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Sparking Debate: Private or Public? The Effect of Ownership on Electric Utility Performance

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Abstract

The privatization of municipal electric utilities has prompted the public vs private debate among local government leaders. Private utilities want to increase their profits by expanding their territory and municipalities hope to see an influx of cash from the sale of their utility. Public administrators are left with questions about how this will serve their community. This research addresses the topic of performance differences between public and private ownership among electric utilities in Florida. Specifically, the research question is, *Does ownership type (public or private) affect the performance of electric utilities in the State of Florida?* All of Florida's 19 generating capable electric utilities are examined in this study, seven Investor-Owned Utilities (IOUs) and 12 Publicly Owned Utilities (POUs). The two metrics used for measuring performance are rates and reliability. Using Independent T-tests to compare means to measure their performance, the research looks at 14 tiers of rates (two residential, eight commercial, and four industrial) and two common reliability metrics, SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index). The results showed that POUs have statistically significant lower rates on the two residential tiers and two lowest commercial tiers, while IOUs showed statistically significant lower rates on the five highest commercial rate tiers and all four of the industrial rate tiers. There were no statistically significant differences in performance across reliability metrics SAIDI and SAIFI. Results suggest a difference in philosophy between public and private utilities on how rates are structured.

Keywords: Privatization, electric utilities, ownership, public vs private.

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Chapter 1: Introduction

The electric utility industry is under constant scrutiny and change as customer demands shift, environmental regulations expand, improved efficiency reduces usage, renewable energies are introduced, and electric vehicles become more popular among consumers. Utilities are forced to decide how to manage these evolutions, with numerous stakeholders (customers, investors, state, and federal regulating agencies) and competing constraints (finances, reliability, rates, resources, etc.). Ownership is a topic that goes hand in hand with these issues, and the public vs. private ownership debate is still relevant.

Recent issues in California regarding the devastating wildfires shifted even more attention to the electric utility industry. A single, San Francisco headquartered, Investor-Owned Utility (IOU), Pacific Gas and Electric (PG&E), caused over 1,500 wildfires, resulting in hundreds of thousands of acres of destruction, nearly 100 deaths and the incineration of tens of thousands of homes (Gold et al., 2019; Penn et al., 2019). The wildfires were linked to poor maintenance practices by PG&E, with its run to failure philosophy and prioritization of profits over reliable and safe performance (Penn et al., 2019). Run to failure is an approach that some utilities take that requires less operations and maintenance (O&M) funds for some equipment, as they choose to forgo maintenance and operate it until it fails, then using capital funds to replace it. These notoriously devastating practices raised concerns from public officials, such as San Francisco City Attorney Dennis Herrera. He floated the possibility of transitioning their electric service to a Publicly Owned Utility (POU) to ensure the residents are not subject to inadequate service and increasing rates (Penn et al., 2019). PG&E customers were faced with unreliable power, planned disruptions, dangerous consequences of poor vegetation management practices, and an increase in rates. PG&E customers are facing a potential 82.6% rate increase from 2018-2030 (Hay & Chhabra, 2020).

While these examples are among the most extreme and most devastating, it puts a spotlight on the discussion of business practices by electric utilities and led many to question the private industry's ability to provide reliable service. It provides contextual background for the apprehension towards IOUs for many customers, public administrators, local governments, and communities. These examples of poor performance are not exclusive to private industry utilities. Public utilities experience shortfalls. However, there are certainly different motivations between the two types of ownership, and they are bound to create differences in performance and operations.

As local, state, and federal governments are faced with competing constraints of service, quality, and funds, many are forced to consider privatization as an option. From the privatization and New Public Management movement that gained traction with the Reagan Administration, many public services are being contracted out or completely turned over to private entities. According to the *International Public Administration Review*, the most common reason government agencies turn to the private industry is cost savings, with other reasons identified as lack of expertise, unwillingness to invest in the needed tools or infrastructure, and the inability to hire skilled staff (Anttiroiko et al., 2014). Furthermore, the financial windfall such a sale is attractive to even the most reluctant public administrator. From 2000-2009, contracting and privatization in the United States increased by 30% (Guy & Rubin, 2015). This brings to light the potential for principal-agent problems among public administrators. However, despite the negative media attention gained by the investor-owned utilities (IOUs) in recent years, this trend is unlikely to stop.

The State of Florida experienced several utility acquisitions/mergers, conversions, and attempted conversions in the last several years. With rates and rate increases vetted and approved by state Public Service Commissions, it is difficult for power companies to increase their profits without expanding their number of customers served. It is not simply a matter of raising prices to increase profits within this heavily regulated industry. Florida Power & Light (FPL) is Florida's largest IOU and is expanding its territory across the state. In 2018, FPL finalized a decade-long battle to acquire a struggling Vero Beach municipal utility, adding 35,000 customers to its 4.9 million customer base (Walton, 2018). Customers of Vero Beach are expected to benefit from the acquisition, lowering bills by approximately 21% (Walton, 2018). In 2019, FPL's parent company NextEra Energy acquired Gulf Power from a neighboring parent IOU, Southern Company. Since acquiring Gulf Power, NextEra reduced the company's workforce by 22%, which is a common fear of communities whose power companies are taken over by IOUs (Wheeler, 2020). By 2022, the FPL/Gulf Power merger will be complete, increasing its customer base by 500,000 and creating a service territory in Florida that extends from Florida's panhandle all the way down to Miami Beach (Saunders, 2020). In a failed attempt to purchase JEA, Florida's largest municipally owned utility, FPL offered over $11B to broaden its territory into the Jacksonville area, which would add over 400,000 electric customers and expand its operations into the water and sewer industry (Bauerlein, 2020). Two other large Florida IOUs, Duke and Emera (parent company to Tampa Electric), both placed bids on JEA (JEA, n.d.). In 2020, FPL's parent company NextEra Energy expressed interest in purchasing Duke Energy. This would increase the NextEra/FPL footprint in Florida by an additional 1.8 million customers, potentially creating a monopoly and possibly eliminating as many as 1,000 jobs across the state (Wheeler, 2020). For maps of POU and IOU territories, see Appendix A and B.

With this quickly changing landscape due to mergers and acquisitions, a look at the performance of IOUs vs. POUs is fitting. Communities with municipally owned utilities may face the decision of whether to remain public or whether they should allow an IOU to take over. Recent history shows a high probability of further expansion by IOUs in the State of Florida. Ronald Moe, a political scientist and analyst, offered several ideas in favor of public sector control- public safety, accountability through publicly elected officials, and more transparent financial operations (Moe, 1987). Citizens and city leaders must decide if relinquishing control is worth the infusion of capital into their often cash-strapped communities. Understanding what history shows of private and public ownership is valuable information for communities faced with such a momentous decision. Many of the recent examples that gained national media attention revolve around IOUs (such as the PG&E example), as they affect many more customers than most POUs. However, public ownership does not automatically mean high performance. The widely publicized Flint, Michigan water crisis is a flagrant example of public service failure and the inability of public administrators to provide quality service to their communities. There are certainly instances where IOU takeovers, such as the FPL takeover of Vero Beach, offer better rates and more reliable service for their customers.

Research evaluating Florida's IOU and POU performance provides insight into the ownership debate going on in Florida and the utility industry. The research question is: Does ownership type (public or private) affect the performance of electric utilities in the State of Florida? The metrics to measure performance are rates and reliability. Rates are measured in dollars and reflect the amount of money that residential, commercial, and industrial customers pay on a monthly basis for their usage. They are broken into multiple tiers, based on consumption. Utilities structure these rates differently, which is at the heart of this research. The reliability metrics, System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI), measure the quality of service that the utility provides to the customer. These two metrics measure the length of an average power outage (SAIDI) and the frequency of power outages (SAIFI).

Briefly stated, the researcher hypothesizes that POUs will outperform IOUs in residential rates, commercial rates, and reliability metrics, whilst IOUs will outperform POUs in industrial rates. This information is valuable to consider while reading the literature review and the existing research on utility performance.

The literature review investigates the research on the subject, including the history of utility ownership and metrics used to measure utility performance. The following section focuses on the methods, research design, variables, data samples, analysis, and hypotheses. Next, the findings of the analysis are examined in detail. Lastly, there is a thorough discussion on the implications of the results and its relation to public administration.

Chapter 2: Literature Review

The modern American way of life has the consumer irrevocably linked to their electric utilities. From the execution of daily business to the modern comforts afforded to most Americans, everyday life depends on the electric utility provider. Such a vital industry, one that is naturally monopolistic, is sure to raise the question of ownership. Who should own and operate such a company with such a significant impact on infrastructure and day-to-day life? Should these electric utilities be publicly owned to ensure the end users are considered, or should they be privately owned to capitalize on the operational efficiencies typically associated with private industry companies? This section will examine these questions in depth.

The literature review is broken into three parts. The first section explores the historical context of utility ownership. The second section investigates existing research on the subject and how it applies to Public Administration. The literature review finishes by examining the most common metrics used for electric utilities- rates, reliability, and customer service. These concepts will provide a framework and justification for the methods section, as well as the research design that follows.

The debate between private vs. public utility ownership is not a new topic, globally or within the United States. An examination of the history of the two schools of thought is worth investigating in detail. It gives proper perspective regarding the arguments made by each side. First, adding clarity to the meaning of public and private ownership is essential. Utility ownership falls into one of three categories. Publicly Owned Utilities (POUs) are defined as those run by federal, state, or municipal governments, while Investor-Owned Utilities (IOUs) are private utilities that issue stock to shareholders (U.S. Energy Information Administration, 2019). Throughout this research, the term public utility and POU will be used interchangeably. On the other side of ownership, the words private and IOU are used interchangeably. The third type of ownership is rural co-operatives, which exist primarily in the Midwest and Southeast, is a non-profit member-owned utility (U.S. Energy Information Administration, 2019). This type of organization differs from POUs and IOUs in that they typically cover a vast geographical area, but they tend to serve a relatively small number of customers, as their focus is serving customers who are not enticing to private companies or who include customers outside a single municipal boundary. For this reason, rural co-operatives are excluded from the study. Such a vast territory with few customers makes comparisons to IOUs and POUs unfair.

According to statistics from the U.S. Energy Information Administration (2019), across the United States, there are approximately 3,000 electric distribution utility companies, with 1,958 being POUs and only 168 being IOUs. While the IOUs are only a fraction of the total number of companies compared to POUs, they serve a much larger customer base. The IOUs serve 72% of all customers in America, compared to 16% of POUs. These numbers make it evident that a small number of companies supply power to a large percentage of customers across the country.

There are advocates and antagonists on both sides of the ownership debate. Some advocates even lobby for change in ownership type, which is known as privatization or municipalization. In America, the term privatization is when services (and for purposes of this research, *ownership*) offered by a public entity are transferred to a private entity (Megginson, 2005). In contrast, municipalization is when a government entity acquires ownership of assets and control of operations of a privately owned system, usually in response to high rates or poor service (Robbins & Gould, 1997). Privatization of electric utilities is much more common than municipalization and it can occur for the same reasons as municipalization. Privatization became even more popular in the post-Reagan era of deregulation and the New Public Management (NPM) movement, where governments made use of the private sector to change the status quo (Savas, 2001). Within the context of discussing ownership, one must address the fundamentals behind why an entity, or its stakeholders, would desire to be private or public. These concepts are complex and intertwined, and the justification for privately owned utilities is embedded within the arguments for privatization. The same holds true for public ownership and municipalization.

Not every utility or local government experiences the same set of circumstances, thus every situation is unique. Nevertheless, it is important to explore the evidence and academic literature on the subject. The next portion of the literature review dives deeper into the origins of these debates and varying schools of thought, particularly sorted within the context of public administration. The research is complex, and the conclusions are often opposing. However, an exploration of private ownership and privatization will be examined first.

History of Electric Utility Ownership

Private Ownership

The idea of privatization grew from the thought that the public sector was too large and that the private sector could take care of many of the tasks performed by the government. The prevailing theory is that these jobs could be more efficiently executed by the private sector (Moe, 1987). Private ownership places high value on market ideals. This offers up a challenge to various public industries and begs the question, where does public service end, and where should a private business begin? In the late 19^{th} century, the United States public utility industry grew and caught the attention of private investors. The National Civic Federation financed and initiated an investigation to determine, which ownership type was best for utilities, public or private (Makholm, 2019). The investigation compared public and private electric, gas, water, and railway companies in the U.K. and United States. The result was three volumes of research totaling over 2,500 pages, with the final report condensed down to “less than eight” pages (Darwin, 1908, p. 283). The committee reported that government control is necessary in all utilities and that municipal ownership should never extend beyond industries that do not involve “the public health, the public safety, public transportation, or the permanent occupation of public streets or grounds” (Darwin, 1908, p. 284). The investigation looked at concepts such as political influence, labor conditions, and fiscal quality, with arguments for and against both types of ownership. Ultimately, in contrast to some of the arguments for public ownership, the report concluded that the case of private ownership was most convincing and, thus, creating favorable conditions for privatized utilities within the United States. The United States moved towards the path of privatization for many of its utilities. At the same time, other countries around the globe continued investing in public utilities until the late 20th century (Makholm, 2019). These same ideas and principles from over a century ago are still touted today by those who promote private ownership of utilities.

The trend of privatization became even more prevalent towards the end of the century and was considered by some to be the most popular public administrative movement of the 1980s (Moe, 1987). Privatization presented a solution when local government agencies faced fiscal challenges, thanks to mounting public debt (Wen & Yuan, 2010). A popular response to this debt problem was to sell off public assets or look outside of the government for answers. Privatization of services and the sale of locally owned assets provided municipal government agencies multiple benefits; not only are they infusing cash into a capital-strapped system, but also, they promote (at least the appearance of) competition among the industry (Wen & Yuan, 2010).

Privatization satiates the anti-statist desire that many Americans have, which is to keep government intervention minimal and allows the free market to meet the needs of consumers. Within the public sector, the quest for more market-oriented operations and the concept of New Public Management (NPM) encouraged many POUs to embrace this idea, turning over the keys to IOUs (Denhardt et al., 2014). The thread of New Public Management is at the heart of this entire conversation. Using these NPM market-based solutions, public organizations seek to improve effectiveness and operational excellence by embracing the private industry. As a result, many public-works companies have turned their operations over to private entities in the name of efficiency, improved services, market choice, performance-based contracts, and market-based solutions. These prevailing themes of NPM are woven throughout this literature review.

To this day, private enterprises still seek to acquire public assets to make a profit, and governments seek to capitalize on the potential influx of cash from a sale. IOUs desire to expand their territory to maximize their revenues, as their rates are regulated by Public Service Commissions and are based on the money spent towards investments and upgrades (Bliss, 2015). An easy way to do this is to increase their customer base by acquiring smaller POUs, usually municipalities. For municipal governments, the ability to wash their hands of aging electric infrastructure provides an attractive solution to even the most hesitant public administrator. Many see this solution as a win-win. The municipal government gains by alleviating their maintenance and operations burdens, as well as the immediate financial gain from the sale of the utility. The IOU gains because they can increase profits and expand their business.

Private Ownership and the Principal-Agent Problem

Private ownership certainly presents its own unique set of issues for public organizations and citizens. Part of the debate that local governments must address is whether this privatized utility will provide the service that they desire for the community. Obviously, they are trading local ownership in for some monetary benefit, but with all transactions, there is a cost. Part of this cost is loss of control on the part of the local government and for the people. The POUs are supposed to work on behalf of the public, as outlined by their nature of being publicly owned. However, IOUs are incentivized quite differently than POUs, which present the principal-agent problem.

