energy and Progress Energy was relatively limited, only transmission workers in the overlapped regions are likely to be affected. These workers could potentially find employment with other transmission entities within the state, mitigating the merger's impact on competition for workers.