Endogenous Price Mechanisms, Capture and Accountability Rules: Theory and Evidence

Summary

This paper analyzes the constitutional determinants of cost reimbursement rules. In order to design the optimal incentive schemes, a possibly partisan planner will take into account the market cost structure, the institutional design of the supervision hierarchical structure and its technology. I employ electricity data from the U.S. electric power market to test the model's predictions. The evidence shows that reforms from low powered incentive scheme (COS) to high powered one (PBR) are linked to high cost industries, the presence of elected supervisors, high inter-party platform distance and large (slim) majority when the reformer is Republican (Democratic). Moreover, there is some evidence in the data that performance-based regulation lowers regulated prices.

Keywords: Industrial Policy, Political Economy, Regulation and Incentives

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A Francesco e Pierluigi con Amore e Profondo Rispetto.

1. Introduction

A major task of economics is to explain the pattern of government intervention in industries that is to say industrial policy. An idealized, but illuminating, view of regulatory institutions is that they result from a broadly defined constitution drafted by some benevolent "founders" behind a veil of ignorance.[1] This "public interest" research program derives policies able to correct market failures such as monopoly pricing. In the last twenty years this paradigm has been substantially improved by explicitly considering informational asymmetries. Industrial policy can be thought as resulting from the optimal trade-off between efficiency enhancement and rent extraction and, indeed, in regulating a natural monopoly, the planner will select optimal cost-reimbursement rules, which arbitrate differently between cost reducement effort (i.e.: moral hazard with risk neutral firm) and informational rents (i.e.: adverse selection). Price-cap favors efficiency, while cost-plus regulation (COS) favors rent extraction. However, the public interest approach completely fails in taking into consideration both the watchdog role of consumers' (i.e.: residential and industrial) interest groups and the delicate set of controls on bureaucrats and politicians. Indeed, judges have discretionary power and compete with executive branches and regulators in filling in unforeseen contingencies (see Shapiro [1986], Spiller and Tiller [1999] and

[1] These social "planners" must delegate actual social choices to other agents (i.e., "public decision makers") and they possibly design a set of institutions or rules of the game inducing these public decision makers to behave as if their respective assessments of welfare coincided.

Guerriero [2006 a]). Moreover, politicians may favor special interest groups (see the Chicago tradition in Peltzman [1976] and Becker [1985]) leaving conspicuous rents to the officials involved in regulation (see Niskanen [1971] and Wilson [1980]). The recent New Theory of Regulation approach has tried to overcome such an inconsistency, employing both the classical principal-agent model and the growing political economy literature. Two are the main merits of this program: 1. the explicit design of the political system details and of the positive forces driving public intervention; 2. the crucial role entrusted to private information in giving rent seeking incentives to regulated firms' interest group and signal extraction foundations to the hierarchical structure of real world regulatory institutions. When explicit contracts on observable efforts or performances are available for supervisors, the low type quantity-effort allocation is distorted even more to take into account the possible capture and the institutional design of the supervision hierarchy (Laffont and Tirole [1993] and Laffont and Martimort [1999]), and the planner's partisan interests (Laffont [1996] and [2000]). In such a collusion-proof equilibrium (i.e. in which capture does not prevail), costly incentive payments are given to non-benevolent regulators for a value equal to the maximum expected collusion offer, which is the firm's expected stake (i.e. high type rent). However this set up basically fails in capturing real world institutions. Regulators and judges are implicitly motivated by simple election-appointment rules. Moreover the review processes' structure makes difficult to swallow the hypothesis that the real role of these officials is one of decision making. Only recently, Guerriero [2006, a] has given a first complete and realistic description of this complex agency structure. A hierarchical rate review process makes crucial the generosity of settlement if judges are interested in leaving a legacy of correctness ("legacy

effect"). This is more likely when regulators are not willing to exert costly effort because they are concerned with obtaining job offers from the industry (i.e.: "revolving door effect"); election magnifies these incentives. A possibly partisan (i.e., interested in the long run profitability of the industry) planner will take into consideration the effectiveness of the signal extraction technology and the accountability power of different selection rules in designing the regulatory institutions. This paper brings two main contributions: 1. It broadens the scope of the Guerriero [2006 a]'s model to the optimal selection of incentive schemes; 2. It empirically evaluates the merit of this new cost-reimbursement selection theory facing it with electricity data. My focus is the economics of regulation but the idea is wider and applies to a rich set of market, fiscal and monetary institutions. The remainder of the paper is organized as follows. *Section 2* briefly illustrates the institutions of the US electric power market. Next, *Section 3* explains the model clarifying the efficiency driven and strategic determinants of incentive schemes. *Section 4* tests this theory, taking into consideration the introduction of performance based regulations (PBR) in the US electricity market during the 80s and 90s; besides, an analysis of the effects of these reforms on the sector-regulated prices is provided. *Section 5* discusses the significance of the paper's findings and proposes an agenda for future research. Tables, proofs and a detailed description of the data are contained in the *Appendix*.

