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

Carmine Guerriero*
LSE

This Draft: June 2005

Abstract

Starting from the NRT model of regulation this paper analyzes the constitutional determinants of the reforms from low powered to high powered incentive scheme that have interested the US Electric power market during the 90s. A regulation performed by an uninformed social welfare maximizer will lead to different outcome under symmetric and asymmetric information, in presence of capture or pandering by the regulator: the constitutional founders will naturally take the different comparative advantages of the reform into account. Once stated the theoretical propositions, I employ both cross sectional and panel data to test the related empirical predictions. The results show how the probability of a reform from low powered incentive scheme (COS) to high powered one (Incentive Based Regulation) has been linked to a lower threat for regulatory capture, a low cost industry structure and a presence of more accountable regulators, large (slim) majority and high (low) inter-party distance if the constitutional reform was enhanced by a Republican (Democratic) incumbent party. Moreover, in not switching states electricity prices are more responsiveness to fossil fuels cost changes. These results are robust to different estimation procedures.

Keywords: Industrial policy; Political economy; Regulation; Asymmetric information; Majority voting; Incentives.

JEL classification: L51; D72; D82; H11.

---

* I want to thank all the people whose help has permitted this research. I am deeply grateful to Mark Schankerman for his comments on the first draft and for the valuable guidance on the literature. I would like to thank Claudia de Rosa for many very helpful comments on the English final version. I am deeply indebted to Michele Polo and Guido Tabellini for many useful discussions during a first phase of this project and for the continuous support. I don't know how to thank Timothy Besley and Andy Hanssen for the data provided and for their kind encouragement. Moreover I want to acknowledge Ente "Luigi Einaudi" and MCC for funds and Anna Natale for her kindness. All the remaining errors are naturally mine.

Carmine Guerriero, 105, Hallam Street, W_1 W 5HD, London, UK.
Telephone number: 3487086993. E-mail: C.Guerriero@lse.ac.uk.

A Francesco e Pierluigi con Amore e Profondo Rispetto.

1. Introduction

A major task of economics and political science 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" view derives policies which correct market imperfections such as monopoly pricing. In the last twenty years this paradigm has been substantially improved through the explicit consideration of the various informational asymmetries faced by the planner: as a result, industrial policy can then be viewed as resulting from the optimal trade-off between efficiency distortions and informational rents. In the case of current interest, the regulation of natural monopolies, the planner will select optimal cost-reimbursement rules which arbitrate differently between the exertion of cost reducement effort (moral hazard with risk neutral firm) and the size of the informational rent (i.e.: adverse selection issue). Price-cap regulation favours efficiency, cost-plus regulation favours rent extraction.

This approach can explain why such a trade off matters and how the optimal choice depends on the available information regarding the cost structure and on the industry technology, but it completely fails in taking into account both the delicate set of controls on the bureaucrats and the politicians and the watch-dog role of nongovernmental groups (residential and industrial consumers through their advocates). Judges may have discretionary power and compete with the executive branches and the independent agency in filling unforeseen contingencies (see Shapiro [1986], Spiller and

[1] These social "planners" must delegate actual social choices to other agents, broadly labeled "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.

Tiller [1999], Guerriero [2004]) and governments may favour special interest groups (see Truman [1951] and Bernstein [1955]) leaving conspicuous rents to the various intermediaries needed in the implementation of industrial policies (Niskanen [1971], Kaufman [1961], Wilson [1980]). The public interest paradigm can help in recognizing the hierarchical structure of government through the complete contracting framework; but, as underlined by the Virginia and Chicago school (Pelzman [1976] and Becker [1985]), only a special interest framework can formalize how interest groups rent seeking activities can influence the policy making of elected politicians. Nevertheless both approach, taking the political system as uncontrollable and essentially given and ignoring informational asymmetries, are basically mute in explaining why regulated firms would be able to extract rents and therefore have incentive in influencing industrial policy.

Two research programs have tried to overcome such an inconsistency, employing both the classical principal agent model and the continually growing political economy literature. The first one, maintaining the public interest paradigm with full contracting or not at the constitutional level, has studied how a disaggregated view of government can explain the phenomenon of capture and rent-seeking, in a way that provides structural forms amenable to estimation. This line of research is pursued theoretically in Laffont and Tirole [1993] and empirically in Gasmi et al. [1993]. The second one has taken aside the public interest approach and has tried to explain how such inefficiencies are a by-product of the existence of communication costs and different judicial systems through the tools of both the voting and the career concern literatures (see Laffont [1996, 2000] and Persson and Tabellini [2000]).

Two are the main contributions of this paper: 1. a first theoretical section summarizes the alternative views, offering new insights about the strategic reasons driving the choice of the regulatory regime at the constitutional level; 2. a second empirical part

evaluate the relevance of one or another program. The focus of this research will be the economics of regulation and in particular the constitutional determinants of the reform from low powered to high powered incentive scheme widely manifested in the last decades in the US regulated markets.

The remainder of the paper is organized as follows. *Section 2* puts in place the theoretical foundation introducing first the main features of the Laffont and Tirole [1993] model under perfect and imperfect information if the regulator is public interested. Here, I will show how the model hypotheses meet the institutional setting of the market considered. *Section 2.2*. and *Section 2.3* handle the regulatory capture idea; besides new insights are given about the effect of different accountability rules.[2] *Section 2.4* completes the theoretical part extending the scope of the previous section to the possibility of strategic use of the cost reimbursement institution. The third section is dedicated to the empirical analysis of this wide literature. *Sections 3.1* lists the model main proposition in testable empirical predictions, while *Section 3.2* tests those predictions taking as experimental field the introduction of performance based regulation rules in the U. S. Power Market during the 90s. For the first time in literature, this session goes deeply through the endogenous constitution selection of an high powered incentive scheme exploiting both the time and cross sectional variation. *Section 3.3* analyzes the effects of this reform (taken as endogenous) on the sector regulated prices. *Section 4* concludes reporting a series of robustness checks, discussing the significance of the paper findings and proposing an agenda for future research. *Appendixes 8.1* to *8.3* contain a more detailed description of the model reported in *Section 2*. *Appendix 8.4*, finally, contains the figures, the main results as well as a detailed description of the data and sources used.

[2] The notion of "constitution" should be interpreted broadly: the "founders" might stand for lawmakers or tradition and the social welfare function can be generalized to account for potentially partial goals of the founders.

2. Theory

Investor-owned electric utilities account for over three-fourths of the electric sales and revenues of the US electric power market. Historically retail service is regulated by a state level public utility commission, or PUC.[3] These commissions perform a variety of functions, the most important being the regulation of prices. Indeed, firms are not allowed to receive subsidies from the government: this implies that the firm's revenue from sales to consumers must exactly cover its cost (including managerial rewards). IOUs usually charge a two part tariff,[4] triggering rate reviews in response to rising costs (Joskow, [1974]). While the majority of rate reviews results in rate increases, utilities typically receive only a fraction of the total increase requested.[5] The same commission may review the case, provided that the onus of injustice and illegality of the decision lies on the company. In any case, any party interested in the filing could go to high courts for a rehearing of the trial. Such an institutional setting leads to the version of the Laffont and Tirole [1993] regulation model, that the next session is going to explain.

2.1 Basic Model: No Transfers and Incomplete Information

Let begin the analysis from the standard framework under complete information, that is the cost C is observable by the regulator[6] and the regulator is benevolent.[7] The

[3] On the other hand, jurisdiction over both interstate transmission and wholesales transactions lied inside the *Federal Energy Regulatory Commission*.

[4] As Joskow and Schmalensee [1986] suggests the fixed premium paid by consumer turns out to be the transfer to the government usually present in the regulation-procurement literature. In this case, the economic shadow cost of public funds is replaced by the marginal deadweight loss associated with an increase in the fixed premium.

[5] The review process is quite involved. The PUC staff presents its analysis and recommendations after it evaluates the previous decisions, in addition to the involved company's official papers and accounting books. This process is completed during a series of public hearings open both to the utilities and other interested parties (including consumer advocates). Afterwards, commissioners take action on the proposal by making a motion to approve the filing. If a filing is not approved, in most cases it is "suspended" and set for a formal quasi-judicial style hearing: an Administrative Law Judge presides at hearings, often with the commission sitting on the bench during sessions. The main parties, PUC staff, the company, and ratepayers are represented by attorneys. Subsequently the quasi-judicial tribunal takes a qualified majority enforceable judgment.

[6] The realized cost C, the outputs and the prices are verifiable. However, the regulator cannot distinguish between the various component of the realized cost.

