Methods of Incentive Regulation: Applications to Electricity

Sanford V. Berg
Public Utility Research Center
University of Florida

Abstract

This note applies some principles of incentive regulation to the electricity market. After review program attributes and the role of discretion, four issues are examined.

- What are the strengths and limitations of the CPI-X and the Utility-Specific Cost Index as yardsticks?
- Under what circumstances would a utility DSM program that lowers consumers use of electricity be welfare reducing?
- What are the advantages and disadvantages of targeted incentive mechanisms and broad-based incentive mechanisms?
- What are the long-run/short-run tradeoffs that managers face under traditional rate of return regulation?

Dr. Sanford V. Berg
University of Florida
Warrington College of Business Administration
P.O. Box 117142 (205 Matherly Hall)
Gainesville, FL 32606

Phone (352) 392-6148
Fax (352) 392-7796
E-mail: berg@dale.cba.ufl.edu

Methods of Incentive Regulation: Applications to Electricity

Sanford V. Berg
Public Utility Research Center
University of Florida

Some of the desired attributes of incentive regulations include simplicity, efficiency, fairness, and staying power. Excessively complex mechanisms may be difficult to translate into schemes that can be implemented. In addition, the general public needs to understand the nature of the plan. The strong point of incentive regulation is the focus on efficiency (recognizing relevant information asymmetries). One part of efficiency involves a reduction of "gaming" by regulators and firms--since that absorbs resources and induces delays in the process. The legitimacy of incentive plans depends on citizen perceptions of fairness--that customers (large and small) benefit from the rules. Finally, the program must have a time horizon that is credible--or capital markets will not view the incentive system as sustainable.

Whatever the program, some attention must be given to the role of discretion. A contract might eliminate (or reduce) the role of discretion, but all systems have some flexibility in terms of interpretation or application of principles. For example, cost of service regulation need not have the excessive capital intensity predicted by Averch and Johnson if regulators institute disallowances or have informal benchmarks to ensure that some outlays are not excessive. Price cap plans must establish starting prices, determine which services should be in the basket, and determine the X factor. At the end of the period, the new price and X will depend on judgements. Even yardstick regulation involves some selection of comparable firms and possible data adjustments to reflect unique situations. Hybrid schemes (such as those with sharing rules) may permit some discretion regarding accounting treatment of some outlays (whether to expense or capitalize a plant modernization outlay).

In addition, there is the issue of targeted vs. generalized incentives (discussed below). Experience with the UK (with price caps) and Norway (with benchmarking) provide lessons for regulators. The accompanying slides outline key points for these cases. For now, to illustrate some of the principles as applied to electricity regulation, four questions are addressed:[1]

Question #1: What are the strengths and limitations of the CPI-X and the Utility-Specific Cost Index as yardsticks?

Question #2: Under what circumstances would a utility DSM program that lowers consumers use of electricity be welfare reducing?

[1] Tracy R. Lewis and David E.M. Sappington assisted in the development of these questions and answers.

Question #3: What are the advantages and disadvantages of targeted incentive mechanisms and broad-based incentive mechanisms?

Question #4: What are the long-run/short-run tradeoffs that managers face under traditional rate of return regulation?

These questions serve to illustrate how the conceptual framework associated with incentive regulation can be applied to the electric utility industry.

Question #1: What are the strengths and limitations of the CPI-X and the Utility-Specific Cost Index as yardsticks?

Advantages of yardstick (a): CPI-X

(1) There would be an incentive for the target utility to minimize costs.

(2) There are fewer measurement difficulties with this alternative: the CPI is exogenously determined and so once X is chose, the yardstick is completely determined.

Disadvantages of yardstick (a)

(1) It will be difficult to choose the appropriate productivity offset rate X. If it is based on the past performance of electric utilities, there is no guarantee that this past rate will be relevant in the future.

(2) The CPI inflation rate will generally not represent the rate of increase in input prices that the utility will face. Wage rates in the U.S. generally grow faster than the CPI rate. Furthermore, energy price have fluctuated wildly in the past and probably will in the future. Since energy inputs are a very large component of utility input cost, it can be seen that the CPI inflation rate will not generally represent the trends in utility input prices. Thus at times, alternative (1) would lead to "excessively" high rates of return for the target utility and at other times, the rate of return would be so low that the financial viability of the target utility would be threatened.