Principal-agent theory describes the relationship between the interactions of two parties. The principal seeks to contract the agent to perform a type of work or service on their behalf, often something that the principal is incapable of or willing to do on their own (Bertelli, 2012). Bertelli (2012) uses the example of doctor and patient to illustrate the theory. A patient (the agent) needs medical services and advice that they are unqualified to obtain independently, so they seek out the services from a doctor (the agent), where payment is exchanged for services rendered. Such a transaction is standard and represented in every area of business. If the principal is happy with the services rendered and the agent is agreeable to the payment, the transaction is successful. However, problems may arise due to conflicting interests. The principal wants to get high-quality service for the best price, where the agent wants to receive the highest payment for the least effort. Maximizing profit is, by its nature, the focus of the private firm. Furthermore, the principal hires the agent with hopes that the service provider will work in his or her best interest, not overcharging for the services. These incongruent goals present the principal-agent problem. In the context of utility ownership, local communities would be the principals and the incoming IOUs would be their agents. There is likely no greater example of the principal-agent problem than one that occurred within the energy and utility industry- The Enron Scandal.

The Enron Scandal. Enron, a now-defunct investor-owned energy company, was the center of the most complex white-collar fraud in the history of the FBI, resulting in 22 fraud-related convictions, $164M in seized assets, the bankruptcy of one of the largest companies in the world (annual revenues exceeding $150B), and the loss of jobs/pensions for its employees (Federal Bureau of Investigation, n.d.). The actions of Enron and its executives, rooted in corporate greed and corruption, financially devastated its investors, customers, and workers. The Enron Scandal provides a look into an example of private industry corruption. While the following details are extreme examples of exploitation, it highlights several common criticisms of privatization.

Enron was involved in numerous industries, including electricity, natural gas, communications, coal, paper, and steel (Bondarenko, 2019). As energy industry deregulation became more popular, Enron increased its business footprint through the derivatives market. These derivatives allowed Enron to draft contracts that were promised on future purchases and performances. Through some questionable accounting practices concerning these derivatives, Enron used these future gains to inflate their current income statements, help boost confidence in revenues, and drive up their stock price (Bondarenko, 2019). It was up to Enron's discretion on how to value these future contracts; thus, Enron took significant liberties in inflating the value of these assets (Arnold & de Lange, 2004). Along with some creative asset cover-ups, these practices misled the shareholders, covering up their actual financial situation.

In other nefarious business practices, Enron took advantage of the deregulated and privatized industry to drive up electricity prices in the wholesale energy market, specifically in California. In a 2002 Senate hearing, the revelations of misconduct were egregious. The U.S. Senate (2002) report showed that through market manipulation, Enron was able to create the appearance of energy shortages by reselling energy through as many as five subsidiaries of Enron, drastically driving up energy costs for the state.

These subsidiary companies were all housed under Enron, and they would sell power back and forth, artificially driving up the rates with the appearance of increasing demand. As a result of this market manipulation, California paid 266% more for electricity in 2001 than it did in 2000 (despite only a 4% rise in demand). Additionally, the state experienced 49 days of blackouts, which put community health and safety at risk. Finally, the market manipulation increased California's debt by $35B. Ultimately, it contributed to the bankruptcy of California utility giant PG&E, as they were forced to buy power from out-of-state providers (Enron) at artificially high rates (U.S. Senate, 2002).

Enron is one of the most extreme, but indisputable cases of market manipulation in any industry. Many of the executives were held accountable through criminal conviction. According to the California Office of the Attorney General (2005), $1.52B was paid out in a settlement. However, the effects of this fraud and deception go well beyond $1.52B. Workers lost their jobs and their pensions. Californians were gouged and experienced blackouts. Investors were tricked into buying stock manipulated with accounting tricks, concealing toxic assets, and overvaluing derivatives.

Australian researchers Arnold and de Lange (2004), investigating the principal-agent problem specific to Enron, noted two particular issues that arrive in these interactions between principals and agents. The first issue is the question of whether the agent performs the work assigned. The second concern is whether the agent is performing the work to the extent of their abilities. Both issues stem from the concept of information asymmetry, where one party is privy to information that makes the other party vulnerable. The principal depends on the agent for expertise; after all, it is difficult for the principal to understand the inner workings of an industry as complex as energy and power delivery.

Specifically applied to the cases discussed earlier, examined within the context of public versus private ownership, it becomes evident that an agent with selfish motives would have disastrous effects on the principal. The motives behind the two types of ownership deserve a brief explanation. The motivation behind public ownership is summarized best with the work done by Perry and Wise (1990) regarding Public Service Motivation. Perry and Wise (1990) explored how public service is designed to promote social welfare/equity and create a better society. This focus on societal impact contradicts the motives of privately owned businesses. Private businesses follow the shareholder primacy concept, an economic principle promoted by Milton Friedman that emphasizes shareholder gains over all other obligations (Weber-Elżanowska, 2020). Not to suggest that all private businesses operate outside proper moral boundaries or act with impunity, but their primary responsibility is profit.

Looking at the Enron case, the information asymmetry is astounding. Enron took advantage of customers and investors in pursuit of their profits. Enron had insider help from Senators and regulators. For example, Texas Senator Phil Gramm and his wife Wendy Gramm, two influential players in privatization and deregulation, were instrumental in creating this information asymmetry that contributes to the principal-agent problem. Senator Gramm spearheaded legislation to exempt energy companies from regulation and public disclosure for commodity trading (Herbert, 2002). Exemptions do not exist for POUs, which are subject to public record laws. Wendy Gramm served as the head of Reagan's Task Force on Regulatory Relief and was chair of the U.S. Commodity Futures Trading Commission. One of her last actions as chair of the trading commission was to pass a ruling that Enron pushed, which provided regulatory exemptions for energy futures contracts. Five weeks after this passed, Wendy Gramm resigned and joined Enron's Board of Directors, receiving approximately $1M in payments from the energy giant (Herbert, 2002).

This kind of insider information and influence creates an unfair relationship between the principal and the agent. Enron had access to those making the rules and was able to influence the policymakers for their gain. Under significant pressure to increase return on investment, Enron exploited these rules and acted in their self-interest. Investors were not privy to the information due to exemptions put in place by quid-pro-quo arrangements, such as with Phil and Wendy Gramm. This lack of public accountability paved the way for the State of California to be overcharged billions of dollars. It is only fair to note that, while this is a criticism of the principal-agent problem regarding a private company, there were numerous public actors who helped contribute to the issue. Therefore, while this principal-agent problem may manifest itself most obviously in this situation within the private sector, the public sector is certainly not immune to corruption.

Public Ownership

An exploration of the origins and principles of public ownership is crucial. The public electric utility landscape sustained numerous changes over the past 120 years. Near the turn of the 20th century, many private utilities sprang up, aware of the vast market demand for electrical providers, and small generating stations were placed all over large cities (Hirsch, 2002). These companies had franchises with the local municipalities, which granted the companies license to operate within the city limits and use their streets and rights-of-way to distribute electricity to their customers (Troesken, 2006). These franchise agreements were typically several decades-long contracts that established minimum requirements regarding service obligations and maximum rates (Troesken, 2006). Because of economies of scale, it did not make much sense for numerous power companies to exist within city limits. For instance, it is unrealistic and cumbersome to have various companies with generating plants or multiple transmission and distribution lines running throughout a single city. As a result, consolidation took place, and the number of competitive companies reduced. Competition diminished and monopolies were established (Hirsch, 1999). Due to the natural monopolistic nature of many utilities like electric, water, gas, and sewer services, these services were placed under governmental (most often municipal) control or, at a minimum, some form of regulation (Grout et al., 2013). The government sought to curb the abuses of natural monopolies like electricity to save its citizens from exploitation. Since government-controlled utilities could take advantage of the fact that they are not beholden to shareholders, their focus should be on public service and community welfare (Denhardt et al., 2014). Many city governments purchased the entities providing these essential services to ensure that the benefits were directly realized by the consumer, not the shareholders (Hirsch, 2002).

Throughout the rest of the 20th century, many cities opted for public ownership of their electric utilities, while others continued down the path of private ownership. In an odd, cyclical turn of events, municipalities began relinquishing their control to privately owned utilities. As economies of scale once forced many private utilities to be absorbed by municipalities in the early to mid-1900s, the reverse happened, and many municipalities had to turn over their control to IOUs (U.S. Energy Information Administration, 2019). Once again, the industry is seeing some cases of movement in the opposite direction. Today, there is an emerging trend of municipalization in some cities and governments, which is in direct opposition to privatization. Often cited reasons for moving towards a POU include: high rates, poor customer service in response to major storms, and concentration on renewable energy (Boylan, 2016). For many, this represents the government's strength to step in when private industry fails to meet the needs of critical industries and the citizens experience a market failure (Farazmand, 2012).

With these historical ideals in context, the debate of public or private ownership continues forward today, citing many of the same arguments from the early 1900s. Utility performance is typically measured in quantifiable terms of rates (usually broken into residential, commercial, and industrial), reliability, and customer satisfaction. Many attribute ownership type to the performance of these metrics. Furthermore, some consider less tangible factors such as local control and public consideration in terms of ownership, usually associated with POUs and their commitment to community, rather than shareholder return or stock price. This conversation led some to ask, why is this such a heated debate, particularly among the utility industry? There are, indeed, successful utilities in all ownership types. Conversely, there are poorly performing utilities of the public and private sectors.

Looking at recent history, there are instances where public utilities failed their customers tragically. Consider the 2014 disaster in Flint, Michigan, where the public officials let down the town's residents with their water supply. As part of a cost-saving measure, the city's emergency manager decided to switch the city's water source to help alleviate the mounting financial burdens facing Flint, Michigan (Boufides et al., 2019). Unfortunately, due to contamination from existing lead pipes and lack of proper treatment, the new water supply contained high levels of lead, which exposed the residents for more than a year before the source was fixed. These were the decisions made by public servants that put the community at risk. Government officials downplayed the risks, engaged in the stereotypical bureaucracy of government agencies, and acted too slowly to prevent severe damage to the residents of Flint, Michigan. Critics may argue that this is a failure of the government to properly protect its people. When faced with significant challenges, the government officials were unable to meet the demands and needs of the community it serves.

On the other side of the argument, the unprecedented Texas snowstorms in February 2021 brought similar criticism to the private utility industry. When an unlikely snowstorm took Texas by surprise, the results were tragic. After several days of harsh weather, the storm contributed to the deaths of more than 50 people (mostly from hypothermia). It left millions without power, compromised the water supply, and prevented hospitals/emergency services from performing their duties (Nieto, 2021). Engineering professors at Texas A & M University Xie et al. (2021) pointed to weaknesses in the grid, resulting in catastrophe. Xie et al. (2021) noted several contributing factors to the grid failure: the isolated Texas electric grid (which makes importing power from other interconnected utilities difficult), a lack of winterization on generating equipment, and an increased demand due to the extreme weather. As a result, generating units were pushed beyond capacity and demand far exceeded production capabilities. Customers received electric bills over ten thousand dollars, compared to their usual $200-300 bills, thanks to what some deemed predatory, demand-based pricing models (Connelly, 2021). The nation’s eyes turned to Texas and its deregulated energy market, where companies compete for market share among customers. Customers cried to government officials and regulators for change and oversight to help prevent this situation from happening again.

The previous two examples are extreme failures of both the public and private utility markets. Nevertheless, they offer significant fuel for the argument on either side. These anecdotal arguments, however compelling in their content or ability to appeal to the emotions of the audience, are not good representations of the entire energy industry. However, this fact does not stop these extreme outliers from appearing as commonly cited comparisons or talking points during debates about privatizing a utility. These extremes often shape the arguments that people hear. While the previous paragraphs briefly touched on the historical context of these arguments, the next section will further dive into the discussions for public versus private performance. The focus will be on the electric industry, but studies including other utilities are referenced as part of the overall conversation about general utility ownership performance.

Private vs Public Ownership

A common assumption exists among many regarding private ownership. Economist Megginson (2005) pointed out that government agencies considering privatization rely on the belief that privately run organizations are, by nature, inherently more efficient than those run by the state. Megginson (2005) contended that there is some economic consensus that private entities do tend to be more profitable than publicly owned agencies. However, this idea is not nearly as transferable when considering industries where market failures exist, such as the natural monopoly that is the electric utility industry. When enterprises lack competition, public ownership becomes more reasonable, and the efficiencies of the private industry are not as applicable. In a study on this debate about private and public ownership of electric utilities, economics professors Hausman and Neufeld (1994) reaffirm the fact that modern-day public and private electric utilities are not subject to the same comparisons of private firms. Since the services provided by electric utilities are so crucial to life, their operations are scrutinized and regulated differently than many private industries. Hausman and Neufeld (1994) propose that these protected monopolies, whether public or private, are subject to significant control from regulatory agencies, such as public service commissions.

So why does this idea of private efficiency still exist, given the unwarranted parallels between the theoretical private firm and the IOU? In a study published in the *Annals of Public and Cooperative Economics*, Peters (1993) explored public and private utilities' cost and efficiency performance. Peters (1993) pointed to attenuation theory as a plausible reason for believing that private utilities perform with more efficiency. This theory poses that public utilities have different incentives than private utilities. Namely, they are not subject to shareholder concerns and their actions are attenuated by this fact. Since public utilities are motivated differently, the way they operate their business differs from private firms. The criticism is that POUs will not capitalize on efficiencies, work as hard to reduce costs, bargain for wholesale power, or adapt to the changing market (Peters, 1993). Peters (1993) quickly dismisses this over-generalization, as broadly grouping all industries into a single theoretical framework is not applicable and is incomplete. This theory also does not account for the fact that public organizations have some financial advantages, like access to lower-cost capital, the ability to issue government bonds, and tax exemption status.

Applying the presumptive logic discussed in the previous paragraph where private ownership assumes superior performance, IOUs should surpass the performance of public utilities. However, The Review of Economic Statistics published a study showing that public electric utilities outperformed private utilities with better rates in nearly every category (Meyer, 1975). The study is certainly dated, but the regulations and controls during this time would have been much less stringent, making the ownership comparison much more faithful to the conventional ideals of the private firm. Peters (1993) concluded similar results in his study, showing that even though public and private utility managers behave differently, the majority of the results showed no statistical differences in performance of efficiency and cost, or the results favored POUs. Peters (1993) supplements this with the fact that only in rare instances does the IOU perform more favorably than the POU.

The results of a private versus public ownership study of various Italian utilities (electric, water, sewer, gas, pharmacy, transportation, waste management, and others) revealed that the best economic performance was in public-private partnerships, not solely public or private (Monteduro, 2012). Indeed, the Italian landscape is different from that of America, but the conclusions are worth noting. These results suggest that each type of ownership may bring something to an organization. A private utility’s efficiencies may have an advantage over the bureaucratic set-up or political interference of a public utility. In contrast, the public utility’s focus on the customer offers a divergence from the profit-first mentality of the private industry. While beyond the scope of this research, this may be a viable option for municipalities considering privatization as a solution.

This public versus private debate is an idea that frequently makes its way into city council meetings, economic journals, and industry magazines. As the preceding evidence shows, some of the prevailing ideas about private ownership exist without regard to the complex nuances of the electric utility industry. Results are mixed between the two schools of thought. One can look at the results of Megginson and Netter’s (2001) writings, where the evidence shows that privatization in various industries across the globe has produced significantly better results (e.g., lower prices, better service, etc.). In eight out of ten studies compared by Megginson and Netter, it was revealed that private firms performed better, with those fully privatized performing the best (Monteduro, 2012). Both Meyer's (1975) and Peters' (1993) studies showed the opposite results, providing evidence that POUs perform the same or better than private utilities.

