

The Power of Accounting: Capitalization of Cloud Computing for Utilities

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Abstract

This study investigates the real effects of changes in accounting standards on utilities. Following changes in U.S. GAAP related to the accounting for cloud computing costs, an increasing number of utilities requested and received approval from their state public service commission to include cloud computing costs in their rate base, while other utilities made no such request. Approval to capitalize costs in the rate base allows utilities to earn a rate of return on those costs. Using a difference-in-difference design, we find utilities with approval to include cloud computing costs in their rate base increase their investment in cloud computing, generate greater revenue per kilowatt hour from their customers, have shorter duration of power outages, and have lower regulatory penalties. Increased investment in cloud computing and greater operational benefits are magnified in states with more experienced public service commissioners while these changes are less costly to customers. Our results provide evidence of the impact of accounting on both investment decisions and operational outcomes.

1. Introduction

Cloud computing arrangements (“cloud computing”) and on-premise software licenses (“on-premise software”) provide similar technological solutions, but the accounting for these solutions differs. Traditionally, on-premise software development and implementation costs were capitalized, while all cloud computing costs were expensed. Recent accounting standards allow more similar treatment in certain situations. Accounting Standards Update (ASU) 2015-05 stipulates that fees for cloud computing could be capitalized if the arrangement includes a software license. However, in practice, relatively few arrangements include a software license and therefore do not result in capitalization, but ASU 2015-05 did bring attention to the broader accounting treatment of cloud computing. Many companies argued that while their cloud computing arrangements do not qualify for capitalization, they do involve significant implementation costs that should be capitalized. In 2018, the Financial Accounting Standards Board (FASB) issued ASU 2018-15, which allows capitalization of implementation costs associated with cloud computing, even if the arrangement itself does not qualify for capitalization. We examine whether the change in the accounting for cloud computing by the FASB affects utilities’ investment in cloud computing and operational performance.

Cloud computing refers to the delivery of computing services, including storage, servers, databases, networking, software, and analytics, over the internet (“the cloud”). These services are typically offered by cloud service providers on a pay-as-you-go basis, eliminating the need for organizations to invest in and maintain physical infrastructure. In contrast to cloud computing, on-premise software refers to software applications that are installed and operated on the premises of an organization, typically within its own data centers or server infrastructure.

Cloud computing offers several advantages over traditional on-premise software. First, cloud computing is typically more cost-effective through eliminating both the need for upfront hardware investments and the costs associated with maintaining physical infrastructure (Surbiryala and Rong 2019; Gajbhiye and Shrivastva 2014; Marston et al. 2011). Second, cloud computing allows for easy scalability, enabling businesses to quickly scale up or down their computing resources based on demand (Marston et al. 2011; Surbiryala and Rong 2019; AEE/EEI 2021). Third, cloud service providers typically offer high levels of reliability and security through redundant infrastructure and data backup mechanisms which reduces the risk of downtime and ensures continuous access to critical business applications and data (Gajbhiye and Shrivastva 2014; NARUC 2016).

While cloud computing may offer technological advantages in many situations, one reason utilities may have been reluctant to invest in cloud computing relates to its traditional accounting treatment. As discussed previously, costs of cloud computing have traditionally been expensed, while costs of on-premise software development and implementation have been capitalized. This difference may be particularly impactful for utilities because it directly affects their revenue. A utility's rates in the U.S. are set by its respective state's public service commission ("PSC"). PSCs aim to establish rates based on what is fair to customers while also providing a reasonable rate of return on investment for the utility. In the rate-making process, when a PSC allows costs to be capitalized as part of a utility's rate base, the utility can earn a rate of return on the underlying costs. In contrast, when a PSC does not allow costs to be capitalized as part of the utility's rate base, the costs can be passed on to the customer but cannot be marked up to earn a return. Due to this differential effect on revenue, a utility prefers to incur costs that

can be capitalized in its rate base over costs that cannot. Thus, all else equal, utilities may have been more likely to opt for on-premise software because of its preferential accounting treatment.

The state PSC has the sole authority to approve what costs are capitalized in a utility's rate base. However, the accounting treatment of costs within the Federal Energy Regulatory Commission's (FERC's) uniform system of accounts (USoA) can affect the determination of a utility's rate base. The USoA generally follows GAAP with modifications for specific regulatory requirements and adjustments (American Public Power Association 2012; USAID 2019). In the USoA, licensing fees and development costs for on-premise software are capitalized as Miscellaneous Intangible Plant and are typically included in a utility's rate base. Therefore, a utility can earn a rate of return on its investments in on-premise software. On the other hand, the USoA traditionally classified cloud computing costs as an operating and maintenance expense. Therefore, these costs were typically not capitalized in the rate base, and the utility could not earn a rate of return on its investment in cloud computing.

The inability to earn a return on cloud computing costs created a disincentive for utilities to invest in cloud computing technology solutions. The National Association of Regulatory Utility Commissions (NARUC) recognized this disincentive in a 2016 resolution in which it encouraged PSCs to approve accounting treatment for cloud computing costs similar to that of on-premise software.

Following the issuance ASU 2015-05 and 2018-15, the FERC issued an accounting order ("FERC Accounting Order") on December 20, 2019 stating that cloud computing implementation costs capitalizable under GAAP should also be capitalized for regulatory accounting purposes. We suggest that the standard-setting activities by the FASB and the FERC regarding cloud computing costs raised the general awareness of the accounting for these costs

and, importantly, provided support for utilities seeking regulatory approval to capitalize cloud computing costs in their rate base. We examine publicly filed rate cases to identify utilities seeking approval for rate-based capitalization of cloud computing costs. We predict and find a significant increase in the number of utilities seeking this approval in 2018 and thereafter.

To examine the real effects of rate base capitalization of cloud computing on utilities, we identify a sample of 41 utilities that we estimate received approval to include cloud computing costs in their rate base (“treatment firms”) and 16 utilities that we estimate did not receive such approval (“control firms”). We validate this sample identification by examining cloud computing expenditures included in utilities’ regulatory assets. We show that treatment firms have a significant increase in these expenditures in 2018 and the years following, while control firms have no such expenditures.

Using a difference-in-difference design, we examine the effects of approval to capitalize cloud computing costs in the rate base. Our first test is the effect of capitalization of cloud computing on customer electricity rates. More costs included in a utility’s rate base should result in increased rates for customers. A recent article in the Wall Street Journal explains that the electrical grid is becoming less reliable due to age and extreme weather and that investments in the grid, including technological investments, lead to customer rate increases (Blunt 2024). To analyze the effect of capitalization of cloud computing costs in the rate base on customers’ electricity rates, we examine total revenue per kilowatt hour as well as revenue per kilowatt hour segmented by customer class: residential customers, small commercial customers, and large industrial customers. We find, consistent with our expectations, that treatment firms, compared to control firms, show a greater increase in revenue per kilowatt hour in total as well as for each

customer class. This result suggests that the ability to capitalize cloud computing costs in the rate base results in higher electricity costs for customers.

We next examine the benefits of investing in cloud computing. Cloud computing solutions can improve utilities' reliability, efficiency, and security (AEE/EEI 2021; NARUC 2016; Oracle 2024). As an anecdotal example, in a recent article in Power Magazine, representatives from Alabama Power, one of our treatment firms, explain how a cloud-based data analytics solution helped them identify locations to make targeted improvements, which resulted in improved operating efficiencies and reduced customer outages (PowerMag 2024). We measure operating reliability with indexes on the duration and frequency of power outages. We measure operating efficiency with a utility's operating and maintenance expense scaled by total revenue. Finally, we measure operating security and reliability with fines assessed by the North American Electric Reliability Corporation ("NERC") for violations of its reliability and security standards. We find, consistent with our expectations, that after receiving regulatory approval to capitalize cloud computing costs, treatment firms have shorter duration of power outages and have lower average penalties assessed by the NERC.

Collectively, our results suggest that regulatory approval to capitalize cloud computing costs in a utility's rate base incentivizes investment in cloud computing and results in higher electricity rates charged to customers. In addition, this investment, on average, reduces a utility's duration of power outages and regulatory violations.

Our results suggest that capitalization of technology costs, compared to expensing these costs, encourages investment in technological innovation. Utilities are unique in that capitalization in the rate base affects their top line revenue, which makes capitalization particularly impactful to management decisions in the utilities industry. Therefore, it is possible

that our findings are not generalizable to other industries. However, it is important to note that GAAP accounting for on-premise software and cloud computing has differing effects on earnings before interest, taxes, and depreciation (“EBITDA”) which can affect management decisions to invest (Ma and Thomas 2023). Therefore, it is possible that the difference in accounting for cloud computing and on-premise software affects management decisions in industries that are specifically mindful of EBITDA. At the same time, given the unique regulatory environment of utilities, we acknowledge that our results may not be generalizable to other industries.

This paper makes three contributions. First, this study adds to the extant literature that documents the real effects of accounting on management decisions. Research shows that management decisions can be affected by accounting, including the accounting for leases (Ma and Thomas 2023; Li and Venkatachalam 2024), stock options (Choudhary et al. 2009; Carter and Lynch 2003), post-retirement benefits (Mittelstaedt et al. 1995) and depreciation (Jackson et al. 2009). This study adds to that stream of literature in the area of software capitalization.