Advantages of yardstick (b): Percentage Change in Average Cost of Peer Group

(1) There would be an incentive for the target utility to minimize costs.

(2) It is probable that utility owners and managers would regard yardstick (b) as being "fairer" than yardstick (a): it seems more appropriate to compare the rate of increase in the average cost of the target utility to the corresponding average rate of increase in the average cost of a group of very similar utilities than to the rather arbitrary CPI inflation rate minus an exogenous productivity growth rate.

(3) The overall yardstick will not fluctuate wildly as energy prices fluctuate.

Disadvantages of yardstick (b):

(1) The informational requirements for this alternative are much greater; see (2) below.

(2) In this alternative, there is much more scope for the individual targeted utilities to argue over and attempt to influence the specific construction of the "basket" yardstick. There could be disagreement on: (i) how the "basket" utilities are chosen, (ii) how costs should be measured in a uniform fashion across firms (depreciation rates may differ, accounting treatments of capital gains may differ, cost categories may differ, etc.), (iii) the choice of an index number formula to compute output indexes (or productivity indexes and input price indexes), or (iv) how the individual utility unit cost indexes should be averaged to form the "basket" index (i.e., we could use "democratic" weights where each utility is weighted equally or we could use "plutocratic" weights where each firm's weight in the basket yardstick is proportional to its hare of total basket cost).

(3) It could be the case that the target utility has certain restrictions placed upon it by the regulatory authorities that prevent it from engaging in cost minimizing behavior; e.g., the target utility may be forced to serve certain classed of customers at "uneconomic" prices or it may be forced to buy certain local inputs (union laborers or high sulfur coal) at "uneconomic" prices. Thus there may not be "basket" utilities that are comparable in every respect to the target utility.

(4) Due to economies of scale, it will not be fair to compare the very smallest (and the very largest) target utility to an average of large and small utilities. Thus, again in certain cases, it may be difficult to obtain an appropriate peer group of utilities.

Regulators need to be aware of the strengths and limitations of such alternatives.

Question #2: Under what circumstances would a utility DSM program that lowers consumers use of electricity be welfare reducing?

We first present a simple answer to this question, followed by some important qualifications. To characterize the simple response, we assume in addition to the assumptions listed in Question 2 that (a) all consumers are DSM participants, (b) reductions in demand which would occur in the absence of DSM and measurements of DSM reductions are accurate, and (c) customers' level of satisfaction from electricity consumption is unchanged by the DSM program.

Given these assumptions, a reduction in electricity use is welfare enhancing provided the total cost of the DSM program, inclusive of customer costs, utility costs, and the costs of administration, is less than the social cost of generating the electricity. Otherwise, if the total cost of the DSM program exceeds the cost of generation, the DSM program is welfare reducing. The explanation is that as long as customer satisfaction from electricity consumption is unchanged under DSM, any DSM program which costs less than the cost of generating the saved electricity must increase total net surplus.

There are, however, some important qualifications to this answer. If the program targets only some group of customers, then the non-participating customers may be harmed, even if total net surplus is higher under DSM. The reason is that with price exceeding marginal generation costs, a cut in electricity consumption reduces utility operating profits. Revenue requirements to cover embedded costs remain the same, so that non-participant bills will rise to cover the shortfall, unless these losses are absorbed by the utility or participating customers pay a surcharge. Consequently, welfare may fall because of adverse distributional effects of the program. Note that DSM participants are typically wealthier than non-participants, and subsidies from non-participants to participants may be highly regressive. In addition, it may be impossible to implement the program if non-participants object to the burden placed upon them.

The DSM program may also decrease welfare if it induces customers to adopt measures which are more costly than the conservation measures which customers would have adopted in the absence of DSM. Presumably, though, DSM is only sanctioned by the commission when consumers fail to efficiently conserve electricity due to market imperfections.

As a practical matter, the simple test we have proposed for determining the social desirability of DSM may be incomplete and difficult to implement. Attributing reductions in electricity use to DSM may be problematic because of "free rider" effects. Also, it may be difficult to accurately measure the cost to the consumer of adopting energy efficient measures (i.e., accounting for the hassel factors). Besides this, the test described may be incomplete. A DSM program resulting in an increase in electricity consumption need not be welfare decreasing. Electricity and energy efficient appliances may be complementary (rather than substitute) inputs.

