

Incentives, Efficiency and Quality in Regulated Monopolies under Customer Ownership

Richard Meade
Toulouse School of Economics

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Introduction

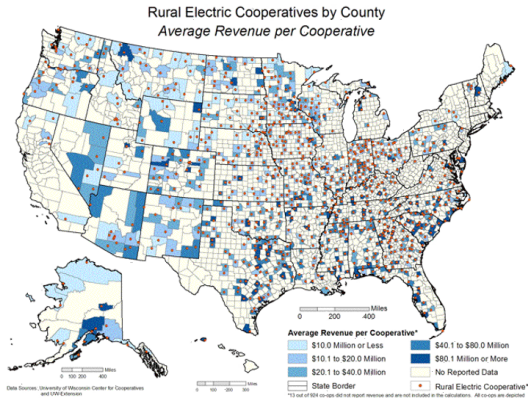
- Established literature shows how incentive problems influence price regulation
- Quality often an important dimension of firm output
- Literature recognises tradeoff between efficiency and quality:

“Clearly if a regulatory mechanism focuses only on reducing costs and ignores quality it will lead [a] firm to provide too little quality.” (Joskow (2006))

Introduction (cont'd)

- Implicit assumption – regulated firms are *investor*-owned and maximise profits
- Reality – many regulated firms are *customer*-owned (a.k.a. “cooperatives”) – maximise consumer surplus as well as profits
- **My question** – how does ownership affect the efficiency-quality tradeoff – and hence optimal regulation – assuming managerial moral hazard?

Prevalence of Customer Ownership – US RECs



47 states, networks over 75% of US, 43% of distribution lines
Distribute c. US\$600m to customer owners annually

Prevalence of Customer Ownership (cont'd)

- Other US customer-owned utilities:
 - Rural telecommunications – 260 customer-owned firms with networks over 40% of US
 - Rural water services – 3,300 customer-owned firms
- Non-US utilities with significant customer ownership:
 - Electricity distribution:
 - OECD – Italy and Spain; Chile; New Zealand;
 - Non-OECD – Argentina, Bolivia, Brazil, and Costa Rica; India, the Philippines and Bangladesh; Kenya;
 - Rural irrigation schemes – Australia, New Zealand
 - Finland – 938 water cooperatives, and 74 energy cooperatives

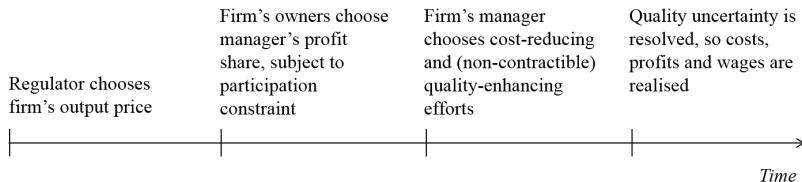
Diversity of Regulatory Treatments

- US customer-owned utilities often regarded as self-regulating, and exempted from price regulations:
 - But RECs are price-regulated in 16 of 47 states
 - Some customer-owned telecommunications firms also regulated
- 12 of 29 New Zealand electricity distribution companies are sufficiently customer-owned to opt out of regulation
- **Begs question** – should comparable customer-owned and investor-owned firms be regulated the same, or differently?

Setup – Setting

- Customers care about both price and quality (e.g. reliability, safety, visual amenity, ...)
- Manager exerts efforts on both cost savings and quality enhancement
- Quality increases demand, revenue and consumer surplus, but not necessarily profits
- Customer owners care about consumer surplus as well as profits
- Owners contract on profits, since quality depends unobservably on “nature” as well as managerial effort

Timing



The Firm

- Conditional on manager's *quality-enhancing effort* e_s , output quality is $s \sim f(s|e_s)$
- $f(\cdot)$ is common knowledge, so expected quality is known ex ante (in particular, by consumers):

$$\bar{s}(e_s) = \int_s x f(x|e_s) dx$$

$$\bar{s}'_s \equiv \frac{\partial \bar{s}(\cdot)}{\partial e_s} > 0$$

- Firm faces non-random demand $q(p, \bar{s}(e_s)) \equiv q(p, e_s)$:

$$q'_p < 0 \quad q'_s \equiv \frac{\partial q(\cdot)}{\partial e_s} > 0$$

The Firm (cont'd)

- Conditional on manager's *cost-reducing effort* e_q , cost of producing $q(\cdot)$ at random quality s is $c(s|e_q)$, with:

$$c(s|e_q) \sim N(\bar{c}(\cdot), \sigma_c^2)$$

- Conditional on both e_s and e_q , expected costs are:

$$\bar{c}(e_q, e_s) = \int_s c(x|e_q) f(x|e_s) dx$$

$$\bar{c}'_q < 0, \quad \bar{c}''_{qq} > 0 \quad \bar{c}'_s > 0, \quad \bar{c}''_{ss} > 0 \quad \bar{c}''_{qs} \leq 0$$

- With costs normal, *pre-wage* profits are also normal, having conditional mean:

$$\bar{\Pi}(p, e_q, e_s) = pq(p, e_s) - \bar{c}(e_q, e_s)$$

The Manager

- CARA preferences with risk aversion $\rho > 0$
- Outside wage $w_0 = 0$, and wage contract (t, β) , so:

$$\bar{w} = t + \beta \bar{\Pi}(p, e_q, e_s) \quad 0 \leq \beta \leq 1$$

- Incurs private effort costs $\psi(e_q, e_s)$:

$$\psi'_i > 0 \quad \psi''_{ii} > 0 \quad \psi''_{qs} \leq 0$$

- Has certainty equivalent of wages net of private effort costs:

$$CE(w - \psi) = \bar{w} - \frac{\rho}{2} \beta^2 \sigma_c^2 - \psi(e_q, e_s)$$

- Given p and (t, β) , chooses (e_q, e_s) to maximise $CE(w - \psi)$

The Owners

- Choose wage contract (t, β) subject to the manager's:
 - Optimal effort choices
 - Participation Constraint: $CE(w - \psi) \geq CE(w_0) = 0$
→ yields $t = t(p, \beta)$