Second, this study addresses a void in existing research regarding utilities. Utilities and financial institutions are often excluded from accounting research studies because of the unique accounting considerations and the effects of regulation on these two industries. However, unlike financial institutions, utilities are seldom the subject of academic research. In the last 20 years, we find only three articles that specifically examine utilities in the leading accounting academic journals (Preston and Vesey 2008; Mueller and Carter 2007; Bhojraj et al. 2004) and none in the last 15 years.¹ Due to the uniqueness of the accounting for utilities and the direct link between

¹ Consistent with Oler et al. (2016), we define the leading accounting academic journals as (ordered alphabetically): *Accounting, Organizations, and Society*, *Contemporary Accounting Review*, *Journal of Accounting and Economics*, *Journal of Accounting Research*, *The Accounting Review*, and *Review of Accounting Studies*.

accounting and rates charged to utility consumers, we believe that more accounting research is needed in the utility industry.

Third, this study provides information to regulators about the consequences of the capitalization of software costs. The FASB should be aware that capitalization of technological costs can incentivize investment and result in associated operational benefits. Additionally, as standard setters consider changes to the accounting for software, utility regulators should consider how changes in this area and associated approval or denial of inclusion in the rate base can create incentives or disincentives for utilities to invest in and receive the benefits of technological innovations.

2. Background, Hypotheses, and Empirical Design

The Ratemaking Process

State regulators set utility rates. These regulators aim to establish rates that are fair to consumers and, at the same time, provide a reasonable rate of return to utilities. For example, on its website, the State of Georgia Public Service Commission states the following regarding its role and responsibility (https://psc.ga.gov/about-the-psc/#roles_and_responsibilities):

The Georgia Public Service Commission has exclusive power to decide what are fair and reasonable rates for services under its jurisdiction. It must balance Georgia citizens' need for reliable services and reasonable rates with the need for utilities to earn a reasonable return on investment.

Typically, the rate-making process begins when a utility files a rate case with its respective state PSC. In its rate case, a utility proposes rates to charge its customers and justifies its proposed rates. The PSC holds public hearings and solicits input from consumers, advocacy

groups, and other stakeholders. The PSC then issues a decision approving, modifying, or denying the proposed rate changes.

Finalized rates are based on a utility's total revenue requirement, which is spread over the various classes of consumers (e.g., residential, commercial, etc.). An important distinction in calculating the revenue requirement is costs included in the rate base versus operating expenses. If a cost is allowed to be capitalized as part of a utility's rate base, the utility can earn a rate of return on the investment. In contrast, if a cost is excluded from the rate base and, instead, is treated as an operating expense, the utility can recover the cost as part of its revenue requirement but cannot mark it up to earn a return on the underlying cost. This calculation is demonstrated in Equation (1).:

$$\text{Revenue Requirement} = (\text{Rate Base} * \text{Rate of Return}) + \text{Operating Expenses} \quad (1)$$

Rate Base represents a utility's assets on which a utility is allowed to earn a return, and the *Rate of Return* represents a return on invested capital to ensure that the utility can provide a fair return to its investors. *Operating Expenses* represent an estimate of a utility's recurring operating expenses. In the rate-making process, the PSC approves the rate base, the rate of return, and the estimate of operating expenses. See Chakravarthy et al. (2021) for a more thorough discussion of the rate-making process.

In general, to be included in a utility's rate base, the PSC must conclude that the investment is prudent and satisfies the "used and useful" criterion (Lyon and Mayo 2005). That is, the investment is either used in operations or is necessary for meeting customer demand and maintaining the quality and reliability of the service. State PSCs review costs included in the rate base to ensure that customers are only charged for prudent and necessary investments related to

the provision of utility services. Therefore, the rate-making process helps maintain fair and reasonable rates while encouraging efficient and effective utility management.

In addition to influencing the rates that utilities charge their customers, the rate-making process also impacts capitalization in GAAP financial statements. Specifically, according to ASC 980-340-25, utilities are allowed to recognize a regulatory asset for cost capitalizations approved in the rate-making process because it is probable they will recover these costs through future revenues. Therefore, when costs are allowed to be included in the rate base, the incurred costs are capitalized as a regulatory asset in GAAP financial statements even if GAAP doesn't allow for non-regulated entities to capitalize these same costs. For example, if a utility incurs significant costs associated with a storm and its PSC allows the utility to include these costs in its rate base to pass along these costs to its customers, the utility can capitalize these storm costs in its GAAP financial statements as a regulatory asset because it is probable the utility will recover these costs through future revenues. In contrast, GAAP does not allow non-regulated entities to capitalize storm costs.

Accounting for Cloud Computing

Most state PSCs require financial information prepared in accordance with the FERC's USoA (American Public Power Association 2012; USAID 2019). The USoA generally follows GAAP with modifications for specific regulatory requirements and adjustments. We first discuss the accounting for cloud computing under GAAP and then the differences between GAAP and the USoA.

While cloud computing and on-premise software solutions are two different forms of technology solutions, the accounting for these two solutions has historically been quite different.

For on-premise software, costs such as license fees and implementation costs are capitalized as intangible assets on the balance sheet. Conversely, cloud computing costs without a software license have traditionally been accounted for as service contracts, with costs expensed as they are incurred.

When cloud computing emerged as a technology solution, neither GAAP nor the USoA specifically addressed how to account for the fees associated with these arrangements, and thus, a diversity of practice emerged (FASB 2014). In response, the FASB issued ASU 2015-05, which specifies that if a cloud computing arrangement includes an internal-use software license, then it should be accounted for similar to on-premise software (i.e., generally capitalized as an intangible asset), and otherwise, it should be expensed as a service contract. However, this ASU does not provide guidance on the accounting treatment for implementation costs.

Implementation costs include the initial costs associated with setting up and integrating a technology solution to get it ready for use. GAAP generally allows for implementation costs for on-premise software to be capitalized. After the issuance of ASU 2015-05, it remained unclear how these costs should be treated for cloud computing arrangements, specifically for those that do not include an internal-use software license. On May 10, 2017, the FASB added this issue to the agenda of the Emerging Issues Task Force (“EITF”), and on January 18, 2018, the EITF reached a consensus that certain implementation costs of cloud computing arrangements should be capitalized even if the arrangement does not include an internal-use software license. The FASB ratified the EITF’s consensus and, on March 1, 2018, issued an Exposure Draft soliciting feedback on this issue.

On August 29, 2018, the FASB issued ASU 2018-15, an accounting standard that essentially aligns the accounting of implementation costs for cloud computing arrangements with

those of on-premise software, regardless of whether the arrangement includes an internal-use software license. Based on this standard, cloud computing implementation costs in the development stage are capitalized as a prepaid asset and expensed over the term of the arrangement as an operating expense.

Following the issuance of ASU 2018-15, the FERC updated its USoA to similarly address cloud computing implementation costs. On December 20, 2019, the FERC issued an accounting order (“FERC Accounting Order”) stating that cloud computing implementation costs capitalizable under GAAP should also be capitalized for regulatory accounting purposes. However, the FERC specified that, for regulatory accounting purposes, cloud computing costs should be recorded as Miscellaneous Intangible Plant instead of being recorded as a prepaid asset. In essence, the regulatory accounting treatment for cloud computing implementation costs is consistent with that of on-premise software.

Cloud Computing Costs and the Ratemaking Process

A utility’s rate base does not include operating expenses. As such, when cloud computing costs are classified as operating expenses, a utility is not able to earn a return on these costs. In contrast, on-premise software is generally capitalized as an intangible asset, which *is* included in the rate base.

The issuance of ASU 2018-15 did not automatically imply that cloud computing implementation costs were to be capitalized in a utility’s rate base. GAAP capitalization rules do not dictate which costs receive regulatory approval to be capitalized in a utility’s rate base. Also, ASU 2018-15 requires that cloud computing implementation costs be recorded as a prepaid asset

and expensed over time as an operating expense. Prepaid assets are typically not included in a utility's rate base.

The FERC Accounting Order provides that cloud computing implementation costs are capitalized as Miscellaneous Intangible Plant, an asset that is typically included in the utility's rate base. Based on this accounting treatment in the USoA, a utility's PSC might simply consider these implementation costs automatically eligible to be included in the rate base, or the rate base may be determined using some other method (USAID 2019). Regardless of the specific approach to determining the rate base, the FERC Accounting Order provides specific support for utilities seeking regulatory approval to capitalize cloud computing costs in their rate base.

While the FERC has a potentially direct effect on a utility's rate base, it is important to note that GAAP also influences the utility's ratemaking process, albeit indirectly. GAAP capitalization rules provided the foundational framework (i.e., a starting point) for the FERC Accounting Order, as evidenced by the fact that the Accounting Order does not reconsider issues previously debated in the development of ASU 2018-15, such as which cloud computing costs should be capitalized. In addition, GAAP also provides a foundational framework for regulators as they consider what should be capitalized in a rate base. As one example, in the 2018 rate case for Ameren Illinois, the Director of Regulatory Accounting was asked if the proposed rate base additions "include any cloud computing projects that do not qualify for capitalization under generally accepted accounting principles?" (Illinois Commerce Commission 2018, 26). He was not asked about technology solutions that *do* qualify for capitalization under GAAP. In essence, GAAP provided the foundation for this line of questioning.