[7] The regulator is a Stackelberg leader and makes take-or-live it offer, knowing β and observing e.

regulated firm charges a two party tariff $A + pq$ for $q > 0$, where A and p are positive. The benchmark case is given in *Appendix 8.1*: here I consider the most interesting case of incomplete information. The regulator observe only total cost and output (i.e.: the demand function is know) and there are two potential technological parameters only.[8] Let β now be private knowledge of the firm. I will assume for simplicity that β will turn out to be equal to $\underline{\beta}$ with probability v and to $\tilde{\beta}$ with probability $1 - v$. Let $\Delta\beta$ be $\Delta\beta \equiv \tilde{\beta} - \underline{\beta}$. Average cost $c = \beta - e$ are ex post observable.[9] Let $\{(\underline{t}, \underline{q}, \underline{C}, \underline{c}, \underline{U}, \underline{e}), (\tilde{t}, \tilde{q}, \tilde{C}, \tilde{c}, \tilde{U}, \tilde{e})\}$ denote the equilibrium transfer, output, cost, marginal cost, and utility of the two types. A contract based on the observables t and C specifies a transfer-cost pair for each type. The regulator wants to keep both types; as usual in the mechanism design literature the program envisions a solution with binding low type's (inefficient firm) individual rationality (rewards are socially costly) constraint (IR_H) and binding high type's (low cost structure firm) incentive compatibility (IC_L); moreover, the high type will enjoy an informational rent.[10] To be precise, we have that:

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

$$\underline{U} = \underline{t} - \psi(\underline{\beta} - \underline{c}) = \tilde{U} + \psi(\tilde{\beta} - \tilde{c}) - \psi(\underline{\beta} - \tilde{c}) = \Phi(\tilde{\beta} - \tilde{c}) = \Phi(\tilde{e}) \qquad \text{(IC\_L)}$$

where $\Phi(\cdot)$ is an increasing function defined as $\Phi(e) \equiv \psi(e) - \psi(e - \Delta\beta)$.

The efficient type's rent is entirely determined by the inefficient type's marginal cost. Expected social welfare is given by:

$$W = v[V(\underline{q}) - (1+\lambda)[(\underline{\beta} - \underline{e})\underline{q} + \psi(\underline{e})] - \lambda\Phi(\tilde{e})] + (1 - v)[V(\tilde{q}) - (1+\lambda)[(\tilde{\beta} - \tilde{e})\tilde{q} + \psi(\tilde{e})]] \quad (1)$$

For each agent, the maximization is the same as for the full information case except for the expected rent $v\lambda\Phi(\tilde{e})$ that the principal has to leave to the efficient type.

---

[8] The theoretical propositions to be stated apply in the same manner to the continuous case.

[9] Given the linearity of cost, here average cost is equal to marginal cost. With fixed cost α, the regulator would observe $(C - \alpha)/q = \beta - e$ and the result of the analysis remains unchanged.

[10] Incentive compatibility says that the contract designed for type $\underline{\beta}$ (respectively type $\tilde{\beta}$) is the one preferred by type $\underline{\beta}$ (respectively type $\tilde{\beta}$) in the menu of transfer-costs pairs. It amount to say that:
$\underline{t} - \psi(\underline{\beta} - \underline{c}) \geq \tilde{t} - \psi(\underline{\beta} - \tilde{c})$ (IC_L) and $\tilde{t} - \psi(\tilde{\beta} - \tilde{c}) \geq \underline{t} - \psi(\tilde{\beta} - \underline{c})$ (IC_H).

Since this term depends only on $\tilde{e}$, the levels of $\underset{\sim}{q}$ and $\underset{\sim}{e}$ are the same as under full information. Now we have:

$$\underset{\sim}{q} = q^*(\underset{\sim}{\beta} - \underset{\sim}{e}), \tag{2}$$

$$\psi'(\underset{\sim}{e}) = \underset{\sim}{q}, \tag{3}$$

$$\tilde{q} = q^*(\tilde{\beta} - \tilde{e}), \tag{4}$$

$$\psi'(\tilde{e}) = \tilde{q} - (\lambda/1+\lambda)(v/1+v)\Phi'(\tilde{e}). \tag{5}$$

Equation (2) and (4) show that the rule giving price as a function of marginal cost is the same under full information: incentive concerns are entirely taken care of by the cost-reimbursement rule. The efficient type now enjoys an informational rent; indeed, the inefficient type effort $\tilde{e}$ is smaller under asymmetric information; moreover its average cost and output are respectively higher and lower. The cost reimbursement rule is affected by informational asymmetries: a low powered incentive scheme is given to the inefficient type to limit the efficient type's rent. Focusing on the probability of reform from COS to high powered scheme, the model prediction can be summarized as follow:

Proposition 1: The more efficient is the cost structure the more likely will be a reform from a low powered to an higher powered incentive scheme (the more eager the firm will be to push for or to accept such a reform).

2.2 Regulatory Capture

Now leaving aside the hypothesis of public interest, this section considers the "capture" or "interest group" theory, that is the role of interest group in the formation of public policies. Let's consider a three-tier hierarchy: Firm/Agency/Congress. All parties are risk neutral.

The full model explanation is given in *Appendix 8.2*. The following proposition summarize the findings:

Proposition 2: Under producer protection:

1. collusion reduces social welfare, $\partial(EW)/\partial\lambda_f > 0$;
2. under asymmetric information the threat for capture lower the inefficient firm incentive scheme even more than without producer protection; as a consequence the efficient type enjoys a lower rent (Congress has to reduce the firm stakes to prevent collusion);
3. output is still at the full information level except for the inefficient type for which is lowered even more under asymmetric information;
4. the agency is given an incentive scheme such that $\underline{s} > \tilde{s} = s_0$;[11]
5. e, and therefore $\Phi(e)$ and $\tilde{q}^*(e)$, increases with λ_f.

Moreover, with little extra structure, it is possible to go a step further and consider a simple comparative static exercise regarding the shadow cost of transfers for the firm. Suppose that different accountability rules (namely election and appointment) lead the agency to have different monetary disutility of accepting bribes from regulated firms. Following the rich literature on elected *vs* appointed regulators,[12] I suppose that $\lambda_f^E > \lambda_f^A$: the cost of accepting bribes is higher for a more populist agent that has his eyes on the ballot box than for an eventually career concerned bureaucrat. According to the last point of Proposition 2 this leads to an higher powered incentive scheme if the planner is faced in the reform stage with an elected regulator;[13] or otherwise stated:

[11] Also the price of the inefficient firm turns up to be greater with respect with the AI equilibrium under no collusion.

[12] The main theoretical contribution on the field is the one of Besley and Coate [2003]. If the regulator type is determined in a gubernatorial election, regulatory policy is bundled with other issues and it results salient only for voters who wish to secure a high price in the regulated industry (e.g. the stakeholders). This means that parties have electoral incentives to run pro–stakeholder candidates. Direct elections unbundles these issues and limit the scope for this kind of endogenous regulatory capture. The power of these incentives is greater when parties prefer to obtain their preferred public spending level rather than their desiderated regulation policy.

[13] A glance to the expression for $\underline{s}_1$ in (A.6) suggests how appointed regulators must be rewarded more than elected regulators. According to the data on regulatory rewards, indeed, appointed regulator earned an higher wage both in 1996 and along all the time period spanned by the panel analysis (76764 *vs* 63022 dollars in 1996 and 1.120 *vs* 0.746 dollars for million Kwh along the period 1970 – 1992).

Proposition 3: The probability of a reform from a low powered to an higher powered incentive scheme is enhanced in the presence of an elected regulator.

The following two sessions complete the theoretical analysis asking the following question: What would be a positive analysis of the regulatory regime reform?

2.3 A Positive Analysis of Cost-Reimbursement Rule: Laffont [1996]

The population of consumers is a continuum composed of two types, type 1 and type 2. The gross consumer surplus from the production of q unit of the product is S_1 (respectively S_2 with $S_2 > S_1$ for all q in the interesting analysis range) for type1 (respectively 2) and γ (respectively $1 - \gamma$) is the proportion of the type 1 (respectively 2) population. At the beginning of the period, γ is a random variable on [0, 1], firm utility is $U = t - C - \psi(e)$ and the social welfare function is utilitarian; all the remaining assumption are equal to the one posited in section 2.1 and consequently the solution under perfect information resembles in all the one in *Appendix 8.1*.[14] More interesting is the case of incomplete information. Consider a two-step institution in which there is first an election in which the two candidates are committed to govern in favour of type 1 and type 2 consumers respectively.[15] Let pose that type 2 consumers have the majority and appropriates the rent (i.e.: it holds the monopoly) and that the firm's managers do not offer freely their information.[16] In this set up, the equilibrium will be characterized as follows:

$$\psi(\underline{e}^{M2}) = \underline{q},$$

$$\psi'(\tilde{e}^{M2}) = \tilde{q} - (\lambda/1+\lambda)(\nu/1+\nu)\,[(1+\lambda)/\lambda - 1/((1-\gamma)\lambda)]\,\Phi'(\tilde{e}^{M2}). \qquad (6)$$

with $(1-\gamma) \in [1/2, 1]$. This time the firm's rent is captured only by one group.

[14] Efficiency of production can be obtained either by reimbursement of cost with a monitoring of effort or by a "price cap" of $t^* = (\beta - e^*)q + \psi(e^*)$. There is no real issue of which cost – reimbursement rule is chosen.
[15] This type of commitment can be enforced by reputation of political parties.
[16] This is clearly a short-cut to a more general theory which would make explicit the agency relationship within the majority; but it allows as to attach to the firm budget constraint the usual shadow cost of manager rewards.

