Cost Information Transmission in Regulation

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August 2018

Abstract

In rate-of-return regulation, a firm applies to the regulator for a revenue increase that is supposed to reflect its increased costs. I prove that for a risk-neutral firm, the only equilibrium that can exist is the one in which there is no cost information transmission from the firm to the regulator. I argue that this equilibrium is consistent with empirical results from Florida that there seems to be no association between the firm's allowed-revenue increase and the change in its future operating cost.

Keywords: Rate-of-Return Regulation; Cost Reporting; Rate Increase.

JEL Classification: L51 Economics of Regulation.

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1 Introduction

Rate-of-return regulation (ROR regulation) is the traditional form of regulation of public utilities firms that provide essential services like electricity in the US and Canada. Under this regulatory regime, a regulatory commission holds a formal hearing in which the regulated utility and other interested parties give testimony. After consideration of the testimonies, the commission sets the prices of the utility to generate enough revenue to cover its costs and also provide a fair rate of return on its rate base (the book value of the firm's capital investment less depreciation). One type of rate case called company-request cases occur when the utility applies for a rate increase to the commission. The utility usually requests a revenue increase because of increasing costs. The subject of this study is the relationship between the firm's revenue-increase request that is supposed to reflect its projected increased costs and the actual increase granted by the regulatory commission in such company-request cases.

Beginning with the seminal works of Baron and Myerson (1982) and Laffont and Tirole (1986), there has been a substantial theoretical literature on the regulator's problem of the design of an optimal regulatory policy when faced with the unobservability of the firm's costs, and how the insights gained from these studies relate to actual regulatory practices. In this literature, the optimal regulatory policy is designed such that the firm always reveals its true costs. In some of these studies, a simpler regulatory contract that is easier to implement is then formulated guided by the design of the optimal regulatory contract (for example, Rogerson 2003 and more recently, Abito

2017).

In contrast to the theoretical literature, the scant empirical analyses on the relation between a regulated firm's cost reporting and the firm's allowed revenue has examined the effect the firm's requested rate of return has on the final allowed rate of return. These studies have assumed that it is the firm's cost reporting that affects the firm's rate of return, and not the regulator-designed rate schedule that affects the firm's cost reporting as is the theoretical approach. Four such studies are Joskow (1972), Roberts et al. (1978), Bae-Geun et al. (1988) and Bae-Geun et al. (1989). All four papers analyze how a firm's allowed rate of return is affected by the rate of return requested by the firm. Joskow (1972), Bae-Geun et al. (1988) and Bae-Geun et al. (1989) find that a firm's allowed rate of return is positively associated with its requested rate of return. Roberts et al. (1978) re-estimates the econometric models of Joskow (1972) and another closely-related paper (Joskow, 1973) using more sophisticated econometric techniques and data from public utilities firms in Florida. This study also finds a positive relationship between the firm's allowed and requested rates of return. Additionally, Joskow (1972), Roberts et al. (1978) and Bae-Geun et al. (1988) estimate what factors affect a firm's requested rate of return. All three analyses find that a firm's requested rate of return is associated positively with the different measures of the firm's cost of capital used in each of the studies.

In this paper, I show that if a regulated firm is risk neutral then the only equilibrium that can exist is that in which there is no meaningful cost information transmission from the regulated firm to the regulator. That is, there is no equilibrium in which the regulator can credibly discern any level of the firm's true increase in future operating costs from the firm's signal in the form of a requested-revenue increase. Therefore, the only possible equilibrium is in which the regulator ignores the firm's requested-revenue increase, and sets the actual revenue increase according to her prior belief about the firm's increase in future operating costs.

Then using company-request rate case data from the Florida Public Service Commission (FPSC), the regulatory commission responsible for regulating investor-owned public utilities firms in Florida, I estimate reduced-form econometric models on the factors affecting the regulated firm's requested revenue increase, the regulated firm's revenue increase allowed by the regulator and the fraction of the requested-revenue increase allowed by the regulator (i.e. the allowed-revenue revenue increase divided by the requested-revenue increase). This is the first empirical analysis, to my knowledge, that uses the actual revenue increase requested by the firm and granted by the regulator rather than rates used in previous analyses that study the determinants of the regulator's decision. I believe that using actual revenue increases provides a better measure of whether cost information transmission occurs, and a better measure of how regulators react to firms in general than rates because there is evidence to suggest that regulators allow higher rates of return to firms whose rate base they believe to be undervalued (for example, see Eiteman 1962 and Petersen 1976). Hence, estimations done in terms of revenue increases capture the entire effect of a firm's cost reporting on the regulator.