In Appendix A, we provide excerpts from two rate cases showing how the FERC USoA and GAAP provide support for rate base capitalization. In the first example, the Wisconsin PSC

references the FERC Accounting Order in its justification for approving capitalization (Public Service Commission of Wisconsin 2020). In the second example, the Mississippi PSC references GAAP in its justification for approving capitalization (Mississippi Public Service Commission 2022). ASU 2018-15 and the FERC Accounting Order collectively provide support for utilities that seek regulatory approval to capitalize cloud computing costs in their rate base.

In this paper, we examine the effects of regulatory approval to capitalize cloud computing costs. We do not attempt to untangle the specific accounting standard on which this regulatory approval relies. Rather, we credit the FASB and the FERC for raising the general awareness of accounting for cloud computing costs, and we examine the effects of regulators responding to this issue by approving capitalization of these costs in a utility's rate base.

Hypotheses

Averch and Johnson (1962) and Wellisz (1963) propose an effect of regulation which is commonly termed the AJW effect (Kahn 1988). The AJW effect suggests that when companies operate under rate of return regulation, as do utilities, and the approved rate of return is greater than the firm's cost of capital, regulated firms will overinvest in their rate base to generate the allowable return. Kahn (1988) explains that the AJW effect implies that regulated firms will resist technologies that save capital (i.e., not included in the rate base). Based on this theory, if investments in on-premise software costs are included in the rate base and cloud computing costs are not included in the rate base, utilities have an incentive to invest in on-premise software.

Prior to the FERC Accounting Order, the National Association of Regulatory Utility Commissions (NARUC) recognized this disincentive in a 2016 resolution in which it stated the following (NARUC 2016, 1; emphasis added):

*The **disparity in accounting treatments** between these two software approaches creates a regulatory incentive for utilities to invest in on-premise software solutions and creates unintended financial hurdles that hinder utilities from realizing the benefits that so many other industries are experiencing with cloud-based software.*

Consistent with this resolution, a recent survey of 152 U.S. utilities by Cloud for Utilities, a non-profit organization, shows that 58% of respondents indicated that their utility invested in on-premises software over cloud computing because of the inability to earn a rate of return for cloud computing (NARUC 2020).

The ability to capitalize cloud computing costs in the utility's rate base can increase a utility's willingness to invest in cloud computing as a technology solution because it allows them to earn a rate of return on their investment. Therefore, utilities with an interest in investing in cloud computing will likely seek approval from their respective PSC to include the related costs in their rate base. Further, the standard-setting activities regarding cloud computing provided utilities with justification for capitalizing these costs. Therefore, we predict that standard-setting activities regarding cloud computing encouraged utilities to petition their respective PSC for approval to capitalize cloud computing costs in its rate base, leading to our first hypothesis:

H1: The number of rate cases requesting approval to capitalize cloud computing costs increased in connection with the standard-setting activities supporting the capitalization of cloud computing costs.

Utilities are unique in that the rate-making process directly links accounting (i.e., rate base capitalization) and rates charged to utility consumers. All else equal, if a firm invests in

cloud computing and the associated costs are capitalized in the firm’s rate base, then the utility rates will correspondingly increase, leading to our second hypothesis.

H2: Utility customer rates are positively associated with the ability to capitalize cloud computing costs in a utility’s rate base.

Cloud computing solutions can improve utilities’ reliability, efficiency, and security (AEE/EEI 2021; NARUC 2016; Oracle 2024). If, as we predict in H1, regulatory approval to include cloud computing costs in a firm’s rate base encourages investment in cloud computing, it follows that this regulatory approval should also be associated with the realization of operational benefits of cloud computing, leading to our third hypothesis:

H3: The realization of operational benefits from cloud computing are positively associated with the ability to capitalize cloud computing costs in a utility’s rate base.

Empirical Design

We first examine whether utilities increased their requests for capitalization of cloud computing costs in their rate base in connection with the standard-setting activities supporting the capitalization. We test H1 by examining utility rate cases with the following model:

$$REQUEST = \alpha_0 + \alpha_1 POST + \alpha_2 Controls + \varepsilon \quad (2)$$

REQUEST is measured by *RateCaseMention*, which equals one if the rate case contains the key phrase “cloud computing” or “software as a service” and equals zero otherwise. With the idiosyncratic nature of each state’s rate-making process and the large volume of documents

included in each rate case, we are unable to isolate specific requests and approvals for capitalization of cloud computing costs. The PSC reviews items included in the rate base for prudence and for satisfaction of the “used and useful” criterion. Therefore, capitalization of costs in the rate base typically results in some mention either by the utility or the PSC in the rate-making process. We treat the presence of these key phrases in a rate case as an indication that the utility is requesting approval for capitalization of cloud computing costs.

POST is an indicator variable that equals one for years ending in or after 2018, and zero otherwise. We select 2018 as the benchmark year for our analyses since the EITF reached a consensus on the accounting for cloud computing implementation costs on January 18, 2018 and the related FASB Exposure Draft was issued on March 1, 2018.

We next examine whether firms that requested capitalization of cloud computing costs experienced higher electricity rates for customers and the operational benefits associated with cloud computing arrangements. For H2 and H3, we use a difference-in-difference design in which we compare utilities that have received regulatory approval to capitalize cloud computing costs in their rate base (“treatment firms”) and those that have not (“control firms”) as follows:

$$REVENUE = \beta_0 + \beta_1 TRT \times POST + \beta_2 Controls + \text{Firm FE} + \text{Year FE} + \varepsilon \quad (3)$$

$$OUTCOME = \lambda_0 + \lambda_1 TRT \times POST + \lambda_2 Controls + \text{Firm FE} + \text{Year FE} + \varepsilon \quad (4)$$

REVENUE is one of four proxies to capture the sales dollars per kilowatt hour, and *OUTCOME* is one of four proxies to capture the operational outcomes associated with cloud computing investment. *TRT* is an indicator variable that equals one for the treatment firms (i.e., firms that have received regulatory approval to capitalize cloud computing costs in the rate base) and zero otherwise.²

² Details of this identification are provided in Section 3.

We measure revenue per kilowatt hour, *REVENUE*, with four proxies. Our first proxy, *SALE_TOT*, is total ultimate sales to customers scaled by total kilowatt hours supplied. Our following three proxies represent revenue per kilowatt hour segmented by customer class. *SALE_RES*, *SALE_COM*, and *SALE_IND* are “residential” sales, “small commercial” sales, and “large industrial” sales, respectively, divided by the kilowatt hours sold to each respective customer class.

We measure the operational outcomes associated with cloud computing (*OUTCOME*) with four proxies. Our first two operational outcome proxies capture the service reliability based on the duration and frequency of power outages. We obtain the utility’s average duration of each power outage per customer per year in minutes (*AVG_DUR_OUT*) and the average frequency of power outages per customer per year (*AVG_FREQ_OUT*). For each utility, we calculate a state average duration and frequency metric, which excludes the respective test utility (*STATE_AVG*). This state average provides a control for variation in power outages due to factors beyond the control of the test utility (e.g., severe weather patterns).³

We measure operating efficiency with a utility’s operating and maintenance expense scaled by total revenue (*O&M*). We measure the reliability and security of a utility’s system with NERC fines. NERC establishes reliability and security standards for North American utilities, and issues fines for violations of those standards. *LN_PENALTY* equals the natural log of one plus the NERC assessed fine.

While linking an investment in cloud computing to changes in NERC fines or power outages may seem rather indirect, we note that this is consistent with industry publications denoting the benefits of cloud computing (AEE/EEI 2022), claims made by providers of cloud

³ The results without controlling for state averages stay qualitatively the same.

computing systems (e.g., Oracle 2024; AMCS 2024; ESource 2024), as well as an anecdotal example in a recent industry publication (Power Magazine 2024). For each of the outcome variables, lower values are more desirable. We expect that cloud computing results in lower duration and frequency of power outages, lower O&M, and lower NERC penalties.

Our variable of interest, $TRT \times POST$, captures the treatment effect, that is, the effect of regulatory approval to capitalize cloud computing costs in the rate base on the dependent variables. We expect that regulatory approval will result in increased revenue per kilowatt hour (H2: $\beta_1 > 0$) and a reduction in negative outcomes (H3: $\lambda_1 < 0$). Consistent with Chakravarthy et al. (2021), we control for firm size (*SIZE*), leverage (*LEVERAGE*), and net losses (*LOSS*). See Appendix B for variable definitions.

Cross-sectional Tests

We examine the extent to which our results vary cross-sectionally with regulator experience. Carpenter (2004) studies the pharmaceutical regulatory environment and explains that regulators learn and adapt over time. Chakravarthy et al. (2021) apply this theory to utilities and show that regulators with more experience are better able to unravel accounting manipulation when a utility presents abnormally high operating expenses in the rate making process. They suggest that regulators learn over time by identifying high operating expenses in the rate case review followed by subsequent decreases in operating expenses. These regulators then adapt by identifying the permanent and transitory components of operating expenses.