Dynamic factors may also make the test inconclusive. Suppose that a reduction in electricity used enables the utility to avoid building an expensive new generation facility in the future. Then DSM may be welfare enhancing even if the current costs of the program exceed current generating costs. This assumes that current generating costs exclude the longer run costs of installing additional generation capacity.

Question #3: What are the advantages and disadvantages of targeted incentive mechanisms and broad-based incentive mechanisms?

Traditional rate of return on rate base regulation is a form of incentive regulation established to protect consumers from the exercise of monopoly power. Traditional regulation has targeted features such as prudency tests and detailed cost accounting procedures and allocations. It also introduces more generalized constraints into the process through limitations on the allowed rate of return. As the answer to question #4 indicates, however, traditional regulatory constraints induce adjustments by utilities which can partially negate some of the savings sought by regulators for consumers.

New Incentive Schemes

In reaction to concerns over incentives associated with traditional regulation, a number of state regulatory commissions have established alternative incentive regulation programs designed to promote efficiency in electricity production. Some proposed incentive schemes are generalized, such as price-cap regulations: these provide firms with a comprehensive incentive to control costs, but such schemes have their own limitations. For example, what price level should serve as the starting point? What productivity index is appropriate? To what time frame can both parties commit? At a more micro level, targeted incentive payment programs condition financial rewards or penalties upon a specific measure of a utility's performance, such as changes in a component of costs.

A concern with all these schemes is that overlaying different sets of regulations could result in contradictory incentives--leading to costly proceedings, further adjustments, and fine-tuning. For example, the targeted indices could encourage firms to incur excessive expenses to ensure that one particular index, such as unit availability, is maximized. The generalized indices require weights that ought to reflect the relative importance of the various components. A key task of the proposed project is to identify the strengths and limitations of specific indices.

Implementation Issues

Implementation of either scheme raises many issues. For both generalized and targeted indices, the reference point becomes a source of potential contention. If the reference point is the firm's most recent performance level, this level could already involve substantial slack so that improvements were easy. Or, if the firm was already performing very well, the benchmark index allows little room for improvement--and then, only at high costs. An alternative reference point is to compare the firm's index with that of a sample of comparable firms. Improvements relative to the external yardstick are then rewarded. Of course, selecting a comparable group becomes another important task.

For both types of incentives, it is crucial to avoid policy uncertainties. Incentive rules are part of the structure of property rights (and obligations) imposed on a firm. Uncertainty about the calculation of an index or the duration over which the program will be in effect reduces the impact of a plan. Strategic gaming by both regulators and by firms limits the positive outcomes that might result from incentive regulation. Parties to the regulatory contract need to limit incentives to misrepresent positions or misreport data. Dependence on quantitative indicators rather than qualitative indicators is another way to reduce uncertainties. Indices must be measurable from historical data, with updates available on a timely basis.

Targeted Incentives

Berg and Jeong (1991) examined the determinants and impacts of regulatory decisions to adopt targeted incentives. They adopted the Edison Electric Institute's (1987) definition of an incentive scheme as one which "(i) is intended to improve regulated utilities' performance, (ii) evaluates utility performance against specific, pre-defined standards, (iii) provides incentives (rewards) or disincentives (punishments), depending on the utility's performance in relation to applicable standards," (p. 11).

These incentive payment programs were found to take many forms and focus on different operating statistics: they reward utilities which experience high levels of base load generating unit utilization and availability, low heat rates (reflecting the efficient transformation of fuel into electricity), and keep fuel and purchased power costs below externally-determined indices. For example, the State of Florida adopted an incentive regulation entitled "Generating Performance Incentive Factor (GPIF)" in 1980. The GPIF program sets the targets for many indicators, including average heat rates, fuel expenses, and past performance records. The FPSC uses complex formulas estimated by several computer simulations of the utility system's economic dispatch. Rewards and penalties are imposed by comparing actual performance with pre-set targets.

Also, the heat rate, defined as the energy input in BTU used for 1 kwh electric generation, has been widely used as a measure of operating efficiency. Higher heat rate has been interpreted as inefficient performance. Of course, heat rates will differ across firms due to many factors, including average age of generating units (reflecting technological differences and historical demand growth patterns), generating mix (base load vs. peaking capacity -- where the mix depends on seasonal and daily demand patterns), and environmental regulations in place when capacity investments were made. Thus, heat rates may not be a good proxy for relative efficiency.

