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Getting what they pay for?
Price, performance, and the political economy of U.S. water utilities[1]

Manny Teodoro
University of Wisconsin-Madison
mteodoro@wisc.edu

Robin Rose Saywitz
Saint Louis University
Robin.saywitz@slu.edu

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Abstract

Political institutions shape how public organizations balance the costs of service provision with the quality of environmental and infrastructure services. This paper develops a theory of institutionally conditioned price–performance tradeoffs, in which regulatory oversight and electoral accountability create distinct incentives for investment, performance, and rate-setting for public and private utility organizations. Under rate regulation, investor-owned utilities seek to increase rate revenue, but must link price increases to capital improvements that improve performance. Government utilities face political pressure to keep rates low, and so policymakers defer investments that might improve performance. These institutional differences generate divergent patterns: prices correlate with performance for investor-owned utilities, but not for government utilities. We offer an initial test of this argument using original national pricing data for local government and investor-owned water utilities, linked to U.S. Safe Drinking Water Act compliance data. Findings demonstrate how institutions shape resource allocation and management in essential public services under government and investor ownership.

[1] Work in progress; questions, comments, and criticism welcome.

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Institutions shape how societies allocate resources, manage environmental risks, and define acceptable levels of public service. Drinking water utilities offer a particularly revealing case: although water systems all seek to provide safe, sustainable, affordable service, the political institutions that govern them can create starkly different incentives to invest, maintain compliance, and set prices. Conventional microeconomic theory predicts a positive correlation between prices and quality for consumer goods, ceteris paribus. However, as natural monopolies, drinking water utilities do not respond to market forces. Instead, in the United States state regulatory agencies control pricing for investor-owned utilities, while local elected officials and public managers determine pricing for government utilities. Building on existing theories of government enterprise, local politics, and utility pricing, we argue that the institutions governing water utilities in the United States result in different price-performance relationships for investor-owned and government water utilities.

Although investor-owned utilities naturally seek to maximize their revenue and profit, their service prices are constrained by state-level regulatory commissions (U.S. Environmental Protection Agency 2010). Under Public Utility Commission (PUC) regulation, investor-owned utilities must justify service prices with investments that support service and must adhere to the PUC's service quality standards. Investor-owned utilities thus have strong incentives to invest in capital, allowing them to raise prices continuously. By contrast, government utilities in most of the United States are "self-regulated," meaning that local elected officials make investment and pricing decisions without PUC review. Political factors, not necessarily performance, determine water utility prices under local government ownership (Mullin 2009; Switzer 2020). Since water customers are also voters, local government officials have strong incentives to minimize prices (Trexler and Mullin 2024), even if service quality suffers to some degree (Lindsay 1976). The result is an ownership-contingent relationship between price and

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performance for water systems in American communities: higher prices mean higher performance for investor-owned utilities, but not government-owned utilities.

This paper makes three contributions to the study of regulatory politics and environmental governance. First, we advance a general framework for understanding how political institutions condition price–performance tradeoffs in essential public services, highlighting the different incentive structures that shape investment and compliance under state regulatory oversight and local electoral accountability. Second, we integrate lines of research on water utility pricing and water utility performance, which have mostly been studied in isolation. Third, linking original national pricing data to regulatory compliance records, we provide an initial empirical test of the price–performance relationship in drinking water systems. These contributions show how institutions can shape the allocation of resources, environmental management, and the political dynamics that govern critical infrastructure.

A note on language. Much of the existing research on water utility ownership uses the words "public" and "private" to distinguish between government-owned and investor-owned systems. However, regulatory and legal conventions can make "public" and "private" confusing terms, since investor-owned firms are regulated by *public* utilities commissions, while government-owned utilities are not. Additionally, a large portion of "private" utilities are owned not by investors, but rather by nonprofit or cooperative organizations. Because we are interested in the economic logic of profit-maximizing firms and the political logic of local governments, we use the terms "investor-owned utility" and "government utility."

Investor-owned vs. government water utilities: price and performance

Research comparing *prices* charged by government and investor-owned water utilities and research on the relative *performance* of government and investor-owned water utilities are

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strangely disconnected from one another. Although the relationship between the performance and prices of goods is a central interest of microeconomics, analyses of the effects of ownership on drinking water quality and prices have paid little attention to the possibility that one might relate to the other. Here we briefly review recent studies that compare prices for government- and investor-owned utilities, followed by the emerging literature comparing performance of government- and investor-owned utilities. Both literatures generally assume—usually implicitly, occasionally explicitly—that drinking water quality and drinking water prices are unrelated to one another. Relaxing this assumption invites examination of the institutional logic connecting quality and price for natural monopolies like drinking water service. Since our empirical interest here is in the institutions that govern and manage water systems in the United States, we restrict this review to studies of American water systems.

Price. A large body of research consistently finds that investor-owned drinking water utilities in the United States are, on average, significantly more expensive than their government counterparts (El-Khattabi, Gmoser-Daskalakis, and Pierce 2023; Teodoro and Saywitz 2020). Investor-owned utilities' profit motive is one explanation for their higher prices: investor-owned utilities must charge customers prices sufficient to earn profit margins after recouping the cost of running the utility (Wait and Petrie 2017). Local government utilities' lower average prices also reflect state and federal grants and subsidies that are typically unavailable to investor-owned utilities (Beecher and Kalmbach 2013). Local elected officials' fear of political backlash also places consistent downward pressure on water prices where local governments run utilities (Hansen, Eskaf, and Mullin 2021; Hansen and Mullin 2022)—a point to which we will return.

