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Research Brief

Designing Incentive Regulation in the Electricity Sector

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In industries with extensive infrastructure needs and pronounced scale economies, consumers can be better served by well-designed regulation than by competition. Regulation that replicates the discipline of competitive markets can enhance the welfare of electricity consumers. However, replicating competitive discipline is challenging when regulators have limited knowledge of relevant industry conditions and when the regulators' policy instruments are restricted. Incentive regulation attempts to harness the regulated firm's superior knowledge of industry conditions to achieve regulatory objectives. This paper reviews key principles of incentive regulation and examines how incentive regulation can be designed to enhance performance in the electricity sector.

Competition compels industry suppliers to serve the best interests of consumers in many sectors of the economy. Intense competition to secure the patronage of consumers can compel suppliers to deliver high-quality services and charge prices that reflect realized production costs, generating only a normal profit for suppliers in the long run. Competition also compels suppliers to find new ways to control costs and to enhance service quality as industry conditions change.

Although competition can enhance consumer welfare in many industries, competition can be prohibitively expensive in industries with considerable infrastructure needs and pronounced scale economies. To illustrate, in network industries such as the electricity sector, firms could in principle compete by constructing duplicative transmission and distribution (T&D) electricity networks. However, when these duplicative costs are extremely large (as they typically are in the case of electricity T&D networks), consumers can be better served by well-designed regulation of a single supplier than by competition among suppliers. A regulator can protect consumers in part by limiting the prices that the monopoly network charges for its services, and by specifying the minimum levels of service quality that the network must deliver.

Consumers can be well served by regulation that strives to replicate the discipline of competitive markets. In principle, a regulator could employ a "command and control" policy that directs the T&D network owner to employ the most efficient technology, deliver the welfare-maximizing level of service quality, and set prices to ensure only a normal profit for the network owner when it operates at minimum cost. In practice, regulators seldom have the information required to ensure that command and control regulation can replicate the discipline of competitive markets. Regulated suppliers often have better information than regulators about prevailing industry conditions. Therefore, regulators may be better able to replicate competitive discipline and achieve other relevant goals if they can induce regulated suppliers to employ their superior knowledge of industry conditions to achieve the relevant goals. This is the essence of incentive

regulation, which can be viewed as the implementation of rules that induce a regulated firm to employ its privileged information to achieve regulatory goals.

This paper reviews the basic principles of incentive regulation and examines how incentive regulation can be employed to enhance performance in the electricity sector. The paper begins by reviewing how the electricity sector has evolved, and by discussing the nature and extent of industry regulation that has been implemented. In many jurisdictions, competition prevails in the generation and retail segments, but regulation governs activities in the T&D sectors. Consequently, the paper focuses on the design and implementation of incentive regulation in the T&D segment of the electricity sector.

The paper emphasizes how the regulator's task of designing and implementing incentive regulation is complicated by her limited information about the capabilities and operations of the firms she regulates. The paper reviews particular forms of incentive regulation that are employed in practice, including price cap regulation and earnings sharing regulation. Price cap regulation sets the prices that the regulated firm can charge below levels that would be set if the firm operated under cost-of-service regulation. Earning sharing regulation requires the firm to share a fraction of its realized earnings above or below specified thresholds with consumers. Both of these policies seek to motivate the firm to employ its superior knowledge of industry conditions to reduce its operating costs. They do so by rewarding the firm for realized cost reductions with a portion of the associated gains. The paper emphasizes the fact that the policy that best motivates a regulated supplier to operate efficiently and to serve the best interests of consumers varies with the nature and extent of the regulator's information, and with the policy instruments at her disposal.

In principle, policies that reward cost reduction can encourage the regulated firm to reduce the level of service quality it delivers. We explain how incentive regulation plans can be designed to motivate cost reduction and simultaneously maintain high levels of service quality. For example, a target level of service quality can be specified, and financial rewards or penalties for realized service quality that exceeds or falls below the identified target can be specified. Such policies have been employed in practice. In Hawaii, for example, regulated suppliers are penalized if realized service quality is significantly below historic levels of service quality. We explain both how incentive regulation can be designed to induce desired levels of traditional dimensions of service quality that pertain to the frequency and length of power outages, and how it can be designed to ensure grid resiliency. Resiliency efforts seek to limit damages from relatively unlikely, but particularly detrimental, events. These events include severe weather (e.g., hurricanes or floods), wildfires, and cyber or terrorist attacks.

In the coming decades, the T&D sector will require substantial investment to replace aging infrastructure, to modernize the network, and to meet the anticipated growth in electricity demand. Consequently, it is important to structure regulatory policy to induce both the efficient levels and the efficient types of investment. Doing so can be particularly challenging as distributed energy resource (DERs) technologies such as rooftop solar, electric vehicles, and demand-side management become more widespread. The presence of DERs calls for changing the traditional policy of undertaking large-scale centralized investments to accommodating and leveraging dispersed DERs that are located closer to the point of electricity consumption. Utilities can have little incentive to make investments that rely on or accommodate DERs under traditional regulatory frameworks. We review new regulatory policies that are being employed to motivate utilities to invest in the efficient mix of traditional and DER assets, and to reduce system peaks to reduce investment needs altogether. We also explain how incentive regulation policies can be designed to achieve environmental objectives.

The paper also reviews the empirical evidence on the effects of incentive regulation. The literature suggests that incentive regulation has induced substantial cost reduction in the energy sector and more broadly. The literature also suggests that incentive regulation has enhanced service quality when the regulatory policy includes explicit financial incentives to improve quality, but may not have done so more generally.

The paper concludes by identifying important directions

for further research. To illustrate, energy regulators have implemented a wide array of incentive regulation plans in recent decades. Ubiquitous sharing of experiences with incentive regulation – both successes and failures – would be valuable. Additional empirical research that systematically controls for relevant differences across regulatory jurisdictions is needed to identify the particular forms of incentive regulation that best achieve desired goals in specific environments. Additional research is also required to determine how traditional forms of incentive regulation should be modified as new technologies and new industry structures emerge in the energy sector.

References

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David Brown is a Professor at the University of Alberta's Department of Economics where he holds a Canada Research Chair in Energy Economics and Policy. He is the President of the Canadian Association for Energy Economics. His research lies at the intersection of energy economics, industrial organization, and regulatory policy. Professor Brown's recent work considers questions in the electricity sector ranging from market design, market power, and pricing mechanisms for demand-side management and emerging technologies such as rooftop solar, battery storage, and electric vehicles. He received a Ph.D. in Economics from the University of Florida and bachelor's degrees in Economics and Mathematics from Miami University (Ohio).

David Sappington holds the title of Eminent Scholar in the Department of Economics at the University of Florida. He is also the Director of the University's Robert F. Lanzillotti Public Policy Research Center. Professor Sappington presently serves on the editorial boards of several journals, including the Rand Journal of Economics, the Journal of Economics and Management Strategy, the Journal of Regulatory Economics, and the Review of Industrial Organization. He has also served as the Chief Economist for the U.S. Federal Communications Commission. His research focuses on the design of incentive regulation in the presence of limited information. Professor Sappington received his Ph.D. in Economics from Princeton University in 1980.

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