Researchers Haney and Pollitt (2013) of the University of Cambridge Electricity Policy Research Group and Judge Business School provided an excellent analysis of the two schools of thought regarding public and private ownership theory. Citing research and literature from various sources focusing on ownership, finance, risk, and public-private partnerships, Haney and Pollitt painted a comprehensive list of pros and cons for each type of ownership. The arguments Haney and Pollitt (2013) provided in support of public ownership focus on some of the most important topics of today. First, they focus on the public utilities' ability to promote social welfare and equity at the expense of profit. This idea is supported by a California study of public and private water utilities that show customers are more willing to comply with water restrictions and even higher rates if their utility is public, as they are perceived to be more focused on the public good, not profit (Kallis et al., 2009). Showing similar sentiments on the financial side, researchers point that the focus of public utilities is not on profit; therefore, the response to customers is based on service, not shareholder return (Haney & Pollitt, 2013; Nye, 1984).

The weaknesses of the public industry are highlighted by the strengths of the private industry. The private industry is considered efficient and focused, as opposed to the bureaucratic structure of public utilities. Research notes that the private utility industry has stronger control mechanisms, greater efficiency, larger capacity, and better risk mitigation (Amaral, 2008; Cohen & Eimicke, 2008; Haney & Pollitt, 2013). These are all aims of the New Public Management theory that grew throughout the 1970s and continues today. The private utility can adapt quicker than the public utility, as there is less red tape and political hurdles to overcome.

These differences are brief overviews of existing research on the subject. However, they provide a guide for reasons why certain governments choose to stay public or turn private. These theories do not always hold true with every utility, but they appear throughout much of the research on this topic. The next section will look at the differences in performance between public and private utilities.

Most research on the performance of utilities focuses on metrics such as rates and reliability. Research on this topic is surprisingly sparse and dated (Monteduro, 2012), particularly regarding electrical utilities, with many of the research designs focusing on quantitative approaches. There is not significant emphasis on the qualitative factors such as customer satisfaction and local control. As well, research within the United States is not prevalent, as there is a stronger focus on public versus private performance in developing nations. The purpose of this research is to fill in these gaps in understanding. However, the following section will highlight the contributions of the most relevant studies on the subject, some within the United States and some abroad.

Economic researchers Gassner et al. (2008) studied the public versus private performance debate across over 1,200 electric and water utilities. Gassner et al.'s study examined price, coverage, reliability, productivity, and employment, pre and post privatization. The study's findings showed that the private influence provided some dramatic improvement in performance. Specific to electric utilities, privatization delivered a 32% increase in productivity, 45% increase in bill collection, 11% decrease in distribution losses, and a staff reduction of 24% (Gassner et al., 2008). The negative side was that there was a perceived decrease in service quality.

Another study of 822 organizations across 78 countries from 1985-2007 by Gwinnett College and Wake Forest University researchers examined the political and economic benefits of public control. Benefits of public or state control is defined as the social and political advantages that are available to the government leaders (D’Souza & Nash, 2017). The study showed that an inverse relationship between institutional quality and benefits of control exists. As an organization operates more efficiently and with strong leadership, the benefits of public control become less valuable. Conversely, those organizations with weaknesses benefit much more from the control and government intervention.

Other research provides conclusions supporting both sides of the debate. A Duke University study looked at a case study between one public and one private Australian airline (whose operations are akin to American electric utilities) and determined that, while the private firm operated with greater efficiency, other political considerations are important (Davies, 1971). State control of the airline industry caps profits, the same way regulatory bodies cap profits of electric utilities, which is a benefit of public influence to the consumer (Davies, 1971). Italian researcher Monteduro (2012) noted that electric utilities with public and private partnerships, where the public influence was greater, performed most efficiently. A compendium of studies analyzed in the Journal of Economics noted that most studies showed a preference for public utilities regarding rates (Färe et al., 1985). Other studies observed that public and private electric firms exhibit no differences in efficiency, and that the arguments of the effects of ownership are largely exaggerated (Cullman et al., 2016).

By combining the two schools of thought for public and private operations, Italian researcher Monteduro (2012) concluded that there were elements of both ownership types that contributed to success and that private-public partnerships performed best. Unfortunately, a sizable portion of the research in the field is dated and was conducted before a much of the regulatory oversight of The North American Electric Reliability Corporation (NERC) existed.

Furthermore, standardized reliability metrics (to be discussed in the following paragraphs) were not monitored and reported on the level they are today. Building on this research, the hope is to add to the existing bodies of literature, by incorporating the current industry standards, regulations, and constraints. This research will arm local governments and public administrators with knowledge when considering incorporating these New Public Management ideas into their operations. The next paragraphs will expand on the measurements used for rates and reliability; the metrics used in this research to measure performance. While customer service is a common metric for performance and one that is addressed in the literature review, it is not used as a metric in this research. The data for many of the smaller POUs is simply not available. The participation in such studies as the JD Power customer service is voluntary and, as a result, does not capture enough data to effectively compare the sample in this study.

Metrics

Rates

Rates for utilities are regulated by the National Association of Regulatory Utility Commissioners (NARUC), a non-profit entity that represents the commissions that oversee the Public Service Commissions, which set rates within each state (NARUC, n.d.). Each state has its own Public Service Commission (PSC) in charge of setting rates for utilities. The Florida Public Service Commission (n.d.-b) explains in its Utility Ratemaking in Florida brochure that their jurisdiction for rate regulation extends to IOUs. Entities may submit a request for a rate increase. At this time, the PSC will review the request based on several factors, including the size and age of the system, geographic representation, and the number of customers. During this application process, numerous engineers, economists, and accountants review the validity of the request to ensure that the customers are not being burdened with rate increases due to unreasonable expenditures by the utility. This audit will determine whether the IOU is granted its request for a rate increase. PSCs have only minimal jurisdiction over municipal and co-op rates. They are permitted to review their various classes of rates (e.g., commercial, industrial, residential) to ensure they are not discriminatory.

According to 2017 statistical data from American Public Power Association and the United States Energy Information Administration (EIA), the POU vs. IOU rate war is split between residential, commercial, and industrial rates. The U.S. average residential electric rate per kilowatt-hour (kWh) is 11.8 cents for POUs and 13.5 cents for IOUs, a difference of 14.4% or $176.79 (per year) for the average U.S. household (American Public Power Association, 2019). POUs also come out slightly ahead with better rates for their commercial customers per kWh at 10.8 cents vs. 10.9 cents for IOUs, just a 1% difference. However, the IOUs outperform POUs with the industrial customers. IOU rates are 7.0 cents per kWh vs. 7.4 cents for POUs, a difference of 5.7%. This difference in performance is often the source of debate within the POU and IOU debate.

A 2007 report by the Connecticut General Assembly observed the differences in IOU rates versus the POU rates. The study examined why the municipal rates within the state are so much lower than those of the IOUs. Connecticut is one of the 16 deregulated states in the United States (Albireo Energy, 2018). The rates for POUs ranged from 11.8-16.3 cents per kWh, and for the IOUs, Connecticut Power and Light and United Illuminating, the rates were 19.9 and 23.1 cents, respectively (McKarthy, 2007). McKarthy offered several reasons that may influence the rate disparities: financing through tax-exempt bonds, exemption from certain regulations, geographical and population distribution of power lines, and fewer conservation requirements of municipal utilities. However, the most significant factor influencing rates is the purchase power agreements, which make up the largest part of the rates. Due to the smaller size of municipal utilities, more power generation companies can bid on the power needs of Connecticut's POUs. The demand for the IOUs is much greater due to their size, so competition is limited. As well, municipal utilities are permitted to go to the market to seek power purchase agreements. In contrast, IOUs are limited by law on when and how often they can enter into agreements. This limitation on IOUs creates a significant impact. As mentioned earlier, the State of Connecticut has a deregulated energy market, and these issues are specific to deregulated states. However, it speaks to the larger picture of municipalities' regulatory advantages over IOUs that directly affect customer rates.

Reliability

The next topic for examination is reliability among utilities. Reliability for an electric utility is vital to the daily life of people and businesses. Edison Energy (2016) cites the most common causes of power outages as extreme weather events (hurricanes, rain, wind, heat, earthquakes, ice storms, lightning), car crashes, vegetation issues, animals, and intense system demand. Reliability has a serious effect on its customers. Eaton Corporation's 2018 Blackout Tracker examines the costs and consequences of power outages among its customers over the years 2008-2017. In terms of cost, data centers lose an estimated $8,851 per minute, hospitals lose an average of $690,000 per power outage, and 18% of industrial companies experienced a power outage with a cost of over $100,000 (Eaton, n.d.). The same report lists security and safety issues as serious effects such as cybersecurity threats, water quality, disabled traffic signals, and elevator operations. These events cause grave concern over reliability and provide justification for the importance of this research.

A serious, cascading blackout that began in Ohio in 2003 of over 50,000,000 customers across eight states, resulting in at least 11 deaths and a cost of $6 billion, created a stronger emphasis on reliability standards and metrics (Minkel, 2008). The initial cause of this massive blackout was poor vegetation management by the IOU FirstEnergy Corporation. Renewed concerns over reliability have made their way to the front pages again, with the California wildfires of 2017 and rolling blackouts that followed. Pacific Gas & Electric (PG&E) is the IOU that serves approximately 40% of California's population and is blamed for 17 out of the 21 major wildfires in 2017 that killed dozens of residents and destroyed thousands of homes throughout the California service area (Penn, 2019). As with the major 2003 blackout in Ohio, fire inspectors cited poor vegetation management as the root cause. Faced with increased costs for mitigating risks from tree trimming and increasing reliability, IOUs lobbied to be free from bearing the cost of the fires and to be permitted to pass the costs on to the customers (Penn, 2019). To prevent more wildfires from continuing, PG&E is rolling blackouts, sometimes lasting more than four days, throughout the state as temperatures increase and utilities struggle to safely meet demand (Penn, 2020). During this time, customers are subject to losing power in the hottest times of the year, causing severe inconvenience and cost.

The most common utility metric for reliability is SAIDI, System Average Interruption Duration Index (EIA, 2018). SAIDI is the average duration of interruptions for the average customer. The SAIDI is calculated by the sum of all customer minutes interrupted divided by the total number of customers served. Another measure of reliability is SAIFI (System Average Interruption Frequency Index), which measures the average frequency of interruptions for the average customer. It is calculated by the total number of customer interruptions divided by the total number of customers served. Between these two measurements, it answers the questions of how long an outage is and how frequently they occur. In 2018, the average electric customer in the United States experienced 7.8 hours of outages when major events were included (hurricanes) and nearly 2 hours when they were excluded (EIA, 2018). Major events like hurricanes and earthquakes are excluded from these metrics, as they are typically considered beyond the utility's control. As well, the definition of "customer interruption" varies, as the IEEE (Institute for Electrical and Electronics Engineers) standard is five minutes, while other states may use a duration of only one minute (Teixeira, 2019). Eaton (n.d.) revealed in their 2018 Blackout Tracker report that, over ten years, the state of Florida led the outage list in terms of the number of customers affected, at 25.3 million customers experiencing power loss. Montana, while they report few outages in number, the duration of the outages is significant, at 212 minutes per outage. California led the group in total outages, with 4,297 outages, more than twice the number of the next runner-up, which was Texas at 1,603.

A Northeastern University study by Kwoka (2005) showed that U.S. municipally owned utilities provide significantly better SAIDI (how long a customer is without power) numbers than their IOU counterparts. One portion of the study examined SAIDI numbers from IOUs and POUs, which revealed IOUs average SAIDI metrics were more than twice that of POUs, 161 vs. 79, respectively (Kwoka, 2005). This trend persisted year over year. The study noted that size is also a factor that may significantly impact reliability, as proximity to customers served is a critical aspect of reliability. The American Public Power Association (2020) states that, excluding major events, POUs experience, on average, a yearly outage duration of 75 minutes, compared to 142 minutes for IOUs.

Regarding reliability during large storm events, a Rice University study offers a slightly conflicting opinion, stating that evidence is mixed on IOU versus POU performance during storm events (Boylan, 2016). A common argument for public ownership is that IOU response during storms is inadequate and one reason for this is maintenance expenditures. Boylan (2016) noted that POUs spend more money on maintenance of their distribution system, but they do not have as many of their power lines underground. Underground power lines are less susceptible to the elements, so they are typically more reliable. Furthermore, Boylan (2016) suggested that higher maintenance budgets do not mean wise or effective spending. A common criticism of public operations is wasteful spending; therefore, the real measure is how the money is spent, not the dollar amount. The political process and bureaucratic issues inherent to POUs are also noted as reasons for wasteful spending. Boylan (2016) did not conclusively state that IOUs do a better job. Boylan suggested that evidence is mixed about whether POUs perform better than IOUs during storms. Therefore, Boylan advocated that this talking point as evidence for public ownership should be re-examined.

Customer Satisfaction

Another important metric for utility performance is customer satisfaction. While customer satisfaction is not a metric used in this particular research study (due to unavailability of data for smaller IOUs), the research does include metrics highly relevant to customer satisfaction. It is important to explore what customers want from their electric utilities and its relation to the topic of ownership. For this reason, it is included in the literature review. There is little academic research in this area as this is a much more difficult metric to measure due to its reliance on opinions and survey data and the needs of customers regarding their utility change over time. For instance, payment options from decades back will not be acceptable in today’s culture of automated, online payments. Customer satisfaction is often heavily dependent on the first two metrics discussed earlier, rates and reliability. There are also three distinct types of customers: residential, commercial, and industrial. The expectations of these customers may be vastly different, as well as how the utility charges and serves these customers.

J.D. Power & Associates is a data analytics and market research company that investigates customer opinions about their electric utility provider. Their research indicates that customer satisfaction drivers include rates, reliability, customer service, community involvement, and easy payment options (J.D. Power, n.d.). Their reports break the utilities down by size and region to help compare the utilities evenly. In another customer service related report for California utilities, the California Public Utilities Commission uses call center responsiveness, order fulfillment, missed appointments, and avoided service disconnections (as set up between the utility and the customer) as crucial drivers for residential customers satisfaction (State of California, n.d.).

In J.D. Power & Associates' 2020 report on Business Customer Satisfaction, IOUs comprise eight of the nine top-performing utilities, as well as six of eight of the poorest performing utilities (J.D. Power, n.d.). The disparity in numbers (eight versus nine) is due to a tie in the East Large category. The American Public Power Association (2020) notes that POUs typically rank high in customer satisfaction due to their priorities being in line with its customers' needs and focus on community, instead of profit. Additionally, POU customers can express dissatisfaction with their utilities to elected officials, the option for in-person communications, and utility sponsored energy efficiency programs. In a 2017 report prepared for the District of Columbia Department of Energy and Environment, researchers examined four instances where customer dissatisfaction with high bills, poor reliability, loss of local control, and sustainability issues led communities to opt for a change in ownership, from IOUs to POUs (Vitolo et al., 2017).

Conclusion

The public vs private debate has been a part of utility ownership since the emergence of electric utilities. Certain assumptions tend to get attached to each type of ownership. Private organizations are often associated with efficiency, lower rates, profit maximization for shareholders, and reduced payrolls. Public organizations tend to be linked to providing fair services for all, bureaucracy, equitable distribution of services, and public representation. As the literature review points out, some research supports these claims, and other research shows that these assumptions are simplistic generalizations. Nevertheless, there are widely supported differences in the two types of ownership.

The makeup of a utility contributes to their performance. While there are numerous influential performance factors (size, geographical area, terrain, weather, politics, economies of scale, etc.), one of the most debated factors is ownership. This literature review explored the history of ownership within the electric utility industry, and the factors that make up measurable performance. The following methods section will explain exactly how this study seeks to provide answers to the question of performance concerning rates and reliability metrics. It will detail the approach, variables, sample, analysis, and hypotheses for this research.