2. Institutions

Investor-owned electric utilities (IOUs) account for over three-fourths of the electricity sales and revenues of the U. S. electric power market. Jurisdiction over

both interstate transmission and wholesale transactions lies inside a federal body (FERC); retail services are regulated by state public utility commissions (PUCs), which deal with several utilities (i.e., natural gas, telecommunications, water and wastewater, insurance, trucking and railroad) and perform a broad range of tasks (e.g. they suggest lines of conduct on services provision, avoid by-passing by non regulated utilities, they rule on environmental issues and so forth) among which the most important is the regulation of prices.[2] Regulated utilities are not allowed to receive governmental subsides and their revenue must cover their cost (including managerial rewards). IOUs usually charge a two-part tariff,[3] triggering rate reviews in response to rising costs (Joskow, [1974]). Even if a docket can be entrusted directly to a commissioner or to an Administrative Law Judge (ALJ), almost all the files are evaluated within formal meetings open to all the interested parties (firms, ratepayers, lawyers of the Attorney General's Office and so forth). In the first instance, commissioners sit on the bench during sessions and consumer advocates[4] represent ratepayers. If the proposed filing is not approved, a formal quasi-judicial hearing, presided by one or more ALJs, is opened. Next, the quasi-judicial tribunal takes a qualified majority enforceable judgment. PUCs may review the case, provided that the onus of injustice and illegality of the decision

[2] Here I follow the descriptions contained in the 1992 and 1997 *Sunset Review of the Colorado PUC* and on the *Washington Utilities and Transportation Commission* (WUTC) official website.

[3] As Joskow and Schmalensee [1986] suggest the fixed premium paid by consumer turns out to assume the some role of the governmental transfer typical of the regulation-procurement literature. As a consequence, I will replace the economic shadow cost of public funds with the marginal deadweight loss associated with an increase in the fixed premium.

[4] Consumer advocates are state funded independent bodies established during the 70s and 80s in the face of steeply rising rates in order to allow even residential users to proceed before PUCs.

lies on the firm. Finally, utilities can also appeal to High Courts on formal issues. These two last appeal levels are rarely granted. Within the hearings, the role of commissioners and ALJs is one of supervision: they examine witnesses and experts, receive the evidence and interpret precedents and regulations. The final motion to be approved is proposed by the PUC's staff. During the process, this body is divided in a "trial" and in an "advisory" team. While the latter reviews the case formulating a staff position in all equated to the one of any other interested party; the former advices regulators and judges on technical and policy issues, proposing *de facto* the motion. The complete record of the hearings and the participation of all parties assure that the PUC's staff uses only "hard" evidence. This is a by-product of the "adversary" scope of the hearings: no evidence can be denied once the precedent is individuated. Thus, the design of incentive schemes can be modeled through the following version of the Guerriero [2006, a]'s model.

3. Theory

The regulated firm produces a variable scale product q and charges a two part tariff $A + pq$ for $q > 0$, where A and p are positive. It can refuse to produce if the contract offered by the principal does not guarantee a minimum level of expected utility, that I will normalize at a reservation level of 0. Both the firm and the supervisors are risk neutral with respect to income. Total cost is $C = (\beta - a)q + \upsilon$ and a represents the manager's effort, while β is an inefficiency parameter, which turns out to be equal to $\underline{\beta}$ with probability ν and to $\overline{\beta}$ with probability $1 - \nu$; with $\Delta\beta \equiv \overline{\beta} - \underline{\beta}$. Assuming that the fixed cost is known, and normalizing it at zero ($\upsilon = 0$) it is possible to denote marginal cost as $c \equiv \beta - a$. Regulation is subject to

both adverse selection (as captured by β) and moral hazard (as captured by a). Let assume that effort remains strictly positive over the relevant range of equilibrium production. If the manager exerts effort level a, she decreases the monetary marginal cost of output by a, and incurs in a disutility (in monetary units) of $\psi(a)$. This disutility is increasing and convex in a (i.e.: $\psi' > 0$; $\psi'' > 0$); moreover the following hold: $\psi(0) = 0$, $\lim_{a \to \beta} \psi(a) = +\infty$ and $\psi''' > 0$.[5] All consumers have the same preferences; thus, the demand is the one of a representative consumer with gross consumer surplus given by $S(\cdot)$. The inverse and regular demand functions and the firm's revenue are given by $p = P(q) = S'(q)$, $q = D(p)$, $R(q) = P(q)q + A$ respectively. Consumers choose q as to maximize net surplus $S(\cdot) - A - pq$ and A is chosen optimally so as to make her indifferent between buying and not buying the good i.e., $A \equiv S(q) - P(q)q$. Firm's revenues must cover both average costs and managerial compensation t; moreover the firm can refuse to produce if a level of expected utility U weakly greater than the reservation level of 0 is not guaranteed. As a result, I have that $A + (p - c)q(p) \geq t$ and $U = t - \psi(a) \geq 0$.

Let denote the social surplus obtained by the production of q as $V(q)$ with $V(0) = 0$, $V' > 0$, and $V'' < 0$. $V(q)$ is the sum of consumers' net surplus plus the firm's revenue evaluated at the shadow price of managerial reward. $V(q)$ rewrites as:

$$V(q) = (S(q) - R(q)) + (1+\lambda)R(q) = S(q) + \lambda R(q) = (1+\lambda)S(q).$$

The planner's objective function, labeled with subscript P, is:

$$W_P = S(q(p)) - A - pq(p) + (1+\lambda)\,[A + (p - c)\,q(p) - t] + U =$$

$$= V(q) - (1+\lambda)[(\beta - a)q + \psi(a)] - \lambda U \qquad (1)$$

[5] This is a sufficient condition for the regulator's optimization programs to be concave and for the optimal incentive schemes to be deterministic.