My results are similar to previous studies in that I find a positive statistically significant relationship between the firm's requested-revenue increase and change in future operating cost, and the firm's allowed- and requested-revenue increases. I argue that these findings are consistent with the no-cost-information transmission equilibrium if we interpret the firm's request as a proxy for the regulator's unobserved belief about the firm's cost structure rather than the request conveying any information to the regulator by itself. In so doing, I also offer an alternative explanation to the results of Joskow (1972), Roberts et al. (1978), Bae-Geun et al. (1988) and Bae-Geun et al. (1989). To support this argument, I show that the allowed-revenue increase does not vary with a change in future operating cost whereas the requested-revenue increase varies positively. Consequently, the fraction of the requested-revenue increase allowed by the regulator has a negative association with the change in the firm's future operating cost.

The analysis proceeds as follows. Section 2 proves the unique existence of a no-cost-information transmission equilibrium, Section 3 formulates the reduced-form econometric models to be estimated, Section 4 discusses the data, Section 5 presents and explains the results, and Section 6 concludes.

2 Theory

To model the interaction between a regulated public utilities firm and a regulator, I use the framework developed by Crawford and Sobel (1982). I believe their model of strategic information transmission is the most appropriate to model the repeated interactions between a regulated public utilities firm and a regulatory commission. In the model, there is a risk-neutral natural monopolist (F) that supplies an essential service like electricity and a regulator (R) that determines the revenue the monopolist is allowed to earn.

There are three time periods t in which the interaction between F and R occurs: $t = 0, 1, 2$. When $t = 0$, F accurately determines its increase in its future total cost, ΔC. However, R does not observe ΔC. In $t = 1$, F applies to R for a revenue increase of $\hat{r}$ to compensate it for its projected higher costs. In the last period of the interaction $t = 2$, R observes $\hat{r}$ and determines the revenue increase, r, according to the function $r(\hat{r})$ that F is allowed.

If R could observe ΔC, then it would set r equal to $\tilde{r}$ according to the deterministic, continuous, and increasing function $g(\Delta C)$: $\tilde{r} = g(\Delta C)$ where $g'(\Delta C) > 0$. Although R cannot observe ΔC, she has a belief represented by the uniform probability density function $h(\tilde{r})$[1] that the $\tilde{r}$ that corresponds to ΔC falls in the range $[\underline{r}, \overline{r}]$. $H(\tilde{r})$ is the probability cumulative function that corresponds to $f(\tilde{r})$. F's profit function after ΔC is realized $\pi(r)$ is given by:

$$\pi(r) = \pi_0 + r - \Delta C, \tag{1}$$

where π_0 is F's present profit in Equation (1). F observes ΔC in $t = 1$ and therefore, also knows $\tilde{r}$. Consequently, F applies for $\hat{r}$ based on $\tilde{r}$. F's strategy can thus be represented by the function $\hat{r}(\tilde{r})$.

In the following two lemmas and proposition, I prove that the only equilibrium that can exist in the game described above is one in which there is no meaningful information transmission. I use the concept of sequential equi-

[1]The results are unchanged if a different probability distribution is assumed.

librium as developed by Kreps and Wilson (1982). A sequential equilibrium consists of the strategies of F and R and R's belief system about $\tilde{r}$ called an assessment. The two conditions required for an assessment to be a sequential equilibrium are sequential rationality and consistency. Sequential rationality means both players' strategies are optimal given their beliefs. Consistency means that R's beliefs are consistent given the strategies of both F and R. Lemma 1 states that there exists a sequential equilibrium in which there will be no cost information transmission from F to R.

Lemma 1. *In a strategic information transmission game in which a risk-neutral regulated monopolist firm F sends a signal in the form of a requested-revenue increase $\hat{r}$ to reflect its increase in future total cost ΔC to the regulator R, there will exist a sequential equilibrium in which there is no cost information transmission from F to R.*

Proof. Consider F's requested-revenue increase function to be $\hat{r}(\tilde{r}) = \overline{w}$ where $\overline{w}$ is a positive constant. This implies F's requested-revenue increase is not dependent on $\tilde{r}$ and therefore, also ΔC. For such a strategy of F, consistency requires R maintain her prior belief $h(\tilde{r})$ that she had even after observing $\hat{r}$. Therefore, R's optimal strategy is her expected value of $\tilde{r}$, $E(\tilde{r})$: $r(\hat{r}) = E(\tilde{r})$. $E(\tilde{r})$ is calculated below:

$$\begin{aligned} E(\tilde{r}) &= \int_{\underline{r}}^{\overline{r}} z h(z) \mathrm{d}\tilde{r} \\ &= \frac{\overline{r}^2 - \underline{r}^2}{2(\overline{r} - \underline{r})}. \end{aligned} \tag{2}$$