Applying this theory to rate base capitalization, regulators can learn over time by reviewing utilities' investments proposed for rate base capitalization and examining, ex post, the operational benefits of the approved investments. Regulators can then adapt by improving their

ability to discern, ex ante, the investments that are cost effective and will yield operational benefits. Thus, we expect utilities with more experienced PSC commissioners invest more in cloud computing and experience greater associated operational benefits compared to firms with less experienced commissioners. We measure regulator tenure with the number of years of tenure of the PSC commissioner as of 2020, and test the differences between utilities with above or below three years of PSC commissioner experience.⁴

3. H1 Sample Selection and Results

We obtain utilities' financial information from 2010 to 2022 using HData, a comprehensive repository of annual and quarterly reports filed with the FERC, and rate case information from Insight Engine, a comprehensive repository of filings with regulatory commission of each state. We obtain information on penalties from NERC, and reliability and revenue per kilowatt data from the U.S. Energy Information Administration.

Table 1 presents our sample selection process. From a list of all utilities from HData, we identify firm location from page 101 of the FERC Form 1 and eliminate utilities operating in more than one state, and therefore, subject to more than one state regulatory commission. Next, we eliminate utilities for which we cannot identify a finalized rate case from 2013 to 2022.⁵ We require that all utilities in our sample have at least one rate case in or after 2018 to ensure the opportunity for the PSC to consider capitalization of cloud computing costs in at least one rate

⁴ We repeat our tests using different benchmarks such as two years instead of three and median tenure. The results do not vary.

⁵ We begin our search for rate cases in 2013 to examine the five years prior to the issuance of ASU 2018-15. We end in 2022 as all the other data (FERC Form 1 financial information, NERC fines, revenue per kilowatt hour) is examined through 2022.

case after ASU 2018-15 and the FERC Accounting Order. The process results in a sample of 71 utilities.

H1 predicts an increase in the number of utilities seeking approval for rate base capitalization of cloud computing costs beginning in 2018. To test this prediction, we utilize Insight Engine to search the rate cases of our sample utilities. We search for key phrases “cloud computing” and “software as a service”, and we search for an accounting order regarding cloud computing costs. Figure 1 presents the number of utility rate cases each year that mention “cloud computing” (CC), “software as a service” (SaaS), or either from 2013 through 2022. We see a sharp increase in rate cases mentioning either key phrases in 2018 with a sustained level of rate case mentions thereafter. These findings are consistent with more utilities requesting inclusion of cloud computing costs in their rate base beginning in 2018.

Table 2 presents our regression estimation of Equation (2) in which we analyze all rate cases for our 71 sample firms. The dependent variable in these regressions is *RateCaseMention*, an indicator equal to one if the rate case mentions either “cloud computing” or “software as a service”. The coefficient for our variable of interest, *POST*, is positive and significant across Table 2 using OLS or logistic regressions, with or without control variables. These regression results align with those shown in Figure 1 and support H1, that beginning in 2018, utilities significantly increased to seek PSC approval to include cloud computing costs in the rate base.

4. H2 and H3 Sample Selection and Results

Next, we focus on the outcomes of capitalization of cloud computing costs by utilities. First, we consider a utility to have approval to capitalize cloud computing in its rate base, and therefore identify the utility as a treatment firm, if it satisfies one of two conditions between

March 1, 2018 and December 31, 2020: (1) any rate case finalized during this time period includes the key phrases “cloud computing” or “software as a service”; or (2) the state PSC issues an accounting order for that utility specifically allowing the capitalization of cloud computing costs in the rate base. We select March 1, 2018 as the beginning date of the search period because this is the issuance date of the FASB Exposure Draft on cloud computing costs which provided visibility to this issue. We select December 31, 2020 as the ending date of the search period to ensure that the 2020 fiscal year can be considered a year, which includes regulatory approval to capitalize cloud computing costs in the rate base. This process selects 41 utilities as treatment firms.

We classify utilities as control firms if the key phrases “cloud computing” or “software as a service” do not appear in any of the rate cases between 2013 and 2022, and if there is no accounting order for cloud computing costs prior to June 30, 2022. There are 15 firms identified as control firms. We exclude the remaining 15 utilities that contain the key phrases “cloud computing” or “software as a service” in rate cases finalized in 2021 and 2022. These rate cases occur years after ASU 2018-15 and the FERC Accounting Order and it leaves limited or no post-approval observations in our sample period.

It is possible that our treatment sample includes firms that request approval to capitalize cloud computing in the rate base but are not granted approval. Likewise, it is possible that our control sample includes firms that have automatic approval by the FERC order and, therefore, do not specifically mention any related terms in the rate case. However, both of these scenarios create a bias against finding our predicted results.

Table 3 presents descriptive statistics for our sample of treatment and control firms combined. We winsorize our variables at the 1st and 99th percentiles. We note that due to our

small sample size, our analysis is susceptible to the influence of outliers since each observation is weighted more heavily for a small sample compared to a large sample. Therefore, we also remove observations with dependent variables greater than 300% of the state average, where available. Finally, to limit the effect of outliers in the regression for *O&M* and *LN_PENALTY*, we eliminate outliers with *dfbeta* values greater than $2/\sqrt{n}$ (Belsley et al. 1980; Blankespoor et al. 2014).

Pivotal to our tests of H2 and H3 is the assumption that utilities identified as treatment firms receive regulatory approval to include cloud computing costs in their rate base and subsequently increase their investment in cloud computing. To validate this assumption, we measure cloud computing spending using the capital expenditures in regulatory assets containing keywords associated with cloud computing ('cloud', 'cyber', 'data', 'software', or 'system') each year. While cloud computing costs could be included in regulatory assets, miscellaneous intangible plant or PP&E, regulatory assets are the only reported location on the FERC Form 1 that allows for specific identification of cloud computing spending due to the level of disaggregated detail for regulatory assets.⁶ With this identification of cloud computing spending, we validate our treatment classification by examining spending on cloud computing by both treatment firms over the period between 2013 and 2022.

Figure 2 shows that the aggregate annual spending on cloud computing by treatment firms increases from \$0 in 2013 to just over \$3 million in 2017 to more than \$81.7 million in 2022. Similarly, the average cloud computing spending per utility reporting cloud computing

⁶ Utilities report on page 232 of the FERC Form 1 a list of all their regulatory assets and the changes in the balance of those assets during the year. We identify regulatory assets associated with cloud computing based on whether the description in column (a) of page 232 contains any of the listed keywords. Unlike regulatory assets, which are enumerated individually on page 232 of the FERC Form 1, Miscellaneous Intangible Plant is reported as a single aggregated line item on page 204 of the FERC Form 1.

regulatory assets increases from less than \$75 thousand in 2017 to nearly \$2 million per utility in 2022. Of significant note is that this measure of spending on cloud computing is equal to zero for control firms in all years.⁷

Table 4 presents regression analyses to validate our treatment identification. The significant positive coefficient on *POST* in the different specifications in columns (1) through (3) indicate an average increase in cloud computing spending of between \$793 thousand and \$909 thousand by treatment firms beginning in 2018. Columns (4) through (6) present results with the dependent variable defined as the utility's amount of cloud computing spending scaled by the balance of all the utility's reported regulatory assets. The positive coefficients indicate that the cloud computing spending as a proportion of regulatory assets by treatment firms also increased in the post periods. Together with Figure 2, these results provide validation for our assumption that treatment firms receive regulatory approval to include cloud computing costs in their rate base and increase their spending on cloud computing.

Table 5 presents our regression estimation of Equation (3). The dependent variable is total revenue per kilowatt hour (*SALE_TOT*), revenue from residential customers per kilowatt hour (*SALE_RES*), revenue from small commercial customers per kilowatt hour (*SALE_COM*), and revenue from large industrial customers per kilowatt hour (*SALE_IND*), across the six columns. When we include firm and year fixed effects in the model, the main effects of *TRT* and *POST* are redundant and are therefore excluded from the model.

The coefficient for our variable of interest, $TRT \times POST$, is positive and significant across all columns. Total revenue for our treatment firms increases by approximately 1.6 cents per

⁷ This does not mean that control firms spend nothing on cloud computing services, but does indicate that control firms report no regulatory assets related to cloud computing. This is consistent with not having regulatory approval to include cloud computing costs in the rate base.

kilowatt hour more than that of our control firms. Interestingly, we note that, on average, residential customers experience a rate increase of 1.3 cents per kilowatt hour, small commercial customers experience a rate increase of 1.1 cents per kilowatt hour, and large industrial customers experience a rate increase of 1.1 cents per kilowatt hour.⁸ Collectively, these results support our prediction in H2 that approval to capitalize cloud computing costs results in an increase in electricity rates for customers.

Table 6 presents our regression estimation of Equation (4) for power outage metrics. The dependent variable is the average duration of power outage per customer (*AVG_DUR_OUT*) and the average number of power outages per customer (*AVG_FREQ_OUT*). When the dependent variable is *AVG_DUR_OUT*, the coefficient for our variable of interest, $TRT \times POST$, is negative and significant across all three specifications. When the dependent variable is *AVG_FREQ_OUT*, the coefficient on $TRT \times POST$ is negative but insignificant. These results suggest that the average reduction in the length of power outages attributable to the capitalization of cloud computing costs is 46 to 55 minutes. These results also suggest no difference between treatment and control firms in the change in the frequencies of power outages.