Here, $1 + \lambda$ can be interpreted as the shadow price of the firm's budget constraint; note that, in contrast to the program with governmental transfers, λ depends on both c and t. Under complete information,[6] the planner implements the first best allocation leaving no rent to the firm with a simple "fixed price" (or a cost target) contract (see *Appendix 6.1* for details). Instead, under asymmetric information, the planner observes only total cost and output[7] and not a: as a result, β is now private information of the firm. Label equilibrium rewards, outputs, average and marginal costs and utilities for the two types as: $\left\{\left(\underline{t},\underline{q},\underline{C},\underline{c},\underline{U},\underline{a}\right),\left(\overline{t},\overline{q},\overline{C},\overline{c},\overline{U},\overline{a}\right)\right\}$.

A contract based on the observables t and C specifies a reward-cost pair for each type. As usual, the program envisions a solution with binding low (inefficient) type's individual rationality and high type's incentive compatibility constraints:

$$\overline{U} = \overline{t} - \psi(\overline{\beta} - \overline{c}) = 0 \qquad \text{(IR\_L)}$$

$$\underline{U} = \underline{t} - \psi(\underline{\beta} - \underline{c}) = \overline{U} + \psi(\overline{\beta} - \overline{c}) - \psi(\underline{\beta} - \overline{c}) = \Phi(\overline{a}) \qquad \text{(IC\_H)}$$

where $\Phi(\cdot)$ is an increasing function defined as $\Phi(a) \equiv \psi(a) - \psi(a - \Delta\beta)$.[8] Such a solution entails an efficient level of effort and a positive informational rent $\underline{U}$ for the high type and under-effort and no rent for the low type. Now suppose that the planner can relax the informational asymmetry by employing a hierarchy of

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[6] Realized costs, outputs and prices are verifiable. The planner knows β and acts as a Stackelberg leader making take-or-live it offers on the observable a.

[7] With a linear technology, the planner observes average costs, which are equal to marginal cost. With know fixed cost υ, she observes $(C - \upsilon)/q = \beta - a$ and the analysis goes on unchanged.

[8] Incentive compatibility prescribes that the contract designed for type $\underline{\beta}$ ($\overline{\beta}$) is the one preferred by type $\underline{\beta}$ ($\overline{\beta}$) in the menu of managerial rewards-cost pairs. This amounts to say that:

$\underline{t} - \psi(\underline{\beta} - \underline{c}) \geq \overline{t} - \psi(\underline{\beta} - \overline{c})$ (IC_H) and $\overline{t} - \psi(\overline{\beta} - \overline{c}) \geq \underline{t} - \psi(\overline{\beta} - \underline{c})$ (IC_L).

two supervisors (i.e. a regulator and a judge) designed exactly as the market described in the institutional analysis. The question is the following: is it possible to assess the ex post normative qualities of the incentive schemes selected by a possibly partisan planner? As the following theory will make clear, the success of the regulatory regime design is sensible to efficiency and political dimensions. I will first treat the former underlining the main similarity with the model of Laffont and Tirole [1993], leaving the positive side of the issue to the next subsection. There I will compare the results with the seminal work of Laffont [1996]. The following analysis strictly tracks the approach of Guerriero [2006, a]. Supervisors can, exerting costly effort, tailor the supervision activity to the specific docket (i.e., they choose the number and quality of the experts, the firms' official papers to be examined and so forth). The equilibrium level of effort and the supervisors' random ability (e.g., ability to examine experts given precedents and prevailing regulations) determine the precision of the planner's signal. As explained above, the report is effectively delivered by the PUC's staff, so I simply assume that the planner has directly at her disposal this benevolent information device.[9] Moreover, given that in our market PUCs' rules and conducts prohibit communication between supervisors, no side contract is allowed between these players. Once one of the two docket's filing steps is set up, the planner receives a signal $\sigma = \{\underline{\beta}; \phi\}$ about the cost structure with precision ξ, determined by the supervisors' activity. This signal can only inform about $\underline{\beta}$. The information is hard, i.e. it is verifiable (in the sense that every interested party can convince

[9] Note that, besides the constraints imposed by the adversary process structure, explicit incentives can be designed for the staff members, who are not implicitly motivated by an appointment rule.

himself that the signal corresponds to the true state of the world). If $\beta = \underline{\beta}$ with probability ξ the planner sees $\sigma = \underline{\beta}$ and implements the complete information contract and with probability $1 - \xi$ she observes $\sigma = \phi$. If $\beta = \overline{\beta}$, then $\sigma = \phi$ always.[10] When $\sigma = \phi$, the planner is uninformed, and she updates her beliefs applying Bayes's rule. Supervisors are evaluated according to the performance $\xi \in [0, 1]$, which is described by the process' records and has a technology given by $\xi = \alpha e + e$. Effort takes value on $(0, \xi^u/(1 + \alpha)]$ with ξ^u to be defined below. The effort cost function can be written as $\tilde{C}(\bullet) = \underset{\sim}{C}(\bullet)(1-K)$ where K measures the effectiveness of the signal extraction technology and is increasing in the PUC's funds and in the watchdog groups' ability to provide hard information. Besides, I have that: $\tilde{C}_e > 0$, $\tilde{C}_{ee} > 0$, $\tilde{C}(0) = 0$ and $\lim_{e \to \xi^U} \tilde{C}_e = \infty$ (with $0 < \xi^u < 1$), i.e. the full precision case is ruled out. Clearly, it is not possible to obtain a perfect signal through effort only. The random ability α has support (0, 1) and a natural choice is to have $\alpha \sim$ Beta (g, b) with density $f_y(y; g, b) = [y^{g-1}(1 - y)^{b-1}]/B(g, b)$ and $B(g, b) = \int_0^1 y^{g-1}(1-y)^{b-1} dy$ - Beta function. The mean is $\bar{\alpha} = g/(g + b)$. If $g = b = 1$, I obtain a uniform distribution on (0, 1): from a Bayesian point of view this corresponds to the case of uninformative prior on the supervisor ability. The only restrictions I impose on g and b is that the distribution is symmetric ($g = b$) and hump-shaped (informative): $g > 1$ and $b > 1$. Note how α and e assume the meaning of overall measures i.e.: they take into account the different judges' and regulators' abilities. The first best arises either for e or ξ verifiable and