The consistency requirement does not constrain R's beliefs if she receives a requested-revenue increase other than $\overline{w}$ from F because such a request never comes if players follow their strategies. We can assume that R completely ignores F's request whatever it is. This means $r(\hat{r}) = E(\tilde{r})\ \forall\ \hat{r}$. Hence, the assessment $(E(\tilde{r}), \overline{w}, h(\tilde{r}))$ is a sequential equilibrium and represents the no-cost-information transmission equilibrium. □

In Lemma 2, I prove that there can never be a sequential equilibrium in which R can receive any meaningful information about ΔC from $\hat{r}$.

Lemma 2. *In a strategic information transmission game in which a risk-neutral regulated monopolist firm F sends a signal in the form of a requested-revenue increase $\hat{r}$ to reflect its increase in future total cost ΔC to the regulator R, there will never exist a sequential equilibrium in which there is some cost information transmission from F to R.*

Proof. Suppose there exists a sequential equilibrium with some cost information transmission from F to R. One such equilibrium is if F applies for a requested-revenue increase of $\hat{r}_1$ if $\tilde{r}$ is in the set A_1 and a different requested-revenue increase of $\hat{r}_2$ if $\tilde{r}$ is in the set A_2. For there to be any information transmission, it must be that $\hat{r}_1 \neq \hat{r}_2$, and A_1 and A_2 must be disjoint sets whose union is the set of all $\tilde{r}$ in the interval $[\underline{r}, \overline{r}]$ i.e. $A_1 \cup A_2 = \{\tilde{r} : \tilde{r} \in [\underline{r}, \overline{r}]\}$. Consistency would require R to believe that $\tilde{r}$ was in A_1 when she observes $\hat{r}_1$ and $\tilde{r}$ was in A_2 when she observes $\hat{r}_2$. Given this belief, sequential rationality would imply that R's strategy would be $r_1 = r(\tilde{r}_1)$ and $r_2 = r(\tilde{r}_2)$ where r_1 and r_2 are the expected values of $\tilde{r}$ in A_1 and A_2 respectively. Suppose that $r_1 > r_2$, then it is not optimal for F to request the revenue increase

r_2 when $\tilde{r}$ is in A_2 because it can increase its profit by requesting r_1. This proves that there can never be a sequential equilibrium in which the strategy of R involves having at least two different allowed-revenue increases because it is always in the best interest of the risk-neutral F to request the revenue increase that will result in the highest allowed revenue.[2] Therefore, there can never be a sequential equilibrium in which there is any cost information transmission. □

Any equilibrium in which there is any meaningful cost information transmission from F to R entails R allowing different revenue increases for different requested-revenue increases from F. But as long as at least one possible allowed-revenue increase is more than the others, it is always in the best interest of risk-neutral F to misrepresent its cost increase in its application in order to always acquire the highest allowed-revenue increase possible from R. This is the intuition that underlies Lemma 2.

Lemmas 1 and 2 imply that there can only be one sequential equilibrium in which there is no cost information transmission in this strategic information transmission game. This is stated in Proposition 1.

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[2]Strictly speaking there can be a sequential equilibrium in which there is some cost information transmission if all the expected revenues of each different set of $\tilde{r}$s represented by different $\hat{r}$s of F were equal. In such a case, the result would be the same as the no-cost-information transmission equilibrium in that there would be only one allowed revenue for all $\hat{r}$s. The only difference would be that R would be able to narrow the potential values of $\tilde{r}$ to the set that the particular requested-revenue increase indicated.