DSM

Concern over energy conservation has led to another set of targeted incentives, this time associated with demand-side management. Three mechanisms have been used: recovery of expenditures, compensation for lost revenues, and incentive mechanisms. As an example of the first, Florida has a conservation cost recovery system, tied to conservation goals for the state and individual utilities. On the other hand, California's ERAM program provides a more comprehensive set of incentives, but has its own set of measurement issues. In particular, quantification of program impacts is problematic. Thus, various states have adopted different approaches to encouraging DSM.

Quality of Service

Another area for potential targeted programs is service quality. A number of indices of service quality could be used reflecting hook-ups, emergency service, and reliability. Within reliability, numerous indices capture different dimensions of service quality: loss-of-load probability, frequency and duration of capacity shortages, and expected energy not served--to list a few.

There is a rich literature on the theory of service quality--as provided under competition, monopoly, or regulation [see, eg. Spence (1975)]. Under price cap incentives, in particular, there may be limited incentives to enhance service quality--even when such enhancements would increase welfare. The Florida PSC funded Public Utility Research Center researchers to develop an index of telephone service quality which could be used to monitor and reward improvements in service quality. As is described in Berg and Lynch (1992), weights were developed for the various dimensions of quality, so they could be collapsed into a single index. Such an index could replace the current system of pass/fail standards--which has severe limitations.

Technical pass/fail standards are clear and precise, but three major classes of problems arise in using them to monitor and reward quality. First, by evaluating performance relative to a pass/fail cut-off, distinctions among various levels of sub-standard and super-standard performance are ignored. Utilities have little incentive to exceed targets. Second, the targets themselves are somewhat arbitrary, having arisen from a chaotic process reflecting historical engineering capabilities, political pressures, and administrative happenstance. Consumer valuations of different quality dimensions and emerging technological opportunities are not likely to be reflected in pass-fail standards. Third, combining information on multiple dimensions into an overall assessment is very difficult for regulators. Information overload could lead to "management by exception". By focusing on the rules that a company fails, regulators essentially ignore dimensions on which the company being evaluated has exceeded the standards. Perverse incentives result. Developing an appropriately weighted index is no simple task, but the approach represents a potential improvement over pass/fail quality standards.

Generalized Indices

Examples of broad-based incentive mechanisms include the generalized quality index noted above. Average cost per kWh and indices of consumer satisfaction are additional examples. For the latter, measures of change in consumer surplus provide an indication of consumer impacts. Conceptually, this index has a strong economic foundation. Demand elasticities can be estimated and changes in consumer surplus due to price changes can be calculated. Measures of consumer satisfaction obtained via surveys are far more problematic. Electric utilities are not likely to win popularity contests except under extraordinary circumstances. Favorable or unfavorable attitudes can be driven by circumstances beyond a firm's control.

Incentive Structures

Even after identifying an appropriate index, there is still a question of how to link financial incentives to improved performance as reflected in that index. First, one could adopt a return on equity adjustment to total rate base or to DSM investment. A variant of this would be a shared equity adjustment. Instead of a cap on allowed rate of return, a sharing rule could be adopted. The split could be a function of performance based on an index. Second, in the case of DSM, there are shared savings mechanisms which apportion savings from deferred construction to shareholders and ratepayers. Third, in the case of DSM programs, a bounty could be awarded for saved energy. Of course, quantifying the actual energy quantities saved and costs avoided can be highly contentious.

The goal of specific target incentive payment regulations in electric production during 1968-1987 appears to be the reduction of managerial slack. The Berg-Jeong (1991) study argues that by focusing on specific categories or determinants of cost, regulators could induce utilities to devote excessive resources to ensuring that a narrow goal is reached--so no net cost savings are realized (Joskow and Schmalensee, 1986, p. 38; Berg and Tschirhart, 1988, p. 517-519). The jury is still out on this issue. Re-testing the model using an improved data set did not change the conclusions of the earlier study. However, our simultaneous model only tested whether the existence of a program in that year had an impact -- yet some of these programs were subsequently discontinued. By comparing these discontinued programs with the continuing programs, one would be able to evaluate the impact of incentive regulations. It would also be instructive to analyze the precise types of regulation in greater detail -- some types may have impacts even if, on average, current incentive regulations fail to have measurable impacts. The inability of Berg-Jeong to find an impact of cost component regulation suggests that either the factors affecting performance are not adequately captured in our model specification, or that this particular type of regulatory innovation has failed to achieve its goal of increased efficiency. If incentive regulation is to be adopted, more comprehensive schemes (such as price caps) might warrant greater attention.