[10] This technology simplifies the notation and has the appealing feature that the agent can provide verifiable information only when the proof is possible, i.e., $\underline{\beta}$-case (see also Laffont [2000]).

contractible: "selling the store" contracts reach efficiency. However, the assumption that the planner can write unrestricted contingent contracts with the supervisors does not fit in any way reality and so I assume that ξ is always observable but not contractible. The timing of the game is as follows:

1. Society (planner, firm, regulator and judge if addressed; see stage 3 and 4 below) learns the nature of the regulatory environment: $P(q)$ and that $\beta \in \left\{\underline{\beta}, \overline{\beta}\right\}$. Next the firm discovers the only piece of private information: β.

2. The planner offers a menu of managerial reward-cost pairs to the firm contingent to the realization of the signal obtained through the hearing process. Moreover, an exogenously given wage $\hat{s}$, set a reservation level (for sake of simplicity assumed equal for both), is given to the two supervisors.

3. The regulator chooses the level of effort; next she discovers her random ability and, at last, the planner receives the first signal. If this is informative the first best is implemented; otherwise a hearing is open and the judge enters the game.

4. Step 3 is repeated for the judge. If the signal is again uninformative, the planner asks for a report to the firm and the asymmetric information regime arises.

5. Last a reward-quantity pair is implemented and evaluators make their move.[11]

In order to understand the incentives faced by the supervisors as a function of the selection rules and the nature of the task, note that two are the dimensions of heterogeneity: regulators *vs.* judges and appointed *vs.* elected officials. I capture the latter referring to the set up developed in Alesina and Tabellini [2005, a]. A supervisor receives a payment $\hat{s}$ and she has a utility function given by:

[11] For an elected supervisor the evaluator will be a rational electorate. Note how also ALJs are elected in the US. The evaluator of appointed supervisors is the industry or a selection committee.

$$R_{i,l}(e_{i,l},S)=\left\{1+\tau\left[(1-SR)G^{i}(e_{i,l})-(1-(1-S)J)\tilde{C}(e_{i,l})\right]\right\}\hat{s} \qquad (2)$$

Here, the parameter τ measures the strength of the career concern incentives. For sake of comparison I will exhibit the case of equal draw of α and denote with i = {*Appointed*, *Elected*} and l = {*Regulator*, *Judge*}. In (2), S will be equal to 1 for a regulator and 0 for a judge while $G^{i}\left(e_{i,l}\right)$ differentiates bureaucrats and politicians. A politician's goal is to be re-elected and this happens if ξ exceeds a threshold $\overline{\xi}$. This amounts to say that $G^{E}\left(e_{E,l}\right)=\Pr\left\{\xi\geq\overline{\xi}\right\}$. Voters are rational and understand that the alternative to the incumbent is another politician with average talent who will exert effort $\overline{\xi}=(3/2)e_{E,l}^{\exp}$. So I have that: $G^{E}\left(e_{E,l}\right)=\Pr\left\{\alpha\geq\left[\left(3e_{E,l}^{\exp}/2e_{E,l}\right)-1\right]\right\}$. On the other hand, a bureaucrat is career concerned and she wants to maximize the perception of her ability α given the realization of the relevant measure of performance ξ, i.e., $G^{A}\left(e_{A,l}\right)=E\left(\mathrm{E}\left(\alpha/\xi_{A,l}\right)\right)=E\left\{\left[\left(1+\alpha\right)e_{A,l}-e_{A,l}^{\exp}\right]/e_{A,l}^{\exp}\right\}$. Here, E(·) is the evaluator's expectation over α given the precision realization and E denotes the unconditional expectation over ξ. A glance at $G^{E}(\bullet)$ and $G^{A}(\bullet)$ reveals how elected supervisors will exert more effort than appointed one. This is due to the fact that the density of the Beta evaluated at the mean is always greater than 1 for all g and b greater than 1. The relevant inequality is $f_{\alpha}(\bar{\alpha})>1$. This result is not upset when the distribution of α is asymmetric.[12] Focusing on R and J, they are both defined on (0, 1) and represent regulators and judges specific parameters. The first one captures the so-called "revolving-door" effect: regulators can be attracted by future job opportunities in the regulated industry. The second one (J)

[12] Proofs are available upon request. A local result holds if the substitutability between e and α is imperfect: $\xi=(\alpha+Z)e$. Here, I need: $[Z+g/(g+b)]\,f_{\alpha}(\bar{\alpha})>[1+Zg/(g+b)]$.

