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Estimating market power in homogenous product markets using a composed error model: application to the California electricity market

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This study contributes to the literature on estimating market power in homogenous product markets. Our econometric approach allows for the value of estimated conduct parameter to vary across both firms and time. We estimate a composed error model, where the stochastic part of the firm's pricing equation is formed by two random variables: the traditional error term, capturing random shocks, and a random conduct term, which measures the degree of market power. Treating firms' behaviour as a random parameter helps solving the over-parameterization problem in the continuous time. Other advantages of our approach are its applicability to cross-sectional or short data sets, and when individual pricing equations cannot be consistently estimated with the available instruments. In addition, by imposing upper bound on the value of estimated conduct parameter we ensure that estimated market power scores are always consistent with the economic theory.

The model can be estimated in three stages using either cross-sectional or panel data sets. While the first stage of our model is the same as in the previous literature, the second and the third stages allow us to distinguish variation in market power from volatility in demand and cost, and get firm-specific market power scores, conditional on the first-stage parameter estimates. Model identification is based on the assumption that the conduct term is asymmetrically distributed, which, to our best knowledge, has not been previously used in the empirical industrial organization literature.

We illustrate the proposed approach with an application to the California wholesale electricity market using a well-known dataset

from Puller (2007). We supplement the dataset with a different, and more accurate measure of the elasticity of residual hourly demand function of the five strategic firms, calculated based on California Power Exchange (PX) bidding data. After estimating the parameters of the pricing equation, we implement the second and third stages based on the truncated normal distributions, which imposes both lower and upper theoretical bounds on the values of the random conduct term.

Our first-stage results are generally similar to previous findings of Puller (2007). The estimated market power values are closer to Cournot than to static collusion. We find an increase in collusive behavior of all firms above Cournot levels during the period of price run-up in June – November 2000, using the residual demand elasticities based on Puller (2007) but not using the residual demand elasticities based on PX data. The analysis of firm-specific conduct parameters suggests that realization of market power varies over both time and firms, and rejects the assumption of a common conduct parameter for all firms. Estimated firm-specific conduct parameters generally tend to move in the same direction across time, suggesting that firms pursue similar market strategies as market conditions change.

Finally, we use the estimates of firm-specific conduct parameters to clarify the extent to which firms' potential for exercising market power unilaterally affects their market conduct. Similar to Wolak (2003) we compute the residual demand elasticities facing each firm individually on the California PX market, and use their reciprocals (Lerner indices) as a measure of the firms' potential to exercise unilateral market power. We find strong negative correlation between Lerner indices and estimated conduct parameters for 3 out of 4 firms during the first period of our sample (before entry of Southern) and for 2 out of 5 firms during the second period of our sample. This result indicates that, for some firms the potential for realization of the market power unilaterally is associated with lower values of the conduct parameter.