Notably absent from these studies on the relative prices of government and investor-owned utilities is the relative *performance* of government and investor-owned utilities in the

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United States. Wait and Petrie (2017) acknowledge a price-performance relationship in developing countries (e.g., Zaki and Nurul Amin 2009), but dismiss the possibility that performance differences could explain observed public-private differences in water prices. "In the United States drinking water standards have already been in place for decades, and must be met by private and public utilities alike," argue Wait and Petrie (2017). "Therefore it is not certain that the higher prices paid by US consumers served by for- profit companies result in better quality or access" (979). The relationship between water utility price and performance in the U.S. remains largely unknown, under both government and investor ownership. Extensive review of the literature yielded just one study, Albrecht et al. (2024), that identified service quality as a potential variable that might affect prices. In their analysis of local government water utilities in Illinois, Albrecht, et al. hypothesize a *negative* relationship between water utility prices and service quality, reasoning that poor service quality might require utilities to raise prices reactively in order to correct service failures.

Performance. Another body of research on drinking water service quality in the United States find that, on average, investor-owned utilities perform better than their government counterparts when utility performance is measured in terms of regulatory compliance. Konisky and Teodoro (2016) argue that investor-owned firms face higher likelihood of enforcement action when they violate environmental regulations, and so are more likely to comply. Meanwhile, government managers must navigate governance processes that stymie robust investment, operations, and maintenance in hopes of avoiding politically unpopular rate increases (see also Scott, Scott, and Greer 2022). Konisky and Teodoro's analysis of Safe Drinking Water Act (SDWA) violations demonstrates that, on average, government water utilities commit more violations than investor-owned utilities; subsequent studies affirm these findings (Allaire, Wu, and Lall 2018; Fu, Liu, and Swallow 2020).

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A few studies find no significant relationship between ownership and performance among American water systems. For example, state-level analyses in Pennsylvania (Statman-Weil, Nanus, and Wilkinson 2020) and California (Acquah and Allaire 2023) find little difference in SDWA compliance under government- versus investor-ownership. Wallsten and Kosec (2008) find that investor ownership has no significant effect on SDWA violations; Montgomery, Lyon, and Zhao (2018) find that size strongly moderates the relationship between ownership and SDWA compliance, with investor-owned utilities performing better as size increases.[2] We are aware of no national studies of drinking water quality that find government utilities outperform investor-owned utilities.

Price-performance tradeoff. We could not identify any peer-reviewed studies that investigate or seek to explain potential tradeoffs between the price and performance of water systems in the United States. This lacuna is surprising because a price-performance relationship appears in most other areas of public policy. For example, local property tax revenue strongly predicts the performance of public schools in the United States (Figlio 1997; Lin and Quayes 2006). Studies of water utility prices and performance point to different institutional incentives for government and investor-owned utility managers as explanations for differences across sectors.

Water utility governance in the United States

Utilities of all kinds (e.g., water, sewer, electricity, gas, and telecommunications) are natural monopolies due to their high fixed costs, large capital requirements, and economies of scale (Viscusi, Vernon, and Harrington, Jr. 2005). In the United States, nearly all water utilities

[2] Importantly, Wallsten and Kosec's analysis includes more than 30,000 very small community water systems (serving populations of fewer than 500), many of which are operated by homeowner associations or nonprofit cooperatives, not investor-owned corporations.

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rely on service fees, rather than taxes, as their principal sources of revenue. As monopolies, water utilities do not face direct market competition and so are prone to inefficiently high prices and poor quality. In order to avoid those inefficiencies, utilities in the United States are subject to government regulation over prices and performance (Breyer 1982).

American utilities are operated by a mix of government agencies and investor-owned firms. According to U.S. Environmental Protection Agency data, about 85 percent of people in the United States who receive drinking water utility service are served by local governments—including municipalities, special districts, and counties—with the remaining 15 percent served by investor-owned firms or nonprofit cooperatives. The political institutions that regulate government-owned and investor-owned utilities create different incentives regarding prices and organizational performance. Here we describe those institutions.

Investor-owned utilities: state utility commissions. State Public Utilities Commissions (PUCs) regulate pricing and performance for investor-owned utilities in most of the United States. PUCs are meant to protect consumers by setting rules for utility performance and especially pricing. PUCs take different institutional forms and names across states, but generally they are composed of 3-7 officials who are either elected or appointed by governors to fixed terms. These commissioners are supported by agencies staffed by attorneys, engineers, economists, administrative law judges, and other experts. Investor-owned utility prices are subject to PUC approval following review by PUC staff and public comment.

The *cost of service* principle constrains prices under PUC regulation (Breyer 1982). According to this principle, the investors who own utilities may only collect from their customers the actual cost of providing service, plus a PUC-approved rate of return on their capital investment. Investor-owned utilities must justify any proposed changes to their prices by accounting for all operating expenses and capital investments. A significant goal of the PUC

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regulatory process is to scrutinize utilities' operating budgets and capital investments in order to ensure that consumers receive high-quality service and to protect consumers from inefficiently high prices.

