Estimation of Maintenance and Switching Costs for Peaking Power Plants

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Extended abstract

We use nonparametric structural estimation to estimate the costs associated with shutting down, starting up, and abandoning peaking power plants, specifically simple cycle combustion turbines. Estimates of switching costs are surprisingly difficult to obtain in practice.

Our case study is made possible by the availability of detailed power plant data from the United States. Each year the owners of existing power plants must file Form 860 with the Energy Information Administration (EIA). From these data it is possible to determine whether an existing plant was shutdown, started up, or abandoned. Our sample includes 8189 plant-year observations from the period 2001–2009. These data are augmented with time series of electricity prices and fuel prices, available from electricity market operators and the EIA.

We use the discrete decision process framework of Rust (1987). The papers by Gamba and Tesser (2009) and Su and Judd (2012) also consider parametric stochastic processes – processes involving exponential distributions or geometric Brownian motions – to model the underlying state variable. We employ the estimator developed by Su and Judd (2012). Intrinsic to this framework is the use of a shock process, reflecting the unobserved heterogeneity across plants and over time.

In contrast to the existing literature on structural estimation, we do not normalize to unit value the scaling parameter of the unobserved payoff shock process. Instead, we present an estimator for the scaling parameter. We also modify the Su and Judd (2012) approach by capturing the dynamics of the exogenous state variable using a nonparametric kernel density estimator. The nonparametric kernel density estimator does not require unrealistic assumptions about the data generating process. Instead, the time series of observed state variable transitions are used directly to estimate managers' expectations regarding future profitability.

Understanding shutdown, startup, and abandonment decisions is important for designing efficient mechanisms in electricity capacity markets. In an effort to provide incentive for firms to build and maintain sufficient peaking capacity, Independent System Operators in the United States recently have introduced capacity markets such as the Reliability Pricing Model (RPM) in the PJM system. Capacity markets provide revenue to plants for maintaining availability and therefore help to ensure system reliability.

Participants in RPM bid an Avoidable Cost Rate (ACR). Avoidable costs are the incremental costs of being a capacity resource, i.e., the costs which could be avoided if a particular plant were shut down for a year. Owners of power plants may either develop estimates of these costs for each individual plant or use default rates provided by the market. From our switching and maintenance costs we

estimate ACRs. Our estimates of ACRs are less than the default values used in PJM's capacity market, implying that consumers may be paying too much for system reliability.

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