Chapter 3: Methods

Introduction

The argument for or against private ownership of utilities is not a novel debate, as the literature review shows. Ownership is argued to have a significant effect on performance across the electric utility industry. Promoters of private ownership suggest that the efficiencies of the private industry will benefit the communities served by municipally run, city-focused utilities. This argument is often grounded in the assumption that cost is the primary measure of success for a utility. However, when other items such as reliability measures like SAIDI (System Average Interruption Duration Index) are considered, previous research shows that public utilities come out ahead (Kwoka, 2005). Goodman and Loveman (1991) noted that many measures of privatization's success are short-term in nature. One must look at the public interest (which is, admittedly, a wide range of residential and commercial customers) and what effects exist, both short and long-term, that can either harm or benefit a particular community. The public, including residents and businesses, want to have affordable, reliable power available to them.

This study uses a quantitative design with two independent variables (public or private ownership) to test whether there are statistically significant differences between public and private utilities based on five dependent variables (residential rates, commercial rates, industrial rates, SAIDI, and SAIFI). The purpose is to measure the performance of the two types of ownership and outline any differences that may exist between them, regarding these metrics.

The following sections outline the research design and approach, variables and descriptions, data and samples, analysis and procedures, and hypotheses for the research question: Does ownership affect performance of electrical utilities in the State of Florida?

Research Design and Approach

The purpose of this design is to explore whether performance differs by public or private ownership. Rate data is sourced from the Florida Municipal Electric Association, who publishes electric bill comparisons each month. Reliability data is sourced from the Public Service Commission of Florida and the Florida Municipal Power Association. The focus on Florida utilities is due to the increased conversation surrounding utility ownership in the state over the last decade. As stated in the introduction of this paper, Florida's utility market has seen an uptick in privatization or attempted privatization efforts by the larger Investor-Owned Utilities (IOUs) in the Florida market, namely Florida Power and Light (FPL), Duke, and Tampa Electric Company's (TECO) parent company Emera. To analyze whether significant differences exist between Florida's public and private utilities, data on rates and reliability are compared through statistical means testing. The methods used in this research are purely quantitative.

To compare public and private utility performance, the metrics for performance must be appropriately defined. Two of the most notable and essential aspects of performance are rates and reliability, which will be further defined in the variables section of this paper. Previous research in the field considers these factors as performance indicators. Research results are often mixed. Some studies, such as the Rice University study by Boylan (2016), indicate that private utilities have certain reliability advantages over public utilities during storms, due to their increased number of underground power lines (versus overhead which are much more susceptible to weather related outages). Other studies show that POUs outperform on rates and reliability (Kwoka, 2005; McKarthy, 2007; Meyer, 1975; Peters, 1993).

Rates are divided into three separate categories: residential, commercial, and industrial. This research examines each of these categories separately to explore how ownership may affect rates specific to each category. Examining the differences in the various rate categories may reveal how public and private utilities structure their rates and if this benefits a particular group (e.g., residential, commercial, or industrial customers).

For reliability, the research examines the two most common industry standards, System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI). These two indices measure how long and how frequently a customer experiences an outage, respectively. The Institute of Electrical and Electronics Engineers (IEEE) standard definition of an outage is five minutes (Teixeira, 2019), but Florida uses a duration of one minute for outages (Florida Public Service Commission, n.d.-a). These outages are adjusted in their reporting to exclude certain outage events, such as planned maintenance or severe weather events.

These metrics (rates and reliability) are crucial to the public. Customers demand reliable power and competitive rates, which is the reason for the research. The results of the differences will provide insight into how electric utilities perform concerning ownership.

Variables

Concept: The effects of public or private ownership on Florida's electric utility performance.

Conceptual Definition: The concept of utility ownership is defined as the extent to which a utility company is owned by private investors; or by a public entity, be it municipally, state, or federally owned.

Operational Definition of Performance: Measure the effects of ownership by comparing means of rates and reliability.

Independent Variable: Electric Utility Ownership (Public or Private)

Dependent Variables: Residential Rates, Commercial Rates, Industrial Rates, Reliability Metric SAIDI, Reliability Metric SAIFI

Variable Descriptions

Independent Variable

The independent variable for this research is ownership (public or private). Publicly Owned Utilities (POUs) are run by federal, state, or municipally agencies (U.S. Energy Information Administration, 2019). Investor-Owned Utilities (IOUs) are utilities that issue stock to shareholders (U.S. Energy Information Administration, 2019). The measures of the independent variables are categorical.

Dependent Variables

The dependent variables in this study are the items influenced by utility ownership, the "performance" as stated in the research question. The following measurements are the dependent variables in this research:

1. Rates/average monthly bills- These are the average monthly bills for residential, commercial, and industrial rates. Each of these three rate structures are tiered by kilowatt-hour (kWh) consumption. For residential rates, there are two tiers: 1,000kWh and 2,500kWh. The commercial category includes eight tiers: No Demand (ND)-750kWh, ND–1,500kWh, 30-6,000kWh, 40-10,000kWh, 75-15,000kWh, 75-30,000kWh, 150-30,000kWh, and 150-60,000kWh. Lastly, the industrial rates are broken into four tiers: 300-60,000kWh, 300-120,000kWh, 500-100,000kWh, and 500-200,000kWh. Historical data for monthly bills will be used for the nine years ranging from 2012-2020, as these are the years available for comparison. The electric bill comparison data is sourced from Florida Municipal Electric Association (n.d.).

2. Reliability- Reliability in the electric utility industry is measured by metrics that incorporate the number of interruptions and outage durations. The two metrics used to define these measurements are SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index). SAIDI measures the average duration of interruptions for the average customer (Customer Minutes Interrupted ÷ Number of Customers). SAIFI measures the average frequency of interruptions for the average customer (Number of Customer Interruptions ÷ Number of Customers). Lower numbers indicate better performance for SAIDI and SAIFI. In this study, SAIDI values range from 32.9 to 289.7 and SAIFI values range from .55 to 3.26. These metrics are compared on an annual basis for the years 2014-2019. This time period is when the available data for both POUs and IOUs are accurately gathered and adjusted. The adjusted data must be compared to maintain consistency. Comparing raw data without adjusting for the allowed exclusions (weather, planned outages, etc.) would create unfair comparisons, skewing the results. These metrics are available from the Public Service Commission of Florida and the Florida Municipal Power Association.

The measurement for both sets of Dependent Variables is continuous.

Data and Sample

The study's data comes from rates and reliability metrics of Florida-based electric utilities. The research focuses on all public and private generating capable utilities in Florida, as identified in the Florida Municipal Electric Association (n.d.) electric bill comparisons. Without this requirement, the research would include utilities with a miniscule customer base and only a small number of power lines in their system, which may be fed radially. A radial feed means that there is no system redundancy, which means outage count and durations are likely increased. A single outage on the system or no outages at all may heavily influence SAIDI and SAIFI metrics on such a system. Generation capability requires a utility to have a certain number of employees, fleet, assets, etc. This distinction is made to ensure that reasonable comparisons are made between utilities. As of February 2021, there are 38 public and private electric utilities operating in Florida. The total number of Florida-based utilities in this study is 19, with seven IOUs and 12 POUs. A list of the Florida generating capable electric utilities included in the sample are shown in table 1 below. 20 utilities were excluded from the total number of Florida-based electric utilities based on lack of generating capability. Florida also has electric co-operatives, excluded from this study because of their large geographic territory and their small customer base. According to Florida Electric Cooperatives Association (FECA), Inc., there are 17 cooperatives spread across 54 of Florida's 67 counties (FECA, n.d.).

Table 1

List of Utilities and Ownership Type

Utility Name	Ownership Type
Gainesville	Public
Homestead[a]	Public
JEA (Jacksonville)	Public
Key West	Public
Kissimmee	Public
Lake Worth[b]	Public
Lakeland	Public
New Smyrna Beach	Public
Orlando Utilities Commission (OUC)	Public
St Cloud[c]	Public
Tallahassee	Public
Vero Beach[d]	Public
Florida Power and Light (FPL)	Private
Gulf Power	Private
Duke Energy[e]	Private
Progress Energy[e]	Private
Tampa Electric Company (TECO)	Private
Florida Public Utilities (FPU) Northeast (NE)[f]	Private
Florida Public Utilities (FPU) Northwest (NW)[f]	Private

[a] Reliability data for SAIDI is unavailable for year 2019. SAIFI is unavailable for 2018 or 2019.

[b] Reliability data unavailable before 2018.

[c] Reliability data is reported with OUC. Rates are reported individually.

[d] Reliability data not reported. Purchased by FPL in 2018.

[e] Duke purchases Progress Energy in March 2013.

[f] Reliability data are reported together. Rates are reported separately until January 2015.

Not all utilities are present throughout the entire timeline of the research. Gaps are listed in the footnotes in Table 1 above. These discrepancies are due to mergers or acquisitions of other utilities. For maps of the geographical locations and service territories of Florida's public and private utilities across the state, please refer to Appendix A and B. Please note that these are maps from 2015 and some of the information and service territories have changed slightly over time.

For the Independent Variable Ownership, there are 12 POUs and seven IOUs. For the Dependent Variable Rates (Residential, Commercial, and Industrial), each variable has 1,271 measurements for POUs and 552 measurements for IOUs. For the Dependent Variable Reliability (SAIDI), the variable has 55 measurements for POUs and 30 measurements for IOUs. For the Dependent Variable Reliability (SAIFI), the variable has 54 measurements for POUs and 30 measurements for IOUs. Table 2 shows a clear breakdown of the metrics, variables, and number of measurements.

Table 2

Metrics, Categories, and Number of Measurements

Metric	Variable/Category	Demand Tier (usage in kWh)	*N* for Publicly Owned Utilities	*N* for Investor-Owned Utilities
Rates	Residential	1,000	1,271	552
Rates	Residential	2,500	1,271	552
Rates	Commercial	No Demand-750	1,271	552
Rates	Commercial	No Demand-1,500	1,271	552
Rates	Commercial	30-6,000	1,271	552
Rates	Commercial	40-10,000	1,271	552
Rates	Commercial	75-15,000	1,271	552
Rates	Commercial	75-30,000	1,271	552
Rates	Commercial	150-30,000	1,271	552
Rates	Commercial	150-60,000	1,271	552
Rates	Industrial	300-60,000	1,271	552
Rates	Industrial	300-120,000	1,271	552
Rates	Industrial	500-100,000	1,271	552
Rates	Industrial	500-200,000	1,271	552
Reliability	SAIDI	Not Applicable	55	30
Reliability	SAIFI	Not Applicable	54	30

The data collected for the variables is not subject to the Institutional Review Board (IRB). None of the data collection involves human subjects and it is all available via public records request or published online, as outlined in the variable descriptions. For this reason, no IRB approval is required.

Analysis and Procedures

To compare performance between IOUs and POUs, a purely quantitative approach is used. The research looks at separate means tests for each category (and tier) of rates, SAIDI and SAIFI. Since the independent variable is both categorical and dichotomous, along with the dependent variables being continuous, the most appropriate means test was the Independent t-Test. The Independent t-Test will show whether statistically significant differences, at the 95% confidence level, exist between IOUs and POUs regarding rates and reliability. While it is obvious that lower rates are desirable, SAIDI and SAIFI measurements may not be as obvious to those without a background in the electrical utility industry. For clarification, lower numbers for both SAIDI and SAIFI are considered desirable. A lower number for SAIDI is indicative of a shorter outage duration. A lower number for SAIFI signifies less frequent outages.

Prior research relied on similar statistical analysis. Meyer’s (1975) comparative study between private and public utilities relied on linear regression to draw conclusions that showed POUs offered more favorable rates. Peters’ (1993) research offered a comprehensive look at several studies in the field, comparing ownership. Peters (1993) noted that research comparing the two types of ownership relies heavily on means comparisons and regression techniques. Similar filtering techniques among the samples were also used among studies to extract certain utilities, such as eliminating those without generating capabilities, as done in this study. Cost and reliability were frequently cited in prior research and customer satisfaction surveys mentioned in the literature review, such as the JD Power studies, as the common metrics for measuring an electric utility’s performance.

In the following hypotheses section, the term outperform suggests statistically significant lower numbers. Lower rates are preferable to customers and lower SAIDI and SAIFI numbers indicate shorter power outage durations and less frequent power outages, respectively.

Hypotheses

Since the research examines multiple metrics (rates and reliability), there are multiple hypotheses in this section. Each tier within each category of rates (e.g., Residential Rates 1000kWh) will have its own hypothesis, along with SAIDI and SAIFI for reliability. There are two residential rate hypotheses, eight commercial rate hypotheses, and four industrial rate hypotheses, for a total of 14 tiers measuring rate performance. For reliability, SAIDI and SAIFI have their own hypotheses. This brings the total hypotheses count to 16. Below, each individual research question and its corresponding hypothesis is stated. For clarity's sake, each item is given its own research question number and corresponding suffix. Residential rates will have the suffix A, commercial rates suffix B, industrial rates suffix C, SAIDI suffix D, and SAIFI suffix E.

The prediction is that public utilities will outperform in residential rates, commercial rates, and both reliability metrics (SAIDI and SAIFI), while private utilities will outperform in industrial rates.

Rates

Residential Rates Hypotheses

Research question 1.A: Is there a significant difference between Florida's public and private electric utilities regarding residential rates (1,000kWh)?

Research hypothesis 1.A: Florida's public utilities will have significantly lower rates than their private counterparts.

Research question 2.A: Is there a significant difference between Florida's public and private electric utilities regarding residential rates (2,500kWh)?

Research hypothesis 2.A: Florida's public utilities will have significantly lower rates than their private counterparts.

Commercial Rates Hypotheses

Research question 1.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (ND-750kWh)?

Research hypothesis 1.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

Research question 2.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (ND-1,500kWh)?

Research hypothesis 2.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

Research question 3.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (30-6,000kWh)?

Research hypothesis 3.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

Research question 4.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (40-10,000kWh)?

Research hypothesis 4.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

Research question 5.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (75-15,000kWh)?

Research hypothesis 5.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

Research question 6.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (75-30,000kWh)?

Research hypothesis 6.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

Research question 7.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (150-30,000kWh)?

Research hypothesis 7.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

Research question 8.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (150-60,000kWh)?

Research hypothesis 8.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

Industrial Rates Hypotheses

Research question 1.C: Is there a significant difference between Florida's public and private electric utilities regarding industrial rates (300-60,000kWh)?

Research hypothesis 1.C: Florida's private utilities will have significantly lower industrial rates than their public counterparts.

Research question 2.C: Is there a significant difference between Florida's public and private electric utilities regarding industrial rates (300-120,000kWh)?

Research hypothesis 2.C: Florida's private utilities will have significantly lower industrial rates than their public counterparts.

Research question 3.C: Is there a significant difference between Florida's public and private electric utilities regarding industrial rates (500-100,000kWh)?

Research hypothesis 3.C: Florida's private utilities will have significantly lower industrial rates than their public counterparts.

Research question 4.C: Is there a significant difference between Florida's public and private electric utilities regarding industrial rates (500-200,000kWh)?

Research hypothesis 4.C: Florida's private utilities will have significantly lower industrial rates than their public counterparts.

Reliability

SAIDI

Research question 1.D: Is there a significant difference between Florida's public and private electric utilities regarding the reliability metric SAIDI?

Research hypothesis 1.D: Florida's public utilities will have significantly lower SAIDI numbers than their private counterparts.

SAIFI

Research question 1.E: Is there a significant difference between Florida's public and private electric utilities regarding the reliability metric SAIFI?

Research hypothesis 1.E: Florida's public utilities will have significantly lower SAIFI numbers than their private counterparts.

The following section will analyze the results of the study, followed by any conclusions that can be drawn from the statistical analysis.

Chapter 4: Findings

This chapter examines through the pre-screening of the data and data adjustments, a presentation of the results, an analysis of the various hypotheses, tables and figures, and final comments on the results of the data.

Because of the substantial number of hypotheses in this study, the discussions of results will be broken up for the sake of clarity. Rates will be discussed in their three respective categories: residential, commercial, and industrial. Then, the reliability metrics will be discussed together, in terms of SAIDI and SAIFI. The statistical analysis and SPSS outputs will be in Appendices D-S.