Compared with the often contentious local government water pricing process, rate setting through PUCs is technocratic and legalistic (Shumway et al. 2024). Utility staff and attorneys file a formal case for their proposed rates to the PUC, supported by economic, engineering, and legal analysis. PUC staff and ratepayer advocates scrutinize these proposals and often argue for lower rates on behalf of utility customers. Members of the public may review and comment on proposed rate changes, as well. The evidentiary and procedural records for these rate-setting processes can easily run to hundreds or thousands of pages of dense, technical analysis. Rate-setting authority ultimately lies with the commissioners, who vote to approve or reject proposed rate changes after reviewing the record. PUC rate processes usually draw little media attention, and their public hearings usually are lightly attended.

Government utilities: local politics. Local governments in the United States that own water utilities operate them as enterprises (Switzer and Teodoro 2025): governments make investment and operational decisions, and bill customers to cover costs. In most circumstances, state laws prohibit local governments from using utilities as profit centers; that is, water rate revenue cannot legally exceed the cost of providing service; rate revenue is supposed to be used only for the water system, not to support other government functions. Beyond these general limitations, however, local governments are effectively self-regulated with respect to investment and pricing for utility services (Corssmit 2011).[3] Under "self-regulation," local

[3] A few states are exceptions: in Indiana, Maine, Pennsylvania, and Rhode Island, some local government utilities also are subject to PUC regulation. Wisconsin is the only state that regulates all local government utilities.

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government legislatures (i.e., city councils, special district boards, or county commissions) set water utility prices as they see fit. Investment and pricing proposals typically originate with water system managers, but elected or politically appointed officials have ultimate authority over these decisions (Hansen and Mullin 2022). Local electoral accountability is supposed to guard against the inefficiently high prices and poor quality that can accompany monopolies.

Because local voters are also water utility customers, and water utility investments and pricing are matters of local politics in much of the United States. As such, water utility prices and performance are shaped significantly by political factors like institutional form (Mullin 2008; Saywitz and Switzer 2023), electoral competition (Allaire and Ignacio 2026), community activism (Glennon 2004), and ideology (Switzer 2020). Water rate setting in local government can be contentious, with considerable media coverage and public involvement, especially when officials contemplate significant rate increases (Hansen, Eskaf, and Mullin 2021; Hansen and Mullin 2022; Martin et al. 2015; Mullin and Hansen 2023a; Postel 1999; Raftelis 2014; Teodoro, Zhang, and Switzer 2020; Trexler and Mullin 2024).

The institutional politics of pricing and performance

The different institutions that govern investor-owned and government water utilities lead to different expectations about the relationship between price and organizational performance for government and investor-owned utilities.

Investor-owned utilities. Cost-of-service pricing principles create strong incentives for investor-owned utilities to invest in their systems. Averch and Johnson's (1962) canonical model of price regulation posits that the PUC-regulated rate of return is less than it would be in a free market, but greater than the cost of capital to the investor. Regulated firms can recover operating costs on a dollar-for-dollar basis but cannot reap a return on labor expenses.

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Consequently, PUC regulation incentivizes capital investment over labor expenditures, as only increases in capital investment increase firm profits. The resulting Averch-Johnson hypothesis is that PUC regulation can lead to rampant over-investing, or "gold-plating" of investor-owned utility facilities.

Although the Averch-Johnson model is foundational in the study of regulatory behavior, there are few direct tests of the model and the results of those tests are inconclusive. Law (2014) provides two reasons why the distorted firm behavior that Averch and Johnson (1962) predict may not emerge in practice. First, regulators are aware of firms' incentives and so curb firms' tendency to overinvest. Both firms and regulators know that obviously excessive capital investments will cause regulators to reject proposed price increases (Burns and Riechmann 2004). Second, Law (2014) points out that capital investments and labor expenditures are as much complements as they are substitutes. Under Averch-Johnson, regulation incentivizes firms to substitute capital for labor because they cannot earn a return from labor investments. However, the Averch-Johnson model does not account for the post-installation period, when firms will likely need to further invest in labor to run and maintain additional investments in capital (Law 2014). The higher labor costs associated with marginal increases in capital investments yield no marginal profit to the investor. Labor expenses are recoverable under cost-of-service regulation, but in practice, ever-increasing labor costs and their attendant rate increases risk the ire of PUCs that are charged with ensuring efficient service delivery (Burns and Riechmann 2004).

Thus, investor-owned utilities are unlikely to overinvest in infrastructure to the point where the investments serve no practical purpose. Instead, profit incentives and regulatory constraints, along with relatively low public attention, encourage investor-owned utilities invest in capital proactively in ways that maintain or improve service.

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Government utilities. The politicians and managers who operate government utilities face very different incentives and constraints. In addition to the capital and operating costs associated with running a utility, public managers face political costs when making investment decisions: utilities must justify higher prices to politicians and a wary public (Konisky and Teodoro 2016). Since many water customers are also voters who prefer lower prices, raising water rates can carry significant electoral risk for local politicians (Hansen, Eskaf, and Mullin 2021; Martin et al. 2015; Mullin and Hansen 2023; Postel 1999; Teodoro, Zhang, and Switzer 2020; Timmins 2002). Local politicians fear being voted out of office for supporting rate increases; by extension, government managers fear public anger at proposing rate increases.