As a consequence, type 2 candidate induces effort levels which are higher than the usual solution with Asymmetric Information (see 2.1) and which create higher rents. This result clearly depends on the inability to discriminate in pricing according to consumer type. If such discrimination were possible the type 2 majority would capture all the surplus and would be led to select the optimal level of effort. On the other hand if type 1 has the majority, it will give zero weight to the firm utility; in that case the objective function and the solution for the firm will be:

$$\gamma S_1(q) - (1+\lambda)\gamma[v\underline{t} + (1-v)\tilde{t}]$$

$$\psi(\underline{e}^{M1}) = \underline{q},$$

$$\psi'(\tilde{e}^{M1}) = \tilde{q} - (v/1+v)\Phi'(\tilde{e}^{M1}). \qquad (7)$$

The above expression highlights how, if the private monopoly is not owned by the political majority, the resulting incentive scheme will be less powerful than both the optimal one and the one chosen by the majority of type 2: a majority that cannot appropriate the firm's rent tend to decrease it. This level of effort is insensitive to the majority and the polarization between party; while having a glance to (6) appears clear that the distortion from optimality is higher the slimmer is the majority, and the lower is the interparty difference party 2 is in power. Summing it all up, the positive analysis in Laffont [1996] can be restated as follows:

Proposition 4: Supposing that the private monopoly is owned by the political majority (Republican), majority voting increases the probability of a reform from a low powered to an higher powered incentive scheme the weaker is the majority holding on power and the lower is the inter–party distance (here I take the derivative of (6) with respect to $1-\gamma$ and to $1-2\gamma$). If Democratic are in power the incentive scheme will be less powered and his level will be insensitive to both political measures.

The model assumption and micro-foundation of the political process is clearly crude and the results essentially stand on the conflict arising between shareholders and

majority. To improve on this critics, the large literature on strategic use of long-run policies is relevant here: indeed, institutional reform is certainly one way of trying to influence future political outcomes.

2.4 Strategic Constitutional Design: How Tie Their Hands

One grand view of policy making, suggested by Buchanan, is to think of there being two stages of analysis. At the first stage, a constitution is designed. This has two components: a procedural constitution that sets the terms by which decisions are made (electoral rules, term limits, the separation of powers etc.) and a fiscal constitution, that builds in constraints on the policies that can be adopted within the framework of the procedural constitution. After the constitution is determined, policies are chosen. However, these are autonomous, and so a key role for the policy advisor will be, at stage one, to anticipate the outcome at stage two from some underlying models. In this sense, a number of studies demonstrate that a lack of permanence in office can inspire policymakers to act strategically (see, e.g., Glazer [1989], Persson and Svensson [1989], Alesina and Tabellini [1990], Milesi-Ferretti [1995], Hanssen [2004]). This could happen, for example, because a future coalition is likely to have policy preferences different from those of the current regime. In this way current officeholders may have the incentive to raise the cost of future policy changes. This, in turn, may lead to deviations from the policies that would have been chosen if the regime did not face replacement. This section investigates whether a similar strategic interaction can explain variations in the constitutional choice of cost reimbursement rule.[17] In this perspective I offer a straightforward variation of the model presented in *Section 2.3* in which the above strategic dynamics is driven by the threat of loosing power and by the

[17] A similar strategic dynamics is exploited by Sappington [1986]; Sappington claims that an institution that prevents a regulator from observing the regulated firm's true cost may be optimal when the regulated firm sinks some non contractible investment and the regulator cannot commit to future incentive schemes. The absence of cost observation partly protects the firm from expropriation of its investment.

difference in the weight the two party attach to the firm utility function. As usual, there are two political parties ($i = [A, B]$) that maximize the some welfare function except for the above described weights. These weights are bounded between 0 and 1 ($\theta_i \in [0, 1]$) and Party A cares more about the firm utility function (more pro-shareholder party, say Republican), that means that $\theta_A > \theta_B$. On top of it, I have that:

$$W_i^{FI} = S(q) - (1+\lambda)t + \theta_i U = V(q) - (1+\lambda)[C + \psi(e)] - (1 + \lambda - \theta_i)U \quad (7)$$

$$W_i^{AI} = S(\cdot) - (1+\lambda)[v\underset{\sim}{t} + (1 - v)\tilde{t}] + \theta_i [v\underset{\sim}{U} + (1 - v)\tilde{U}]. \quad (8)$$

Where $\underset{\sim}{t}$ and $\tilde{t}$ are defined by (A8) and (A9) in *Appendix 8.3*. The model lasts after two periods, and the timing is as follows. Party A is in power and can direct a cost reimbursement constitutional reform: this reform is in the hand of a by partisan planner who only cares about the next period expected utility.[18] After this constitutional design phase is concluded, an election is hold and party A has a chance x to be re-elected. Then, a regulator is appointed by the winning party: this public decision maker act as perfect agent of the politician. Next the regulator chooses q and e. Finally transfers are operated. Now, if the constitutional change is implemented under complete information I have the usual results and no effect is added by the presence of different parties; a more interesting equilibrium arises as solution of the planner maximization problem under asymmetric information. The objective function will be:[19]

$$W_P^{AI} = S(\cdot) - (1+\lambda)[v\underset{\sim}{t} + (1 - v)\tilde{t}] + \mathrm{x}\theta_A U^{\circ} + (1 - \mathrm{x})\theta_B U^{\circ}.$$

where $U^{\circ} = v\underset{\sim}{U} + (1 - v)\tilde{U}$. Following the usual routine, we have that:

$$\psi'(\tilde{e}^{AI}) = \tilde{q} - (v/1+v)[1 - ((x\theta_A + (1 - x)\theta_B)/(1+\lambda))]\, \Phi'(\tilde{e}^{AI}) =$$

$$= \tilde{q} - (v/1+v)\{1 - [((x - 1)(\theta_A - \theta_B) + \theta_A)/(1+\lambda)]\}\Phi'(\tilde{e}^{AI}) \quad (10)$$

Now a glance to (10) reveals how, as in the Laffont [1996]'s model, an higher rent for the low type firm is given in order to partially protect the firm interest. However, this

[18] The idea is that the constitutional committee has a broad component of representatives of the other party and the rule can only be changed under a supermajority. This is a good approximation for this kind of reform.
[19] Where W_P^{AI} indicates the planner objective function.

time, this rent is increasing (decreasing) in the power of the majority and in the degree of polarization between the two parties if the Republican (Democratic) party is in power.[20] The likelihood that the incoming party will enact a constitutional phase and the probability of a reform toward a more powerful incentive scheme will follow the same pattern. The reform, this time, is conducted in response to an eventual defeat in the incoming election and differently to Laffont [1996] is sensitive to both political measures for both type of majority. Proposition 5 summarizes the results of this section:

Proposition 5: The greater (lower) is the hold on power and the wider (slimmer) is the distance between the policy ideals of the rival parties, the more likely the first period incumbent is to direct a reform from a low powered to an higher powered incentive scheme if the party in power is Republican (Democratic).

3. Evidence

Although the main idea that efficiency reason can lead the planner to prefer one rule to another is well established theoretically, there is a real lack of empirical tests of the efficiency, capture-related and strategic determinants of the regulatory regime choice. A major contribution of this paper is to provide evidence that prove how the observed institutional reforms indeed reflect such forward-looking concerns.

In order to evaluate the model's predictions, I will make use of several proxies for the cost structure, the threat of capture and the inter-party competition. To this extent the next section relates the empirical proposition to the proxies employed in form of testable predictions: the sign in parentheses refers to the relation between the proxy and the model variables. Descriptions of these proxies and their sources are provided in Table 1. The data set spans the period from 1992 to 1997 for a total of 288

[20] To obtain the first result take the derivative of (10) with respect the party winning probability (e.g.: x) while for the second it is enough to fix $(\theta_A + \theta_B)/2 = \theta^*$ in such a way that $\theta_A = \theta^* + b$ and $\theta_B = \theta^* - b$. The equilibrium level of effort will be a function of θ^* and b only: the straightforward derivatives with respect to θ^* and b will give the results reported.

observations. *Section 3.2* presents the empirical results on the non-random constitution selection, while *Section 3.3*, treating for the first time in literature the cost reimbursement rule as endogenous, tries to shed more light on the relation between performance based regulation and prices.

3.1 Testable Predictions and Main Specifications

Based on proposition 1 to 5, it is possible to formulate the following empirical testable previsions on the determinants of the probability of a reform from low powered to high powered incentive scheme:

1. An higher cost structure (as captured by the percentage of generation by fossil fuels (+), percentage of generation by hydro (-), cost of fossil fuels (+), depreciation and amortization costs (+), dummy with value 1 if the states is West of the Mississippi river (-))[21] would decrease the probability of a reform toward an higher powered Incentive Scheme, ceteris paribus;
2. A more relevant threat for capture (as revealed by the number of employs in the PUC (+), the commissioners' salary (-), population (+), population aged over 65 (+) or between 5 and 17 (+), percentage of customer that are residential (+))[22] would decrease the probability of a reform toward an higher powered Incentive Scheme, ceteris paribus;
3. The presence of a regulator with a lower cost of accepting firms' bribes (an appointed regulator) would increase the probability of a reform toward an higher

[21] Almost the 70% of the total generation of electricity is driven by fossil fuel font; given the relevance of oil and its derivates as inputs it is also the more sensible to economic shock. Hydro generation is naturally the cheapest one. Finally in the West of the United States there is the higher percentage of public owned (low price) generators. Depreciation and Amortization costs try to capture the level of obsolescence of the plant and technology used. The sign between cost structure and high powered incentive is justified by the analysis of *Section 2.1*.