Proposition 1. *In a strategic information transmission game in which a risk-neutral regulated monopolist firm F sends a signal in the form of a requested-revenue increase $\hat{r}$ to reflect its increase in future total cost ΔC to the regulator R, there will exist a unique sequential equilibrium in which there is no cost information transmission from F to R.*

I end this section with a discussion on one assumption common in the theoretical literature since Laffont and Tirole (1986) but not assumed in this analysis. In Laffont and Tirole (1986), the principal or regulator can observe the cost of the firm that the regulator will reimburse. This is because the cost on the basis of which the regulator reimburses and pays the firm is realized cost, and regulatory commissions usually do have access to firms' operating statistics in which they can look up the firms' incurred costs.[3] However, the regulator sets r on the basis of future costs of the firm not yet incurred. Sometimes this involves choosing a future test year so that the regulator can observe how much of the firm's capacity is being used to provide its service and the costs incurred. If at a later date the regulator suspects that the firm is earning more than its allowed rate of return, then it can initiate a formal hearing and decrease the annual revenue requirement of the firm. Such rate cases termed earnings-review cases do occur in the FPSC, and often involve an one-time refund to the firm's customers. In the

[3]This assumption amounts to R being able to observe ΔC in $t = 2$ and determining r accordingly in our model. One of the sequential equilibrium in such a scenario would involve truthful cost revelation by F. But in such a case, there would be no need for cost reporting by F in the first place.

time between rate cases that usually last a couple of years,[4] the firm would have been enjoying earnings more than those approved by the regulator.

To test whether the FPSC takes corrective action after observing the costs on which they determined the firm's revenue requirement in the firm's last case, I estimate an additional reduced-form econometric model in which I investigate how the allowed revenue requirement varies with the firm's past or lagged change in operating cost that it can now observe.

3 Empirical Analysis

In order to examine whether empirical observations are consistent with the existence of a no-cost-information transmission equilibrium, I first estimate two reduced-form econometric models Equations (3) and (4) by OLS:

$$\hat{r}_i = \alpha_0 + \alpha_1 \Delta C_i + \vec{\alpha}_2 \vec{X}_i + e_{1i}, \tag{3}$$

$$r_i = \beta_0 + \beta_1 \hat{r}_i + \vec{\beta}_2 \vec{X}_i + e_{2i}. \tag{4}$$

Equation (3) shows how in rate case i, the firm's annual requested-revenue increase $\hat{r}_i$ is associated with its annual change in future operating cost since its last rate case ΔC_i. To reflect a change in future operating costs, ΔC_i is calculated using the annual total operating costs at least eleven months after the annual rate changes corresponding to their rate case have been im-

[4]The average time between rate cases of a particular firm is 2.27 years in Florida.

plemented. Equation (4) shows how the annual revenue increase granted by the regulator r_i in rate case i is associated with the firm's annual requested-revenue increase $\hat{r}_i$.

Next, I estimate the reduced-form econometric model Equation (5) that is derived by substituting $\hat{r}_i$ from Equation (3) into Equation (4):

$$r_i = \gamma_0 + \gamma_1 \Delta C_i + \vec{\gamma}_2 \vec{X}_i + e_{3i}, \tag{5}$$

where $\gamma_0 = \beta_0 + \alpha_0\beta_1$, $\gamma_1 = \alpha_1\beta_1$, $\vec{\gamma}_2 = \beta_1\vec{\alpha}_2 + \vec{\beta}_2$ and $e_{3i} = \beta_1 e_{1i} + e_{2i}$. Equation (5) is estimated to see how r_i is associated with ΔC_i through $\hat{r}_i$.

Equations (3)-(5) are estimated by using company-request rate case data from the FPSC. The rate cases in the sample were of investor-owned Florida telephone, electric and natural gas public utilities firms. Each observation represents a FPSC rate case docket (an offical summary of rate case proceedings).

In Equations (3)-(5), $\vec{X}_i$ consists of other factors that might affect the dependent variable. These other independent variables in $\vec{X}_i$ are the firm's operating revenue S_i, two dummies– $elec_i$ and gas_i– to indicate whether the firm was an electric or natural gas utility respectively, and $repub_i$ which is the fraction of Florida legislature seats (both in the Florida House of Representatives and Florida Senate) held by Republicans in the year of final order of the rate case. S_i and $repub_i$ serve as controls for the firm's size and the political environment respectively. Apart from $elec_i$, gas_i and $repub_i$, all the variables were measured in $1/100,000,000^{th}$ of a 2010 US Dollar. Any effects of unobserved variables are captured by e_{ji} where $j = 1, 2, 3$.

I also estimate the reduced-form econometric model Equation (6) that examines the factors that affect the fraction of the requested-revenue increase that is granted by the FPSC:[5]

$$\frac{r_i}{\hat{r}_i} = \lambda_0 + \lambda_1 \Delta C_i + \vec{\lambda}_2 \vec{X}_i + e_{4i}. \tag{6}$$

In Equation (6), e_{4i} captures the effect of any unobserved variable on $\frac{r_i}{\hat{r}_i}$.