Lindsay (1976) argues that governments tend to perform well in ways that are apparent to politicians and the public but have little incentive to invest in outputs that are less visible. For example, Lindsay explains, the number of enrolled students is a highly visible metric for public universities, whereas instruction quality is less apparent and harder to measure. Therefore, universities invest in metrics that politicians can see (e.g., the number of engineering degrees conferred), rather than in instructional quality (e.g., the quality of engineering graduates). "[The] increase in the quality of government enterprise output increases the 'unit' cost of the product. The increase in the quality may not be apparent to the elected officials," argues Lindsay (1976). But "The increase in cost almost certainly will be" (1076). The result, according to Lindsay, is that government enterprises tend to provide inefficiently low-quality, low-cost services.

In the case of water, we argue that differences in the observability of price and performance lead to lower prices but also poorer performance for government utilities compared with investor-owned utilities. Apart from acute failures, most consumers cannot easily gauge how well their water utilities are managed. Conversely, most utility customers see

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the price of water in their monthly bills. In theoretical terms, citizen-customers and their elected officials observe *price* with high certainty but observe utility *performance* with low certainty. As a result, government utilities have strong incentives to keep prices low rather than to make the kinds of expensive investments that improve performance but also raise rates (Hansen and Mullin 2022). Local governments will raise prices to pay for capital investments only when utility performance deteriorates to a point where it is noticeable to the public and so becomes politically salient (Mullin and Hansen 2023). Indeed, Barnes, Koebele, and Deslatte (2025) suggest that local governments may seek to privatize water operations in part to avoid public scrutiny about prices and performance. These institutional incentives imply that the relationship between price and organizational performance should vary systematically by ownership.

Implications for price and performance by sector. At least two hypotheses emerge from the established literature and our institutional theory of ownership, price, and performance. The first is a straightforward expectation:

> **Hypothesis 1 | Price and performance:** as water service prices increase, utility management quality improves.

This proposition simply applies the conventional logic of resources and performance: an organization with more funds will perform better, ceteris paribus.

Our second hypothesis follows from our core argument about the institutional incentives and constraints for utility pricing and management under government or investor ownership.

> **Hypothesis 2 | Ownership-contingent price and performance:** the positive relationship between water service price and management quality is stronger for investor-owned utilities than for government utilities.

Compared to local government utilities, investor-owned utilities have greater incentives and

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more political latitude to raise prices pursuant to operational and capital improvements. For government utilities, the combination of highly observable prices and poorly observable discourages performance proactive investment. Government utilities will suppress rate increases until performance deteriorates (Hansen and Mullin 2022), and then increase prices after failures prompt renewed investment to return to compliance (Albrecht et al. 2024). Local governments' more reactive investment mutes and obscures the price-performance relationship.

Analysis: water pricing and SDWA management compliance

Here we analyze the relationship between water utility prices and management performance in the United States as an initial test of our expectations about the institutional politics of water investment. To that end, we combine original water pricing data with administrative data from the United States Environmental Protection Agency (EPA).

Performance: Safe Drinking Water Act compliance

Our measure of utility performance is compliance with the SDWA over a two-year period, which we draw from the EPA's Safe Drinking Water Information System (SDWIS). SDWIS maintains comprehensive data on a variety of system characteristics and SDWA compliance for every community water system in the United States[4]. Over the past decade SDWA compliance has emerged as a common means of analyzing water utility performance (M. Allaire, Wu, and Lall 2018b; Statman-Weil, Nanus, and Wilkinson 2020b; Teodoro and Switzer 2016). Unlike other organizational goals like financial performance or public support, SDWA compliance is a universal and uniform goal for water utilities. Further, all American

[4] SDWIS has received significant scrutiny as a data source, owing to coding problems and fragmented reporting processes (Beecher, Redican, and Kolioupoulos 2020). A 2011 audit of SDWIS found that states tend to under-report violations but did not identify any systematic bias in reporting (GAO 2011). For present purposes, random errors in reporting inflate error terms in estimation, which biases analysis in favor of a null finding, but should not cause bias in parameter estimation.

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water systems are formally subject to similar regulatory requirements under the SDWA, regardless of ownership. Thus, SDWA compliance is especially useful for comparative analysis of government- and investor-owned utilities (Fu, Liu, and Swallow 2020b; Wallsten and Kosec 2008b).

The SDWA imposes dozens of rules concerning water quality and administrative procedures. EPA's categorization scheme and much of the empirical literature on SDWA implementation analyze violations separately in two categories: *health* violations and *management* violations. Health violations relate to chemical and biological contaminants that may endanger human health. Compliance with SDWA health requirements is of paramount importance from a public policy perspective. However, health compliance is problematic as a measure of *organizational* performance because health violations can occur for reasons that are beyond the control of utility managers. Source water varies considerably in initial quality and vulnerability to pollution from industrial or agricultural sources (Levin, et al. 2002). Natural disasters and unforeseeable accidents can also cause health violations in ways that do not necessarily reflect organizational failure (Exum et al. 2018).

In contrast, *management* violations relate to the SDWA's requirements for testing, record-keeping, and public communications. Compliance with these rules requires no advanced technology and does not involve water quality directly; rather, compliance with management rules means executing specified procedural tasks in a timely manner. Violations of SDWA's management regulations typically involve failure of utility personnel to test water samples properly, keep adequate records, file required reports to regulators, or communicate water quality information to the public. Compliance with SDWA management rules is entirely a function of organizational capacity and management practices, not source water quality, natural disasters, or environmental hazards. In this way, compliance with SDWA management rules

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offers a better indication of a water utility's *organizational* performance than compliance with SDWA's health rule (Teodoro 2014).

