Demand Response: Smart Market Designs for Smart Consumers

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Although the marginal cost of producing electricity may vary significantly over time, electricity retailers have historically charged simple tariffs subject to infrequent updates. However, as smart metering technologies are being rolled out, more complex tariff structures are becoming implementable.

Peak-Time Rebate (PTR) pricing is one of the most popular of these new tariff structures. It consists in rewarding consumers financially if, during specific hours when wholesale prices are high, they decrease their consumption relative to a counterfactual called *baseline*. Because customers are likely to be better informed than their retailer about (some aspects of) their future consumption, computing this baseline raises a problem of asymmetric information.

This work explicitly takes asymmetric information into account to study Peak-Time-Rebate contracts in day-ahead electricity markets. We start by highlighting a structural flaw of these mechanisms: embedded arbitrage opportunities. Consumers are allowed to buy their baseline power at a constant (state-independent) price while this power is worth more by construction. Under asymmetric information, PTR tariffs thus incentivize strategic consumers to inflate their baseline. We then show that making PTR contracts incentive compatible is equivalent to implementing a variable Critical-Peak-Pricing mechanism (vCPP), in which customers have to purchase their peak consumption at the spot price.

Whenever asymmetric information is a significant concern, vCPP mechanisms should thus be preferred. The relevant economic issue then becomes to design vCPP contracts optimally in order to achieve high enrollment rates under voluntary opt-in. We argue that this problem has different solutions depending on the industry structure on the one hand, and on whether or not policy-makers choose to maintain historical cross-subsidies on the other hand. We suggest there may exist complementarities between both aspects. Indeed, if subsidies to non-switchers are not to be maintained, retailers under perfect competition will offer Real Time Pricing contracts, all consumers will enroll, and the most efficient outcome will be reached. If on the contrary subsidies are to be maintained, a monopoly retailer may be in a better position to reach the second-best outcome, due to its ability to monitor the level of public spending. Other combinations of retail industry structures and political choices regarding historical cross-subsidies face difficulties than may induce inferior outcomes.

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