Lastly, to examine whether the regulator takes corrective action once she observes the change in operating costs on which she based her last decision of a firm's revenue requirement, I estimate the reduced-form econometric model Equation (7):

$$r_i = \zeta_0 + \zeta_1 \Delta C_i + \zeta_2 \Delta C_{i-1} + \vec{\zeta}_3 \vec{X}_i + e_{5i}. \tag{7}$$

In Equation (7), ΔC_{i-1} is the change in future operating cost corresponding to the last rate case of the firm under consideration and e_{5i} again captures

[5] I use OLS to estimate Equation (6) because there are some observations in which $\frac{r_i}{\hat{r}_i}$ is negative and some observations in which $\frac{r_i}{\hat{r}_i}$ is greater than 1. $\frac{r_i}{\hat{r}_i}$ is negative in company-request cases in which the FPSC orders an annual revenue reduction instead of a revenue increase in which case $r_i < 0$. $\frac{r_i}{\hat{r}_i}$ is greater than 1 in cases in which the revenue increase granted by the FPSC is greater than the revenue increase requested by the firm i.e. $r_i > \hat{r}_i$.

the effect of any unobserved variables. . In the estimation of Equation (7), all rate cases involving any change to a regulated firm's revenue are included in the sample. This includes earnings-review cases as well as the company-request cases used to estimate Equations (3)-(6). In rate cases which end with a permanent annual revenue decrease, $r_i < 0$. I aggregate the one-time annual revenue decreases that represent one-time customer refunds with the permanent revenue decreases by dividing the one-time revenue decrease by 2.27 which is the average time in years between rate cases of a particular firm.

One must note that the dependent variables ($\hat{r}_i$ and r_i) and the main independent variables of interest ($\hat{r}_i$, ΔC_i and ΔC_{i-1}) in Equations (3)-(5) and Equation (7) are changes and not total values. $\hat{r}_i$ and r_i are annual requested- and allowed-revenue increases respectively, and ΔC_i and ΔC_{i-1} are changes in the firm's operating cost. Unfortunately, I do not have data on the firms' costs of capital, and therefore cannot include them with the other independent variables in these econometric models. However, if there was little change in the total cost of capital of a firm between two consecutive rate cases, and these changes were uncorrelated to the other independent variables then the estimated regression coefficients should be unbiased.

4 Data

The main source of my data is a database compiled by the FPSC that covers all decisions of rate cases intiated from 1978 to 2008 that affect the firm's revenue for the largest FPSC-regulated investor-owned companies (13 telephone companies, 8 natural gas companies and 5 electric companies). Initially this database consisted of 86 rate case dockets that each represented a company-request rate case in this time period. Four such cases were of three telephone companies (Florala Telephone Company, Frontier Communications of the South and Quincy Telephone Company) whose operating cost and revenue in Florida could not be separated from their operations in other states and one case was of a natural gas comapany (Sebring Gas System) whose operating cost and revenue could not be found for the relevant time of the rate case. Therefore, these five cases could not be used as observations leaving 81 rate case docket observations. From this database, I obtained the annual revenue requested $\hat{r}_i$ by the firm i, the annual revenue increase r_i granted by the FPSC, the type of firm (telephone, electric or natural gas) and relevant dates such as when the rate case was initiated by the firm, when the final order establishing the granted rates and revenue increases was issued by the FPSC, and when these new rates and revenue increases became effective.

The change in operating cost variable ΔC_i for a rate case observation was calculated by sorting rate cases[6] for each company chronologically, and then subtracting the operating cost corresponding to the company's preceding rate case from the operating cost corresponding to the rate case observation. The annual operating cost used to calculate ΔC_i and annual operating revenue S_i were obtained from FPSC Annual Reports and company annual reports filed with the FPSC or the Federal Energy Regulatory Commission (FERC). The operating revenue corresponding to each rate case observation like the

[6]This includes not just company-request rate cases but all rate cases that affect the firm's revenue.

operating costs used to calculate ΔC_i was collected at least eleven months[7] after the annual revenue approved in the case was implemented. In addition to reflecting changes in future operating costs, the reason for taking this operating statistic variables at least eleven months after the new rates had been implemented was to capture the entire effect of the newly-approved annual revenue change in the associated rate case. Additionally, because the calculation of ΔC_i entails first differencing, this variable is missing for the earliest rate case observation of a company. There were 14 such observations in my sample. Therefore, these observations had to be excluded leaving 67 rate case observations when estimating Equations (3), (5) and (6). All 81 observations are used to estimate Equation (4) because ΔC_i is not included as an independent variable in that econometric model. Also, because all rate cases (and not just company-request cases) that had a bearing on a firm's revenue are included in the estimation of Equation (7), there were 152 observations in the estimation of this reduced-form econometric model.