Price: monthly residential water bills

An ideal evaluation of our theory would employ a panel of pricing and performance data for a large number of utilities over decades; unfortunately, such data do not exist. No comprehensive, national, publicly available dataset on United States water and sewer prices currently exists. Consequently, studies of water prices are almost entirely cross-sectional and typically include only large utilities or specific states or regions (Beecher and Kalmbach 2013; El-Khattabi, Gmoser-Daskalakis, and Pierce 2023; Hansen, Eskaf, and Mullin 2021). Others rely on secondary compilations of prices or rely on proprietary datasets made up of convenience samples (Standard & Poor's 2018) or non-random, skewed samples (Mack and Wrase 2017). Inferences drawn from biased samples risk under- or over-estimating prices with errors of unknown direction and magnitude.

To overcome these problems, we use original data from a randomized, stratified sample of United States community water systems gathered from 2019-2023. We used SDWIS to define our sampling frame, since it contains basic system information and regulatory compliance data for each of the roughly 50,000 community water systems in the United States. More than 80 percent of these systems are very small, serving populations of less than 3,300. Collectively these small systems provide water to just eight percent of the U.S. population that receives water utility service. Meanwhile, the largest 500 water utilities serve nearly 60 percent of the U.S. population. A purely random sample from SDWIS would likely result in a sample of mostly utilities with populations less than 3,300 and very few utilities medium and large utilities. Thus, simple random sampling would likely provide little information about the

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systems that serve most of the U.S. population, and insufficient information to make valid comparisons of investor- and government-owned utilities.

In order to obtain a representative sample that provides empirical leverage on water utility service prices, quality, and ownership, we use a sample that stratifies water systems by both ownership and size. We began by splitting the SDWIS dataset into government-owned and investor-owned utilities. Utilities serving United States territories, tribal communities, and federal installations such as military bases were excluded. We then divided the government and investor-owned sets into the six strata that EPA uses to classify water systems. The smallest two strata (systems serving fewer than 3,300 population) were dropped from the sample due to the difficulty of securing reliable pricing data for these very small systems and because they collectively serve a very small population. We drew random samples of 82 government utilities and 22 investor-owned utilities from each of the remaining four population strata (3,330-10,000; 10,001-50,000; 50,001-100,000; >100,000). Each utility was reviewed individually to ensure that its ownership and governance classification in SDWIS was correct. The final sample of utilities served a total population of 43.7 million in 2019. [5] Water utility price data were collected for all utilities in the 2019 sample, and then the collection procedure was repeated for the same set of utilities in 2021 and 2023.

We measure water price as the monthly price of water utility service for single-family residential customers. The focus on single-family residential customers is consistent with literature on the political economy of water pricing, since residential customers are the majority of customers in most United states water utilities. More importantly for the present analysis, residential customers are also citizens who are may respond politically to water prices (Hansen,

[5] Sampling frame and sample information is reported in the Appendix.

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Eskaf, and Mullin 2021; Mullin 2008; Switzer 2020).

Data collection. We collected single-family residential water prices directly from the sampled utilities in three waves, over the spring and summer months, in 2019, 2021, and 2023. The final set of utilities with complete data includes 414 of the 416 sampled utilities. The final sample includes a total of 1,234 observations across the three time periods.[6] Instead of calculating prices at a single benchmark volume, we gathered full rate structure information and calculated prices at volumes ranging from zero to 18,000 gallons monthly. During the period of analysis, average monthly residential water consumption in the United States was about 7,300 gallons per month (DeOreo et al. 2016).

Comparative prices and organizational performance

The ideal estimation procedure for evaluating the price-performance dynamics hypothesized here would be to measure price and performance changes over decades for investor-owned and government utilities. As in nearly all other published research on the correlates of water pricing, the present inquiry is limited to a pooled cross-sectional analysis across three biennial waves. Although we have repeated observations of the same utilities over time, we use a pooled-time series approach because we have just three time periods. With such a limited timeframe, most traditional time series estimation techniques (e.g. unit-level fixed effects or two-way fixed effects) are inappropriate. This approach cannot provide direct causal evidence, but it offers some leverage on the present hypotheses insofar as the observed 2019, 2021, and 2023 prices are contemporaneous with or in advance of SDWA compliance in 2019-2020, 2021-2022, and 2023-2024. To account for temporal variation, we included cross-sectional indicators in model estimates. Finally, we cluster standard errors at the utility-level to account

[6] Rates for a handful of utilities proved impossible to find in the 2021 and 2023 waves of data collection, resulting in a total of seven missing observations.

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for within-utility error correlation. Given the limitations of this estimation procedure, evidence consistent with our hypotheses should be considered suggestive rather than conclusive, providing a promising foundation for further evaluation of the dynamic process that we expect drives the cross-sectional correlations.

Following other studies on SDWA compliance, we model compliance as a 0/1 state over a given period of time, with utilities that commit no violations coded as compliant and utilities that commit one or more violations coded as non-compliant (Bennear and Olmstead 2008; Cory, Rahman, and Aradhyula 2012; Guerrero-Preston, Rafael et al. 2008; Montgomery, Lyon, and Zhao 2018). We fit logistic regressions that estimate the likelihood of full SDWA management compliance over each two-year period. The main independent variables of interest are price and ownership. Inverse probability post-stratification weights were applied in estimation order to offset biases introduced with stratified sampling.