Finally, Table 7 presents our regression estimation of Equation (4) with dependent variables of operating and maintenance expense (*O&M*) and the natural log of one plus the dollar value of NERC fines (*LN_PENALTY*). The coefficient for our variable of interest, $TRT \times POST$, is negative and significant for one of the three specifications when the dependent variable is *O&M*. We make no inference from these results since the results vary with the fixed effect specification. When the dependent variable is *LN_PENALTY*, the variable of interest is negative

⁸ We repeat our analyses using state-adjusted rates and the results stay qualitatively similar. Specifically, we find electricity rates of treatment firms relative to the state average are higher than for control firms in all four specifications and significant in three of the four specifications. The higher rate for industrial customers is not statistically significant.

and significant across all three specifications, suggesting that investment in cloud computing results in lower regulatory penalties.

5. Additional Tests

For the cross-sectional tests, we examine how our results vary with the tenure of the PSC commissioner and present the results in Table 8. We divide the sample into two using the PSC commissioners' tenure across states as of 2020 and test the difference between high (greater than three years) and low (equal to or below three years) groups for regressions in equations (3) and (4).

First, untabulated results show that the expenditure on cloud computing (CC_SPD and $CC_SPD_RA\%$) is significantly greater for treatment firms with high commissioner's tenure than those with low tenure. This result supports our expectation that the utility firms with more experienced commissioners are more likely to increase investment in cloud computing.

Next, we test the difference between the high and low tenure groups for equations (3) and (4) and present the results in Table 8. Panel A presents results using revenue proxies. We find that the extent of increases, in total, in the electricity rate per kilowatt hour for treatment firms compared to control firms is lower for states with high tenure of PSC commissioners. Specifically, when the dependent variable is $SALE_TOT$, the coefficient on $TRT \times POST$ is significantly positive at 0.0109 for the high tenure group and 0.0240 for the low group as shown in columns (1) and (2) of Panel A. The significant difference between the two (-0.0131) indicates that the extent of increase in electricity rate per kilowatt hour for treatment firms compared to control firms is lower for firms with higher commissioners' tenure. This result does not appear to be attributable to a specific customer type. For example, when tested using residential customers, while the coefficient on $TRT \times POST$ is smaller for higher tenure (0.0105) in column (3) than for

lower tenure (0.0197) in column (4), the difference (-0.0092) is insignificant. Untabulated results using commercial and industrial customers show similar results. Overall, these results suggest that commissioners with high tenure are more likely to approve capitalization of cloud computing, but pass on less costs to customers than commissioners with low tenure.

Panels B and C of Table 8 show the differences in the effect of cloud computing capitalization approval on outcomes between utilities with high and low commissioners' experience. Generally, the results show that utilities with high commissioner tenure experience greater benefits. For example, the decrease in the average duration of outage (*AVG_DUR_OUT*) is greater for firms with high commissioner experience (-39.1938) than low tenure (-35.6017). Similarly, the decrease in the amount of penalty (*LN_PENALTY*) is negative and significant for firms with high commissioner tenure (-1.4883) whereas the amount of penalty significantly increases for firms with low commissioner tenure (1.9085). However, the difference is only significant for the amount of penalty (*LN_PENALTY*) as shown in column (4) of Panel C.

Overall, these results are consistent with the notion that when the PSC commissioner has more experience, the cloud computing capitalization approval results in increased investment in cloud computing, and lower regulatory penalties while, at the same time, these changes are less costly overall to customers.

6. Concluding Remarks

Historically, the differences in the accounting treatment between cloud computing and on-premise software created a disincentive for utilities to invest in cloud computing arrangements, despite their advantages. In this paper, we examine the real effects of aligning regulatory accounting treatment for these technologies. Our findings show that when regulators

approve the rate base capitalization of cloud computing costs, utilities increase investment in cloud computing technology, increase customer rates, receive lower regulatory penalties, and experience shorter power outages. This study demonstrates how accounting methods can create incentives that influence management decisions, leading to significant impacts beyond the financial statements.

References

- Advanced Energy Economy / Edison Electric Institute (AEE/EEI). 2022 Reaching for the Cloud: Solutions for Regulatory Parity for Cloud Services for Utilities. Available at: <https://info.aee.net/hubfs/Reaching%20for%20the%20Cloud.pdf>
- AMCS. <https://www.amcsgroup.com/blogs/5-best-practices-for-utility-compliance-how-to-avoid-regulatory-violations/> retrieved on April 29, 2024.
- American Public Power Association. 2012. Public Utility Accounting: A Public Power System's Introduction to the Federal Energy Regulatory Commission Uniform System of Accounts. Available at: <https://www.publicpower.org/system/files/documents/Public%20Utility%20Accounting%20Manual%202018.pdf>
- Averch, H. and L. L. Johnson. 1962. Behavior of the firm under regulatory constraint. *The American Economic Review* 52 (5): 1052-1069.
- Belsley, D. A., E. Kuh, and R. E. Welsch. 1980. Regression Diagnostics: Identifying Influential Data and Sources of Collinearity. New York, NY: John Wiley & Sons
- Bhojraj, S., W. G. Blacconiere, and J. D. D'Souza. 2004. Voluntary disclosure in a multi-audience setting: An empirical investigation. *The Accounting Review* 79 (4): 921-947.
- Blankespoor, E., G.S. Miller, and H.D. White. 2014. The role of dissemination in market liquidity: Evidence from firms' use of Twitter™. *The Accounting Review*, 89 (1): 79-112.
- Carpenter, D.P. 2004. Protection without capture: Product approval by a politically responsive, learning regulator. *American Political Science Review* 98 (4): 613-631.
- Carter, M. E., and L. J. Lynch. 2003. The consequences of the FASB's 1998 proposal on accounting for stock option repricing. *Journal of Accounting and Economics* 35 (1): 51–72. [https://doi.org/10.1016/S0165-4101\(02\)00097-6](https://doi.org/10.1016/S0165-4101(02)00097-6)
- Chakravarthy, J., K. E. McDermott, and R. M. White. 2021. Are regulators effective at unraveling accounting manipulation? Evidence from public utility commissions. *Management Science* 67 (7): 4532-4555.

- Choudhary, P., S. Rajgopal, and M. Venkatachalam. 2009. Accelerated vesting of employee stock options in anticipation of FAS 123-R. *Journal of Accounting Research* 47 (1): 105–146. <https://doi.org/10.1111/j.1475-679X.2008.00316.x>
- ESource. <https://www.esource.com/public/e-source-gridinform-vegetation-management> retrieved on July 17, 2024.
- Financial Accounting Standards Board (FASB). 2014. Proposed Accounting Standards Update: Intangibles – Goodwill and Other – Internal Use Software (Subtopic 350-40) Customer’s Accounting for Fees Paid in a Cloud Computing Arrangement. Norwalk, CT: FASB.
- Financial Accounting Standards Board (FASB). 2015. Accounting Standards Update No. 2015-05: Intangibles – Goodwill and Other – Internal Use Software (Subtopic 350-40) Customer’s Accounting for Fees Paid in a Cloud Computing Arrangement. Norwalk, CT: FASB.
- Financial Accounting Standards Board (FASB). 2018. Accounting Standards Update No. 2018-15: Intangibles – Goodwill and Other – Internal Use Software (Subtopic 350-40) Customer’s Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement That Is a Service Contract. Norwalk, CT: FASB.
- Gajbhiye, A. and K. M. P. Shrivastva. 2014. Cloud computing: Need, enabling technology, architecture, advantages and challenges. In 2014 5th International Conference-Confluence The Next Generation Information Technology Summit (Confluence), IEEE: 1-7.
- Illinois Commerce Commission. 2018. Direct testimony of Ronald D. Stafford. Docket #18-0807. April 2018.
- Kahn, A.E., 1988. *The economics of regulation: principles and institutions*. MIT press.
- Jackson, S. B., X. K. Liu, and M. Cecchini. 2009. Economic consequences of firms’ depreciation method choice: Evidence from capital investments. *Journal of Accounting and Economics* 48 (1), 54-68.
- Li, B., & M. Venkatachalam. 2024. Leasing loses altitude while ownership takes off: Real effects of the new lease standard. *The Accounting Review* 99 (3): 315-347.
- Lyon, T.P. and J. W. Mayo. 2005. Regulatory opportunism and investment behavior: Evidence from the US electric utility industry. *RAND Journal of Economics*: 628-644.