Fraction of Republicans in the Florida legislature $repub_i$ in the year of the final order of the rate case was calculated from data collected from the Florida Senate Handbooks and the Journals of the Florida House of Representatives.

The summary statistics of the variables used in the estimations of Equations (3), (5) and (6) are presented in Table 1 industry-wise and overall. The average Republican representation in the Florida legislature was 44.42%, the

[7]Eleven months was used instead of one year because the new rates representing the granted revenue increase were usually implemented on 1 January whereas the companies' annual operating costs and revenue were reported on 31 December.

	Telephone	Electric	Natural gas	Total
Company-request rate case observations	12	28	27	67
Mean (Standard deviation)				
Requested-revenue increase $\hat{r}_i$	\$168,393,636	\$193,294,919	\$10,659,732	\$115,235,734
	(\$273,456,319)	(\$233,836,980)	(\$10,881,077)	(\$206,037,237)
Approved-revenue increase r_i	\$62,417,069	\$78,985,521	\$6,102,116	\$46,647,113
	(\$117,286,808)	(\$113,758,194)	(\$6,855,137)	(\$93,630,166)
Change in operating cost ΔC_i	\$211,796,215	\$157,222,002	\$4,055,749	\$105,272,774
	(\$537,634,195)	(\$772,430,614)	(\$35,462,714)	(\$547,862,528)
Operating revenue S_i	\$1,642,891,785	\$3,262,568,563	\$129,123,875	\$1,709,745,758
	(\$2,171,418,528)	(\$3,740,855,167)	(\$165,965,569)	(\$2,927,001,973)

All dollars are 2010 US dollars.

Table 1: Summary statistics

minimum was 27.50% and the maximum 69.36% during the period of analysis (1978-2008).

Figure 1 is a histogram of the fraction of the company-requested revenue increase $\frac{r_i}{\hat{r}_i}$ granted by the FPSC. The mean and median fractions of the company-requested revenue increase granted are 0.49 and 0.48. respectively.

5 Results

Table 2 presents the results from the estimation of Equations (3)-(7). We see from Table 2, that ΔC_i is positive and statistically significant at the 1% level in Equation (3), and $\hat{r}_i$ is positive and statistically significant at the 1% level in Equation (4). The results show that a company's requested-revenue increase will increase by about \$11 million when its operating cost increases in future by \$100 million, and the FPSC will grant about \$40 million more in its annual revenue increase if the firm increases its request by \$100 million. However, from the estimation of Equation (5), we see that ΔC_i does not have a statistically significant effect on r_i. This means that the increase in the firm's future operating cost has no statistically significant association with