The analysis presented here measures *monthly prices* for single-family residential water service at 7,000 gallons, which approximates average household monthly water consumption in the United States during the period of analysis (DeOreo et al. 2016). Ownership is coded 1 for *investor-owned* systems and 0 for government-owned systems. This simple binary coding of ownership obscures potentially important differences in investment and rate-setting decision processes. State PUCs vary in approaches to rate regulation, politicians vary in their tolerance for rate increases, and some local government institutions might facilitate steadier long-term investment. However, such unobserved variation is effectively measurement error in the present analysis, and so biases estimation in favor of a null finding.

Our estimates control for some utility characteristics coded in the SDWIS that are expected to correlate with SDWA compliance based on prior research. In addition to government versus investor ownership, we include a 1/0 dummy for *special district* governance

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structure, since prior research has demonstrated that special district utilities are, on average, more compliant with the SDWA than municipal utilities (Saunders, Johnson, and Shelton-Davenport 2021). Utility size is a consistently strong and positive correlate of SDWA compliance in past research, so we control for size with the natural *log of service population* in 2019. We include indicators coded 1 for utilities that employ *groundwater* as their primary source (0 for surface water), and 1 for utilities that *purchase* wholesale water supplies (0 for own-source water). Table 1 provides a descriptive summary of the data employed in the analysis.

Table 1: Summary statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
Full SDWA management compliance in a two-year period	0.77	10.30	0.00	1.00
Monthly residential price*	51.21	24.83	6.65	177.47
Investor-owned utility (1/0)	0.14	0.35	0.00	1.00
Special district (1/0)	0.26	0.42	0.00	1.00
Service population	31,768.31	10,8327.80	3,315.00	2,319,603.00
Ground water (1/0)	0.48	0.50	0.00	1.00
Purchased water (1/0)	0.30	0.46	0.00	1.00

Note: N=1,228. Parameters reflect post-stratification weighting.
*Single-family residential price at 7,000 gallons per month.

Table 2 reports odds ratios from logistic regression models of the likelihood of SDWA management compliance in a two-year period as a function of monthly price at 7,000 gallons, utility ownership, and other controls. Two models are presented: Model A includes only direct correlates of SDWA compliance, which allows us to test Hypothesis H1; Model B includes a *price x ownership* interaction term to evaluate the ownership-contingent Hypothesis H2.

Concerning endogeneity. Potential endogeneity with respect to water system ownership merits brief discussion here. It is possible that regulatory compliance challenges

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might cause investor or government ownership of water utilities in different communities. There is some evidence that problems with regulatory compliance drive the privatization of municipal water systems, and sometimes the municipalization of investor-owned systems (Barnes and Powell 2026; Lyon, Montgomery, and Zhao 2017). If so, then differences in source water quality, not governance institutions, could account for public-private differences in SDWA compliance observed here. However, changes in utility ownership are rare, ownership of the utilities analyzed here was determined decades ago, and none of the utilities in the present study changed ownership during the decade preceding the period of analysis. Moreover, our analysis of SDWA *management* compliance allays concerns over ex ante differences in utilities' source water or other community characteristics that might affect the price-performance relationship. The SDWA's management rules are purely procedural and have nothing to do with source water quality or community characteristics, so compliance reflects organizational performance apart from environmental conditions.

Results

Model A finds no meaningful relationship between monthly price of water service and management performance when estimated with direct correlates only; we cannot affirm Hypothesis 1. This null result contravenes naive intuition, as higher average prices might be expected to drive stronger average performance, ceteris paribus. Consistent with past research, Table 2 results indicate that investor-owned water utilities perform better than their government counterparts with respect to SDWA compliance. With all other variables at their means, Model A indicates that investor-owned utilities have a .87 probability of maintaining full SDWA management compliance over a two-year period, compared to a .75 probability for government utilities.

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Table 2: Estimated SDWA management compliance over a two-year period

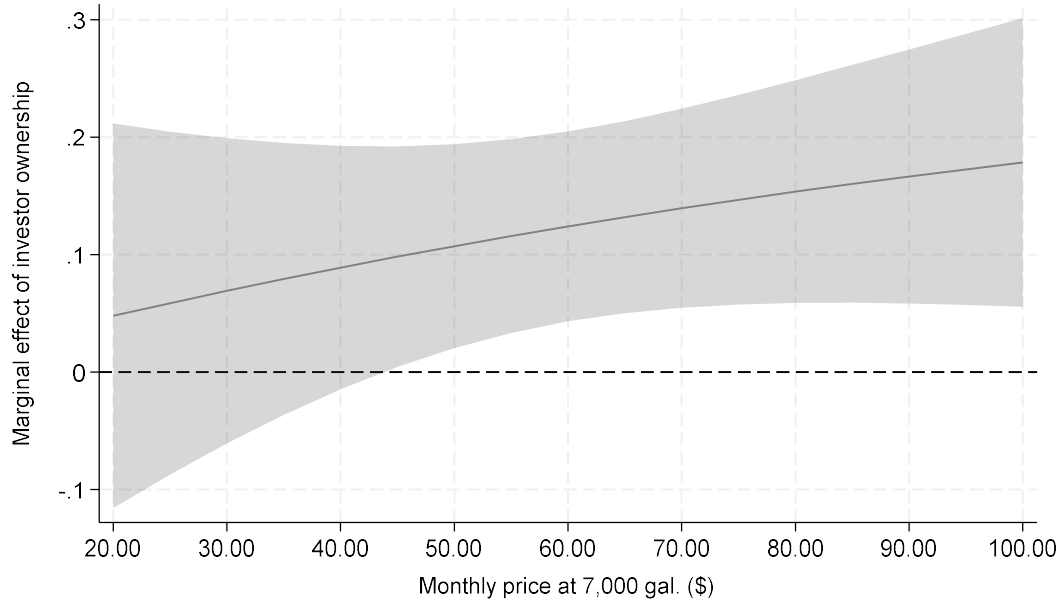
	Model A		Model B	
	Odds Ratio	p	Odds Ratio	p
Price	1.00	0.83	1.00	0.86
Investor-owned utility	2.24	0.02	1.00	1.00
Investor-owned utility x price			1.01	0.19
Special district	1.52	0.18	1.52	0.18
Population served (log)	1.10	0.33	1.10	0.33
Ground water	1.43	0.21	1.45	0.19
Purchased water	1.82	0.04	1.85	0.04
Year 2023	0.74	0.10	0.73	0.10
Year 2021	1.26	0.22	1.26	0.23
Constant	0.79		.85	
Observations	1228		1228	
Wald X^2	24.26		21.42	
$p > X^2$	<.01		<.01	
Log Likelihood	-672.11		-671.47	