Question #4: What are the long-run/short-run tradeoffs that managers face under traditional rate of return regulation.

Rate of return regulation provides inappropriate investment incentives for managers of electric utilities. Incentives for long-run cost reductions are minimal because achieved cost reductions are passed on to ratepayers in the form of lower prices. There may also be incentives for managers to adopt familiar, tested technologies if there is a nontrivial chance that the regulated firm will be forced to bear the downside risk of an unsuccessful project. When a firm is afforded little upside potential from a project but is forced to absorb downside risk, it will rationally avoid as much risk as possible.

The much publicized Averch-Johnson bias can also arise in long-term planning. If the firm's allowed earnings increase with its stock of capital that is deemed to be used and useful, the firm may have an incentive to employ excessive levels of capital. Inappropriate prudency policy, however, can lead to an under-capitalization bias. If firms fear that their investments on new plant and equipment may ultimately be disallowed due to factors beyond their control (e.g., changes in demand, changes in the political climate, etc.), then they may rationally be reluctant to undertake major investments.

This fear of what some call expropriation can lead the firm to undertake temporary, short-run measures to deal with such phenomena as increased demand instead of undertaking a more rational, long-range approach. For example, the firm may attempt to extend the life of outdated facilities rather than build new capacity.

Short-term cost reducing measures may also be favored over more efficient long-term measures under rate of return regulation. The primary source of reward for the firm for reducing costs under rate of return regulation is regulatory lag. In the time period between rate hearings, the firm can sometimes reap the gains of the cost reductions that it effects. Once the new rate hearing takes place, observed cost reductions are passed on to ratepayers in the form of lower prices.

The potential advantage of rate of return regulation for managers is that they are insured to some extent against exogenous variations in the cost of capital. When investors are assured of risk-adjusted returns that are commensurate with alternative uses of their funds, an adequate supply of investment capital is ensured for the regulated firm. In fact, the cost of capital for the firm is lowered, which can be advantageous for all parties. Of course, this advantage will be nullified if prudency policy reintroduces substantial risk into the regulatory environment. Furthermore, because rate of return provides minimal incentives for efficient performance by the regulated firm, operating costs may rise more than capital costs are reduced under rate of return regulation even in the absence of questionable prudency policy.

Of course, just as rate of return regulation is not without its benefits, prudency policy has its attributes also. Sound prudency policy can serve to offset the incentives for over-capitalization that rate of return regulation can create.

In summary, rate of return regulation generally does not provide the ideal incentives for long-term investment because the earnings of the firm are not commensurate with the value it creates. Instead, allowed revenues are tied to perceived costs. Rate of return regulation and the attendant regulatory lag can provide incentives for the regulated firm to substitute short run fixes for more efficient long-run planning. Rate of return regulation can also lead to either over- or under-capitalization by the regulated firm, depending on the nature of past and anticipated prudency policy in the industry.

Concluding Observations

As states and nations gain experience with different types of incentive regulation, additional lessons will be learned about the strengths and weaknesses of alternative approaches. No one has all the answers. Regulators and firms are going to have to be experimental about the process. There is much to be learned.

References

Berg, Sanford V. and Jinook Jeong. "An Evaluation of Incentive Regulation for Electric Utilities," *Journal of Regulatory Economics*, Vol. 3, No. 1, 1991, pp. 45-55.

Berg. Sanford V. and John G.Lynch. "The Measurement and Encouragement of Telephone Service Quality." *Telecommunications Policy*. April 1992.

Berg, Sanford V. and John Tschirhart. " Natural Monopoly Regulation: Principles and Practice." New York: Cambridge University Press. 1988

Joskow, P.L. and R. Schmalensee. "Incentive Regulation for Electric Utilities," *Yale Journal of Regulation*, Vol. 4, 1986, pp. 1-49.

Spence, M. "Monopoly, Quality, and Regulation, *Bell Journal*, 1975, pp. 417-29.