Pre-Screening and Data Adjustments

This portion of the study will discuss issues with data, specifically shapes of normality and outliers. These observations were made before the statistical tests were run, along with checking to ensure that all data entry points were correct.

With over 25,000 data points used in the study, there was a considerable risk of input errors. Plots of the data helped to identify any typographical errors. However, given that the data is secondary, already published data, there were no significant issues with input errors.

Normality of Distribution

Prior to running the statistical tests, some data sets were plotted in SPSS to check for normality. While many of the data sets closely followed the shape of the normal curve, several data sets exhibited a positive skew. As a result, the normal shape requirement was not satisfied. To address this issue, those skewed data sets were put through a power transformation to normalize the curve. In total, there were seven of the 16 data sets that displayed a positive skew, five within the rates metric and two within the reliability metric. Appendix C discusses the mathematics for the transformation in greater detail, but for clarity in this section, a summary is provided.

Table 3 below provides an outline of the specific metric, variable, and tier of the sets that required a power transformation. Due to the shape of each curve, it was determined that the best fit was the logarithmic transformation (Abu-Bader, 2010). However, to be as accurate and thorough as possible, different methods of proposed transformation were tested: square root, logarithm, and inverse. For the following reasons, the logarithmic transformation yielded the best results in creating a normal shaped curve; the power transformation smoothed the curve and eliminated the positive skew, satisfying the normality requirements for the data sets. From these transformations, the data was analyzed with SPSS for the results of the Independent t-Test.

Table 3

Skewness Measures

Metric	Variable/Category	Demand Tier (usage in kWh)	Skewness Type	Method of Transformation
Rates	Residential	1,000	Positive	Logarithm
Rates	Residential	2,500	Positive	Logarithm
Rates	Commercial	No Demand-750	Positive	Logarithm
Rates	Commercial	No Demand-1,500	None	None
Rates	Commercial	30-6,000	Positive	Logarithm
Rates	Commercial	40-10,000	Positive	Logarithm
Rates	Commercial	75-15,000	None	None
Rates	Commercial	75-30,000	None	None
Rates	Commercial	150-30,000	None	None
Rates	Commercial	150-60,000	None	None
Rates	Industrial	300-60,000	None	None
Rates	Industrial	300-120,000	None	None
Rates	Industrial	500-100,000	None	None
Rates	Industrial	500-200,000	None	None
Reliability	SAIDI	Not Applicable	Positive	Logarithm
Reliability	SAIFI	Not Applicable	Positive	Logarithm

The data, once transformed, provides a number that is difficult for purposes of discussion and understanding. Particularly, when discussing rates, the logarithm of a dollar value means little to the reader and makes comparisons difficult. To address this issue, the inverse transformation must be done to the resulting mean values in the Independent t-Test, in order to discuss these values in terms that make sense to the reader. As with the mathematics of the skewness, the inverse transformation details can be seen in Appendix C.

Outliers

A common issue with data sets is outliers. This may show a case where one value may be so extreme that it can affect the entire results of the statistical analysis. Using the *z*-score is one of the widely accepted ways to identify these outliers. SPSS computes the *z*-scores for the data points, which indicates the number of standard deviation units the raw data is above or below the mean (Abu-Bader, 2010). Those *z*-scores that fall outside of the range of -3 and +3 are considered outliers and should be examined. With a sample size greater than 70, this range of -3 to +3 is sufficient for identifying outliers (Newton & Rudestam, 2013).

Once SPSS computed the *z*-scores, it was noted that several outliers were present among the datasets. There were 23 total outliers throughout 11 different data sets. Private utilities accounted for 12 of the 23 outliers, while public utilities accounted for the other 11. Table 4 highlights the distribution of the outliers among the data, respective of their Public and Private ownership.

Table 4

Outliers

Metric	Variable/Category	Demand Tier (usage in kWh)	Total Number of Outliers	Public Outliers	Private Outliers	Total *N*
Rates	Residential	1,000	1	0	1	1,823
Rates	Residential	2,500	1	1	0	1,823
Rates	Commercial	No Demand-750	None	N/A	N/A	1,823
Rates	Commercial	No Demand-1,500	1	1	0	1,823
Rates	Commercial	30-6,000	2	2	0	1,823
Rates	Commercial	40-10,000	4	2	2	1,823
Rates	Commercial	75-15,000	None	N/A	N/A	1,823
Rates	Commercial	75-30,000	3	0	3	1,823
Rates	Commercial	150-30,000	None	N/A	N/A	1,823
Rates	Commercial	150-60,000	3	0	3	1,823
Rates	Industrial	300-60,000	None	N/A	N/A	1,823
Rates	Industrial	300-120,000	3	0	3	1,823
Rates	Industrial	500-100,000	None	N/A	N/A	1,823
Rates	Industrial	500-200,000	1	1	1	1,823
Reliability	SAIDI	Not Applicable	2	2	0	85
Reliability	SAIFI	Not Applicable	2	2	0	84

After identifying the number of outliers and their position within the data, a decision was made to leave them in the analysis. Several factors influenced this decision. First, the number of outliers is relatively low compared to the number of data points within each set. As a result, the influence of an outlier would be unlikely to have a strong effect. More importantly, the outliers were widely dispersed, including public and private utilities, across numerous tiers of rates, and in both reliability metrics. Finally, there is no reason to consider these outliers as the result of a single, excludable event. They provide evidence for a more holistic understanding of ownership among the sample and make a stronger case for generalizability (Newton & Rudestam, 2013).

While it is unrealistic to answer the reason for the outliers, they may have simple explanations. For instance, a utility's rate may be significantly lower for a particular month if they choose to refund fuel savings back to customers. This activity would reflect a one-time refund that would result in a bill that is uncharacteristically low, but still valuable in the analysis. Using the metrics of reliability, one particularly poor performance may signify a genuine weakness that should be reflected in the results.

While the decision to include the outliers in the analysis was made, the tests were run twice to determine the impact of the outliers. Newton and Rudestam (2013) recommend running the tests both ways, with and without outliers, to determine their impact on the results. After running each tier twice, one including the outliers and the other excluding the outliers, it was determined that their influence had an insignificant effect on the overall results and conclusions of this study. Due to the large sample sizes and small number of outliers, leaving the outliers in the study yields comparable results.

Results

Rates

This section will examine the results of the Independent t-Tests for each category of rates. The results of the Independent t-Tests show that there are statistically significant differences between public and private utilities regarding rates. Out of the 14 rate tiers tested, 13 showed significant differences in means, with a minimum confidence level of 95%. In the 13 results with statistically significant mean differences, private utilities outperformed public utilities in nine tiers. The original hypotheses predicted that public utilities would outperform private in 10 of the 14 tiers; therefore, the actual results were nearly flipped to the private utilities' favor.

A general overview of the results is displayed in Table 5. Following this overview, each hypothesis will be restated and discussed individually, along with each result. All results in this section are discussed using the data power transformations for normalization as described in Appendix C. This allows the results to be discussed in dollars. Raw outputs and SPSS tables will be displayed in Appendices D-Q.

Table 5

Results of Statistical Analysis on Rates

Hypothesis	Category	Demand Tier (usage in kWh)	Mean for Public Utilities	Mean for Private Utilities	Mean[a] Difference
1.A	Residential	1,000[b]	$112.75	$121.42	-$8.68***
2.A	Residential	2,500 [b]	$286.35	$312.32	-$25.97***
1.B	Commercial	No Demand-750 [b]	$93.43	$101.46	-$8.03***
2.B	Commercial	No Demand-1,500	$176.13	$187.33	-$11.20***
3.B	Commercial	30-6,000 [b]	$729.46	$716.14	$13.31*
4.B	Commercial	40-10,000 [b]	$1,132.14	$1,121.76	$10.38
5.B	Commercial	75-15,000	$1,901.70	$1,782.01	$119.69***
6.B	Commercial	75-30,000	$3,083.60	$2,913.75	$169.85***
7.B	Commercial	150-30,000	$3,743.99	$3,524.68	$219.31***
8.B	Commercial	150-60,000	$6,107.46	$5,788.16	$319.30***
1.C	Industrial	300-60,000	$7,372.38	$7,009.81	$362.57***
2.C	Industrial	300-120,000	$12,067.14	$11,537.05	$530.09***
3.C	Industrial	500-100,000	$12,350.70	$12,201.43	$149.27*
4.C	Industrial	500-200,000	$20,068.64	$19,160.99	$907.65***

Note. All rates are reported in US dollars. Results from the SPSS analysis are located in Appendices D-Q.

[a]A negative number indicates Public Utilities performed better. A positive number indicates Private Utilities performed better.

[b]Logarithmic power transformation was used to normalize data. Results in this table were transformed back into dollars, as described in Appendix C.

* Indicates statistical significance of $p \leq .05$

*** Indicates statistical significance of $p \leq .001$

Rates Results Summary

While the next section provides the statistical details of each individual hypothesis, this section offers a brief overview and discussion of the results for rates. Due to the number of hypotheses, the presentation can become cumbersome; therefore, this summary of the mean comparison data is intended to provide clarity.

For residential rates, public utilities outperformed private utilities in both tiers (1,000kWh and 2,500kWh), supporting the hypotheses. Public utilities provided rates 7.69% and 9.01% cheaper than the private utilities. Both are statistically significant differences and show clear difference in performance between public and private utilities.

For commercial rates, there was a clear split between public and private performance. While the original hypotheses stated that public utilities would outperform in the commercial tier, this was mostly incorrect. The results showed that public utilities only outperformed private utilities in the two lowest tiers, No Demand-750kWh and No Demand-1,500kWh. POU rates were 8.59% and 6.36% cheaper, respectively.

However, after the first two commercial tiers, there was a crossover where private utilities outperformed public in all six of the remaining tiers, with five of them at a 95% or greater confidence level. The 40-10,000kWh tier is where the mean difference between the two was not significantly different, showing a mean percentage difference of only .089%. For those that showed statistically significant results, private outperformed by 1.89% in the 30-6,000kWh tier, 6.7% in the 75-15,000kWh tier, 5.83% in the 75-30,000kWh tier, 6.22% in the 150-30,000kWh tier, and 5.52% in the 150-60,000kWh tier.

Finally, industrial rates were dominated by the private sector utilities. The private utilities boasted better performance in all four tiers. The IOUs outperformed by 5.17% in the 300-

60,000kWh tier, 4.59% in the 300-120,000kWh tier, 1.2% in the 500-100,000kWh tier, and 4.74% in the 500-200,000kWh tier.

Ultimately, the private utilities performed better than the public utilities, showing statistically significant better performance in nine of the 14 tiers, as opposed to public utilities only outperforming in four of the tiers. The discussion section will explore further the possible reasons for the differences in prices. The next section will explore each individual hypothesis, along with the statistical outputs of the Independent t-Tests.

Residential Rates Hypotheses

1,000kWh

Research question 1.A: Is there a significant difference between Florida's public and private electric utilities regarding residential rates (1,000kWh)?

Research hypothesis 1.A: Florida's public utilities will have significantly lower rates than their private counterparts.

The results of the Independent t-Test show an overall significant difference in residential rates (1,000kWh) based on ownership (t = -13.628, df = 1821, $p < .001$). Public utilities reported significantly lower rates than private utilities (mean = $112.75, mean = $121.42, respectively). This is a mean difference of $8.68. Hypothesis 1.A was supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix D.

2,500kWh

Research question 2.A: Is there a significant difference between Florida's public and private electric utilities regarding residential rates (2,500kWh)?

Research hypothesis 2.A: Florida's public utilities will have significantly lower rates than their private counterparts.

The results of the Independent t-Test show an overall significant difference in residential rates (2,500kWh) based on ownership (t = -15.687, df = 1821, $p < .001$). Public utilities reported significantly lower rates than private utilities (mean = \$286.35, mean = \$312.32, respectively). This is a mean difference of \$25.97. Hypothesis 2.A was supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix E.

Commercial Rates Hypotheses

No Demand (ND) – 750kWh

Research question 1.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (ND-750kWh)?

Research hypothesis 1.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

The results of the Independent t-Test show an overall significant difference in commercial rates (ND-750kWh) based on ownership (t = -10.565, df = 1821, $p < .001$). Public utilities reported significantly lower rates than private utilities (mean = \$93.43, mean = \$101.46, respectively). This is a mean difference of \$8.03. Hypothesis 1.B was supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix F.

No Demand (ND) – 1,500kWh

Research question 2.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (ND-1,500kWh)?

Research hypothesis 2.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

The results of the Independent t-Test show an overall significant difference in commercial rates (ND-1,500kWh) based on ownership (t = -8.693, df = 1821, $p < .001$). Public utilities reported significantly lower rates than private utilities (mean = \$176.13, mean = \$187.33, respectively). This is a mean difference of \$11.20. Hypothesis 2.B was supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix G.

30-6,000kWh

Research question 3.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (30-6,000kWh)?

Research hypothesis 3.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

The results of the Independent t-Test show an overall significant difference in commercial rates (30-6,000kWh) based on ownership (t = 2.274, df = 1821, $p < .05$). Private utilities reported significantly lower rates than public utilities (mean = \$729.46, mean = \$716.14, respectively). This is a mean difference of \$13.31. Hypothesis 3.B was not supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix H.

40-10,000kWh

Research question 4.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (40-10,000kWh)?

Research hypothesis 4.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

The results of the Independent t-Test show no overall significant difference in commercial rates (40-10,000kWh) based on ownership (t = 1.278, df = 1821, $p > .05$). Private utilities reported lower rates than public utilities, though the difference was not significant (mean

= \$1,132.13, mean = \$1,121.76, respectively). This is a mean difference of \$10.38. Hypothesis 4.B was not supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix I.

75-15,000kWh

Research question 5.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (75-15,000kWh)?

Research hypothesis 5.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

The results of the Independent t-Test show an overall significant difference in commercial rates (75-15,000kWh) based on ownership (t = 10.300, df = 1821, $p < .001$). Private utilities reported significantly lower rates than public utilities (mean = \$1,901.70, mean = \$1,782.01, respectively). This is a mean difference of \$119.69. Hypothesis 5.B was not supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix J.

75-30,000kWh

Research question 6.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (75-30,000kWh)?

Research hypothesis 6.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

The results of the Independent t-Test show an overall significant difference in commercial rates (75-30,000kWh) based on ownership (t = 7.572, df = 1821, $p < .001$). Private utilities reported significantly lower rates than public utilities (mean = \$3,083.60, mean = \$2,913.75, respectively). This is a mean difference of \$169.85. Hypothesis 6.B was not supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix K.

150-30,000kWh

Research question 7.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (150-30,000kWh)?

Research hypothesis 7.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

The results of the Independent t-Test show an overall significant difference in commercial rates (150-30,000kWh) based on ownership (t = 9.828, df = 1821, $p < .001$). Private utilities reported significantly lower rates than public utilities (mean = $3,743.99, mean = $3,524.68, respectively). This is a mean difference of $219.31. Hypothesis 7.B was not supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix L.

150-60,000kWh

Research question 8.B: Is there a significant difference between Florida's public and private electric utilities regarding commercial rates (150-60,000kWh)?

Research hypothesis 8.B: Florida's public utilities will have significantly lower commercial rates than their private counterparts.

The results of the Independent t-Test show an overall significant difference in commercial rates (150-60,000kWh) based on ownership (t = 7.241, df = 1821, $p < .001$). Private utilities reported significantly lower rates than public utilities (mean = $6,107.46, mean = $5,788.16, respectively). This is a mean difference of $319.30. Hypothesis 8.B was not supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix M.

Industrial Rates Hypotheses

300-60,000kWh

Research question 1.C: Is there a significant difference between Florida's public and private electric utilities regarding industrial rates (300-60,000kWh)?