reveals the judges' desire to leave a legacy of correctness and unbiasedness (see also Levy [2005]).[13] Clearly enough the equilibrium level of effort can be ranked as follows: $\hat{e}^S_{E,J} > \hat{e}^S_{A,J}$ and $\hat{e}^S_{E,R} > \hat{e}^S_{A,R}$ (see Guerriero [2006 a] for proofs). Moreover these levels will be greater the more effective is the supervision technology *K*. In **2.,** the planner foresees the supervisors' moves and offers to the firm a menu of contracts contingent on the eventual signals $\{\sigma_R, \sigma_J\}$ and fully characterized by the above equilibrium levels of effort. The planner's posterior beliefs on $\beta = \underline{\beta}$ is:

$$\Pr(\beta = \underline{\beta} / \sigma_R = \phi, \sigma_J = \phi) = \frac{v(1 - \{E[\xi^S_{i,R}(\hat{e}^S_{i,R})] + (1 - E[\xi^S_{i,R}(\hat{e}^S_{i,R})])E[\xi^S_{i,J}(\hat{e}^S_{i,J})]\})}{1 - v\{E[\xi^S_{i,R}(\hat{e}^S_{i,R})] + (1 - E[\xi^S_{i,R}(\hat{e}^S_{i,R})])E[\xi^S_{i,J}(\hat{e}^S_{i,J})]\}} = \frac{v(1 - \gamma(\hat{e}^S_{i,R}, \hat{e}^S_{i,J}))}{1 - v\gamma(\hat{e}^S_{i,R}, \hat{e}^S_{i,J})}.$$

where $\gamma(\hat{e}^S_{i,R}, \hat{e}^S_{i,J})$ is greater the higher is K and if supervisors are elected. Now, the planner's ex-post expected welfare function writes as follows:

$$W_P^{AI,S} = v\gamma\left(\hat{e}^S_{i,R}, \hat{e}^S_{i,J}\right)\underline{W}^* + \left[1 - v\gamma\left(\hat{e}^S_{i,R}, \hat{e}^S_{i,J}\right)\right]\left\{\frac{v\left(1 - \gamma\left(\hat{e}^S_{i,R}, \hat{e}^S_{i,J}\right)\right)}{1 - v\gamma\left(\hat{e}^S_{i,R}, \hat{e}^S_{i,J}\right)}\left[V(\underline{\hat{q}}^S) - (1+\lambda)\left[(\underline{\beta} - \underline{\hat{a}}^S)\underline{\hat{q}}^S + \right.\right.\right.$$

$$\left.\left.\left. + \psi(\underline{\hat{a}}^S)\right] - \lambda\Phi(\hat{\bar{a}}^S)\right] + \frac{1 - v}{1 - v\gamma\left(\hat{e}^S_{i,R}, \hat{e}^S_{i,J}\right)}\left[V(\hat{\bar{q}}^S) - (1+\lambda)\left[(\bar{\beta} - \hat{\bar{a}}^S)\hat{\bar{q}}^S + \psi(\hat{\bar{a}}^S)\right]\right]\right\} - 2(1+\mu)\hat{s} \quad (3)$$

where μ is the shadow cost of public funds. Again the high type agent obtains an optimal allocation while the allocation-effort pair for the low type is given by:

$$\hat{\bar{q}}^S = q^*(\bar{\beta} - \hat{\bar{a}}^S) \quad \text{i.e.,} \quad V'\left(\hat{\bar{q}}^S\right) = \hat{\bar{c}}^S = \bar{\beta} - \hat{\bar{a}}^S,$$

$$\psi'\left(\hat{\bar{a}}^S\right) = \hat{\bar{q}}^S - \frac{\lambda}{1+\lambda}\frac{v}{1-v}\left(1 - \gamma\left(\hat{e}^S_{i,R}, \hat{e}^S_{i,J}\right)\right)\Phi'(\hat{\bar{a}}^S), \quad (4)$$

The results in (4) suggest how the rule giving price as a function of marginal cost is the same of the full information case: incentive concerns are entirely taken care of by the cost-reimbursement rule. In order to lower the high type rent, the principal is forced to distort away from the first best allocations and toward low

[13] The revolving door effect does not seem to exist for ALJs.

power (i.e., low level of effort $\hat{\bar{a}}^{S}$) incentive schemes. This distortion is lower the more powerful is the signal extraction technology and implicit political incentives (election) for supervisors act here as substitute for possibly costly explicit market incentives (COS). The following proposition summarizes these findings:

Proposition 1: ***A.*** *High powered incentive schemes are linked to the presence of elected supervisors and more efficient supervision technologies (higher K).* ***B.*** *An increase in the power of the incentive scheme lowers ex-ante regulated prices*.

The above proposition extends the basic insights of the New Regulation Theory program's (Laffont and Tirole [1993]) to the more realistic framework with implicitly interested supervisors and hierarchical signal extraction technology. However, it is instructive to insist that the picture drawn in this section is at least partially shaded. I always assume a myopic and public interested planner, but what happens when partisan interests and concerns for the long run firm's profitability affect the planner's objective function?

3.1 Strategic Price Mechanism Reforms

Following Laffont and Tirole [1993], a sharp tension between rent extraction and investment arises in industrial policies: whether or not the planner can commit to a contract contingent on the level of investment, the equilibrium can envision ex post expropriation of sank investments. In this sense, non-benevolent supervisors may relax such a failure. This intuition proposes several crucial questions: is it possible to think of the supervisors' effort exertion as a pandering activity? If this is the case, can a possibly partisan planner take the expropriation effect into consideration in choosing among selection rules? How much is this choice driven by efficiency concerns and how strong are the rent seeking forces? The answer to

the first question arises naturally when the above model is bridged to the analysis in Laffont and Tirole [1993]. Let me assume that before stage **1.** The regulated firm fixes the level of a non contractible investment of cost I that increases of $\zeta(I)$ the probability that a high type is drawn. Moreover I have that: $\zeta'(\bullet)>0, \zeta''(\bullet)<0$, $\lim_{I\to\zeta^{-1}(\bar{v})} I=\infty$ with $\bar{v}=(1-v)/v$ and that investments are sufficiently effective, i.e. $\zeta'(\bullet)>1/(v\Delta\theta)$. The planner lacks commitment but anticipates the optimal I (i.e., I^*). Ex ante the firm maximizes her expected ex post rent minus investment costs:

$$I^* \in \arg\max_{I\geq 0}\left\{v(1+\zeta(I))[1-\gamma(\hat{e}^S_{i,R},\hat{e}^S_{i,J})]\Phi(\hat{\bar{a}}^{S,I}(I^*))-I\right\} \qquad (5)$$