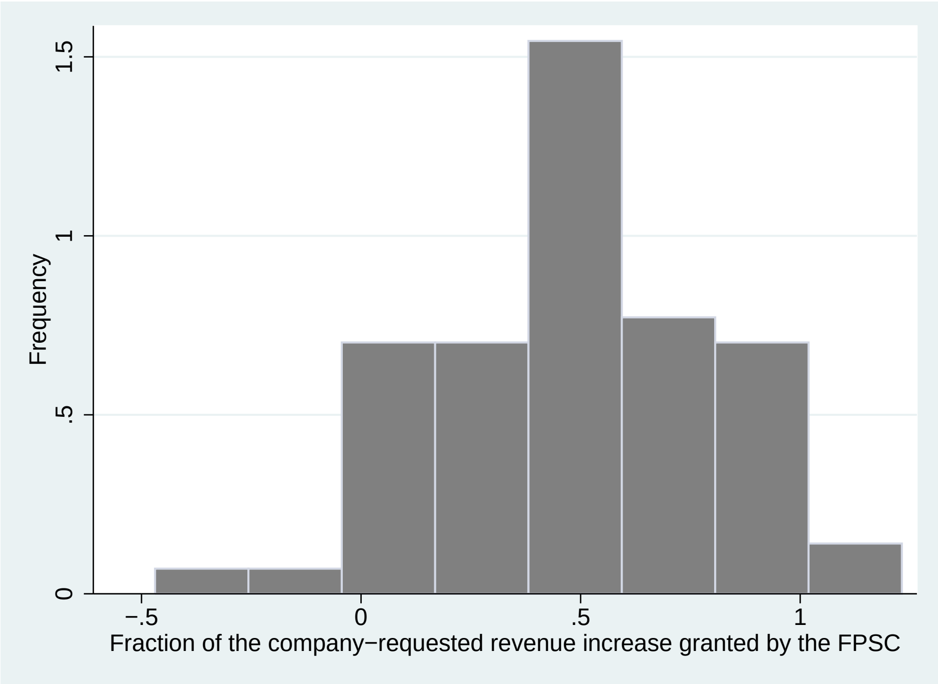

Figure 1: Frequency of fractions of the company request granted by the FPSC

Equation	(3)	(4)	(5)	(6)	(7)
Dependent Variable	$\hat{r}_i$	r_i	r_i	$\frac{r_i}{\hat{r}_i}$	r_i
Observations	n=67	n=81	n=67	n=67	n=152
Constant	2.178***	0.054	0.872***	0.246**	0.217
	(0.450)	(0.196)	(0.273)	(0.120)	(0.488)
$\hat{r}_i$		0.402***			
		(0.040)			
ΔC_i	0.107***		0.002	-0.017**	0.027
	(0.027)		(0.0155)	(0.007)	(0.031)
S_i	0.049***	0.003	0.024***	0.003*	-0.010*
	(0.006)	(0.003)	(0.003)	(0.001)	(0.005)
$repub_i$	-4.393***	-0.350	-1.861***	-0.079	-1.37
	(1.027)	(0.435)	(0.584)	(0.256)	(1.177)
$elec_i$	0.011	0.097	-0.012	0.256**	0.541*
	(0.418)	(0.157)	(0.238)	(0.104)	(0.294)
gas_i	-0.074	0.115	0.033	0.367***	0.501
	(0.434)	(0.158)	(0.247)	(0.108)	(0.338)
ΔC_{i-1}					0.079**
					(0.032)
Adjusted R^2	0.690	0.809	0.515	0.191	0.038

*=10% significance level; **=5% significance level; ***=1% significance level. Standard errors for the estimated coefficients are in parenthesis.

Table 2: Estimation of the Equations (3)-(7)

the revenue increase the FPSC grants. These results are also responsible for the finding that ΔC_i is negative and statistically significant at the 5% level in Equation (6). That is, the fraction of the company's revenue increase allowed by the FPSC is negatively related to the change in the company's future operating cost. This occurs because $\hat{r}_i$ varies positively with ΔC_i while r_i does not vary with ΔC_i. Hence, $\frac{r_i}{\hat{r}_i}$ has a negative association with ΔC_i.

In my opinion, the above empirical results are consistent with the no-cost-information transmission equilibrium. If there exists an equilibrium in which there is some meaningful cost information transmission from the firm to the FPSC, then the firm would be able to credibly signal an increase in its future operating cost by an increase in its revenue request. In such an equilibrium, the FPSC would respond by increasing the firm's allowed revenue. Therefore, we would likely be able to detect an increase in the revenue increase allowed by the FPSC with an increase in the firm's future operating cost which in the present analysis we do not. The reason for this is that r_i and $\hat{r}_i$, in my view, both represent a common unobservable belief about the future operating environment of the firm held by both the firm and the regulator. Consequently, $\hat{r}_i$ is a proxy of this belief in Equation (3).

My findings are similar to Joskow (1972), Roberts et al. (1978), Bae-Geun et al. (1988) and Bae-Geun et al. (1989) who all find a positive relationship between the allowed rate of return and the requested rate of return. But I offer an alternative explanation to their results. One of the main results from Roberts et al. (1978) that I believe supports my argument is that random shocks that prompt firms to ask for greater rate increases than their cost structure would suggest are associated with the regulator granting higher-than-expected rates. This implies that both r_i and $\hat{r}_i$ vary postively together independent of the firm's costs. The underlying reason for this positive relationship could be the common unobservable belief of the firm's operating environment that both the regulator and firm hold.