Research hypothesis 1.C: Florida's private utilities will have significantly lower industrial rates than their public counterparts.

The results of the Independent t-Test show an overall significant difference in industrial rates (300-60,000kWh) based on ownership (t = 8.306, df = 1821, $p < .001$). Private utilities reported significantly lower rates than public utilities (mean = $7,372.38, mean = $7,009.81, respectively). This is a mean difference of $362.57. Hypothesis 1.C was supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix N.

300-120,000kWh

Research question 2.C: Is there a significant difference between Florida's public and private electric utilities regarding industrial rates (300-120,000kWh)?

Research hypothesis 2.C: Florida's private utilities will have significantly lower industrial rates than their public counterparts.

The results of the Independent t-Test show an overall significant difference in industrial rates (300-120,000kWh) based on ownership (t = 6.121, df = 1821, $p < .001$). Private utilities reported significantly lower rates than public utilities (mean = $12,067.14, mean = $11,537.05, respectively). This is a mean difference of $530.09. Hypothesis 2.C was supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix O.

500-100,000kWh

Research question 3.C: Is there a significant difference between Florida's public and private electric utilities regarding industrial rates (500-100,000kWh)?

Research hypothesis 3.C: Florida's private utilities will have significantly lower industrial rates than their public counterparts.

The results of the Independent t-Test show an overall significant difference in industrial rates (500-100,000kWh) based on ownership (t = 2.029, df = 1821, $p < .05$). Private utilities reported significantly lower rates than public utilities (mean = $12,350.70, mean = $12,201.43, respectively). This is a mean difference of $149.27. Hypothesis 3.C was, indeed, supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix P.

500-200,000kWh

Research question 4.C: Is there a significant difference between Florida's public and private electric utilities regarding industrial rates (500-200,000kWh)?

Research hypothesis 4.C: Florida's private utilities will have significantly lower industrial rates than their public counterparts.

The results of the Independent t-Test show an overall significant difference in industrial rates (500-200,000kWh) based on ownership (t = 6.379, df = 1821, $p < .001$). Private utilities reported significantly lower rates than public utilities (mean = $20,068.64, mean = $19,160.99, respectively). This is a mean difference of $907.65. Hypothesis 4.C was supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix Q.

Reliability

This section will examine the results of the Independent t-Tests for each category of Reliability, SAIDI and SAIFI. The results of the Independent t-Tests show that there are no statistically significant differences between public and private utilities regarding reliability.

A general overview of the results is displayed in Table 6. Following this overview, each hypothesis will be restated and discussed individually, along with each result. All results in this section are discussed using the data power transformations for normalization as described in Appendix C. This allows the results to be discussed in ranges that are easier to understand. Raw outputs and SPSS tables will be displayed in Appendices R and S.

Table 6

Results of Independent t-Tests on Reliability

Hypothesis	Category	Mean for Public Utilities	Mean for Private Utilities	Mean[a] Difference
1.D	SAIDI[b]	76.72	88.80	-12.08
1.E	SAIFI[b]	1.29	1.22	.18

Note. Results from the SPSS analysis are located in Appendices R and S.

[a]A negative number indicates Public Utilities performed better. A positive number indicates Private Utilities performed better.

[b]Logarithmic power transformation was used to normalize data. Results in this table were transformed back from the normalized data, as described in Appendix C.

SAIDI

Research question 1.D: Is there a significant difference between Florida's public and private electric utilities regarding the reliability metric SAIDI?

Research hypothesis 1.D: Florida's public utilities will have significantly lower SAIDI numbers than their private counterparts.

The results of the Independent t-Test show no overall significant difference in SAIDI numbers based on ownership (t = -1.413, df = 83, p = .161). Public utilities reported more favorable utilities, though the difference was not significant (mean = 76.72, mean = 88.80, respectively). This is a mean difference of 12.08. Hypothesis 1.D was not supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix R.

SAIFI

Research question 1.E: Is there a significant difference between Florida's public and private electric utilities regarding the reliability metric SAIFI?

Research hypothesis 1.E: Florida's public utilities will have significantly lower SAIFI numbers than their private counterparts.

The results of the Independent t-Test show no overall significant difference in SAIFI numbers based on ownership (t = 1.633, df = 82, p = .106). Public utilities reported more favorable utilities, though the difference was not significant (mean = 1.29, mean = 1.11, respectively). This is a mean difference of .18. Hypothesis 1.E was not supported by the results of the Independent t-Test. The SPSS outputs for the Independent t-Test are in Appendix S.

Chapter 5: Discussion

Summary

The debate on public versus private performance is certainly contentious among public administrators, business owners, and the public. Many members of the community voice concern as local governments look to privatization to solve their fiscal woes. Those who like their local utilities object and argue that a large IOU will come in and raise rates to appease shareholders, lose focus on the local community, and direct resources and restoration efforts on the larger, more populated cities. Conversely, those who feel like their local utilities lack effectiveness call on the efficiencies of the private industry to solve the grievances of the community. However, many of the assertions are based on anecdotal talking points and do not realistically consider the differences between the two types of ownership.

Privatization has become a popular solution for governments over the last several decades, which is one of the key principles provided by the New Public Management movement. Public administrators must decide how much control they want within their jurisdiction and to what extent they want to own services provided to the public. Many local governments provide their constituents with trash collection, sewer, water, and electric services. However, they are faced with the operational challenges and criticisms of a large government within an anti-statist populace. Extravagant privatization efforts lead to a hollow state, leaving little power to the local governments, especially concerning something as critical as power generation, transmission, and distribution. This suggests the common question public officials must face in determining their city services— how much does the city want to steer and how much does the city want to row?

Research related to Public Administration and the utility industry is lacking. However, many city governments are facing a crossroads with one of their largest assets, their electric utility. Municipal utilities may provide local governments and communities with a steady source of revenue, through fund transfers to the city. City governments may even use their utility to collect fees, as it is an easier way to collect fees than through new taxes. With such huge demands on local governments, they have to make decisions on behalf of their community, which may affect the city for decades to come. Leaders must consider these long-term impacts, and they must do so with proper information in hand. City officials need to consider how a potential change in ownership could impact local businesses, whether it would harm those within the community with limited financial means, and whether a decision of this magnitude provides services that create a better community.

This public administration decision presents issues that stem from the principal-agent problem, as these critical services are now provided by an organization whose motivation is driven by shareholder return. That is not to say that IOUs are incapable of providing strong service. Their desire to improve lean and efficient services may, indeed, lead to strong performance. However, it must be noted that, based on the theory of the firm, an IOU is motivated to increase profits and all decisions will stem from this fact. This is a stark contrast to the motivations of a public utility, who does not operate for the purpose of profit, but for the benefit of public well-being.

Specifically, Florida has seen an increase in privatization efforts, as FPL, the state's largest IOU, tries to increase their footprint across the state by absorbing locally owned electric companies. FPL's recent acquisition of Vero Beach's electric utility and failed attempt to acquire Florida's largest municipal utility, JEA, increased scrutiny of the subject. Much of the discussion surrounding these types of issues often involve politics and business interests, rather than facts about utility ownership and their performance. Thus, this research aimed to address these issues and examine the subject with an objective approach and clearly defined performance metrics (rates and reliability).

The results of this study show that some performance differences exist between public and private utilities. The research examined a variety of tiers within residential, commercial, and industrial rates, as well as two common reliability metrics, SAIDI (duration of customer power outages) and SAIFI (frequency of customer power outages). The results showed statistical differences in performance across rates, with a clear distinction between the tiers (to be discussed further in the Interpretation section). Public utilities performed better than private for residential and small commercial customers, whereas private utilities performed better for larger commercial and industrial customers. There were, however, no statistically significant differences between the two regarding reliability. With public utilities, the average customer would experience shorter outage durations (SAIDI) and with private utilities, the average customer would experience less frequent outages (SAIFI). However, neither of these differences were reported at a significant level.

These results supplement the previous research on electric utility performance and ownership. Many prior studies and reports indicate that differences exist between public and private utilities, validating the findings of this research. Past research has shown that public utilities tend to favor residential customers in their rate structures and that private utilities favor larger businesses, which mirror the results of this study (American Public Power Association, 2019). This may be due to the fact that government organizations seek to make services equitable, as opposed to working in a manner consistent with maximizing profit. The existing literature on reliability differences show mixed results. While some studies note differences in reliability, some theorize that they may be due to factors other than ownership, such as size, service territory, and spending (Boylan, 2016; Kwoka, 2005). However, these factors (e.g., utility size, geographic footprint, and spending) may be influenced by ownership type; therefore, the effect may be present, even if its influence is indirect.

The following section will examine the interpretation of the results and will discuss its relevance with respect to the previous literature and research. Following interpretation section will be limitations, future research, and a conclusion.

Interpretation

The results of this study, while focused on electric utilities within the State of Florida, should have good generalizability across other territories and states. When making choices for their communities, local governments are often working with anecdotal evidence, rather than hard facts. With the results showing that there are some clear differences between the two types of ownership, this section aims to interpret these results alongside previous research. The Interpretation section will examine several questions about the study: What do these results imply? Where do these results fit within the research? Do they contribute to or validate any of the previous research on the subject?

As stated in the literature review, studies on the subject are often outdated and offer mixed results. There is not a strong consensus or accepted position on the subject as it relates to utilities, electric or otherwise. While topics on privatization exist in abundance, the concentration down to electric utilities, particularly within the framework of the field of Public Policy and Public Administration, is sparse. This section should strengthen the body of literature and add a new dimension to it, with more specificity than many of the previous researchers' works.

The first portion of the section will examine the interpretation of the rates results, followed by a look into the reliability section.

Rates

The original hypotheses in the study, regarding rates, assumed that public utilities would favor residential and commercial businesses, while private utilities would show preference to the large industrial customers. The results of the Independent t-Tests supported this theory, in particular. However, the cutoff point between better performance between public and private ownership was at a different location than originally hypothesized. The hypotheses stated that, of the 14 different rate tiers (two residential, eight commercial, and four industrial), the eight commercial and two residential tiers would be favored by public utilities and the four industrial tiers by private utilities.

The results of the means comparison showed that POUs performed better on residential rates and the first two tiers of commercial rates. The third commercial tier showed no significant differences in performance. From that point forward, in both commercial and industrial rates, the results showed that IOUs performed better than POUs. This cutoff showed a clear distinction between the two types of ownership and supported the general idea of the hypotheses, with a slightly different transition point than expected. POUs clearly favor the smaller businesses and individuals, whereas the IOUs give better rates to the larger businesses. The fact that there was a stark crossover point raises the question as to why this difference exists between the two types of ownership.

Previous reports on electric utility rates mirrored some of the results found in this study. The American Public Power Association (2019) found that the average residential rate is 14.4% cheaper for residential customers served by public power companies. The rates for industrial customers also reflected the same results, which showed a 5.7% cheaper rate for private utility customers (American Public Power Association, 2019). This figure is close to the spread found in the results of this research, which was around 5-6% for industrial customers. The commercial customers had a very small difference at just 1%, with POUs providing the best rates (American Public Power Association, 2019). This commercial rate difference found by the American Public Power Association shows POUs providing lower commercial rates, whereas this research found IOUs outperformed in five of the eight tiers of commercial customer rates.

The original theory behind the hypotheses was formed in the notion that public service is rooted in providing communities with efficient and equitable access to resources (Denhardt & Denhardt, 2014). Therefore, POUs may be more inclined than their private counterparts to structure their rates such that it favors private residents and small businesses over large corporations who are, in theory, more capable of paying higher rates. The same argument, from the private utility's perspective, is that IOUs prefer larger industrial customers. They buy their power in bulk and are offered discounted volume rates. The idea is that, for a business whose primary motivation is profit, providing service to and billing a single corporation for 100,000kWh is more efficient than billing 100 individual homes at 1,000kWh. It takes less overhead, less equipment, fewer staff to maintain, and a much smaller footprint. For this reason, an IOU would be financially incentivized to provide lower rates to a large volume customer, as opposed to a large group of residential customers.

This notion of public providers focusing more on public welfare than profit is certainly a perception that exists within the community. A study on utility ownership in the water industry revealed that rate payers are generally more sympathetic to public utilities, as the perception of the organization was more positive than towards their private counterparts. Researchers at the University California Berkeley examined the opinions of various households across adjacent public and private utilities (Kallis et al., 2009). Comparing opinions of three neighboring pairs of water utilities, researchers found that some users were willing to pay more for their water if it was provided by a public utility over a private utility, yet none expressed that sentiment towards a private utility. Their research found that there was a negative perception of private utilities by ratepayers.

Another key point from this research by Kallis et al. (2009) was identified through interviews with managers of the public utilities. These managers noted that one critical element of public ownership was the local voter's political influence and voice at city council meetings and town halls, where individuals have much more direct access to those who influence rates and rate structures at the local municipality. The local accountability that exists is likely to be removed with a private utility. The individual voter input and the representative structure that local utilities must face do make them more likely to lean towards the will of the people. Therefore, while the perception of the public agencies keeping rates low for noble purposes may have truth, one cannot ignore the political element and the power of influence present. Just as IOUs are obliged to their shareholders, through some chain of command, POUs will be subject to the voter's voice.

A core value to most public agencies is the notion of equity. This thought process lines up with why a public agency may be more inclined to provide more reasonable fees and rates to residential customers and smaller businesses. A study by Cambridge University examined the emerging models of public ownership within the electric utility market. In doing so, researchers Haney and Pollitt (2013) noted some of the key benefits of public ownership. Haney and Pollitt pointed out that a main focus and potential benefit of public ownership is the ability to address social welfare issues. One way that public agencies may do this is in the way that they structure their rates, favoring the lower tiers over the higher tiers.

With those considerations for the POU's superior performance on the lower end of the usage spectrum, one must look at the performance of the IOUs at the upper end of the spectrum. IOUs handily outperformed public utilities nine to zero within the higher usage tiers of commercial rates and all industrial rates. The better performance by the IOUs in these areas is consistent with much of the literature on the subject. The efficiencies of the private industry are evident in these low rates.

The World Bank's 2008 study on electric utility performance supported the premise of these results. While the study looked at emerging and transitional economies, the results showed that private industry principles positively influence performance in terms of rates (Gassner et al., 2008). The empirical findings showed that private industry impact increased efficiencies in several areas. First, the private industry did a far better job (29% over state-owned utilities) at residential connections per worker. Second, there was a 32% increase in electricity sold per worker. Third, there was a 45% increase in electric bill collection rates. Due to private industry principles and operations, utilities saw an increase in residential connections, production, and bill collections.

This productivity results in a staff reduction of 24% compared to public utilities (Gassner et al., 2008). The researchers do issue the caveat that policymakers do need to consider the overall impact of a reduced staff. There are certainly potential issues with reduced staff, lowered costs, and service quality. These competing constraints could lead to less desirable service quality. There is certainly a point where public administrators need to decide what the value of service and control is in comparison to low cost and efficiency. Gassner et al. (2008) commented that there is a social cost to consider and that lower prices may come with a lack of service quality. These caveats were echoed by a UK study of privatization of public services. Public managers found that the loss of staff reduction impacted performance and its ability to meet community needs (Kakabadse & Kakabadse, 2001). These caveats aside, The World Bank's study supports the idea that private sector principles result in lower overhead costs and increased productivity (Gassner et al., 2008).

A key issue to consider in the electric industry is the lack of competition, which can have an obvious effect on rates. This study focuses its efforts on generating capable utilities within the State of Florida, which does not offer deregulated energy to its residents. Therefore, one's choice for electric providers is pre-determined by your geographic location and there is no competitive pricing from which to choose. Typically, the only place where competition is possible within the electric industry is at the point of generation. Once the power is pushed onto the transmission grid and, eventually, the distribution wires to feed customers, competition becomes less likely due to the capital investments and real estate constraints required to build power lines. It makes no financial sense to duplicate this network of wires, thus the emergence of the electric provider as a natural monopoly (Megginson, 2005).