[22] The last four variables represent proxy for strong watchdog consumer interest groups. This theme is widely exploited in Laffont and Tirole [1993, ch. 15]. Summarizing, the presence of strong watchdog group enhances the probability of a cheating regulator been caught: this explains the negative sign. The population break-downs by age are intended to assess the power of the more intensive users. For what concern the number of employees the positive sign is supposed as resulting from the tension between rent minimization and surplus maximization if there are externalities among agents. The positive sign for the salary of commissioners is fully explained by point 4 in Proposition 2.

powered Incentive Scheme, ceteris paribus (see Besley and Coate [2003] and Guerriero [2004, 2005a] for further insights on this literature);

4. If the reform in enhanced by a Republican (Democratic) government and if the correct perspective is the one of strategic use of the cost reimbursement rule, a stronger hold on power by the incumbent party (as captured by the average - across upper and lower houses - percentage of seats held by the majority party) and a wider difference in party platforms (i.e.: absolute value of distance between Democrats & Republicans)) would increase (decrease) the probability of a reform toward an higher powered incentive scheme,[23] ceteris paribus. The relation will have an opposite sign for the Republican party (under the assumption that it holds the monopoly) and will be null in presence of a Democratic government if, otherwise, the Laffont [1996]'s model is correct.

Section 3.2 and *3.3* present the main empirical results of this research. The empirical strategy is to look to the estimates of two basic models: a probit (logit) with dependent variable set equal to 1 if the state uses in the 1996 a Cost of Service regulation and a random effects probit (logit) with dependent variable set equal to 1 when and if the state has switched to an Incentive Based type of regulation during the period 1992–1997. Data sources, aggregation strategy and the step followed to obtain the cost of fossil fuels measure are reported in *Appendix 4*.

3.2 Non Random Constitution Selection

Table 6 presents the coefficient estimates for the cross section of 47 states referring to the 1996: as the sign and the significance of the estimates show, the result are impressive. All the proxies employed have both an high statistic significance (almost all

[23] The first variable measures the strength of party hold on power within a given state (or equivalently the level of competition in the state legislature). The second variable, on the other hand, measures the size of the difference between party platforms within given states; to this extent, I refer to the Poole and Rosenthals analysis of roll call voting (see Hanssen [2004] for an extensive explanation of this choice).

at 1% except *Da*, at 10%) and the correct sign. As the probit estimates in column 1 of Table 6 highlights, the probability of having not reformed the old status quo rule (cost of service regulation) is positively correlated to an higher cost structure as summarized by the percentage of generation form fossil fuel source (*FFg*), high cost of depreciation and amortization (*Da*) and negatively to indicators of low cost technologies (*West*). Similar results hold true for the proxies gathering the threat for capture; in particular an high average commissioners' salary and a small staff have a negative marginal effect on the probability of adoption of cost of service regulation. The presence of powerful watchdog customer groups (wider population, higher percentage of residential customers and of population aged over 65) is linked to an higher probability of reform toward a more powerful incentive mechanism. Finally the political variable, introduced in this specification as controls, are all highly significant (1%) and suggest how an higher holding on power and less interparty competition increase the probability of a reform. When the distributional hypothesis is changed toward a logit model the evidence remains practically equal.

Interesting, at this point, is the consideration of a time dimension. To this aim, Table 7 presents the result of the random effects logit estimates of the index model with dependent variable set equal to 1 when and if the state has switched to a (broad-defined) performance based type of regulation during the period 1992-1997. Before having a look to the result, it is worth to noticing the choice of the estimation strategy. This is clearly a micro panel with a large number of cross section (48 states constitute the cross section identifiers) and a small number of year (T=6). The probit model does not lend itself well to the fixed effects treatment and so there is no feasible way to remove the heterogeneity. Therefore, with a large number of cross sectional units, the estimation of the fixed effects is intractable and given the dependence of the two MLE estimates also of the βs will be inconsistent; better is the perspective with a random

effects model (see Butlet and Moffit [1982] and Greene [1995a]). Again the result strongly support the model prediction. All the covariates introduced have the correct sign except for *Em* (that was supposed having an uncertain theoretical sign) and are strongly significant except for *Av_Maj* (that is significant at the 20% only). As highlighted before this model is able to test directly the variation of the political variables effects across the dimension suggested by proposition 5. The evidence arbitrates clearly in favour of the strategic use explanation; as the results show, correctly the sign of the two proxies are positive if the reform was enhanced by an incumbent Republican party and negative otherwise (Democratic).

Section 3.3 closes the empirical evidence. There is a wide and relevant literature on the effects of PBR regulation on the performance of the US regulated markets. This literature, mainly based on the TLC market data, has delivered the following stylized facts: PBR can deliver lower prices and higher earnings with no pronounced reduction in overall service quality.[24] What this literature lacks is an endogenous treatment of the cost reimbursement rule: the following section will fill this hole.

3.3 Determinant of Electricity Prices: Panel Estimates

The model considered relates the price of electricity charged at state level to various cost items plus fixed effect terms for the presence of cost of service regulation. At a first approximation it may be said that utilities set prices at, or near, system wide average costs. Utilities' governing bodies establish unit price on the bases of "revenue requirements", that is its total costs. From a normative perspective this consists to the model presented in *Section 2*, that is to the optimal second-best price in the case of a natural monopoly: in other words the regulator maximizes the welfare subject to the non

[24] Sappington and ot. [2001] offer a complete and clear cut summary of the literature. For a review of the evidence have a look to Kridel, Sappington and Weisman [1996], and for evidence regarding the electric power market: Hill [1995].

transfer breakeven constraint. Following Besley and Coate [2003] an important determinant of prices is the component of cost accountable as fossil fuels inputs. The fossil fuel cost measure would help to understand the difference in treated and not treated states in the responsiveness to cost shocks and, moreover, it functions as control for different production structures. The hypothesis I want to test is that PBR regulation lower both the level of prices and the responsiveness of prices to fossil fuels cost shocks. The panel specification ran is the following:

$$p_{st} = \alpha_s + \beta_t + \lambda\delta_{st} + \gamma_1 c_{st} + \gamma_2 \delta_{st} c_{st} + \varphi x_{st} + \varepsilon_{st}$$

where p_{st} is the residential (commercial and industrial) price per kilowatt hour for state s in year t; α_s are state fixed effects controlling for long-run differences in states production and distribution systems due to climate etc; β_t are year dummy variables that pick up macro-shocks and common changes in federal policy; x_{st} is a vector of state specific and time varying demographic characteristic (state population squared, proportion aged 5-17 and proportion aged over 65); δ_{st} is a fixed effects term with value one if the state use a kind of PBR. During the sample period 17 states have changed their cost reimbursement rule: clearly, the possible endogeneity of these right-hand-side variables for costs and regime choices is a real issue. In order to control for both the endogeneity of *PBR* and of the cost measure when the regime is shifted, that is *CFF*PBR*; I turn to a fixed (states) and time effects instrumental variable estimator, using as instruments the political, the capture-related and the economic determinants of the regime choice, that are: *FFg, Elec, Soc, Em, Av_Maj*, *Av_Dist*. *PBR* enters both as direct and indirect institutional effect. Introducing directly this dummy allows us to identify the independent effect of the regime switches: the related coefficient is identified purely off the time series variation in the switching states. The variable c_{st} represents the fossil fuel cost index in state s at time t.

The key implications to be tested are two: 1. $\gamma_2 < 0$: namely prices should respond less to cost shocks in switching states; 2. $\lambda < 0$: namely switching to a PBR pricing rule system should decrease the prices level.

Table 8 presents the basic results: a reform toward more powerful scheme decreases the price responsiveness to cost shocks for every customer class, while the direct effect has the wrong sign but is always not significant. The constitutional change makes the price almost insensitive to cost shocks. The R^2 is very high; nowhere less than 0.92.

4. Concluding Remarks

This paper analyzes the constitutional determinants of the reform from low powered to high powered incentive scheme. Price-cap or cost-plus regulation do not arbitrate the rent-efficiency trade-off in the same way under symmetric and asymmetric information, capture or career concern of the regulator: the constitutional founders will naturally take the different comparative advantages of the reform into account. Moreover this rule can be strategically used to tie the hand of the regulator as check on the new political incumbents policies. Once stated the theoretical propositions, I employ both cross sectional and panel data from the U.S. Electric Power market to test the related empirical predictions. The results show how the probability of a reform from low powered incentive scheme to an high powered one has been linked to large majority and less inter-party distance (if the reforming incumbent party was Democratic), a lower threat for regulatory capture, a more efficient cost structure and the presence of more accountable regulators. Moreover, switching states present a lower responsiveness to costs shocks.