- Ma, M., and W. B. Thomas. 2023. Economic consequences of operating lease recognition. *Journal of Accounting and Economics* 75 (2–3): 101566.
- Marston, S., Z. Li, S. Bandyopadhyay, J. Zhang, and A. Ghalsasi. 2011. Cloud computing—The business perspective. *Decision support systems* 51 (1):176-189.
- Mittelstaedt, H. F., W. D. Nichols, and P. R. Regier. 1995. SFAS no. 106 and benefit reductions in employer-sponsored retiree health care plans. *The Accounting Review* 70 (4): 535–556.
- Mississippi Public Service Commission. 2022. Other – Petition/Accounting Order. Docket # 2022-UA-139. December 6, 2022.
- Mueller, F., and C. Carter. 2007. We are all managers now’: Managerialism and professional engineering in UK electricity utilities. *Accounting, Organizations and Society* 32 (1-2): 181-195.
- National Association of Regulatory Utility Commissioners (NARUC). 2016. Resolution Encouraging State Utility Commissions to Consider Improving the Regulatory Treatment of Cloud Computing Arrangements. (November 16). Available at: <https://pubs.naruc.org/pub/2E54C6FF-FEE9-5368-21AB-638C00554476>
- National Association of Regulatory Utility Commissioners (NARUC). 2020. Financial Toolbox Series: Cloud Computing Brief. Available at: https://pubs.naruc.org/pub/0923A1BA-155D-0A36-3125-703210763F3C?_gl=1*188icho*_ga*OTc3MDM4NjMzLjE3MTE0ODYzOTI.*_ga_QLH1N3Q1NF*MTcxMTQ5NzE1OS4yLjEuMTcxMTQ5NzI0Ny4wLjAuMA..
- Oler, D. K., M. J. Oler, C. J. Skousen, and J. Talakai. 2016. Has concentration in the top accounting journals changed over time?. *Accounting Horizons* 30 (1): 63 - 78.
- Oracle. <https://www.oracle.com/utilities/network-management-system/> retrieved on April 29, 2024.
- Power Magazine. 2024. *Alabama Power Modernizes Grid Using Data Analytics and Advanced Lateral Protection*. (January 2). Available at: <https://www.powermag.com/alabama-power-modernizes-grid-using-data-analytics-and-advanced-lateral-protection/>
- Preston, A. M., and A. M. Vesey. 2008. The construction of US utility accounting: 1882–1944. *Accounting, Organizations and Society* 33 (4-5): 415 - 435.

Public Service Commission of Wisconsin. 2020. Application of Madison Gas and Electric Company for Authority to Change Electric and Natural Gas Rates. Final Decision. Docket #3270-UR-123. December 29, 2020.

State of Georgia Public Service Commission. https://psc.ga.gov/about-the-psc/#roles_and_responsibilities retrieved on March 24, 2024.

Surbiryal, J. and C. Rong. 2019. Cloud computing: History and overview. In 2019 IEEE Cloud Summit, IEEE: 1-7.

United States Agency for International Development (USAID). 2019. Regulatory Accounting: A Primer for Utility Regulators. Available at: https://pdf.usaid.gov/pdf_docs/PA00X2PQ.pdf

Wall Street Journal. 2024. *Get Ready to Pay More for Less-Reliable Electricity*. (July 18). Available at: <https://www.wsj.com/business/energy-oil/electricity-expensive-less-reliable-91555a33>.

Wellisz, S. H. 1963. Regulation of natural gas pipeline companies: An economic analysis. *Journal of Political Economy*, 71 (1): 30-43.

Appendix A. Support for Rate Base Capitalization

This appendix presents two examples of state PSCs supporting the capitalization of cloud computing costs by referencing the FERC Accounting Order (Example 1) and GAAP (Example 2).

Example 1: Madison Gas and Electric

In its final decision issued December 29, 2020, the Wisconsin PSC approved Madison Gas and Electric (MGE), a treatment firm, to continue capitalizing cloud computing costs in its rate base, referencing the FERC Accounting Order in its decision (Public Service Commission of Wisconsin 2020, 42-43; emphasis added):

Cloud-based computing systems are arrangements in which a pool of computing resources, such as servers, storage, applications, and services can be rapidly deployed in response to demand. Cloud computing offers utilities the ability to expand their capacity and sophistication with respect to meter data management, emergency notification, advanced meter data analytics, and predictive maintenance, among other functions. Under previous accounting principles, MGE would treat its prior computing system as a capital expense and include it in its rate base, which allowed MGE to gain a return on it. A cloud-based solution, however, is typically a service contract that can be included as an operating expense, which would not earn a rate of return. As such, a utility is not incentivized to adopt cloud-based solutions, which has been found to cause the utility industry to lag behind corporate peers.

In its Settlement Agreement, MGE included four cloud computing service contracts in its electric and gas rate base. The total of the four contracts included in the rate base for the cloud assets is \$1.7 million, which is a significant upfront software expenditure that is made to improve reliability of service for MGE's customers. ***It is also consistent with Federal Energy Regulatory Commission's (FERC) ruling*** in December 2019, as can be seen in FERC Docket No. AI20-1-000. The ruling allows a utility to represent cloud implementation costs as Plant, Property, and Equipment instead of an Other Asset on its financial statements. MGE has adopted this accounting treatment effective December 2019 for its cloud implementation costs. The implementation costs are amortized to FERC 404, Amortization of Limited Term Plant (60 percent to electric and 40 percent to gas).

The Commission finds it reasonable to authorize MGE to continue to capitalize costs related to cloud computing. This accounting treatment further allows MGE to not only receive a return on its investment, but also incentivize the company to take advantage of opportunities that will save costs and enhance operations. ***In addition, it allows MGE to stay consistent with the FERC ruling***, and to earn a return on a large investment.

Example 2: Mississippi Power Company

Mississippi Power Company (MPC)⁹ filed a petition for an accounting order from the Mississippi PSC to allow capitalization of cloud computing costs in its rate base. The Mississippi PSC approved the request, referencing GAAP in its final decision, issued December 6, 2022: (Mississippi Public Service Commission 2022, 2-3; emphasis added):

Based upon the information and evidence contained in the record of this matter; this Commission finds that MPC's request for an accounting order is just and reasonable and in the public interest. The Commission also finds that the treatment prescribed herein is consistent with applicable accounting guidance.

After the effective date of this order, MPC is hereby authorized to defer in a regulatory asset account, *to the extent allowed by GAAP*, one-time O&M expenditures associated with major technology projects, including, but not limited to, general and administrative and overhead costs, detailed planning, training, data conversion, closeout, hosting fees prior to implementation, license support maintenance and service fees prior to implementation for on premises software, and business re-engineering costs.' This authority shall be available for both new software systems (including cloud-based solutions) and for existing system upgrades that provide improved functionality and/or the opportunity for sustained system life. Because the software and cloud computing solutions provide service to customers over their entire useful life, the deferral of these costs will allow the related costs to be recovered over a period more consistent with when customers receive the benefits of these services. The accounting authority herein will also allow MPC to focus on the best available outcome and benefit for customers when evaluating software solutions.

⁹ MPC is a control firm in our study because of the timing of this order. This order was issued in December 2022, the last year of our sample. Therefore, they did not have approval to capitalize cloud computing costs in their rate base during the years of our sample.

Appendix B. Variable Definitions

Independent Variables

<i>TRT</i>	An indicator variable that equals one for utilities that between March 1, 2018 and June 30, 2020: (1) have any rate case finalized during this time period that mentions “cloud computing” or “software as a service”; or (2) the state PSC issues an accounting order for that utility specifically allowing the capitalization of cloud computing costs in the rate base. It equals zero for utilities that had no mention of “cloud computing” or “software as a service” in any rate case between 2013-2022 and never received an accounting order from their state PSC allowing capitalization of cloud computing costs in the rate base.
<i>POST</i>	An indicator variable that equals one for firm-year observations after January 1, 2018, and zero otherwise.

Dependent Variables

Approval Request (H1)

<i>RateCaseMention</i>	An indicator variable that equals one for rate cases including the key phrase “cloud computing” or “software as a service”, and zero otherwise
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Revenue Outcomes (H2)

<i>SALE_TOT</i>	Ultimate sales to customers per kilowatt hour
<i>SALE_RES</i>	Residential sales per kilowatt hour
<i>SALE_COM</i>	Small commercial sales per kilowatt hour
<i>SALE_IND</i>	Large industrial sales per kilowatt hour

Operational Outcomes (H3)

<i>AVG_DUR_OUT</i>	Customer average interruption duration index, which measures the average duration of customer interruption.
<i>AVG_FREQ_OUT</i>	System average interruption frequency index, which assesses how often a customer experiences interruption on average.
<i>O&M</i>	Operating and maintenance (O&M) expense scaled by revenue.
<i>LN_PENALTY</i>	Natural log of one plus the total amount of penalty.

Other Variables

<i>SIZE</i>	Natural log of one plus total assets.
<i>LEVERAGE</i>	Long-term liabilities scaled by total assets.
<i>LOSS</i>	An indicator variable for loss, which equals one if income before extraordinary items is negative, and zero otherwise.

