Persistent and transient productive inefficiency in a regulated industry: electricity distribution in New Zealand

Massimo **Filippini**

Centre for Energy Policy and Economics (CEPE), ETH Zurich and Department of Economics, Università della Svizzera Italiana, Switzerland

Bill **Greene**

Department of Economics, Stern School of Business, New York University, USA

Giuliano **Masiero**

Department of Management, Information and Production Engineering, University of Bergamo, Italy; Universita della Svizzera italiana (USI), Switzerland.

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1. Overview

The productive efficiency of a firm can be seen as composed of two parts, one persistent and one transient. So far, most cost efficiency studies estimated frontier models that provide either the transient or the persistent part of productive efficiency. This distinction seems to be appealing also for regulators. During the last decades the electricity distribution sector has witnessed a wave of regulatory reforms aimed at improving efficiency through incentive regulation. Most of these regulation schemes use benchmarking, namely measuring companies' efficiency and rewarding them accordingly. The purpose of this paper is to assess the level of persistent and transient efficiency in the electricity sector and to investigate their implications under price cap regulation. Using a theoretical model, we show that the regulator may fail in setting optimal efficiency targets if the two parts of the cost efficiency are not disentangled. The introduction of minimum quality standards may not offer a valid solution. To provide evidence we estimate stocastic frontier models using data on 28 New Zealand electricity distribution companies between 1996 and 2011.

2. Methods

We estimate a total cost function using three stochastic frontier models for panel data: the random effects model (RE) proposed by Pitt and Lee (1981) that provides information on the persistent part of the cost efficiency; the true random effects model (TRE) proposed by Greene (2005a, 2005b) that provides information on the transient part; and the generalized true random effects model (GTRE) proposed by Filippini and Greene (2015) that allows for the simultaneous estimation of both transient and persistent efficiency. We found weak evidence that persistent efficiency is associated to higher quality, and wrong efficiency targets are associated to lower quality compliance.

The total cost estimated in this paper can be written as:

TC = c (Y;CU;NL; LF; Q; T)

where Y and CU represent the output measured by the electricity supplied in kilowatt-hours and the number of final consumers, respectively. NL, LF and Q are output characteristics: NL is the network length, LF denotes the load factor, and Q is service quality measured by SAIDI, an index of the average interruption duration of the system. Finally, T is a time trend which captures changes in the cost over time.

3. Data

The data set used in this study is a panel of 28 New Zealand's electricity distribution businesses (EDBs) between 1996 and 2011.12 The panel is constructed mainly by exploiting information in the "NZ EDB Database" from Economic Insights (Economic Insights, 2009). This database consists of financial and production data on electricity distribution companies.

4. Preliminary Results

In all three models most of the estimated coefficients have the expected signs and are statistically significant at the 1% level. The values reported in Table 4 show that the estimated average values of the persistent efficiency varies from 78 percent in the RE model to 88 percent in the GTRE model. The estimated average values of the transient efficiency varies from 94 percent in the TRE model to 88 percent in the GTRE model. The values of the persistent and transient efficiency obtained by the GTRE model compared to the values obtained by the TRE and RE models are significantly different. This implies, that the values obtained by the RE and TRE models do not provide precise information on the level of persistent and transient efficiency.

Variable	Mean	Std. Dev.	Minimum	Maximum
RE	0.782	0.143	0.515	0.984
TRE	0.940	0.032	0.803	0.987
TGTRE	0.878	0.062	0.644	0.990
PGTRE	0.884	0.021	0.866	0.946

Table 4: Cost efficiency scores.

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