As concluding remark, I would like to offer some insights for future researches on the field. Interesting, in the first place, will be to look to the timing of the reform through

an hazard rate model; such a model will be able to answer a natural question: does the regulator experiment on small firms and in what way? To this extent, it is worth to noticing how a third dimension of regulatory regime variability is not addressed in my estimates and in particular the variation of the constitutional dummy among firms within a state. The main results remain highly robust when has been ran a panel (not shown) with dependent variable the cost reimbursement rule, with cross section identifiers the 146 firms present in my sample and with cost measure: operation and maintenance costs, taxes and the value of the installed plant in cents per Kwh sales for the 1996 assumed as constant for all the period. This type of model presents two clear shortcomings: the low variability of the right hand side variables[25] and the poss ible endogeneity of the cost measure once the regime is shifted.[26] This last point will be correctly addressed using an IV approach similar to the one I employ for the pricing equation model but in a probabilistic type of specification. Finally will be interesting to look to the multivariate side of the problem employing both a multinomial logit or an ordered logit model. Running the latter[27] leaves unchanged all the paper main results (not shown). All in all, the evidence provided in this paper is robust to different estimation procedures and disturbance hypotheses; moreover it rationalizes from a normative and positive point of view the great wave of change that has interested the market during the last decades.

[25] Indeed, the demographic covariates, the political variables and the proxies for capture does not vary across firms; moreover they remains quite stable across years. Such a behaviour in the data makes difficult the identification of the estimated coefficients. One way to solve the problem is to not consider the less variable right hand side covariates and employing the same data involved in the cross sectional analysis for all the period and not only for the 1996. I hope to concentrate on such a model in future related researches.

[26] The idea is that this is really a system of equation: one equation describes the regime choice and the other one the cost measure as a function of a step dummy that takes value one if the regime is shifted and zero otherwise. In order to instrument the costs, I employ a measure of the composite price of fossil fuel cost. This variable is able to pick the input market shocks and will be conditionally exogenous to the constitutional choice once I control it for the other measure of cost structure. I would like to acknowledge Mark Schankerman for having raised this interesting issue to my attention. A deeper analysis of a possible endogeneity of the cost structure measures once the regime has shifted will be a fundamental point in the agenda for future research on the field.

[27] In this model the dependent variable is set equal to 1 if the regulator continues to employ a COS regulation, 2 if a (widely defined) IBR form of regulation is in act and 3 if a pure price cap is in use.

References

[1] Aghion, Philippe, and Patrick Bolton, [1990], "Government Debt and the Risk of Default: A Politico-Economic Model of the Strategic Role of Debt", in Rudiger Dornbusch and Mario Draghi, eds., *Public Debt Management: Theory and Practice*, Cambridge University Press: New York.

[2] Alesina, Alberto and Guido Tabellini, [2003], "Bureaucrats or Politicians?", *IGIER working paper*, No. 238.

[3] Armostrong, Mark and David Sappington "Recent Developments in the Theory of Regulation" forthcoming the *Handbook of Industrial Organization*.

[4] Besley, Timothy and Stephen Coate, [1998] "Sources of Inefficiency in a Representative Democracy: Dynamic Analysis", *American Economic Review*, 88: 139-56.

[5] Besley, Timothy and Anne Case, [2003], "Political Institutions and Policy Choices: Evidence from the United States," forthcoming in the *Journal of Economic Literature*, vol. 41 (1), 7-73.

[6] Besley, Timothy and Abygail Payne, [2003] "Judicial Accountability and Economic Policy Outcomes: Evidence from Employment Discrimination Charges", mimeo, LSE.

[7] Blundell, Richard and Richard J. Smith, [2004], "Coherency and Estimation in Simultaneous Models with Censored or Qualitative Dependent Variables", *Journal of Econometrics*, 64, 335-373.

[8] Clinton, J. Andrews, [1999], "Innovation and Imitation in U.S. Electricity Sector Regulation", mimeo, Rutgers University.

[9] Council of State Government, [1970–1996], The Book of the States, Lexington, KY.

[10] Department of Energy, [1996a], "Financial Statistics of Selected Investor–Owned Electric Utilities", DOE, Washington.

[11] Chunrong Ai and David E. M. Sappington, [2002], The Impact of State Incentive Regulation on the U.S. Telecommunication Industry, *Journal of Regulatory Economics*, 22:2 133-160.

[12] EEI, [1995], "Historical Statistics of the Electric Utility Industry 1960–1992", EEI, Washington D.C.

[13] EEI, [2000], PBR Survey (Member Survey), EEI, Washington D.C.

[14] EEI, [2001], Key facts, Washington DC.

[15] Estache Antonio and David Martimort [2004], "Politics, Transaction Costs, and the Design of Regulatory Institutions", mimeo, INRA.

[16] Falaschetti Dino, [2005], "Electoral Accountability and Consumer Monopsonists: Evidence from Elected vs. Appointed Regulators", mimeo, Montana State Univesity.

[17] Guerriero, Carmine, [2004], "Dependent Controllers and Regulators: Theory and Evidence", *Ente Einaudi working papers, "Temi di ricerca"* n. 33.

[18] Guerriero, Carmine, [2005, a], "Optimal Institutional Design of Independent Regulators: Evidence from the US Electric Power Market", manuscript.

[19] Hanssen, F. Andrew, [2004], "Learning About Judicial Independence: Institutional Change in the State Courts", *Journal of Legal Studies*.

[20] Hanssen, F. Andrew, [2004], "Is there a Politically Optimal Level of Judicial Independence?", *American Economic Review*, 94 (4), 712-729.

[21] Laffont, Jean-Jacques and Jean Tirole, [1993], *"A Theory of Incentives in Procurement and Regulation"*, Cambridge MA: MIT Press.

[22] Laffont, J.-J., [1996] "Industrial Policy and Politics", *International Journal of Industrial Organization*, 14: 1-27.

[23] Laffont, J.-J. and Martimort, D., [1999], "Separation of regulators against collusive behavior", *RAND Journal of Economics*, 30: 232-262.

[24] Laffont, Jean-Jacques, [2000], *"Incentives and Political Economy"*, Oxford University Press.

[25] Leaver, Clare, [2004], "Bureaucratic Minimal Squawk Behavior: Theory and Evidence from Regulatory Agencies", mimeo, LSE.

[26] Levy, Gilat, [2003],"Careerist Judges", forthcoming the *Rand Journal of Economics*.

[27] Lewis Tracy R. and David M. Sappington [1989], "Regulatory Options and Price Cap Regulation", the *Rand Journal of Economics*, 20 (3).

[28] Maskin, Eric and J. Tirole, [2004], "The Politician and The Judge: Accountability in Government", *American Economic Review*, 94 (4), 1034-1054.

[29] Mathios Alan D. and Robert P. Rogers, [1989], "The Impact of Alternative Forms of State Regulation of AT&T on Direct-Dial, Long Distance Telephone Rates", the *Rand Journal of Economics*, 20 (3).

[30] Milesi-Ferretti, Gian Maria, [1995], "The Disadvantage of Tying Their Hands: on the Political Economy of Policy Commitments", *Economic Journal*, 105: 1381-1402.

[31] Persson, Torsten, and Lares E.O. Svensson, [1989], "Why a Stubborn Conservative Would run a Deficit: Policy with Time-Inconsistent Preferences", *Quarterly Journal of Economics*, 104: 325-45.

[32] Persson, T. and G. Tabellini, [2000], *"Political Economics: Explaining Economic Policy"*, Cambridge, MA: MIT Press.

[33] Persson, T. and G. Tabellini, [2003], *"The Economic Effects of Constitutions"*, Cambridge, MA: MIT Press.

[34] Sappington, D., 1986, "Commitment to regulatory bureaucracy". *Information Economics and Policy* 2:243-258

[35] Sappington, David E.M., Johannes P. Pfeifenberger, Philip Hanser and Gregory N.Basheda, 2001, "The State of Performance–Based Regulation in the U.S. Electric Utility Industry", *The Electricity Journal*, 71-79.

[36] U. S. Census Bureau, Population Division, [1960–1996], "Population Estimates Program", Washington, D. C. 20233.

[37] U. S. Department of Commerce, Bureau of the Census. "Compendium of State Government Finances". Annual serial. [1960-1996], G-SF Series No. 2. Washington.

7. Figures Legend

Preliminary Analysis

Table 1: Variable Names and Descriptions.

Table 2: Commissioners Selection Rule, 1970–1996.

Table 3: Incentive Based Regulation in U. S. Electric Power Market, 1970–2002.

Table 4: Descriptive Statistic Commissioners Selection Rule, 1970–1996.

Table 5: Correlation Matrix

Cross–sectional and Panel Inference

Table 6: Determinants of COS choice, Probit and Logit Estimates.

Table 7: Determinants of adoption of PBR, Random-effects Probit and Logit Panel Estimates.

Table 8: Determinants of Price by Customer Class, Time and Fixed (within) Effects Panel Instrumental Variables Estimates.