Employing a revealed preference argument (see *Appendix 6.1*), (5) clarifies that the firm under-invests with respect to the social optimum. Moreover, the objective function in (5) suggests that the extent of inefficiency is higher the more precise is the planner's signal and the less powered the incentive scheme is.[14] Indeed, a fixed-price contract reaches efficiency but at the cost of a too high rent for the high type. It is now clear how a planner caring enough about cost-reducing investments, because faced with a high cost market or because strongly interested in the firm long run profits will prefer a high-powered performance rule. From a long run perspective, the supervisors' signal extraction activity can assume a pandering feature when effort is driven more by career concerns than by a farsighted interest in the market efficiency: this dynamic inconsistency is even stronger when investments in reliability and quality services are taken into

[14] Such an effect is studied in Sappington [1986]. Here, an institution that prevents a regulator from observing the firm's true cost turns out to be optimal to protect the firm from investments' expropriation. In my model the actual presence of higher powered incentives schemes and the appointment rule for supervisors cover the same role.

consideration. These activities do not lower the firm's cost but increase her long run profitability: evidently also a conflict between consumers' groups will arise here. To capture this, I assume that the constitutional reform is decided by the incumbent among two parties: one more pro-shareholders *R* (Republican), and one more pro-consumers *D* (Democratic). Between stages **1.** and **2.,** each party faces an election with winning probability x_j (j = [*D*, *R*]) and decides, if it is the winner, the size of ρ_j, an instrument increasing the investment's utility for the firm, i.e. $G(I,\hat{\rho}_j)$. A type *j* planner attaches a weight $\tilde{\chi}_J$ to the latter and a weight χ_j to *I*. The weights are such that: $\chi_R = 1+2d$, $\chi_D = 1+d$, $\tilde{\chi}_R = 2d-1$, $\tilde{\chi}_R = d-1$. So a Republican planner values more *I* and dislikes less an increase in the firm's utility. The following properties hold: $G_1 > 0, G_{11} < 0, G_{11} < 0, G_2 > 0, G_{22} < 0, G_{12} > 0$, $G_{21} > 0$. The firm shows risk aversion toward non cost-reducing investments and, defining $I^*(\hat{\bar{a}}^{S,I}(i),\hat{\rho}_j) \equiv I(i,j)$, the following regularities hold: $G_{111}/G_{112} \geq G_{11}/G_{12}$ and $\left[G_{11}(I(i,R),\hat{\rho}_j)\,\partial I(i,R)/\partial \bar{a}^{S,I}\right] \Big/ \left[G_{11}(I(i,D),\hat{\rho}_j)\,\partial I(i,D)/\partial \bar{a}^{S,I}\right] \geq 1$ (6)

Before stage **3.**, the firm chooses the non-observable and non-contractible *I* as to maximize her expected ex post utility subject to the budget constraint:

$$I^* \arg\max_{I\geq 0}\left\{G(I,\hat{\rho}_j)+\hat{\underline{t}}-\psi(\hat{\underline{a}}^{S,I})\right\} s.t.: A+(p-c)q \geq t+I. \quad (7)$$

I^* depends from both the power of the incentive scheme and the level of ρ_j and the inter-party distance *d* and the optimal ρ are such that: $\hat{\rho}_R > \hat{\rho}_D$ and $d > \lambda$. So I have that: $I_1(\hat{\bar{a}}^{S,I},\hat{\rho}_R) \geq I_1(\hat{\bar{a}}^{S,I},\hat{\rho}_D) \geq 0$. Clearly, a partisan planner takes into account the political uncertainty and increases the power of the scheme the deeper the fear of expropriation is. Defining $G(I(i,j),\hat{\rho}_j) \equiv G(i,j)$, the ex post expected welfare function for a type *j* planner is:

$$W_j^{AI,S,I}(i,j) = W_P^{AI,S}(i) + v\gamma(i)\left[(1+\lambda+\tilde{\chi}_j)\tilde{G}(i,j) + (\chi_j - 1 - \lambda)\tilde{I}(i,j)\right] - o\left(1 - \partial\tilde{G}(i,j)/\partial I\right).$$

with $\tilde{I}(i,j) \equiv I(i,-j) + x_j(I(i,j) - I(i,-j))$ and $\tilde{G}(i,j) \equiv G(i,-j) + x_j(G(i,j) - G(i,-j))$.

