OUTPUT-BASED INCENTIVE REGULATION AND BENCHMARKING OF NETWORK UTILITIES

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Overview

Since the 1980's, many countries have liberalised their electricity sector. The potentially competitive segments of the sector, such as generation and supply, have been vertically separated from the naturally monopoly transmission and distribution networks. Due to the lack of competition, distribution and transmission of electricity is thus subject to regulation to ensure access, security suppl and fair price for customers. By late 1990s, incentive regulation was common practise in many countries aiming to promote improvements in investment and operating efficiency (Jamasb and Pollitt, 2000).

Incentive regulation has generally been successful in improving technical and economic efficiency and traditionally, regulators have used an input-based approach where firms are rewarded for cost-minimisation. However, network sustainability and innovation concerns are often overseen in the current framework and thus, a new approach is required to address these issues. The new regulatory scheme, RIIO, adopted by the UK regulator Ofgem is an example where incentives focus on output measures of companies' performance, rather than merely cost-minimisation. Other examples include the Italian regulatory authority and the Australian regulator, which are adapting similar approaches. RIIO aims to promote greater benefits for customers and stronger incentives for utilities to deliver a sustainable energy sector for current and future generations. A problem in regulation is information asymmetry between utilities and the regulator. Output-based regulation reduces information asymmetry and increases input efficiency by allowing regulated utilities to decide on the use of its resources. However, as a result of the additional objectives introduced, costs may increase (Cambini *et al.,* 2014; Ofgem, 2010). In the interest of electricity customers, it is therefore important to find a framework which will stirke a balance between costs, quality of supply, and sustainability.

Output-based regulation is a relatively new concept in electricity network regulation and has received limited attention from researches. A notable exception is Cambini *et al.* (2014) using the experience from Italy. In this paper, we build on the ideas developed in the UK and Italy and explore a potential model of benchmarking and performance evaluation of electricity distribution firms under output-based regulation in the context of Norway. We investigate whether relative performance evaluation under the condition that more emphasis is placed on outputs will lead to stronger incentive to deliver a given bundle of quantity and quality in a cost efficient manner. We also examine the unexplored conceptual and practical implications of the shift in regulation paradigm from input-based to output-based benchmarking by contrasting the results against those of conventional input-based models.

Methods

Our approach in this paper includes two distinct parts:

1. First, we introduce a suitable framework to explore the incentive properties under output-based regulation. We investigate the problem of incentive under the condition that quality of supply and network security, which traditionally have been considered as network constraints, being treated as outputs. This analytical framework provides us with a platform upon which we then base our empirical method.

2. Second, we introduce our empirical model to measure the cost performance of firms when definition of outputs is extended to include some of the otherwise network constraints in the benchmarking model as outputs. The econometric model will be estimated using Stochastic Frontier Analysis (SFA) technique. The approach is based on a distance function, which can accommodate multiple inputs and outputs that does not require explicit behavioural assumption of cost minimisation and profit maximisation. In order to determine the effect of including a quality of service indicator on the efficieny we estimate three separate model. One without a quality indicator and two with quality indicators, using information of cost of interuptions and lenth of interuptions.

As one of the leading countries in network regulation, Norway provides a perfect setting for our research. The data available is rich in terms of quality, number of observations, and number of available variables. The Norweian regulator (NVE) operates economic incentive regulation through annually calculated revenue caps for each of the utilities, illustrated in (1).

$$RC_t = 0.4C_t + 0.6(C_t^* - C_t) \qquad (1)$$

where RC_t is the revenue cap in year t, C_t is the cost base for each network company and C_t* is the cost norm for the company. C_t and C_t* are both calculated using data from t-2 and C_t* is the result of Data Envelopment Analysis (DEA) programmed to benchmark the companies costs. Ordinary Least Squares is then used to correct the DEA results for environmental factors. The revenue cap is thus determined using a share of actual cost and the norm cost. The incentive power of regulation and stimulated competition among utilities to improve cost efficiency is achieved by placing a higher weight on the norm cost. The cost base is calculated as follows:

$$C_t = (OM_{t-2} + CENS_{t-2}) \times \frac{CPI_t}{CPI_{t-2}} + PL_{t-2} \times P_t + DEP_{t-2} + RAB_{t-2} \times WACC_t \qquad (2)$$

where OM is the operation and maintenance costs, CEN is the company's costs of energy not supplied. Multiplying actual power loss (PL) with the reference price of power (P, given by a volume-weighted monthly area spot price from Nord Pool Spot) gives the cost of power losses, whilst DEP is depreciation and RAB is the regulatory asset base (book value plus 1 percent working capital). WACC (weighted average cost of capital) is defined by NVE to calculate the capital cost of the companies. The financial variables used are in real terms and adjusted based on 2011 prices. The data used for the analysis comprises a balanced panel of 130 Norwegain distribution network operators (DNOs) observed from 2000 to 2011.

Results

The current forms of incentive regulation model are focused on cost efficiency mainly through the use of inputs such operational and capital costs. The current regulatory challenges related to investment, innovation and sustainability prove that regulatory incentives also need to take into consideration the output performance of network companies such as service quality, network resiliency and commercial quality. Within the paradigm of the output-based regulation, the companies' performance are evaluated according to the quantity and quality of the delivered output and incentives are provided to promote these levels.

Conclusions

The results show that relative performance evaluation under output-based paradigm provides better incentive for the network companies to deliver the bundle of quantity and quality efficiently. When the revenue of regulated companies is linked to their outputs, the incentive for innovation will be strengthened. At the same time, a concern with benchmarking under output-based regulation is how to define output indicators in a consistent and measurable manner. This is specifically important as the reliability of benchmarking results has a direct implication for the company's incentives to improve their performance. The results also suggest that a as shift from input to output-based regulation should be accompanied with an appropriate length of regulatory period to allow for adjustment of outputs when firms undertake investment and innovation activities.

References

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