Figure 1. Mentions in Rate Cases

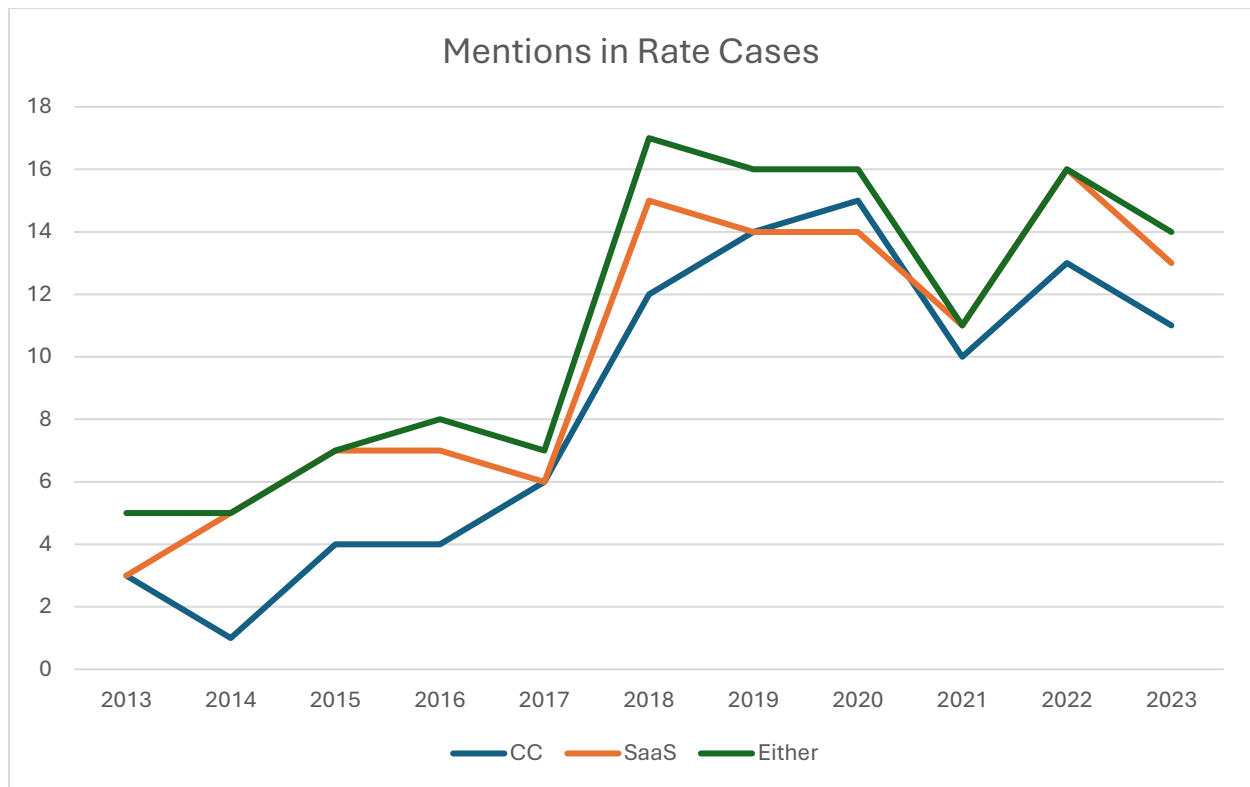
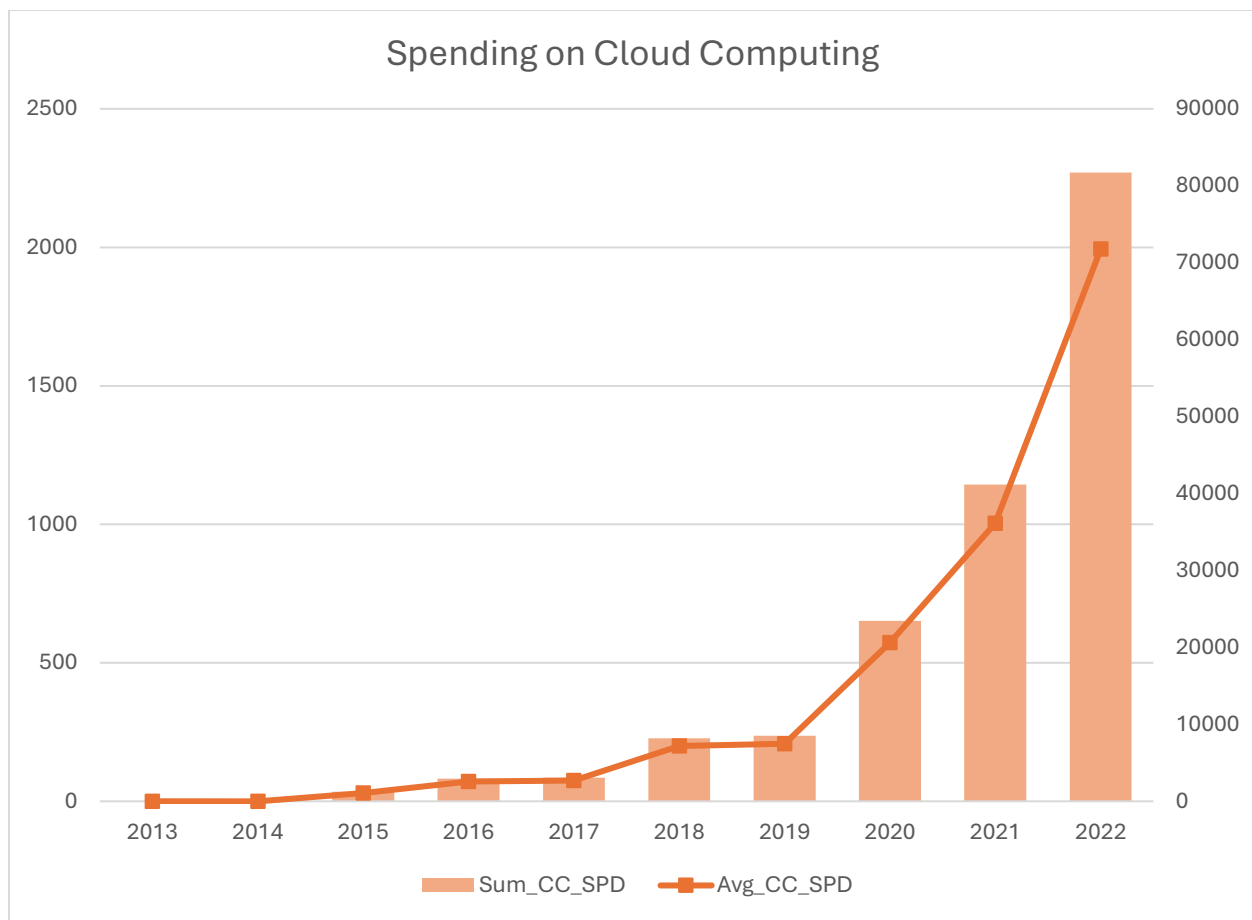


Figure 2. Spending on Cloud Computing by Treatment Firms



This figure shows the amount of cloud computing investment by treatment firms over time. These amounts are reported under regulatory assets in FERC Form 1 with one of the four following tags, cloud, cyber, data, or software. The line shows average amount spent (left axis) and the bar graph shows the aggregate amount spent (right axis). The amounts are shown in thousands. In contrast, control firms report zero dollars.

Table 1
Sample Selection

	<u># of Utilities</u>
Utilities with FERC Form 1 financial data from HData.	246
Removed utilities that operate in more than one state.	(67)
Removed utilities that did not have a finalized rate case in Insight Engine from 2013-2022.	(91)
Removed utilities with no rate case in or after 2018	(17)
Sample of Utilities Eligible for Selection as Treatment or Control	<u>71</u>
Treatment Firms (mention of “cloud computing” or “software as a service” in rate cases finalized between March 1, 2018 and December 31, 2020)	41
Control Firms (no mention of “cloud computing” or “software as a service” in any rate cases between 2013-2022)	15
Uncategorized Firms (mention of “cloud computing” or “software as a service” is in rate cases finalized in 2021 or 2022)	15
	<u>71</u>

This table presents 1) the process of identifying utilities eligible for selection as treatment or control firms, and 2) the allocation of these utilities between treatment firms, control firms, and uncategorized firms.

Table 2
Cloud Computing Mentions in Rate Cases

	<i>RateCaseMention</i>			
	<i>OLS</i>		<i>Logit</i>	
	(1)	(2)	(3)	(4)
POST	0.231*** (3.85)	0.224*** (3.73)	0.960*** (3.83)	0.973*** (3.75)
SIZE		0.065** (2.29)		0.299** (2.08)
LEVERAGE		-0.737 (-0.83)		-3.219 (-0.78)
CONSTANT	0.455*** (6.85)	-0.356 (-0.78)	-0.182 (-0.68)	-3.941* (-1.67)
Fixed effects	No	No	No	No
N	174	174	174	174
Adjusted R ²	0.047	0.075	0.039	0.070

This table presents regulatory approval validation tests. The dependent variable is mentions of either ‘cloud computing’ or ‘software as a service’ in their rate cases.

***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively, using a one-tailed test.

Table 3
Descriptive Statistics

Variable	N	Mean	Median	Std Dev	Q1	Q3
<i>CC_SPD</i>	715	238.21	0	2,602.73	0	0
<i>CC_SPD_RA%</i>	702	0	0	0.0002	0	0
<i>SALE_TOT</i>	580	0.1283	0.1143	0.0505	0.091	0.1524
<i>SALE_RES</i>	580	0.1469	0.1322	0.0501	0.1105	0.1707
<i>SALE_COM</i>	580	0.1245	0.1113	0.0438	0.0951	0.1432
<i>SALE_IND</i>	580	0.0957	0.078	0.0475	0.063	0.1108
<i>O&M</i>	692	0.649	0.6434	0.0944	0.5873	0.7059
<i>LN_PENALTY</i>	715	1.3269	0	3.5569	0	0
<i>AVG_DUR_OUT</i>	487	207.95	152.94	168.24	116.73	227.07
<i>AVG_FREQ_OUT</i>	487	1.3107	1.221	0.6055	0.955	1.57
<i>SIZE</i>	715	15.1812	15.631	2.4797	14.859	16.3645
<i>LEVERAGE</i>	715	0.278	0.28	0.0628	0.2516	0.3103
<i>LOSS</i>	715	0.0224	0	0.148	0	0

This table presents descriptive statistics for both treatment and control firms combined. Variables are winsorized at 1st and 99th percentiles. Variable definitions are presented in Appendix B.

