

Price Regulation and the Incentives to Pursue Efficiency by Minimizing Network Losses

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Energy efficiency, using less energy to provide the same service, is seen as a cost-effective approach to sustainable energy use and greenhouse gas emissions reductions. While energy efficiency programs are once again at the forefront of public policy, energy efficiency opportunities have by and large not been materialized, particularly in the electricity sector where between 20 and 60 percent of total electricity used could be conserved by cost-effective initiatives.

There are two types of approaches that can be used by utilities to pursue energy efficiency in the electricity sector. The first approach focuses on the consumer-end through demand-side management (DSM) programs which reduce consumers' absolute electricity usage or shift it from peak to off peak periods. The second approach concentrates on the utility's internal efficiencies such as minimizing network losses.

While considerable attention has been paid by the academic literature to demand-side management programs, the pursuit of internal efficiencies by the utilities has not attracted the same degree of interest. The aim of this paper is to close the gap. In particular, we analyze the incentives embedded across different regulatory regimes – rate of return, price cap and mandated target regulation – for the electricity suppliers to undertake energy conservation programs to minimize network losses.

We build a theoretical model of a monopolist who can choose whether or not to undertake an investment in energy efficiency. The investment is not observable to the regulator who can only determine whether the investment has been successful in terms of the level of energy efficiency achieved. More specifically, the firm's choice of effort affects the probability of a successful outcome, with a higher effort resulting in a higher probability of achieving a better energy efficiency outcome. In this setting, regulatory regimes cannot explicitly compensate the firm for its effort to improve energy efficiency. We explore how different existing regulatory regimes perform in terms of expected amount of energy efficiency and total welfare.

We show that different regulatory regimes embed different incentives for the regulated firm to pursue energy efficiency at the network end. Rate of return regulation provides no incentive, as under this regulatory regime, the regulator sets ex-post prices conditional on the realization of the energy efficiency outcome, and the cost of effort cannot be recovered by the utility. Both price cap regulation and mandated target regulation provide incentives for supply-side energy efficiency. Under price cap regulation, the regulator tradeoffs providing incentives for energy efficiency and reducing the monopolist's rent. To ensure positive effort, the monopolist is allowed to earn positive rent. Under mandated target regulation, by exerting positive effort, the monopolist may increase the likelihood that it avoids paying the penalty for not achieving the target.

As a corollary, we find that policies that are designed to encourage utilities to promote end-user energy efficiency (e.g., by switching from price cap to rate of return regulation) may reduce the incentives for utilities to pursue internal energy conservation. In particular, when the cost of effort to undertake energy efficiency investment at the network end is low – that is, when there are existing opportunities that can be pursued at low cost and that are likely to result in energy savings – a price cap regime is likely to perform better than a rate of return regulatory regime.

The comparison of the different regulatory regimes based on expected welfare, rather than incentives, is ambiguous and complex. Specifically, if effort cost is sufficiently high that zero effort is undertaken in all cases, then rate of return regulation performs better than price cap regulation. In this case, the former ensures that profits are ex-post zero, whereas under the latter profits are only zero ex-ante – which implies that prices are relatively higher to ensure that the firm's participation constraint is satisfied. If the cost of effort is sufficiently low, price cap regulation always dominates rate of return regulation. The reason is that the monopolist never exerts positive effort under rate of return regulation, while positive effort is undertaken under price cap regulation. For intermediate values of effort cost, the comparison is more complex and depends on the specific cost of effort. Finally, mandated target regulation is dominated by price cap regulation and rate of return regulation, although it does better than an unregulated monopolist. The key reason is that mandated target regulation is too coarse and the trade-off between providing incentives to invest in energy efficiency and rent extraction is less pronounced than under the other regulatory regimes.

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