Note: Table reports odds ratios and p-values generated by logistic regression. The estimates reflect post-stratification weighting; see Appendix A. Standard errors are clustered at the utility-level.

Inclusion of the interaction term in Model B generates results consistent with our expectations about an ownership-contingent relationship between price and performance (Hypothesis H2): SDWA management compliance increases as price increases for investor-owned utilities, but not for government utilities. Maximum likelihood coefficients with interaction terms are difficult to interpret substantively, as they require joint evaluation of three or more variables simultaneously (Brambor, Clark, and Golder 2006). To ease inference, Figure 1 depicts the estimated marginal effect of ownership on the likelihood of SDWA management compliance over the price of 7,000 gallon monthly residential water service, with all other variables evaluated at their means. Figure 2 shows resulting estimated likelihood of SDWA management compliance by ownership over price for government and investor-owned utilities.

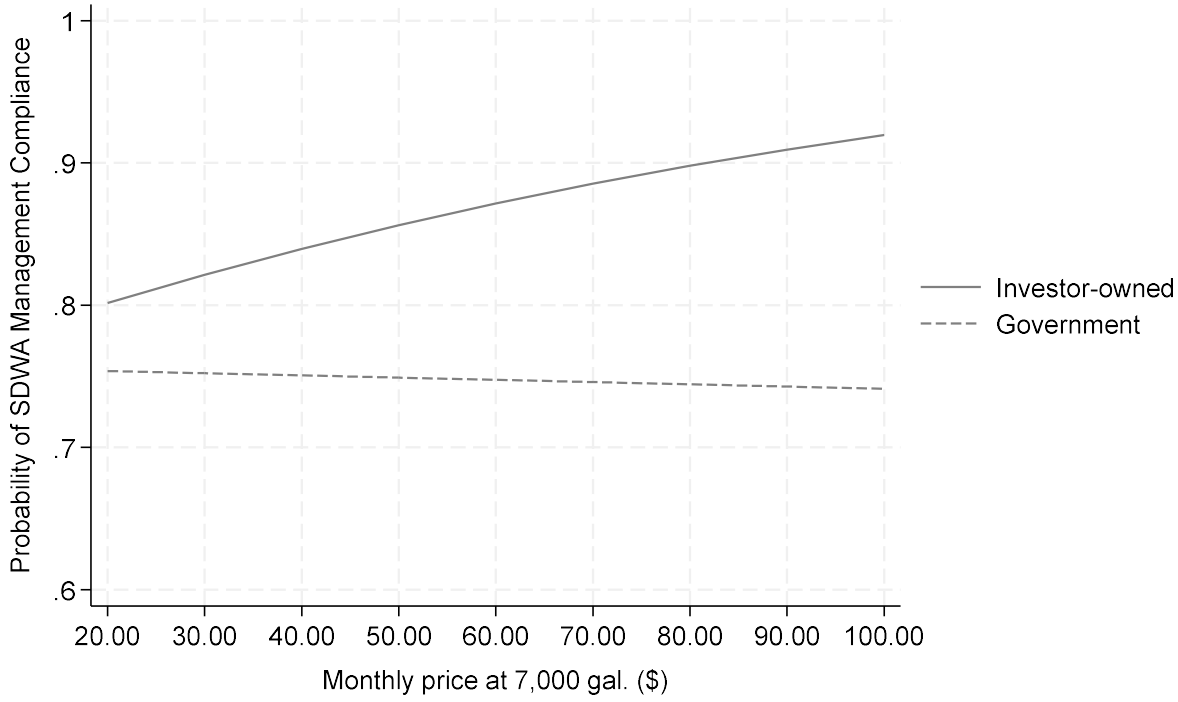
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Figure 1: Marginal effect of investor ownership on probability of full compliance with SDWA management regulations in a two-year period over monthly price



Note: Estimates based on Model B. Other variables evaluated at their means.

Figure 2: Estimated probability of full compliance with SDWA management regulations in a two-year period over monthly price



Note: Estimates based on Model B. Other variables evaluated at their means.