The equilibrium effort for the low type firm is defined as: $\psi'\left(\hat{\bar{a}}^{S,I}\right) =$

$$= \hat{\bar{q}}^{S,I} - \frac{1}{1+\lambda}\frac{1}{1-v}\left\{v\gamma(i)\left[\lambda\Phi'(\hat{\bar{a}}^{S,I}) - (1+\lambda+\tilde{\chi}_j)\,\partial\tilde{G}(i,j)/\partial\bar{a}^{S,I} + \right.\right.$$

$$\left.\left. -(\chi_j - 1 - \lambda)\,\partial\tilde{I}(i,j)/\partial\bar{a}^{S,I}\right] + o\left[\partial^2\tilde{G}(i,j)/\partial I\,\partial\bar{a}^{S,I}\right]\right\}. \qquad (8)$$

Non contractibility of investment along with sharp conflicts over the size of investments' aids among different consumer groups generate the last three new and positive terms in the cost-reimbursement rule. These terms are affected by both the inter-party distance *d* and the holding on power x_j. The latter effect is diametrically different among contrasting partisan planners when the role of public incentives is greater (condition (6)). Such a strategic institutional design[15] extends to the incentive schemes' reform the foundations suggested by Guerriero [2006 a] to the supervisors' selection rules. *Proposition 2* summarizes as follows:

Proposition 2: **A.** *Higher powered incentive schemes will be linked to high cost industries*. **B.** *The likelihood of a reform toward more powerful incentive schemes is higher the higher is the inter-party distance and the higher (lower) is the holding on power if the reformer is Republican (Democratic). The presence of a Republican incumbent reformer increases the likelihood of these reforms.*

These results are strongly at odd with the seminal analysis in Laffont [1996]. There the relation with an incumbent Republican has opposite signs and the

[15] Several studies demonstrate that a lack of permanence in office can inspire policymakers to employ institutional reforms either to influence political outcomes or to impose constraints on future incumbents (see Persson and Svensson [1988] and Tabellini and Alesina [1990]).

incentive rule was insensitive to the holding on power with a Democratic planner. The deep reason is that when loosing the chance of fixing the preferred level of ρ_j becomes more costly (high inter-party distance) an incumbent planner is willing to distort the incentive scheme even more toward less rent extraction.

3.2 Robustness: Lobbying and Bribing

When positive rents remain in equilibrium, they can be employed to capture either partisan parties or directly supervisors. Indeed, *Proposition 1* results somewhat weakened when an organized group interested in maximizing the regulated firm's rent is considered. Both ALJs and PUCs' commissioners exert effort in other tasks. As seen above, examples are the control of bypassing by non-regulated utilities and the analysis of environmental regulation. Well, it turns out that the organized group can relax the supervision constraint offering side-contracts conditional on this second effort level supposed observable and contractible;[16] As in Alesina and Tabellini [2005 a], the interest group has all the bargaining power and influences supervisors either directly (bribes) or indirectly (campaign contributions) before the effort is decided in stages **3.** or in **4.**. The level of performance from the extra task *h* brings a small positive extra-utility to the firm but implies a relevant cost of effort to the supervisor as captured by a non-divisible effort cost function $C\left(e_{i,l}^{S}+e_{i,l}^{h,S}\right)$. In a jointly optimal equilibrium $\hat{e}_{i,l}^{S}=0$ so that the high type's firm enjoys a higher informational rent (proofs are available upon request). Even if discouraging, these equilibria are fragile and the

[16] Here I take aside the eventual multiple principal-multiple agents' strategic interaction, i.e. cost minimization across supervisors' side payments. This remains as open agenda for future research.

following remarks apply: 1 Bribes do not arise if the punishment that a supervisor receives if caught is high enough; 2 Campaign contributions, although legal, would be not even affordable for the interest group, which has to reimburse supervisors for the entire amount of implicit incentives (multiplicative precision technology); 3. Judges are less corruptible even if the return to bribe them is higher (they exert a higher level of effort). Thus, provided that implicit incentives are high enough - high values of τ, R and J in (1) - the model remains robust to possible lobbying and bribing. The next section will face this complex theory, except the firm's lobby part, to the data. The next section will subject this complex theory, except the interest group part, to the U.S. electric market's data.

4. Evidence

The main contribution of the empirical part of the paper is to address finally the constitutional determinants of the reform of cost-reimbursement rules in regulated market, giving, besides, evidence on the effect of the reforms toward performance based regulations on the US Electric power market prices. As *Table 2.A* and *2.B* report, between 1982 and 2002, 41 of the 144 major IOUs operating in the US electric power market switched to some kind of performance based regulations. This enormous wave of change has been interesting 25 of the 49 continental US states and constitutes a perfect source of variation able to test the above model. The empirical questions are: what forces have shaped the reforming planners' incentives at the constitutional tables? How strong were the political positions and how much did the reformer take into consideration efficiency reasons? Can the data reveal the extent of substitutability between market and political institutions?

Such a wide variation over cross sections (i.e. states and firms within states) and time nicely lends itself to a panel approach; moreover, as underlined in Persson and Tabellini [2003], a cross sectional analysis will deliver here fragile inference given the "non-random pattern of constitutional reforms and the extensive differences among [individuals] belonging to different constitutional groups." Thus, I will make use of two main models for evaluating respectively the determinants of the constitutional reforms and the effects of PBRs on prices: 1. a random effects panel with dependent variable a binary for the presence of performance-based regulations; 2. a panel pass-trough pricing equation. *Proposition 1* and *2* arise a set of empirical predictions summarized as follows:

Empirical Prediction: **1. A.** *High powered incentive schemes are linked to more efficient supervision technologies, high cost industries and elected supervisors*. **B.** *High powered incentive schemes are more likely with Republican reformers, the higher is the inter-party distance and the higher (lower) is the holding on power if the incumbent reforming party was Republican (Democratic).* **2.** *High powered incentive schemes lower the level of equilibrium prices.*

4.1 Non Random Constitution Selection

First of all, let define institutions. The high powered incentive schemes' dummy (*PBR_F* and *PBR*) takes value 1 if the firm (or the state) adopts a broadly defined (rate freeze, price or revenue cap with possible earnings sharing)[17] performance based regulation and 0 otherwise (i.e., cost of service regulation). In order to evaluate the *Empirical Prediction*, I make use of several proxies for the efficiency