Because of this lack of competition, particularly obvious in a state without deregulated energy, rate structuring and prices are going to rely solely on the performance and philosophy of the operating utility. A large study of 147 IOUs and 396 POUs showed that the private industry and public industry specialize in different areas of activities with respect to operations (Kwoka, 2005). IOUs showed stronger performance in generation, where they financially benefit from economies of scale. POUs show competitive advantages within the distribution networks. With these advantages in place, it is up to the individual utility to set their own rates and pricing structures.

Kwoka's (2005) study found a similar trend to this one. It showed that public utilities offer more competitive rates at lower outputs, whereas private utilities offered better rates at higher outputs. Public utilities offer an advantage at the end-user, where service is more difficult to maintain. The study also noted that the competitive pricing advantages with the public utilities is inversely proportional to its size. As the utility increases in size, the benefits of public ownership dwindle.

The evidence of this research suggests that, given these different specialties (POUs excel in distribution and private in generation), public utilities have chosen to favor the residential and small business customers over the large industrial ones with their rate philosophy. The IOUs appear to have a competitive advantage on the upper end of the spectrum and provide lower rates for larger groups of customers. This pricing philosophy is something public administrators may need to consider if the option for privatization is on the table. For some, the idea of lower prices for the residential customers may be considered a huge benefit. However, local governments must consider this as a potential incentive for large corporations if their electric rates are low. For industries like manufacturing, where electric usage is a large overhead and operating cost, it may entice more businesses to consider locating their facilities in communities where electric rates are low. There is the potential that lower commercial and industrial electric rates may drive business and create jobs in the area.

Reliability

The original hypotheses for reliability assumed that public utilities would outperform private utilities. However, the results of the statistical analysis showed that this was not the case. There were no statistical differences between public and private utilities in either metric of reliability, SAIDI and SAIFI. This is an important finding, as concerns about reliability are often one of the most common apprehensions for local governments and citizens. The following paragraphs will explore the findings, measured against the extremely limited research that exists on the subject of reliability.

The reasoning behind the original hypotheses is multifaceted. First, all of Florida's POUs are municipal utilities and are confined to a relatively small geographical footprint compared to a larger IOU, such as FPL. The advantage to restoration during an outage, in theory, goes to the POUs in response time and accessibility. Their limited coverage territory could provide a huge benefit in terms of reliability metrics, particularly SAIDI, which measures the average length of time a customer experiences power outages.

Second, the motivation of profit as the primary driver of business, may lead to IOUs responding slower than a POU. If an outage in a remote area happens at night, the cost to bring in a crew of workers after hours may be quite dear to the utility. There may be little financial incentive to respond quickly. However, that lack of financial incentive is seen by both types of utilities. While IOUs are, indeed, motivated by profit, they do have regulations and pressure, both contractual and political, to provide reliable service. They are not directly accountable to the public in the way a POU is, but they experience pressure from the public and local officials. Conversely, POUs are still incentivized to keep costs down and minimize unneeded expenses, just like IOUs.

Finally, as seen with the issues of California's PG&E electric utility causing wildfires across the state, IOUs may be less inclined to spend money on operations and maintenance (O&M). Average O&M costs per kwh for a municipal utility are 4.86 cents vs 4.00 cents for an IOU (Kwoka, 2005). Another study reported a similar finding with Connecticut utilities, indicating that the municipal utility spends $132 per customer on O&M, while the IOU only spent $78 per customer (Cox, 2011, as cited by Boylan, 2016). This lower cost of maintenance creates the potential for increased outages across the service territory.

Like the discussion on rates, there is not a clear consensus in the industry about service reliability between public and private utilities. Kwoka's (2005) comparison of SAIDI numbers between public and private utilities showed a stark contrast in performance, with public utilities outperforming, reporting SAIDI values at nearly half of IOUs, year over year. As with rates, the reliability of the public utilities lessened as the utility's size increased, indicating that smaller POUs provided higher reliability than IOUs and larger POUs. The advantage of public ownership is inversely proportional to the size of the utility. This public advantage appears to be seen at the point of service (the distribution lines), rather than at the generating plant, where IOUs have a more competitive advantage.

The findings from Kwoka's (2005) study were more consistent with the hypotheses of this study than the actual results. Particularly, the size of a utility appears to play a greater role in their reliability than whether it is publicly or privately owned. One particular item of interest is that, while POUs tend to spend more money (per customer) on O&M expenditures to reduce outages, such as vegetation management, IOUs spend more money on large, capital projects, such as replacing overhead wires with underground cable (Boylan, 2016). In a sample of 1,437 municipal utilities and 179 IOUs, municipal electric utilities, on average, had 13% of their distribution lines underground, compared to 20% of IOUs (Boylan, 2016). This information provides insight into why, even though IOUs are commonly criticized for their lack of maintenance activities, they can still provide reliable power. Though an IOU's spending is not as significant on maintenance activities, the capital expenses of placing overhead wires underground inevitably influences reliability metrics. In effect, less maintenance expense does not necessarily correlate to less reliable power. In fact, it is possible that the high maintenance costs are a sign of inefficiencies and a weakness of the POU.

Lastly, as Kwoka (2005) and Boylan (2016) noted, the characteristics and customer makeup of the utility is important. Boylan's (2016) study showed that the average IOU had 16,240 miles of distribution lines and the average municipal utility had only 312 miles. This large differential in service territory means that IOUs would have to travel much farther to reach some of their customers during an outage. The density of customers is also different, with municipal utilities averaging 62 customers per mile of distribution line and IOUs averaging 38 customers per mile (Boylan, 2016). This customer density statistic could work both ways. To the POUs' benefit, when customers experience a power outage, they are located within a more confined space. This would make it easier for the utility to restore power more quickly, as the distance between customers is less. On the other hand, to the IOUs' benefit, a single outage for a municipal utility is likely to take out more individuals at once, given the concentration of customers. There are no clear findings on which has a greater impact, but the customer density's impact on performance is a characteristic of ownership worth consideration.

These previous research findings offer varied reasons for why one type of ownership may outperform or underperform. These include utility size, customer density, capital vs O&M expenditures, and economies of scale. However, with Florida based utilities, there is no difference in reliability performance between public and private utilities.

Limitations

Just like with all research, this study has its limitations. First, by design, the study only looked at utilities within the State of Florida. This was to address a specific issue faced by local governments within the state. However, the study should provide a larger insight to the industry and add to the current literature on the topic. There may be unique characteristics to Florida that make this study and its results difficult to compare across other states. For instance, Florida's definition of outage durations are outages lasting more than one minute, when calculating reliability metrics. Many other states use a delineation of five minutes for outage durations. Therefore, any other studies comparing these metrics across states may be difficult. This is certainly a limitation in comparing metrics across state lines.

Second, the study only focused on private and public utilities with generating capabilities. This excludes a number of utilities throughout the states. There are rural cooperatives which were excluded in this study, as they are not the most common target of IOU acquisition. As well, the nature of their business model makes them less competitive with public and private utilities. Because of their small customer count and large geographical footprint, their rates and reliability are likely going to suffer. With customers spread out far apart and in rural areas, power outages are inevitably longer and more susceptible to the elements. As well, reliability data is not as readily available for co-operatives and may be difficult to obtain, as it would require the cooperation of the utilities. This may be less than desirable for them to share, as few utilities want to highlight their reliability metrics if they are poor.

Third, another limitation is the fact that the reliability metrics are only available from 2014 onwards. Even so, not every single utility had solid reliability metrics to report within those years. As a result, some utilities had missing years for reporting. Lack of resources, particularly with the smaller municipal utilities, is an issue when it comes to dependably tracking data. While there was enough data to meet the requirements for statistical analysis and it does not seem to have negatively impacted the ability to perform the Independent t-Tests, the study could have provided better results if there were more data points over more years. As the emphasis on reliability metric tracking and reporting continues to grow, so will the ability to run more reliable studies.

Finally, and the greatest limitation to the study, is the inability to compare customer satisfaction metrics across the utilities. The original design for the study included customer satisfaction as a third measurement of performance, along with rates and reliability. JD Power has an annual survey among electric utilities, measuring residential and business customer satisfaction. While five of the seven IOUs participated in the residential survey from 2008-2020, only four POUs participated. Out of those four POUs, only two of them had ratings for the entire period and, of the remaining two, one had seven years of participation and the other only had one year. Data for the business satisfaction had similar gaps, with few POUs reporting and large gaps in the years that they participated. The inability to have consistent and reliable data across even a majority of the public utilities left this metric unmeasurable at this time. The size of many of the POUs is certainly a limiting factor, as JD Power limits its search to medium and large utilities, by region. If any comparisons were to be made on this metric, there would have to be a different method for filtering the utilities, not just by generation capabilities. Likely, the comparisons would need to include entire regions and multiple states to gather enough data.

Future Research

The concept of public and private ownership, while heavily debated, is still absent from substantial research on electric utilities. The current research is often outdated, unrelated to electric utilities, or lacking a focus on public administration. This is a growing area of concern for public administrators, as private utilities increase their presence. Privatization may be a huge benefit, or it could be a massive loss for the community. Administrators need to be equipped with facts and recent research to understand the strengths and weaknesses of the various types of ownership. While each utility has its own characteristics, understanding the general nature of public and private ownership may prove vital for the decision-making process.

Comparing individual utilities by size may offer additional insight to the topic. Size, according to previous researchers, has a huge influence on performance. Future research where the study considers size may provide additional insight to utility performance. Using size as a control variable or comparing utilities by size (as opposed to ownership) would help increase the understanding of its influence on rates and reliability. Comparing these results to those of public vs private research could be most valuable in understanding differences in performance.

A second consideration for research is comparing states with and without deregulated energy. While considering deregulation of the electric utility industry is a decision that would concern public administrators at a state level as opposed to the local level, it is an important discussion. Some research exists in this area, to date. However, as reliability metrics and rates are being more accurately tracked, new studies could compare those states with deregulation and those without. Deregulation is a huge topic of concern for states and the impacts have been significant at times (see the corruption of the Enron scandal mentioned in the literature review).

While this study only looked at the State of Florida, comparing ownership across regions and all states would provide even greater generalization on the subject. If there is a reason that Florida might be an outlier and provide skewed results in terms of national performance, the conclusions would be smoothed out by including utilities from across the country. This approach presents potential difficulties for the researcher, as rate tiers and reliability metrics are not entirely consistent across states. However, the study could be done with some manipulation of the data.

Finally, it would be beneficial to examine utilities individually. In doing so, the utilities with stellar performance (public or private) could be identified and studied, perhaps as a case study. Finding the characteristics unique to the top performers would give guidance for utilities looking to improve their performance. Furthermore, examining the lowest performers of the group could also prove valuable in determining which behaviors to avoid.

Conclusion

Local governments across Florida have faced mounting pressures of maintaining and operating their aging utility infrastructure, along with mounting debt and increasing demands from the public. One solution for some governments is the act of privatization. However, the debate about the promises of privatization is fraught with talking points and politics. These may or may not be grounded in research, but it does not stop them from being used. This research was done to provide public administrators with the information required to make informed decisions about where to take their city's most precious resources, their electric utility.

After comparing the two types of ownership, the research concluded that there are some differences between the performances of the two utilities. While neither ownership type demonstrated superior performance on reliability, rates showed some crucial differences. The notable difference was that public utilities favored ratepayers at the lower end of the usage tiers and private utilities favored the larger commercial and industrial customers. Overall, based on the 14 tiers, private utilities outperformed public, nine to four (with one tier showing no differences).

Previous research indicates that several factors play a role in how utilities perform, not just ownership. Some of these factors may be influenced by the type of ownership and some may not. Among these factors are utility size, capital project spending, maintenance expense, and geographical footprint. When contemplating privatization, these are all factors to consider beyond just the public and private components.

There is no doubt that privatization is a huge decision for any local government. With so many voices in the debate, it can be difficult to avoid the political noise. This study provides clear data of where the differences lie and where they do not. From this, public administrators can understand the pros and cons of each. While ownership does influence performance, administrators need to consider the extent of what ownership means to their community.

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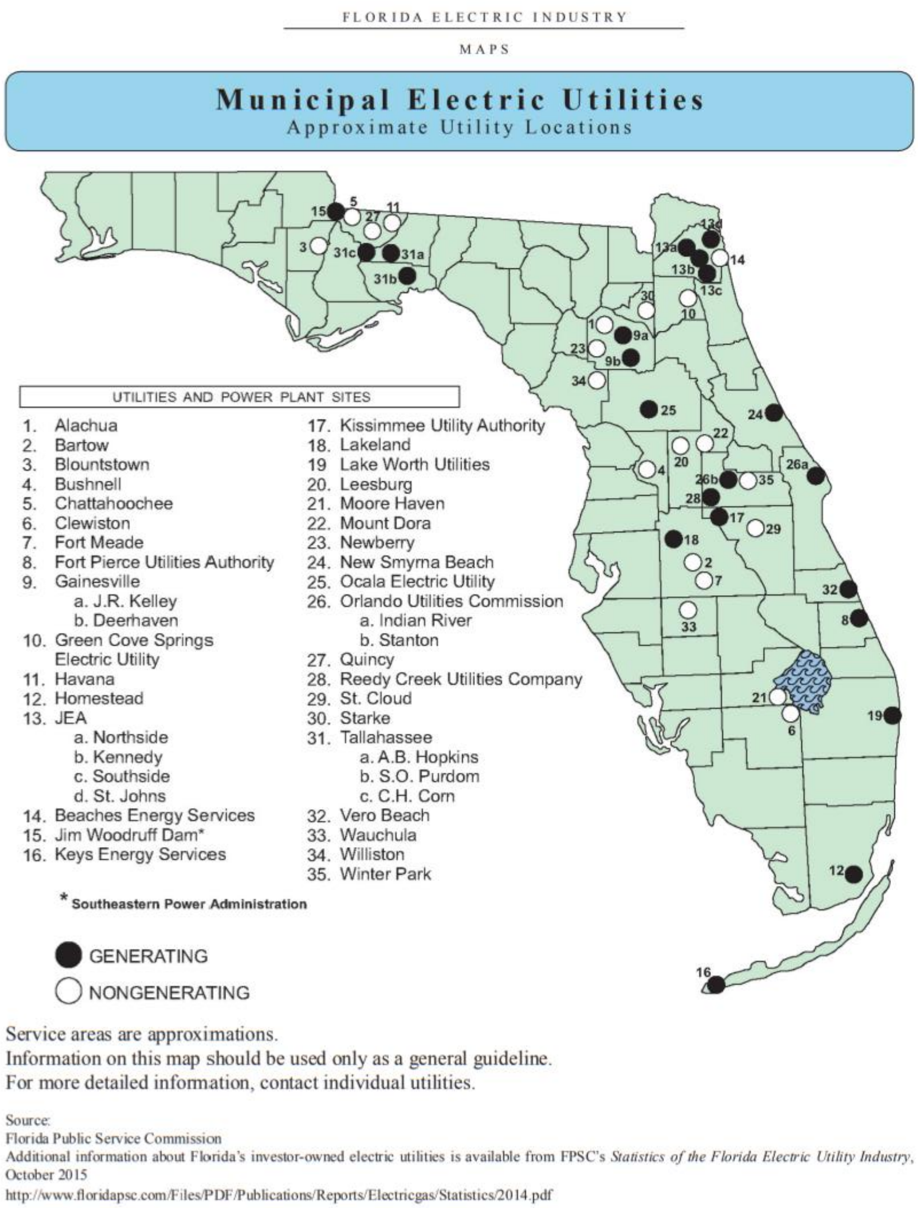
Appendix A