- Expected *post-wage* profits are thus:

$$\bar{\pi}(p, \beta) = \bar{\Pi}(p, \beta) - \frac{\rho}{2} \beta^2 \sigma_c^2 - \psi(p, \beta)$$

- Given p , *investor* owners choose β to maximise $\bar{\pi}(p, \beta)$

The Owners (cont'd)

- By contrast, *customer* owners value *gross* surplus net of expected costs, equalling *net* surplus CS plus expected profits
- CS depends on both price and expected quality:

$$CS(p, \bar{s}(e_s(\beta, p))) = \int_p^{\infty} q(x, e_s(\beta, x)) dx \equiv CS(\beta, p)$$

$$CS'_p < 0 \quad CS'_s > 0$$

- Since $q(\cdot)$ is known ex ante, so too is $CS(\cdot)$
- Given p , customer owners choose β to maximise:

$$CS(\beta, p) + \bar{\pi}(\beta, p)$$

The Regulator

- Chooses p anticipating:
 - Optimal wage contract choice of the owners
 - Optimal effort choices of the manager
- Maximises CS plus α -weighted expected post-wage profits:

$$CS(\beta(p), p) + \alpha \bar{\pi}(\beta(p), p)$$

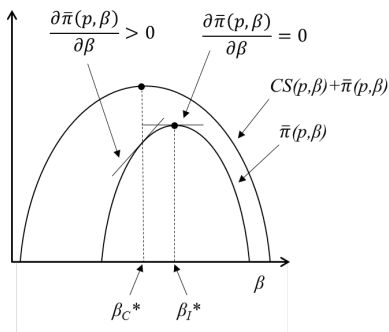
- $\alpha \in (0, 1]$ assumed sufficiently positive to ensure $\bar{\pi} \geq 0$

Result 1 – Manager's Effort Choices Diverge in β

- **Lemma 1:** $\frac{\partial e_q}{\partial \beta} > 0$ and $\frac{\partial e_s}{\partial \beta} < 0$ iff:
 - ① $0 < T_{qs}^{min} < \psi''_{qs} + \beta \bar{c}''_{qs} < T_{qs}^{max}$
 - ② $\psi''_{qq} + \beta \bar{c}''_{qq} < T_{qq}^{max}$
- Note – result can obtain even with $\psi''_{qs} \leq 0$:
 - I.e. *absent* Holmstrom and Milgrom (1991) “effort substitution” ($\psi''_{qs} > 0$)
 - Novel mechanism
- Implications:
 - As β rises, manager prefers more efficiency, but less quality
 - $CS(\cdot)$ is decreasing in β ...

Result 2 – Customer Owners Choose Weaker Incentives

- Proposition 1:** Assuming Lemma 1 conditions, and unique interior maxima for owners' problems, then $\beta_C^*(p) \leq \beta_I^*(p)$:



- Corollary 1:** Given p , expected quality and costs, and revenues, are higher under customer ownership

Regulator's Price Choice

From the owners' incentive choice problems (previous graph):

$$\frac{d\bar{\pi}_C}{dp} = \frac{\partial \bar{\pi}}{\partial p} + \underbrace{\frac{\partial \bar{\pi}(\beta = \beta_C^*)}{\partial \beta}}_+$$

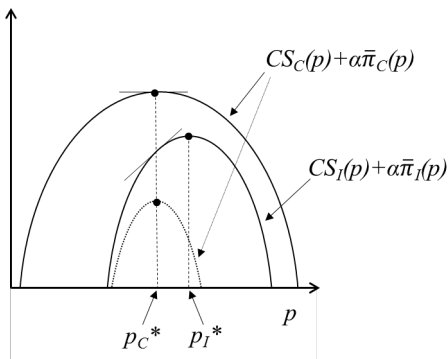
$$\frac{d\bar{\pi}_I}{dp} = \frac{\partial \bar{\pi}}{\partial p} + \underbrace{\frac{\partial \bar{\pi}(\beta = \beta_I^*)}{\partial \beta}}_0 \frac{d\beta_I}{dp}$$

With this, can show that if $\frac{d\beta_C}{dp} < 0$, then:

$$\frac{dCS_C}{dp} + \alpha \frac{d\bar{\pi}_C}{dp} < \frac{dCS_I}{dp} + \alpha \frac{d\bar{\pi}_I}{dp} \quad \dots$$

Result 3 – Regulator Can Optimally set Tighter Price Cap for Customer-Owned Firms

- **Proposition 2:** Assuming the Lemma 1 conditions, and unique interior maxima for the owners' and regulator's problems, then $p_C^* < p_I^*$ if $\frac{d\beta_C}{dp} < 0$:



Regulator's Price Choice (cont'd)

- *Owners' incentive power choices mediate the impact of regulator's p choice on manager's efforts, and do so in different ways under each ownership type:*
 - Under customer ownership, regulator's p choice affects both $CS(\cdot)$ and $\bar{\pi}(\cdot)$, and does so both directly and indirectly
 - Under investor ownership, regulator influences just $\bar{\pi}(\cdot)$, and does so only directly

Conclusions

- We provide new explanations for:
 - How incentive power should optimally be chosen under multitasking
 - Why incentive power might be weaker under customer ownership than investor ownership
- We show that regulators:
 - Should generally apply different prices to otherwise identical customer-owned and investor-owned firms
 - Can optimally set a tighter price cap for customer-owned firms