There is a possibility that the estimation fails to detect the positive relationship between the allowed-revenue increase and the change in the firm's future operating cost that a equilibrium with some cost information transmission would imply. According to Crawford and Sobel (1982), a sequential equilibrium can exist alongside the no-cost-information transmission equilibrium in which there is some cost information transmission. In such an equilibrium, the firm will use different $\hat{r}$ to signal to the regulator that ΔC is within different intervals of operating cost changes. These signals $\hat{r}$ will increase if ΔC falls into intervals of higher operating cost changes. The regulator will respond to these greater $\hat{r}$ by allowing higher r. Therefore, r will vary positively with $\hat{r}$. But there is a possibility that the estimation may not detect a positive relationship between r and ΔC because in this equilibrium r should vary positively with the intervals of ΔC and not ΔC. The conditions for such an equilibrium to exist are that (1) the firm is risk averse and (2) the firm's and regulator's utility functions are sufficiently similar. The firm will be risk averse if there is some uncertainty associated with its profit. This uncertainty can stem from the demand or the cost side. The public utilities firms used in the estimation were all geographically incumbent monopolists providing an essential service such as telecommunications or energy for the period of the study.[8] Therefore, in my opinion, there should be little

[8]From 1999 onwards, commercial and industrial natural gas users in

uncertainty on the demand side at least.

In regards to other variables, S_i is statistically significant at the 1% level and positive in Equations (3) and (5). This seems to suggest that larger firms predictably tend to request and be granted greater revenue increases. S_i is marginally statistically significant at the 10% level and positive in Equation (6). Its magnitude in this equation is also small indicating the firm's size has very little effect on the fraction of the requested-revenue increase granted. $repub_i$ is also statistically significant at the 1% level in Equations (3) and (5). However, $repub_i$ is negative suggesting that when there is a larger Republican representation in the Florida legislature, firms tend to ask for and be granted smaller revenue increases. Both dummies $elec_i$ and gas_i are statistically signifcant at the 1% level and positive in Equation (6). This implies the fraction of the requested-revenue increase allowed by the FPSC are relatively more for electric and natural gas companies than telephone companies. A possible reason for this is that the division in the FPSC that is responsible for giving the FPSC commissioners recommendations concerning electric and natural gas rate cases is different from the division tasked with the same responsibility as regards telephone company rate cases. The statistical significance of $elec_i$ and gas_i is perhaps capturing the differences in recommendations from these two separate divisions.

Finally, we see from the estimation of Equation (7) that the revenue requirement change r_i that the regulator orders has a statistically significant

Florida could choose their provider. This law change may have affected 9 observations of rate cases of natural gas companies in the sample. The results of the estimations remain unchanged if these 9 observations are excluded.

positive association with the change in future operating cost of the firm's last rate case, ΔC_{i-1}. This suggests that the regulator takes corrective action on its revenue change requirement ruling of the firm's previous rate case once the costs on which that ruling was based are incurred, and that can be now subsequently observed. In my opinion, this supports the view that the regulator does not rely on any type of cost reporting by the firm to gain an accurate estimate of the firm's forecasted costs.

The results presented in Table 2 remain unchanged if Equations (3)-(7) are re-estimated using heteroskedasticity- and autocorrelation-consistent standard errors.

6 Conclusion

The present study proves that there can be no cost information transmission from a risk-neutral regulated firm to the regulator in ROR regulation. Then it argues that empirical observations from Florida rate case data that show that the allowed-revenue increase of a firm has a positive association with its requested-revenue increase but does not vary with change in its future operating cost is consistent with a no-cost-transmission equilibrium. This observation is also responsible for the result that the fraction of the requested-revenue increase that is granted by the FPSC is negatively associated with the change in the firm's future operating cost.

As previously discussed, the theoretical literature in regulation stemming from Baron and Myerson (1982) and Laffont and Tirole (1986) has been focused on the formulation of the optimal regulatory policy within the constraint that the regulator is unable to completely observe the firm's costs in time. Generally, the optimal regulatory policy derived in these studies would induce the firm to reveal its true costs. Information has obviously played a central role in this literature. The empirical studies that have examined the determinants of a regulated firm's prices or rates of return have either examined the effect of variables on the allowed rate of return such as Joskow (1972), Roberts et al. (1978), Bae-Geun et al. (1988) and Bae-Geun et al. (1989), or were empirical tests of the Stigler-Peltzman theory of economic regulation such as Stigler and Friedland (1962), Hagerman and Ratchford (1978), Nelson (1982) and DeLorme et al. (1992). Neither of these two strands of literature discuss the importance of information in the determination of a regulated firm's rates or revenues. The present study attempts to examine the actual role of cost information transmission from the firm to the regulator in the resulting allowed revenue of the firm. I believe more such studies will improve our positive understanding of the regulatory process as well as help in future policy formulation.

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