[17] See EEI, [2000] and Sappington et al. [2001] for a precise definition of each scheme.

of the production and signal extraction technologies and the inter-party competition. The latter is captured by the absolute distance between Democrats and Republicans (*Av_Dist*) while the incumbent's holding on power is measured by the average percentage of seats held by the majority party (*Av_Maj*).[18] Let me define selection rules as: *Jud_Elec*, an elected judges' dummy, and *Reg_Elec*, an elected regulators' dummy. More complex it is to find proxies able to directly quantify the efficiency of the supervision technology; my strategy is to use the two sets of observables that most likely enhance the likelihood of information extraction: proxies for the presence of powerful watchdog groups and proxies for the amount of staff's resources. The first set includes: *Young* (proportion aged 5-17), *Ind* and *Res* (proportion of revenues form sales to industrial and residential users respectively). Staff's resources are measured by the PUC's staff budget (*Budget*) and the number of permanent staff's members (*Employ*). The latter, unfortunately, is a very crude proxy for efficiency; different and unobservable (in my data) skills are required to the PUC's members so it is not clear in what measure higher values of *Employ* provide the planner with a more precise signal or instead relax the assumed benevolence. Finally, investments' concerns are captured by proxies for costly generation (c_{st}) and more crudely by residential prices (*Rkhr*). Generations by nuclear and fuel sources (*Gen_Fuel*, *Gen_Nucl*) are introduced (one at the time to avoid multicollinearity) to control for difference in generation sources across states. Finally, other controls are state population (*Pop*), income (*Income*) and electricity sales (*Sales*). A full account of the variables' source and construction is given in the *Appendix 6.2* and *Table 1*. *Table 3* presents the results of the random effects Logit model. While *columns (1)* and *(2)* report,

[18] See Hanssen [2004] for a detailed explanation of the proxies' choice.

respectively, the estimates for a panel of 49 states for the samples 1970-1997 and 1980-1997; *column (3)* shows the evidence when the same model is estimated for a panel of 143 firms over the same 49 states over the period 1980-1997 (the Potomac Electric Power Company is excluded given the non-availability of data points for the District of Columbia). Note that in *column (3)*, the right hand side variables vary only across states and time and identification is obtained through the firms specific random effects. The evidence strongly supports the model predictions. For what concern the proxies for the holding on power, the results arbitrate clearly in favor of the strategic use explanation. The holding on power increases the probability of a reform toward higher powered incentive schemes if interacted with a Republican incumbent while the sign of *Av_Maj* is negative within the Democratic incumbents' group. Republican incumbent are more likely to reform toward *PBR*.[19] All the proxies are highly significant (almost all at 1%-5%) except *Av_Maj* in *column (1)* and *Av_Dist* in *columns (1)* and *(3)*. Looking to selection rules, it is clear (even if *Jud_Elec* is significant at 20% in *column (3)* and negative in *column (2)*) that the planner substitutes out costly rent-extraction incentives (COS) with accountability-driving institutions. A bit more mixed is the evidence on the efficiency of the signal extraction technology. The relevant proxies show the correct sign except *Employ* always negative and *Res* and *Ind* negative in *columns (2)* and *(3)*. While the first sign comes at no surprise given the above remark, an appealing explanation for the last two is that, in a dynamic set up, the friction between supervisors and interested parties would become so

[19] The impact of an incumbent Republican reformer is given by the sum of the coefficient on *Rep* plus the coefficient on *PBR*Rep* multiplied for the mean of *Av_Maj*. In *columns (1)* and *(3)* these figures are respectively: 4.26 = – 25.54 + 44.48*0.67 and 5.43 = – 15.00 + 31.92*0.64.

sour to deteriorate the quality of the signal. Finally investment concerns (high cost industries) increase the attractiveness of high powered cost-reimbursement rules. *Section 4.2* closes the empirical evidence looking to the relation between price and high powered incentive schemes. To this extent, a wide literature, mainly based on telecommunications' market data, has delivered the following stylized facts: PBRs delivers lower prices and higher earnings with no relevant reduction in overall service quality.[20] What these studies lack is an endogenous treatment of the regulatory institutions: the next section will fill this hole.

4.2 Pricing Models

The model considered relates electricity prices charged at state level to various cost items plus fixed effect terms for regulation regimes. Utilities set prices at system wide average costs. The only rough and available measure is the fossil fuels' component (see Besley and Coate [2003]). This item is useful in assessing the pass through of cost shocks into prices and helps in controlling the differences in the production structures. Thus, I test point **2.** of the *Empirical Prediction* running, for each customer class, a panel regression of the form:

$$p_{s,t} = \eta_s + \vartheta_t + \phi_1 Reg\_Elec_{s,t} + \phi_2 Jud\_Elec_{s,t} + \phi_3 Jud\_Elec_{s,t} +$$

$$+\upsilon_1 PBR_{s,t} c_{s,t} + \upsilon_2 Jud\_Elec_{s,t} c_{s,t} + \upsilon_3 c_{s,t} + \varphi Con_{s,t} + \varepsilon_{s,t}. \qquad (9)$$

In (9) $p_{s,t}$ is a price for state *s* in year *t*; η_s are state fixed effects controlling for long-run differences in production and distribution systems; ϑ_t are year dummies

[20] Sappington et al. [2001] offer a complete and clear cut summary of the literature. Kridel, Sappington and Weisman [1996] is a review of the first pieces of evidence on PBRs. The same scope has Hill [1995] for studies focusing on the electric power market.