8. Appendix

8.1 Laffont and Tirole [1993]: Set Up and First Best Solution

The firm can refuse to produce if the contract offered by the regulator does not guarantee it a minimum level of expected utility (that I will normalize at a reservation level of 0). Both the firm and the regulator are risk neutral with respect to income. Take into consideration the production of a variable scale product; where q denote the output. Total cost is given by:

$C = (\beta - e)q + \alpha.$

where β is an efficiency parameter (the higher it is the less efficient is the firm technology) and e is the managers' effort. Assuming that the fixed cost is known, and normalizing it at zero ($\alpha = 0$) it is possible to denote marginal cost as $c \equiv \beta - e$. Clearly regulation is subject to both adverse selection (as captured by β) and moral hazard (as captured by e). For expositional simplicity let assume that effort remains strictly positive over the relevant range of equilibrium production. If the firm exerts effort level e, it decreases the monetary marginal cost of output by e and incurs in a disutility (in monetary units) of $\psi(e)$. This disutility is increasing and convex in $e > 0$ (i.e.: $\psi' > 0$; $\psi'' > 0$); moreover the following hold: $\psi(0) = 0$, $\lim_{e \to \beta} \psi(e) = +\infty$ (Inada condition) and $\psi''' > 0$.[28]

Suppose that all consumers have the same preferences. The gross consumer surplus, the inverse demand function, the regular demand function, and the firm's revenue are given by $S(q)$, $p = P(q) = S'(q)$, $q = D(p)$, $R(q) = qP(q) + A$ respectively. The idea is to think to demand as that of a representative consumer with gross consumer surplus given by $S(\cdot)$. The firm charges a two party tariff $A + pq$ for $q > 0$, where A and p are positive. The consumer chooses q as to maximize the net surplus $S(\cdot) - A - pq$ or $p = P(q)$. Clearly A is chosen optimally so as to make

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

the consumer indifferent between buying and not buying: $A \equiv S(q) - P(q)q$. I assume that firm's revenue must cover both average cost and managerial compensation t :

$A + (p - c)q(p)) \geq t$.

Let U be the firm's utility level:

$U = t - \psi(e)$.

The regulated firm cares about income and effort only. Given its outside opportunity utility the firm's individual rationality constraint is given by $(t - \psi(e) \geq 0)$. Consider now the planner problem of maximizing consumer's net welfare subject to the firm budget constraint and rewrite it in the form of the following LaGrangean:

$\max_{\{A,\ p\}} L(c,t) = S(q(p)) - A - pq(p) + (1+\lambda)\ (A + (p - c)q(p) - t) = N.$ (A.1)

In (A.1) N represent the object of this program and with $(1+\lambda) = (1+\lambda(c,t))$ the shadow price of the firm budget constraint.[29] Let $V(q)$ denote the social surplus brought about the production of output q and assume that $V(0) = 0$, $V' > 0$, and $V'' < 0$. In this case $V(q)$ is the sum of the consumers' net surplus plus the revenue of the firm evaluated at the shadow price of managerial rewards:

$V(q) = (S(q) - R(q)) + (1+\lambda)R(q) = S(q) + \lambda R(q) = (1+\lambda)S(q)$.[30] (A.2)

Define W $(= N + U)$ as the social welfare; employing (A.1) and (A.2) I can write it as:

$W = V(q) - (1+\lambda)[C + \psi(e)] - \lambda U.$ (A.3)

Maximizing (A.3) with respect of U, e and q yields as usual that:

1. the existence of the shadow cost of reward implies that the firm receives no rent:

$U = 0$ or $t \equiv \psi(e^*)$;

2. the disutility of effort is equalized to the cost of saving at the margin:

$\psi'(e^*) = q^*$ or $e \equiv e^*$;

3. the social value of output is equalized to the cost (in term of lower consumption) at the margin:

$V'(q) = (1+\lambda)\ (\beta - e)$ or $S'(q) = p = c$.

[29] The only difference with the program in which government transfers are allowed is the dependence of λ from c and t.
[30] Perfect discrimination allows firm to extract the entire consumer surplus, which is valued at the social cost of rewards.

The regulator will implement the optimal allocation through a simple "selling the store" mechanism (i.e.: she will leave the firm residual claimant for its cost saving) asking the firm to exert effort e and offering a transfer t, that is a fixed price contract equal to:

$t(C) = a - (C - C^*)$

where $a = \psi(e^*)$ and the firm chooses e to maximize $a - ((\beta - e)q - C^*) - \psi(e)$; as usual this mechanism leads to the first best solution.[31] Such a price–cap gives the firm the right incentive for cost reduction; moreover the fixed payment can be tailored to fully extract the firm rent.

8.2 Laffont and Tirole [1993]: Solution Under Capture

Consider a three–tier hierarchy: Firm/Agency/Congress, all parties are risk neutral. The Agency derives utility from its relationship with Congress: $T(s) - s^*$. Clearly s^* represents its reservation income. The agency obtains a signal σ about the firm's technology. With probability ζ the agency learns the true β ($\sigma = \beta$);[32] with probability $1 - \zeta$, the agency learns nothing ($\sigma = 0$). Clearly there are four states of nature:[33] with probability $\zeta\nu$, the technology and the signal are $\underline{\beta}$ while with probability $(1 - \zeta)\nu$ the technology is $\underline{\beta}$, but the agency doesn't know it and so on. The agency reports nothing if the signal is non informative otherwise he can report the truth or not. Congress's utility (i.e.: generalized surplus) is the sum of producer, agency, and consumer surplus minus $(1 + \mu)$ times the total agency reward evaluated at the shadow cost of public funds ($\mu > 0$). According to the notation in 8.1 we have that:

$$W = [S(q) + \lambda R(q)] - (1+\lambda)((\beta - e)q + \psi(e)) - \lambda U - \mu(T(s) - s^*). \qquad (A.4)$$

Congress dislikes leaving a rent to the firm and to the agency.[34] In the case of collusion-free regulation, that is when interest group have no influence on the agency because the cost of transfers is infinite, nothing change with respect to the analysis of 8.1. In this case the agency

[31] Note that, as long as the regulator know β, she can infer effort from the observation of cost.

[32] The signal is hard evidence in the sense that the agency is able to reveal the true technology if $\sigma = \beta$. I assume that the interest groups learn what signal the agency receives. ζ is exogenous.

[33] See Armstrong and Sappington [2003] for a different setting under asymmetrical information only.

[34] Here Congress observe neither β or σ. It observes C, q; then the agency's report r and finally Congress design incentive scheme $s(C,q,r)$ and $t(C,q,r)$ for the agency and the firm in order to maximize social welfare EW. The timing is as follows: first the Congress learns the possible realizations for β, $\{\underline{\beta}, \tilde{\beta}\}$; next the agency and the interest group learn σ and the firm learns β. The probability distribution are common knowledge. At this point, the Congress designs the incentive schemes, then the agency can sign side contracts with the interest groups. Next the agency makes its report, the firm chooses its effort and price and finally transfers are operated.

receives only his reservation utility. The solution is indeed different when firms may collude with the agency. Regulated utilities give to the firm a transfer $s°$ at a cost $1+\lambda_f$, where $\lambda_f \geq 0$ denotes the shadow cost of transfers for the firm or, in a sense that I will embrace from now on, the agency attributes monetary value $1/(1+\lambda_f)$ per dollar of the firm's collusive activity. As usual in the literature (see Laffont and Tirole [1993, ch. 11]), in an equilibrium the Congress can, without loss of generality, restrict attention to "collusion proof" schemes, namely truthtelling schemes that do not induce the agency and the firm to collude.

I denote the agency's income as a function of its report r as: $\underline{s}$, $\tilde{s}$ and s_0 when respectively $r = \underline{\beta}$, $r = \tilde{\beta}$, and $r = 0$. Collusion clearly occurs when the agency has an incentive to hide information from the Congress, that is when the retention of information benefits the firm that corresponds to the case of informative signal equal to $\underline{\beta}$ (since the revelation of the signal lower its rent from $\Phi(e)$ to 0). The regulator will not accept the firms bribes if the income lost by not reporting the truth $(\underline{s} - s_0)$ exceeds its stake:

$$(1+\lambda_f)(\underline{s} - s_0) \geq \Phi(e). \qquad \text{(A.5)}$$

Given that the agency's income is socially costly (that is at the optimum: $\tilde{s} = s_0 = s^*$), (A.5) rewrite as:

$$\underline{s} = s^* + (\Phi(e)/(1+\lambda_f)). \qquad \text{(A.6)}$$

Equation (A.6), which depends only on e and $\underline{s}$, suggests that Congress should give lower incentives to an inefficient firm under asymmetric information and an higher reward to the agency if $r = \underline{\beta}$, and leave all the other variables unchanged. These result appear clear from the strict concavity of the objective function[35] of the Congress that chooses e in order to maximize the following expression for the expected welfare:

$$EW = \max_e \{\zeta W^{FI} + (1+\zeta)W^{AI}(e) - \zeta v \lambda \Phi(e)/(1+\lambda_f)\}. \qquad \text{(A.7)}$$

Where W^{FI} and W^{AI} represent the expected welfare expression that the Congress will maximize respectively under full and asymmetric information in the collusion–free regime. The first order condition and the envelope theorem deriving from (A.7) leads Proposition 2 in the text.

[35] Again, given that $\psi''' > 0$, $\Phi(\cdot)$ will be strictly convex and so the objective function in (A.7) will be strictly concave.

