Efficiency Measurement in Norwegian Electricity Distribution: A Generalized Four-Way-Error-Component Stochastic Frontier Model

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This paper introduces a new model to estimate efficiency by generalizing the state-of-the-art panel stochastic frontier model -- the salient feature of which is decomposition of inefficiency into a persistent and a transient component. We also introduce an autoregressive process to allow for temporal dependence in transient inefficiency. Further, both firm heterogeneity and persistent inefficiency components are allowed to be correlated with some exogenous and endogenous covariates in the model. The proposed model introduces determinants of both persistent and transient inefficiency, and takes care of the endogeneity problem. Since the transient component is autoregressive, the likelihood function is not available in closed form. To address this problem, we use the method of Maximum Simulated Likelihood and Generalized Method of Moments to estimate the parameters and several other quantities of interest, including transient and persistent inefficiency. Given that the model is dynamic and accommodates determinants of inefficiency, it is useful to the production managers in identifying how much of the inefficiency is affected by past inefficiency as well as how and in what ways efficiency can be improved.

We use Norwegian electricity distribution data to showcase the application of our model. In the empirical exercise, both the Cobb Douglas (CD) and translog models show strong temporal dependence of transient inefficiency. Persistent (transient) inefficiency is found to be much lower (higher) in the CD model. The average overall inefficiency in the CD (translog) model is 18.2 (15.31). We also find technical progress (cost diminution) although quite low, in both models. The mean returns to scale is found to be close to unity in the general model, and slightly higher in the CD model.

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The Energy Journal, Vol. 44, No. 2