Hans Nylund[1]

REGULATING TRANSMISSION SYSTEM OPERATORS: AN INCENTIVE SCHEME FOR THE NORDIC ELECTRICITY MARKET

[1]Lulea University of Technology, Sweden, +46-920491254, hans.nylund@ltu.se

Overview

The transmission system operators (TSOs) of the Nordic countries play a crucial role in the development of an integrated regional electricity market in Scandinavia. They provide the transmission networks that enable the trade and exchange of electricity between the countries. The TSOs are currently operating under rate of return or revenue-cap regulation as decided by the national regulators. These regimes may to differing extents provide incentives for cost-efficiency, but they do not explicitly give incentives for integration between national markets. The purpose of this paper is to design a regulatory scheme that incites TSOs to act in ways that increase the trading capacities between countries, thereby promoting the integration of the Nordic electricity market. A benchmark-model is constructed based on data for the Nordic TSOs (Energinet.dk, Statnett, Svenska kraftnat and Fingrid), the Netherlands TSO Tennet and the Polish TSO PSE operator SA.

Benchmarking is a well established method to introduce an element of competition into regulated industries. It has been widely applied to electricity distribution companies [2]. The usual approach when estimating efficiency of transmission and distribution utilities is to assume that output is exogenously given by demand and that the relevant efficiency therefore is input oriented. However, in the development of regional cross-border electricity markets it can be argued that the TSOs have a role in expanding output by increasing the trade capacities between countries, either through changed congestion management routines or by investments in new transmission capacity. This paper expands on this idea by estimating output-oriented technical efficiency of the TSOs as a measure of the potential for increased integration. The estimated efficiency scores are then used as guide marks in designing an incentive regulation scheme for the TSOs.

Method

A Cobb-Douglas production function (1) is specified for the TSO-operation. The output of the production function is defined as total national electricity consumption (including imports) plus electricity export. The inputs are labor and capital specified as the number of full-time equivalent employees (FTE) and network length*kV transmission capacity. Also included as non-discretionary inputs are GDP and share of industry consumption. These are included to control for variation and environmentally determined characteristics of output that is not under the control of the TSO.

$$\ln y = \beta_0 + \beta_1 \ln FTE + \beta_2 Network + \beta_3 \ln GDP + \beta_4 \ln Indust + u \qquad (1)$$

Model (1) is estimated using an unbalanced panel data-set of six TSOs spanning the years 2000-2008. The estimated production function is transformed into a production frontier using the COLS-technique (Corrected Ordinary Least Squares). The frontier represents the best practice and gives the benchmark against which the output-oriented technical efficiencies of the TSOs are measured. The resulting efficiency scores give an estimate of the potential for increased output under the given input levels for each of the TSOs. The efficiency scores can be translated into a target incentive model as in (2).

$$I = \frac{Et_1}{Et_0} - \frac{Et_1^*}{Et_0} \tag{2}$$

I = Reward or penalty
E_{t0} = Efficiency in time t_0
E_{t1} = Efficiency in time t_1
E^*_{t1} = Target efficiency in time t_1

Model (2) compares the efficiency change of a TSO during a regulatory period from time t_0 to t_1, with the target efficiency change for t_1 set by the regulator (E^*_{t1}). The output incentive *I* will give a reward or a penalty to the TSO, depending on whether the realised efficiency change is larger ($I>0$) or smaller ($I<0$) than the target efficiency change. This model can then be coupled with existing regulatory regimes such as price- or revenue caps or rate of return regulation. For example, if a TSO exceeds the targeted technical efficiency level set for the regulatory period it could be allowed to earn a larger revenue or a higher rate of return.

Results

The estimated technical efficiencies of the TSOs are in the range 75-100% with an average efficiency of 85%. The results indicate that there is potential for increased technical efficiency among the TSOs. The target incentive model presented could be a useful tool for including integration incentives in the regulation of TSOs.

Conclusions

Integrating national electricity markets into regional markets is a challenge due to the national character of both TSOs and regulatory institutions. This paper presents a target incentive model based on the output oriented technical efficiencies of the TSOs. Given that a proper estimation of the efficiencies can be derived, the model could provide incentives for the TSOs to use congestion management and investment decisions in a way that increases trade and integration.

References

1. Farsi, M., Filippini, M,. 2004. Regulation and measuring cost-efficiency with panel data models: An application to electricity distribution utilities. *Review of industrial organisation, 25:1-19.*

2. Jamasb, T., Pollitt, M., 2001. International benchmarking and regulation of European electricity distribution utilities. CEER.

3. Joskow, P., 2008. Incentive regulation and its application to electricity networks. *Review of Network Economics, Vol.7 issue 4.*

4. Kumbhakar, S., Lovell, K., 2000. Stochastic frontier analysis. Cambridge university press.