8.3 Laffont [1996]

I assume that consumers vote for the candidate representing their type (they are actually indifferent). If $\gamma > 1/2$, type 1 candidate wins the election and maximizes type 1 consumers' welfare under incentive constraints (i.e. no discrimination in pricing and incentive constraints for firms). Finally, I assume that the sales of the firm are shared uniformly across consumers (that is managers' reward is $t = \gamma t_1 + (1 - \gamma)t_2$ with usual shadow cost for the society). Type 2 candidate's optimization program is:

$$\max\{(1-\gamma)S_2(q) - (1+\lambda)(1-\gamma)[v\underline{t} + (1-v)\tilde{t}] + v\underline{U} + (1-v)\tilde{U}\}$$

$$S_1(q) - (1+\lambda)t_1 \geq 0$$

$$U \geq 0$$

The majority's candidate maximizes the social welfare of its members with the constraint of individual rationality of its non-members. The inability to discriminate in pricing prevents majority 2 from saturating type 1's individual rationality constraint. Clearly type 2 candidate wants to minimize its transfers, hence:

$$\tilde{t} = \psi(\tilde{e}) + (\tilde{\beta} - \tilde{e})\tilde{q} \qquad \text{(A.8)}$$

and

$$\underline{t} = \psi(\underline{e}) + (\underline{\beta} - \underline{e})\underline{q} + \underline{U} = \psi(\underline{e}) + (\underline{\beta} - \underline{e})\underline{q} + \Phi(\tilde{e}). \qquad \text{(A.9)}$$

Substituting into the objective function and maximizing with respect to $\underline{e}$ and $\tilde{e}$ the equation reported in equation (6) results.

8.4 Data

This analysis exploits both cross state and time variation in the data.

The cross sectional sample consists of 46 states and the District of Columbia for 1996. Nebraska, Utah, Wyoming and Alaska have been left out because they have only minor electric utilities (see the following section for more explanations on the classification criteria used).

A wider sample (48 states) is employed in the panel estimates. In this case, due to lack of data, have been excluded: Alaska, District of Columbia and Hawaii.

1. Cross Sectional Analysis:

A.1 Data for electricity prices, operations and maintenance expenses, depreciation and amortization, taxes, utility's net electric plant (in thousands dollars) and sales (in Mwh) are directly collected from a Department of Energy (DOE) publication: *Financial Statistics of Major U.S. Investor–Owned Electric Utilities,* 1996. This survey is processed and published by EIA for the FERC. Major investor-owned electric utilities are defined as those that have reported, in the past three consecutive calendar years, sales or transmission services that exceeded one or more of the following criteria: 1.1 million Mwh of total annual sales; 2. 100 Mwh of annual sales for resale; 3. 500 Mwh of annual power exchanges delivered; 4. 500 Mwh of annual wheeling for others (deliveries plus losses).

The 1996 summary data are based on reports from 179 major investor-owned electric utilities: only those (146) which produce energy not only for the wholesale (sales for resale) market in the states considered have been used to create the state figures.

The U.S. regulation system grants territorial legal monopolies in exchange for the right of fixing reasonable rates; in this perspective, I have considered as costs, sales and revenues for each state, the respective sum of costs, sales and revenues of all state companies. I can therefore look at these numbers as if there was a single monopolist in each state. Depreciation and amortization cost are calculated from revenues and sales and expressed in cents per Kwh.

B.1 State data for electricity generation by generation source, average price of fossil fuel (composite) per net Kwh (in cents per Kwh) and customer share by class of service are reported in the EEI yearbook:

Statistical Yearbook of the Electric Utility Industry, 1996, EEI, Washington D.C.

C.1 Selection rule, salary of commissioners and number of employees within the staff of the PUC are collected from NARUC, Yearbook of Regulatory Agencies, [1992–1997].

II. Panel Analysis:

A.2 Data for average of coal, oil and gas cost per net Kwh are directly collected or calculated from the EEI yearbooks:

1992 – 1997: *Statistical Yearbook of the Electric Utility Industry*, 1992 – 1997, EEI, Washington D.C.

EEI refers to the source of data for its yearbooks to various places including U.S. Department of Energy, Energy Information Administration, Federal Power Commission and Federal Energy Regulatory Commission.

EEI reports annual revenues (in dollar terms) and sales (in kilowatt-hours) of total electric utility industry by state and class of service. The prices are calculated from the revenues and sales in terms of cents per kilowatt-hour. Residential, commercial and industrial sectors take more than 95 percent of the revenues and sales throughout the years. Average price is calculated as total revenue from sales to final customers (residential, commercial and industrial users) all divided by quantity sold. In this way I get the average electricity price weighted for the share of electricity sales in each class of service.

EEI reports electric generation and sources of energy for electric generation in two types of break-down: (1) by type of prime mover driving the generator and (2) by energy source. The total from each different break-down are consistent. I have used the second break-down.

B.2 To construct the fossil fuel cost index for state i in year t, let s_{jit} be the share of energy source j in state i in year t and let p_{it} be the average cost of fossil fuel (composite) per net Kwh (in terms of cents per Kwh) for state i in year t, calculated as:

Given s_{it} as the share of electricity produced in state i year t by all three fossil fuel energy sources (coal, gas and oil) index with j,

$s_{it}=\Sigma_j s_{jit}$,

the fossil fuel serie will be:

$c_{it} = s_{it}p_{ijt}$.

C.2 State income per capita, population, proportion aged over 65 and proportion aged 5-17 are calculated from a U.S. Census Bureau publication: *Population Estimates Program*, 1960–1996, Washington, D.C. 20233.

D.2 Data on political preferences are from the state yearbooks:

1960-1997: The Book of the States, 1960-1997, Council of State Governments, Lexington, KY.

8.2 Tables

Preliminary Analysis

Table 1: Variable Names and Descriptions

Type	*Var.*	*Description*
Incentive Scheme	***COS (PBR)***	COS (PBR) dummy, taking value 1 if the incentive scheme is in use, 0 otherwise.
Prices	***Rkhr,Rkhc,Rkhi***	Revenue per Kwh sales (Residential, Commercial, Industrial).
Political Variables	***Av_Maj*:**	Percentage of seats (averaged across upper and lower houses) held by the majority party (*Av_Maj.96* = Average 1986-1996).
	***Av_Dist*:**	Absolute value of distance (difference between per. Seats) between Democrats & Republicans (*Av_Dist.96* = Average 1986-1996).
	***Rep*:**	Republican dummy, taking value 1 if the government is republican, 0 otherwise.
	***R_1996*:**	Taking value 1 if reforming party was republican.
Capture	***Elec*:**	Elected PUC commissioner dummy, taking the value 1 if commissioners are elected, 0 otherwise.
	***Em (Emr)*:**	Full time employees and full time employees per thousands Kwh sales.
	***Soc (Socr)*:**	Average salary of commissioner and average salary of commissioners in dollars per thousands Kwh sales
Interest Groups	***Pop*:**	State population in thousands people.
	***O65*:**	Percentage aged over 65.
	***Youth*:**	Percentage aged between 5-17.
	***Res*:**	Percentage of ultimate customers that are residential.
Cost Structure	***FFG*:**	Percentage of total generation from fossil fuels.
	***West*:**	Dummy for states that are west of the Mississippi river.
	***D&A*:**	Depreciation and Amortization cost in cents per Kwh sales.
	***CFF*:**	Cost of fossil fuels as defined in *Appendix 8.4*.

Table 2: Commissioners Selection Rule, 1970–1996*

C_Elect [10]:	AL, AZ, GA, LA, MS, MT, ND, NE, OK, SD, VA
C_Appoint [35]:	AK, AR, CA, CO, CT, DC, DE, HI, ID, IL, IN, IA, KS, KY, ME, MD, MA, MI, MO, NV, NH, NJ, NM, NY, NC, OH, OR, PA, RI, UT, VT, WA, WV, WI, WY
Switching [5]:	FL, MN, SC, TN, TX

*Note: There are seven methods of selecting commissioners in my data: direct election; appointment by Governor; appointment by Governor with confirmation by the Senate; appointment by Governor with confirmation by executive council; appointment by Governor with approval by legislature; selection by general assembly; selection by Legislature.

Table 3: Incentive-Based Regulation in the U.S. Electric Power Market (1970-2002).