Table 4
Regulatory Approval Validation

	<i>CC_SPD</i>			<i>CC_SPD_RA%</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>POST</i>	792.72 [*]	817.57 [*]	908.89 [*]	0.0003 ^{**}	0.0003 [*]	0.0003
	(1.48)	(1.50)	(1.45)	(1.69)	(1.63)	(1.16)
<i>SIZE</i>		153.23 [*]	175.74		0.0000	−0.0000
		(1.48)	(1.24)		(0.95)	(−0.07)
<i>LEVERAGE</i>		−5,704.29 [*]	−9,585.13		−0.0003	−0.0004
		(−1.44)	(−1.30)		(−0.48)	(−0.20)
<i>LOSS</i>		799.00 ^{**}	1,050.38 ^{***}		0.0005 [*]	0.0005 [*]
		(1.75)	(3.05)		(1.44)	(1.61)
Fixed effects	No	No	Firm	No	No	Firm
N	520	520	520	509	509	509
Adjusted R ²	0.0141	0.0231	0.131	0.00880	0.00706	0.0258

This table presents regulatory approval validation tests. The dependent variables are the dollar spent on cloud computing (*CC_SPD*), and the amount scaled by total regulatory assets (*CC_SPD_RA%*) by treatment firms. *CC_SPD* and *CC_SPD_RA%* equals zero for control firms.

***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively, using a one-tailed test.

Table 5
Regulatory Approval and Utility Revenue

	<i>SALE_TOT</i>			<i>SALE_RES</i>	<i>SALE_COM</i>	<i>SALE_IND</i>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>TRT</i> × <i>POST</i>	0.0166*** (2.61)	0.0168*** (2.58)	0.0160*** (3.22)	0.0133** (2.13)	0.0105** (2.18)	0.0109** (1.83)
<i>TRT</i>	0.0060 (0.36)	0.0060 (0.35)				
<i>POST</i>	0.0015 (0.42)	0.0264*** (5.42)				
<i>SIZE</i>	0.0020 (0.58)	0.0019 (0.56)	0.0004 (0.33)	0.0002 (0.12)	0.0005 (0.55)	0.0005 (0.40)
<i>LEVERAGE</i>	−0.0966 (−1.21)	−0.1001 (−1.22)	−0.0409 (−0.72)	−0.0179 (−0.27)	−0.0335 (−0.72)	−0.0141 (−0.31)
<i>LOSS</i>	−0.0134 (−1.28)	−0.0137 (−1.27)	0.0028 (0.94)	0.0051* (1.45)	0.0035 (1.08)	−0.0007 (−0.26)
Fixed effects	No	Year	Year & Firm	Year & Firm	Year & Firm	Year & Firm
N	580	580	580	580	580	580
Adjusted R ²	0.0392	0.0429	0.931	0.912	0.915	0.856

This table presents the impact of regulatory approval on reliability. The dependent variables are revenues per kilowatt hours. The first three columns are for total sales to the customers (*SALE_TOT*), and the last three columns divide the customers into three categories, residential (*SALE_RES*), commercial (*SALE_COM*), and industrial (*SALE_IND*) customers.

***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively, using a one-tailed test.

Table 6
Regulatory Approval and Reliability

	<i>AVG_DUR_OUT</i>			<i>AVG_FREQ_OUT</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>TRT × POST</i>	−46.2621**	−46.0092**	−55.2709**	−0.0002	−0.0027	−0.0345
	(−2.34)	(−2.30)	(−2.33)	(−0.00)	(−0.02)	(−0.29)
<i>TRT</i>	59.5590***	60.2773***		−0.0552	−0.0507	
	(2.94)	(2.98)		(−0.45)	(−0.41)	
<i>POST</i>	60.8953***	64.6723***		0.1515*	0.1710	
	(3.14)	(2.60)		(1.34)	(1.08)	
<i>SIZE</i>	4.7281*	4.9221*	−1.7535	−0.0556**	−0.0557**	−0.0475
	(1.35)	(1.39)	(−0.43)	(−1.70)	(−1.71)	(−1.18)
<i>LEVERAGE</i>	−122.1919	−139.2084	−16.4577	−0.4247	−0.4991	0.5887
	(−0.96)	(−1.09)	(−0.09)	(−0.51)	(−0.59)	(0.73)
<i>LOSS</i>	−8.9805	−2.8093	6.9649	0.0478	0.0527	0.1316*
	(−0.52)	(−0.17)	(0.26)	(0.28)	(0.31)	(1.46)
<i>STATE_AVG</i>	0.4155***	0.4068***	0.3953***	0.5357***	0.5337***	0.3161***
	(3.22)	(3.12)	(3.04)	(5.72)	(5.57)	(4.29)
Fixed effects	No	Year	Year & Firm	No	Year	Year & Firm
N	460	460	460	466	466	466
Adjusted R ²	0.253	0.256	0.405	0.289	0.282	0.724

This table presents the impact of regulatory approval on reliability. The dependent variables are the average duration of outages per customer, *AVG_DUR_OUT*, and the average frequency of outages per customer, *AVG_FREQ_OUT*.

***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively, using a one-tailed test.

Table 7
Regulatory Approval and Operational Benefits

	<i>O&M</i>			<i>LN_PENALTY</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>TRT</i> × <i>POST</i>	0.0102	0.0144	−0.0167**	−1.2337***	−1.0623***	−0.9939***
	(0.82)	(1.12)	(−2.19)	(−4.40)	(−3.63)	(−3.44)
<i>TRT</i>	−0.0269**	−0.0298**		1.4061***	1.2104***	
	(−1.77)	(−1.88)		(4.82)	(4.02)	
<i>POST</i>	−0.0314***	−0.0351**		−0.0841	−1.1899**	
	(−2.84)	(−2.34)		(−0.82)	(−2.38)	
<i>SIZE</i>	−0.0320***	−0.0303***	−0.0114	−0.1637**	−0.1428*	−0.1874*
	(−6.83)	(−6.54)	(−0.57)	(−1.84)	(−1.63)	(−1.37)
<i>LEVERAGE</i>	−0.5586***	−0.5434***	−0.0142	−1.8981	−1.7898	1.5047
	(−4.08)	(−3.98)	(−0.18)	(−0.77)	(−0.69)	(0.39)
<i>LOSS</i>	0.0151	0.0164	0.0546**	0.3559	0.5749	0.1905
	(0.47)	(0.54)	(2.14)	(0.55)	(0.84)	(0.60)
Fixed effects	No	Year	Year & Firm	No	Year	Year & Firm
N	641	645	645	674	676	665
Adjusted R ²	0.390	0.437	0.878	0.102	0.136	0.231

This table presents the impact of regulatory approval on reliability. The dependent variables are operating and maintenance expense scaled by revenue (*O&M*), and the natural log of penalty (*LN_PENALTY*).

***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively, using a one-tailed test.

Table 8
Cross-sectional Test using Commissioners' Experience

Panel A. Revenue				
	SALE_TOT		SALE_RES	
	(1) <i>High</i>	(2) <i>Low</i>	(3) <i>High</i>	(4) <i>Low</i>
TRT × POST	0.0109** (2.02)	0.0240*** (3.19)	0.0105* (1.61)	0.0197** (2.05)
Diff (High-Low)		-0.0131* (-1.43)		-0.0092 (-0.80)
N	313	267	313	267
Adjusted R ²	0.953	0.920	0.944	0.895
Panel B. Reliability				
	AVG_DUR_OUT		AVG_FREQ_OUT	
	(1) <i>High</i>	(2) <i>Low</i>	(3) <i>High</i>	(4) <i>Low</i>
TRT × POST	-39.1938 (-1.04)	-35.6017* (-1.38)	0.0040 (0.02)	-0.0345 (-0.28)
Diff (High-Low)		-3.5920 (-0.08)		0.0385 (0.16)
N	216	244	220	246
Adjusted R ²	0.605	0.280	0.694	0.777
Panel C. Operational Benefits				
	O&M		LN_PENALTY	
	(1) <i>High</i>	(2) <i>Low</i>	(3) <i>High</i>	(4) <i>Low</i>
TRT × POST	-0.0084 (-0.49)	-0.0113 (-0.45)	-1.4883* (-1.64)	1.9085** (1.81)
Diff (High-Low)		0.0029 (0.10)		-3.3968*** (-2.47)
N	357	335	364	351
Adjusted R ²	0.849	0.819	0.162	0.186

This table presents cross-sectional tests using commissioners' experience. Panel A presents cross-sectional results on revenue, and Panel B and C on reliability and operational benefits, respectively. 'High' is for firms whose state commissioner's experience is more than three years and 'Low' for those equal to or below three years. All models include control variables and firm- and year-fixed effects.

***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively, using a one-tailed test.