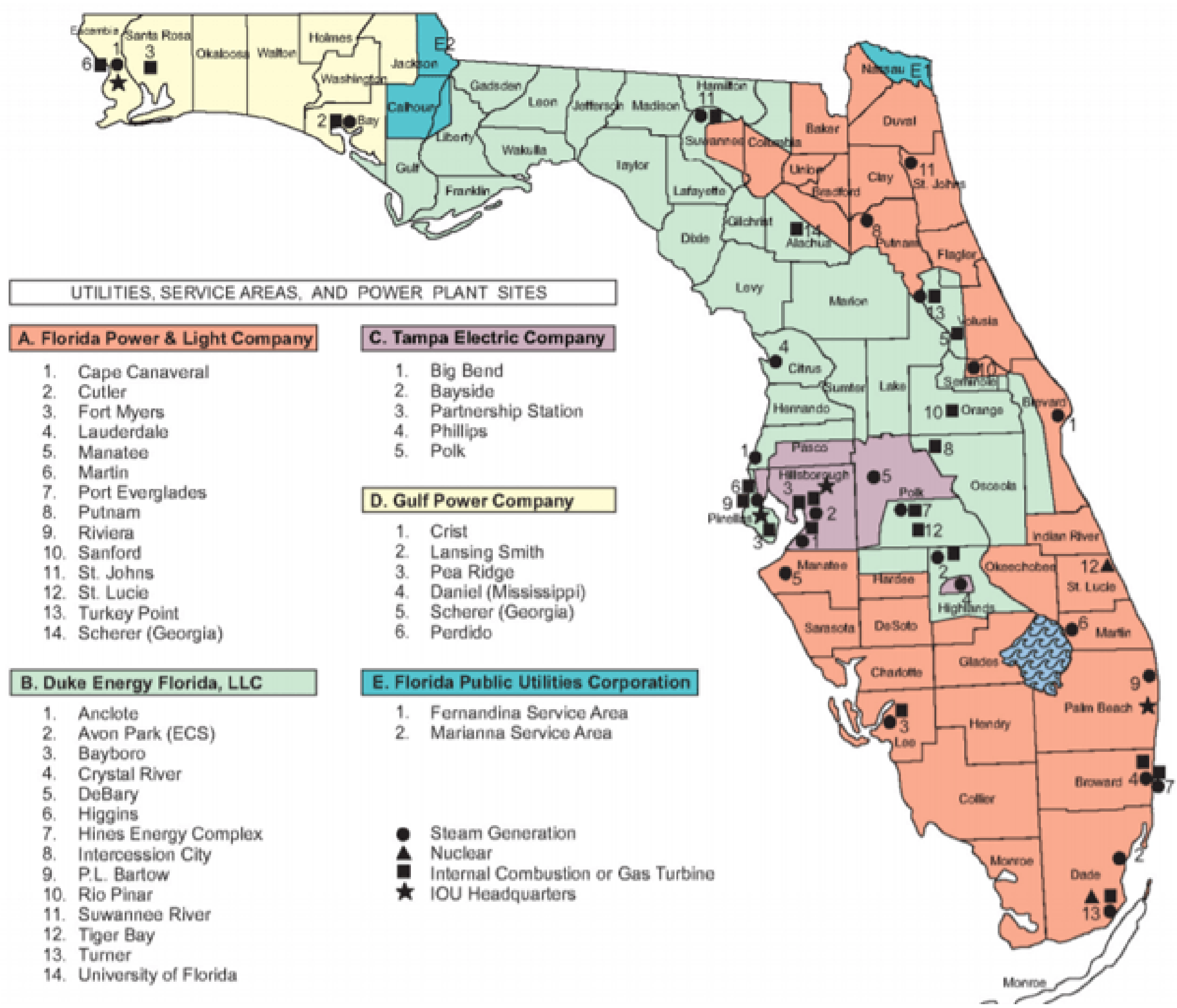
Map of Public/Municipal Utilities in Florida



Source*:* Adapted from "Statistics of the Florida Electric Utility Industry," by Florida Public Service Commission, 2015, (http://www.floridapsc.com/Files/PDF/Publications/Reports/Electricgas/Statistics/2014.pdf).

Appendix B

Map of Service Areas for Private Utilities in Florida



Source*:* Adapted from “Statistics of the Florida Electric Utility Industry,” by Florida Public Service Commission, 2015, (http://www.floridapsc.com/Files/PDF/Publications/Reports/Electricgas/Statistics/2014.pdf).

Appendix C

Explanation of Mathematical Adjustments for Normality of Distribution

An important consideration in data analysis is making sure that the data is useable and provides accurate results. To perform a parametric test, there are several factors that influence the tests. Abu-Bader (2010) identifies these four main factors as Sampling Methods, Levels of Measurement, Normality of Distributions, and Sample Size. The requirements for Sampling Methods, Levels of Measurements, and Sample Size are all well-met by the data in this research. However, upon visual inspection, there were some data sets that did not meet the requirements for normality and offered a skewed representation.

In further detail, the parametric tests require that the shape of the data approaches the shape of a normal curve (Abu-Bader, 2010). If this normal shape is not found, then data transformation must take place to adjust the curve. Before each parametric test was conducted (Independent t-Test), the normality was tested through observation. The raw data was examined through the normal probability plots in SPSS. In seven of the 16 plots, there was a lack of normality and a positive skewness.

Based on this information and data representation, it was obvious that these seven data sets required a power transformation. Texts by Abu-Bader (2010) and Newton and Rudestam (2013) offered several possible solutions to the skewness. After some initial observation and several trial-and-error runs, the appropriate data transformation method was to compute the logarithm of each raw data point (Abu-Bader, 2010). The requirement is that all raw scores be greater than zero, which is not a problem with this data set. The mathematical formula to transform a variable is show in (C1):

$$Y = \log_{10}(X) \tag{C1}$$

This transformation allows the data set to meet the assumptions of normality. There were no issues with overcorrection and was an immediate solution to the problem of normality. However, for the seven data sets with positively skewed data, it opened another set of problems, albeit minor. When the results are discussed in the transformed power set, they mean very little for sake of discussion. For instance, the results of the mean comparisons using the Log Transformation values of the Residential 1,000kWh rate are 2.0521 (public) and 2.0843 (private). The initial input to these power transformations were rates, which are measured in dollars. While these values provide more accurate statistical analysis in SPSS, they provide little meaning in terms of understanding the results.

To address this issue, the inverse of the Log transformation was applied. This helps bring the results back into terms that are better suited for discussion and understanding. Since the bulk of the data sets involve currency (all of them but the reliability metrics SAIDI and SAIFI), which is an easily understood concept, this inverse calculation provides better discussion throughout the research results and conclusion. The inverse of (C1) is show in (C2):

$$\mathrm{Log}_{10}(X) = Y \tag{C1}$$

$$Y = 10^{X} \tag{C2}$$

Using (C2), this allows the result to be displayed in a manner that is understandable to the reader. To show a practical example, look at the values of the Residential 1,000kWh rate listed above (Public = 2.0521 and Private = 2.0843). When using the inverse transformation, the results are shown in (C3) and (C4):

$$Y = 10^{2.0521} = 112.75 \tag{C3}$$

$$Y = 10^{2.0843} = 121.42 \tag{C4}$$

The results of (C3) and (C4) provide much more understandable values. These values of 112.75 and 121.42 are in dollars and make more sense when discussing electric rates. For the purposes of discussion throughout the research, the results of means and mean differences will be reported in this manner.

Appendix D

Results of Independent t-Test for Residential Rates (1,000kWh)

Table D1

Group Statistics

	Ownership Type	N	Mean	Std. Deviation	Std. Error Mean
Lg10_Res Rate1000	Public	1271	2.0521	0.03940	0.00111
	Private	552	2.0843	0.05889	0.00251

Table D2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Lg10_Res Rate1000	Equal variances assumed	286.714	<.001	-13.628	1821	<.001	<.001	-0.0322	0.00236	-0.0368	-0.0276
	Equal variances not assumed			-11.669	768.882	<.001	<.001	-0.0322	0.00276	-0.0376	-0.0268

Appendix E

Results of Independent t-Test for Residential Rates (2,500kWh)

Table E1

Group Statistics

	Ownership Type	N	Mean	Std. Deviation	Std. Error Mean
Lg10_Res Rate2500	Public	1271	2.4570	0.04480	0.00126
	Private	552	2.4946	0.05144	0.00219

Table E2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Lg10_Res Rate2500	Equal variances assumed	50.391	<.001	-15.687	1821	<.001	<.001	-0.0376	0.00240	-0.0423	-0.0330
	Equal variances not assumed			-14.890	934.171	<.001	<.001	-0.0376	0.00253	-0.0426	-0.0327

Appendix F

Results of Independent t-Test for Commercial Rates (No Demand - 750kWh)

Table F1

Group Statistics

	Ownership Type	N	Mean	Std. Deviation	Std. Error Mean
Lg10_Comm ND-750	Public	1271	1.9705	0.06790	0.00190
	Private	552	2.0063	0.06302	0.00268

Table F2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Lg10_ Comm ND-750	Equal variances assumed	0.007	0.934	-10.565	1821	<.001	<.001	-0.03579	0.00339	-0.0424	-0.0292
	Equal variances not assumed			-10.880	1122.926	<.001	<.001	-0.03579	0.00329	-0.0423	-0.0293

Appendix G

Results of Independent t-Test for Commercial Rates (No Demand – 1,500kWh)

Table G1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Comm ND-1500	Public	1271	176.1310	25.75472	0.72241
	Private	552	187.3268	24.09865	1.02571

Table G2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Comm ND-1500	Equal variances assumed	0.737	0.391	-8.693	1821	<.001	<.001	-11.196	1.28787	-13.723	-8.670
	Equal variances not assumed			-8.924	1114.268	<.001	<.001	-11.196	1.25457	-13.657	-8.734

Appendix H

Results of Independent t-Test for Commercial Rates (30-6,000kWh)

Table H1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Lg10_Comm 30-6000	Public	1271	2.8630	0.07706	0.00216
	Private	552	2.8550	0.04598	0.00196

Table H2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Lg10_ Comm 30-6000	Equal variances assumed	146.719	<.001	2.274	1821	0.012	0.023	0.00802	0.00352	0.0011	0.0149
	Equal variances not assumed			2.749	1649.825	0.003	0.006	0.00802	0.00292	0.0023	0.0137

Appendix I

Results of Independent t-Test for Commercial Rates (40-10,000kWh)

Table I1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Lg10_ Comm 40-10000	Public	1271	2.8630	0.07706	0.00216
	Private	552	2.8550	0.04598	0.00196

Table I2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Lg10_Comm 40-10000	Equal variances assumed	192.118	<.001	1.278	1821	0.101	0.201	0.00393	0.00307	-0.0021	0.0099
	Equal variances not assumed			1.582	1721.543	0.057	0.114	0.00393	0.00248	-0.0009	0.0088

Appendix J

Results of Independent t-Test for Commercial Rates (75-15,000kWh)

Table J1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Comm 75-15000	Public	1271	1901.6993	259.53807	7.27995
	Private	552	1782.0114	128.42483	5.46612

Table J2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Comm 75-15000	Equal variances assumed	217.441	<.001	10.300	1821	<.001	<.001	119.688	11.620	96.897	142.479
	Equal variances not assumed			13.147	1792.486	<.001	<.001	119.688	9.104	101.833	137.543

Appendix K

Results of Independent t-Test for Commercial Rates (75-30,000kWh)

Table K1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Comm 75-30000	Public	1271	3083.5993	467.33667	13.10862
	Private	552	2913.7473	369.69011	15.73506

Table K2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Comm 75-30000	Equal variances assumed	79.761	<.001	7.572	1821	<.001	<.001	169.852	22.433	125.855	213.849
	Equal variances not assumed			8.294	1307.900	<.001	<.001	169.852	20.480	129.675	210.029

Appendix L

Results of Independent t-Test for Commercial Rates (150-30,000kWh)

Table L1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Comm 150-30,000	Public	1271	3743.9905	497.93012	13.96676
	Private	552	3524.6782	248.92086	10.59478

Table L2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Comm 150-30000	Equal variances assumed	228.693	<.001	9.828	1821	<.001	<.001	219.312	22.31617	175.544	263.080
	Equal variances not assumed			12.510	1787.726	<.001	<.001	219.312	17.53053	184.930	253.694

Appendix M

Results of Independent t-Test for Commercial Rates (150-60,000kWh)

Table M1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Comm 150-60,000	Public	1271	6107.4643	919.14460	25.78167
	Private	552	5788.1627	725.11859	30.86310

Table M2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Comm 150-60000	Equal variances assumed	84.483	<.001	7.241	1821	<.001	<.001	319.301	44.095	232.820	405.783
	Equal variances not assumed			7.940	1311.277	<.001	<.001	319.301	40.215	240.409	398.194

Appendix N

Results of Independent t-Test for Industrial Rates (300-60,000kWh)

Table N1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Ind Rate 300-60,000	Public	1271	7372.3793	972.94895	27.29086
	Private	552	7009.8132	491.29450	20.91088

Table N2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Ind Rate 300-60,000	Equal variances assumed	274.989	<.001	8.306	1821	<.001	<.001	362.566	43.649	276.959	448.173
	Equal variances not assumed			10.546	1782.694	<.001	<.001	362.566	34.381	295.135	429.998

Appendix O

Results of Independent t-Test for Industrial Rates (300-120,000kWh)

Table O1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Ind Rate 300-120,000	Public	1271	12067.142	1800.9868	50.51702
	Private	552	11537.048	1436.8251	61.15534

Table O2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Ind Rate 300-120,000	Equal variances assumed	67.762	<.001	6.121	1821	<.001	<.001	530.094	86.60803	360.233	699.956
	Equal variances not assumed			6.683	1297.412	<.001	<.001	530.094	79.32178	374.481	685.707

Appendix P

Results of Independent t-Test for Industrial Rates (500-100,000kWh)

Table P1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Ind Rate 500-100,000	Public	1271	12350.699	1534.666	43.0468
	Private	552	12201.429	1205.382	51.3045

Table P2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Ind Rate 500-100,000	Equal variances assumed	57.265	<.001	2.029	1821	0.021	0.043	149.270	73.555	5.009	293.531
	Equal variances not assumed			2.229	1316.753	0.013	0.026	149.270	66.971	17.888	280.652

Appendix Q

Results of Independent t-Test for Industrial Rates (500-200,000kWh)

Table Q1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Ind Rate 500-200,000	Public	1271	20068.635	2988.695	83.832
	Private	552	19160.992	2271.293	96.673

Table Q2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Ind Rate 500-200,000	Equal variances assumed	82.905	<.001	6.379	1821	<.001	<.001	907.643	142.277	628.601	1186.686
	Equal variances not assumed			7.093	1358.080	<.001	<.001	907.643	127.958	656.625	1158.661

Appendix R

Results of Independent t-Test for SAIDI

Table R1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Log10_ SAIDI	Public	55	1.8849	0.21807	0.02940
	Private	30	1.9484	0.15444	0.02820

Table R2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Log10_ SAIDI	Equal variances assumed	6.052	0.016	-1.413	83	0.081	0.161	-0.06356	0.04498	-0.15302	0.02590
	Equal variances not assumed			-1.560	77.286	0.061	0.123	-0.06356	0.04074	-0.14468	0.01756

Appendix S

Results of Independent t-Test for SAIFI

Table S1

Group Statistics

Ownership	Type	N	Mean	Std. Deviation	Std. Error Mean
Log10_ SAIFI	Public	54	0.1120	0.20436	0.02781
	Private	30	0.0468	0.10331	0.01886

Table S2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Log10_ SAIFI	Equal variances assumed	19.341	<.001	1.633	82	0.053	0.106	0.06523	0.03994	-0.01423	0.14469
	Equal variances not assumed			1.941	81.469	0.028	0.056	0.06523	0.03360	-0.00162	0.13208