States	Utility	***IBR***	***RCC****	Period
Alabama	Alabama Power Co.	Rate case moratorium	1	1982-2002
AZ, AR, AK			0	
California	Sempra/San Diego Gas & Electric Co. Sempra/SDGE (Con't) Southern Calif. Edison	Price cap, benchmarks (re. employee safety, reliability, customer satisfaction, call center operations) Revenue Cap for base rates and power procurement incentives with earnings sharing (Price Cap with earning shares: 1999-2002) Price cap (on distribution services) with earnings sh.	1	1994-2002 1993-2002
Colorado	Public Service Co. of CO	Rate freeze, benchmarks (re. customer complaints, interruption duration, etc.); Rate case moratorium with an earnings deadband	0	1997-2002
CT (1)	NU/CT Light & Power	Price cap (rate reduction and freeze)	1	1996-2002
Delaware, DC			0	
Florida	Tampa Electric	Benchmarks (re. Equivalent availability factor); Rate freeze (for base rates) with earnings sharing	0	1995-1999
Georgia			0	
Hawaii	Hawaiian Electric	Price cap earnings sharing benchmarks	0	1996-2002
Idaho			0	
Illinois	Ameren/CIPS	Revenue sharing	1	1995-2002
Indiana			0	
Iowa	Amerei/CIPS-UE; CILCO Com Ed; IP MEC; MidAmerican En.	Price cap and earning sharing with rate adjustments based on regional comparision of average retail rates; Other (pre-scheduled multiyear rate adjustments); Rate case moratorium with an earnings sharing	1	1998-2002
Kansas			0	
Kentucky	Louisville Gas & Elec	Revenue sharing	0	1998-2002
Louisiana	Entergy Louisiana	Benchmarks;	0	1996-2002
Maine	Bangor Hydro Electric Central Maine Power Maine Public Service	Rate case moratorium with an earnings sharing; Rate case moratorium with rate flexibility (Price cap with earnings sharing: 1998-2009); Rate case moratorium with earnings sharing (Revenue per customer cap: 1991-1993) Rate caps, benchmarks (re. reliability and customer service), Revenue sharing; Price cap with earnings sharing	1	1991-2002
Maryland	Baltimore Gas & Elect. Potomac Electric Power	Price cap (rate freeze)	0	1998-2002
Mass.	EUA/Eastern Edison MECo; NSTAR; NU/West. Mass Electric	Rate freeze with earnings sharing; Rate freeze; Revenue sharing (re. Nuclear plant costs)	1	1998-2002
Michigan			0	
Minnesota			0	
Mississippi	Mississippi Power	Benchmarks/adjustment to allowed return (re. rate levels, customer satisfaction, etc.); Rate case moratorium with an earnings sharing	0	1995-2002
Missouri	Ameren/UE	Revenue sharing; Rate freeze with earnings sharing	0	1995-2002
Montana	Montana Power	Price cap with earnings sharing	1	1997-1998
NE,NV, NH, NJ, NM			0	
New York	Consolidated Edison New York State E&G Niagara Mohawk Rochester Gas and Electric Corp.	Revenue-per-customer cap with earnings sharing (Rate case moratorium with earnings sharing: 1997-2002); Revenue sharing (re. NUG contract re-negotiation), asymmetric bench marks (re. reliability, service quality); Price cap with earnings sharing; Rate freeze; Revenue cap with earnings sharing; Revenue sharing, benchmarks re. Metering/billing accuracy, answer time	0	1991-2002
NC			0	
North Dakota	Northern States Power; Otter Tail Power	Revenue sharing; Benchmarks; Price cap with earnings sharing	1	2001-2002
Ohio			0	
Oklahoma			0	
Oregon	PacifiCorp	Alternative form of regulation; Price Cap	1	1994-2002
Pennsylvania			0	
Rhode Island	EUA/Newport Electric EUA/Blackstone Valley NEES/Narragansett El.	Price cap with earnings sharing; Price cap with earnings sharing; Benchmarks (re. Service quality)	1	1997-2002
SC			0	
South Dakota	Black Hills P&L	Price cap (rate freeze)	1	1995-2002
Tennessee			0	
Texas	Texas-NM; TXU Electric	Benchmarks	1	1999-2002
Vermont			0	
Virginia			0	
Washington	Puget Sound Energy	Price cap	0	1997-2001
WV			0	
Wisconsin			0	

*1 if the Republican were in power the year before the constitutional reform, 0 otherwise.
(1) Connecticut is the only state contained in the EEI publication and not in the Sappington and al.'s paper.

Source: **EEI**, [2000]; **Sappington, Pfeifenberger, Hanser and Basheda**, [2001].

Table 4: Descriptive Statistics.

	Mean	Std. Dev.	Minimum	Maximum
	1996			
Inc_cs	0.5106	0.5053	0	1
Ffg	0.7263	0.2558	0	1
D&A	0.6638	0.2439	0.1226	1.3807
West	0.3617	0.4857	0	1
Elec	0.2553	0.4407	0	1
Emr	0.0063	0.0115	0.0006	0.0791
Socr	0.3776	0.5438	0.0302	2.3411
Pop	5542	5897.646	5897.646	31780.83
O65	12.98	1.6403	9.9	18.5
Crp	0.8764	0.0190	0.8295	0.9093
Av_Maj.96	0.7136	0.1200	0.5404	0.9625
Av_Dist.96	0.5719	.2334	0.1429	0.9999

Table 5: Correlation Matrix.

Inc_cs	1										
Ffg	-0.041	1									
D&A	-0.130	0.382	1								
West	-0.237	-0.080	-0.011	1							
Elec	-0.012	-0.183	-0.204	0.168	1						
Emr	0.158	-0.209	-0.311	0.002	0.339	1					
Socr	-0.063	-0.438	-0.160	0.171	0.343	0.670	1				
Pop	-0.174	0.762	0.582	-0.022	-0.185	-0.067	-0.349	1			
O65	-0.130	-0.063	0.151	-0.272	-0.137	0.040	0.140	-0.101	1		
Crp	0.050	0.263	0.251	-0.273	-0.401	0.0378	-0.274	0.295	0.041	1	
Av_Maj.96	-0.024	0.060	-0.202	-0.143	0.443	-0.028	-0.040	-0.132	-0.111	-0.227	1
Av_Dist.96	0.340	-0.260	0.096	-0.002	-0.016	-0.060	0.223	-0.147	-0.147	0.002	-0.136
	Inc_cs	***Ffg***	***D&A***	***Elec***	***Emr***	***Socr***	***Socr***	***Pop***	***O65***	***Crp***	***Av_Maj.96***

Cross–sectional and Panel Inference

Table 6: Determinants of COS Choice, Probit and Logit Estimates.

	(1)	***(2)***
Dep. Var.	***COS***	***COS***
FFg	**0.0002** (0.0007)***	**0.0004** (0.0001)***
Da	**3.062** (1.653)*	**5.021** (2.668)*
West	**-2.5370** (0.723)***	**-4.250** (1.340)***
Elec	**-2.091** (0.962)**	**-3.440** (1.732)**
Emr	**812.575** (255.245)***	**1359.876** (451.393)**
Socr	**-6.46** (1.822)***	**-10.792** (3.214)***
Pop	**-0.0007** (0.0001)***	**-0.0011** (0.0003)***
O65	**-0.913** (0.286)***	**-1.54** (0.561)***
Res	**-42.952** (19.548)**	**-71.81** (33.11)**
Av_Maj.96	**-170.05** (59.748)***	**-292.535** (113.319)***
Av_Dist.96	**80.50** (28.70)***	**138.51** (54.115)***
Constant	134.677 (44.11)***	229.583 (80.93)***
Estimation	Probit	Logit
N of Obs..	47	47
Pseudo R^2	0.52	0.51

Note: 1. *Robust Standard Errors* in parentheses;
2. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Determinants of Adoption of PBR, Random-Effects Probit and Logit Panel Estimates.

	(1)	*(2)*
Dep. Var.	***PBR***	***PBR***
FFg	**-6.13** (1.70)***	**-11.78** (3.62)***
Elec	**1.870** (1.173)*	**3.579** (2.115)*
Em	**0.009** (0.003)***	**0.017** (0.006)***
Soc	**0.0001** (0.00005)**	**0.0002** (0.00009)**
You	**1.733** (0.542)***	**3.250** (1.080)***
Av_Maj	**- 9.622** (7.030)	**- 16.99** (12.74)
Av_Maj*Rep	**7.437** (2.555)***	**13.37** (4.992)***
Av_Dist	**- 9.740** (5.880)*	**- 19.00** (11.31)*
Av_Dist*Rep	**22.040** (7.891)***	**42.61** (15.51)***
Constant	-41.44 (14.78)***	-77.50 (29.23)***
Estimation	Random Effects Probit	Random Effects Logit
N of Obs..	288	288
Log Likelihood	- 58.56	- 58.18
Note: 1. *Standard Errors* in parentheses; 2. * significant at 10%; ** significant at 5%; *** significant at 1%		

Table 8: Determinants of Price by Customer Class, Time and Fixed (Within) Effects Panel Instrumental Variables Estimates.

	(1)	*(2)*	*(3)*
Dep. Var.	***Residential***	***Commercial***	***Industrial***
PBR	**0.378** (1.023)	**0.897** (1.375)	**0.884** (1.076)
CFF	**2.515** (1.365)*	**3.544** (1.834)**	**2.396** (1.436)*
CFF*PBR	**- 2.426** (1.461)*	**- 3.623** (2.097)*	**-2.674** (1.641)*
Other contr.	*Youth, Pop, O65*		
Instrumented	*PBR, CFF*PBR*		
Estimation	Fixed and Time Effects (base period 1997) 2SLS (Panel)	Fixed and Time Effects (base period 1997) 2SLS (Panel)	Fixed and Time Effects (base period 1997) 2SLS (Panel)
N of Obs..	288	288	288
Adj R^2	0.98	0.96	0.92
Note: 1. *Standard errors* in parentheses; 2. * significant at 10%; ** significant at 5%; *** significant at 1%; 3. First-stage specification of 2SLS includes: *FFg, Elec, Em, Soc, Av_Maj, Av_Dist*.			