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Figure 1 shows that the ownership performance gap increases as prices increase: there is little difference in SDWA violations by ownership at prices below $45 for 7,000 gallons monthly, but investor-owned utilities outperform government utilities as prices increase toward $50 and higher. The direct comparison of estimated violations for investor-owned and government-owned utilities in Figure 2 clarifies the substantive significance between government and investor-owned utilities: compliance is effectively flat across the range of prices for government utilities, but increases markedly as prices increase for investor-owned utilities.

Taken together, these results are consistent with Hypothesis H2's conditional prediction about the relationships between price and ownership for government-owned and investor-owned water utilities. Operating under regulatory commissions that impose cost-of-service pricing, investor-owned water utility managers have strong financial incentives to invest proactively in capital and operations. The positive correlation between service prices and performance reflects this dynamic. The striking lack of correlation between price and performance for government utilities is also consistent with our expectations about the political economy of local government water service pricing. If governments resist rate increases due to democratic pressure, then investment in utility infrastructure and organizations will be minimal and often occur in reaction to failures or regulatory pressure.

Discussion

Our study illustrates how utility ownership may condition the relationship between price and quality of water utility performance in the United States. Broadly, as prices increase, the organizational performance of investor-owned utilities also increases. This positive relationship does appear for government utilities.

We argue that the relationship between price and performance differs between

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government and investor-owned utilities in part because the institutions that govern and regulate them create different incentives and constraints for spending on capital, operations, and maintenance. The profit motive incentivizes investor-owned utilities to invest in ways that maintain or improve service quality and organizational performance. The price increases that follow investor-owned firms' investments are largely insulated from public opposition because a legalistic, technocratic regulatory process determines their rates (Barnes and Powell 2026). By contrast, politicians constrain government utilities' capital and operational investments, since those investments usually require price increases that politicians eschew due to popular resistance. Since water's price is more visible to the public than its quality, politicians have little incentive to raise prices until water systems are on the brink of failure or actually fail (Hansen and Mullin 2022). Such a spasmodic, reactive approach to pricing muddies the price-performance relationship.

Limitations and future research. As noted earlier, this study's main empirical limitation is the structure of our data. Our theory's proactive/reactive logic of utility investment, pricing, and quality is fundamentally dynamic. Although our pooled cross sectional results are consistent with that logic, it is possible that unobserved dynamics are driving the price-performance relationships for utilities; each wave in our study only covers a two-year period and we only have three waves in total. It is possible—perhaps likely—that, after performance falls far enough, government utilities invest in capital improvements, raise their prices, and the same price and quality relationship present in investor-owned utilities emerges in the long term. A panel analysis that examined within-utility price and quality data over a much longer timeframe would provide much better leverage on our theory. As such, the present findings should be regarded as suggestive, not conclusive.

Evaluating our theory in time series might illuminate other temporal and spatial

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dynamics that might be embedded in the observed price-performance relationship, as well. Although utilities are natural monopolies, it is possible that neighboring utilities influence their prices and quality, for example, due to formal and informal information and resource sharing arrangements.

Beyond a longer panel data analysis, future work should also investigate further the specific mechanisms at work in utility investment and pricing. Customers' understanding of their water quality, how they view price increases, and their willingness to pay for higher quality water all contribute to the dynamics that we theorize. Politicians' and regulatory commissioners' logics of ratemaking also deserve closer analysis (see, for example Hansen, Eskaf, and Mullin 2021; Mullin and Hansen 2023). Finally, the logic advanced here in the context of water could apply to other public enterprises, such as electricity, gas, telecommunications, state universities, and more.

Conclusion. Perhaps the most frequent charge levied against investor ownership of drinking water utilities is that investor-owned water systems' profit motive means higher prices and worse affordability compared with government-owned systems (Food & Water Watch 2016). That critique relies on an implicit assumption that no drop in performance accompanies lower prices. Meanwhile, privatization advocates point to investor-owned utilities' superior regulatory compliance (Truth from the Tap 2018). The private sector's stronger performance is chalked up to superior organizational capacity and stronger regulatory oversight, with little attention to the potential implications of ownership for pricing (Konisky and Teodoro 2016).

Careful consideration of the institutions that govern water utility pricing in the United States complicates these claims. Our theory and this initial empirical inquiry suggest that water utility price and performance are positively related, just as they are with other collective goods and services. However, the institutions responsible for investments and rate-setting condition

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the price-performance relationship. For government-owned utilities, politics drive decisions in ways that confound the relationship between customers' bills and utilities' performance. Under regulation, investor ownership strengthens the link between water utility prices and performance. Future research comparing public and private sector costs for public service delivery ought to account for performance, and comparisons of government agency and private firm performance ought to account for costs.

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Appendix: Sampling frame and sample details

Table A1. Sampling frame and sample

	Frame *All US community water systems*		Sample *Randomly sampled by stratum*	
Population stratum	Utilities	Population Served	Utilities	Population Served
Government utilities				
3,301-10,000	4,986	24,514,115	82	492,683
10,001-50,000	3,328	61,757,184	82	1,768,576
50,001-100,000	564	33,876,416	82	5,522,615
100,001-250,000	434	124,277,336	82	29,331,737
Investor-owned utilities				
3,301-10,000	500	2,869,559	22	111,987
10,001-50,000	339	7,573,436	22	461,115
50,001-100,000	60	4,351,237	22	1,521,641
100,001-250,000	59	15,570,818	22	4,480,789
TOTAL	10,270	274,790,101	416	43,691,143