



Dynamic Efficiency and Incentive Regulation: An Application to Electricity Distribution Networks

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***Rahmatallah Poudineh, Grigorios Emvalomatis,
and Tooraj Jamasb***

The use of efficiency and productivity techniques such as total cost benchmarking, is becoming now common in incentive regulation to induce cost efficiency and prevent the firms from overcapitalisation. However, the efficiency measures obtained from benchmarking predominantly reflect short term performance and hence, provide only a snapshot of the firm's path towards its long run equilibrium.

The utilities reorganise their production process to become more efficient in the short run. However, the factors that affect short term efficiency of the firms (i.e. network outputs) may not be adjusted instantaneously when firms invest in new and costly technologies and practices which take time to produce result. Under this condition, in the short run, investment creates an induced inefficiency which persists for some time until the inputs and outputs are fully adjusted. On the other hand, the firms' revenues, under incentive regulation, crucially depend on the level of efficiency achieved in the benchmarking process.

The current form of incentives regulation with ex-post regulatory treatment of investment employed by many European regulators does not take this effect into account and, hence, there is a risk of financial loss for regulated companies when undertaking investment. Therefore, the simultaneous incentives for investment and static cost efficiency can send inconsistent signals to regulated firms. This potentially limits the companies' incentives for investment and innovation.

This paper introduces the concept of dynamic efficiency under incentive regulation with ex-post regulatory treatment of investments using the case of electricity distribution networks in Norway. We show that incentive regulatory models based on the total cost benchmarking are problematic for investment and optimal inter-temporal accumulation of capital of regulated firms. This is because it induces an autoregressive process in the level of technical efficiency and exposes the firms to financial loss following investment and capital stock adjustment. The paper demonstrates that, in a given period, technical inefficiency of regulated utilities is a combination of period-specific effects (shocks) and a carry-over component from previous periods. The latter component is due to the sluggish adjustment of outputs in the presence of investment and the associated adjustment costs. Additionally, we estimate these two components of inefficiency along with the rate of inefficiency transmission across periods (adjustment towards the long run equilibrium) for a balanced panel of 128 Norwegian electricity distribution companies from 2004 to 2010.

The results show that, at the sector level, 92% of the efficiency to inefficiency ratio is transferred from one period to another. At the level of individual companies, however, the variation is significant. There are firms with very low or very high elasticity of inefficiency transmission. The high magnitude of elasticity causes the effect of the shocks to die out over a longer period. The distribution of inefficiency decomposition shows that except in 2004, the share of carry-over effects, in the observed level of firms' inefficiency, is considerable. We have simulated the effect of a one-time shock on the autoregressive process and concluded that both the cumulative effect as well as the duration of inefficiency persistence will increase by the magnitude of initial perturbation. The results also indicate that the long run efficiency of the sector is approximately 82% based on the simple and correlated random effects models.

Contact	tooraj.jamasb@durham.ac.uk
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