

# **Investment and Efficiency under Incentive Regulation: The Case of the Norwegian Electricity Distribution Networks**

**EPRG Working Paper 1306**

**Cambridge Working Paper in Economics 1310**

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Following the liberalisation of the electricity industry since the early 1990s, many sector regulators have recognised the potential for cost efficiency improvement in the networks through incentive regulation aided by benchmarking and productivity analysis. Although, benchmarking has achieved efficiency (mainly in operating costs) new challenges have emerged as how to address the issue of network investments. The problem is whether a system of regulation can be designed that provides right incentives for delivery of cost effective services while ensuring there is no systematic underinvestment or overinvestment. Hence, regulators need to balance the cost and risk of underinvestment against the cost of overinvestment in maintaining and modernising the networks.

In this study we analyse the relation between cost efficiency and investment behaviour of electricity distribution networks under ex-post regulatory treatment of investments using the case of Norway. We introduce the concept of “no impact efficiency” as the revenue-neutral efficiency effect of investment under cost benchmarking which, if achieved, makes the firm “investment efficient” and immune from cost disallowance in benchmarking process. Also, we estimate the observed efficiency effect of investment in order to compare this with no impact efficiency and discuss the implication of cost benchmarking for the investment behaviour of distribution companies in Norway.

The results show that the un-weighted average efficiency gain of the sector as a result of investments is 0.8%. However, when the efficiency variations following investment are weighted by their share of total investment in the sector; the effect increases to 17% reflecting the fact that more investment often resulted in higher efficiency. At the same time, there are significant differences in efficiency gain

following investments at the level of individual companies. The results suggest those firms that fall short of no impact efficiency need to reduce their capital expenditure in order to improve their efficiency following investment. On the other hand, the firms that outperformed no impact efficiency may wish to increase their investment levels in order to gain from the efficiency they achieved. Overall, the new reallocation of investments increases the total investment of the sector without lowering the average efficiency gain of the sector.

Efficiency is a relative concept in productivity analysis. Hence, using benchmarking tools to promote cost efficiency and at the same time to ensure efficient levels of investment can result in unintended outcomes. The Norwegian incentive regulation scheme is designed to discourage overinvestment through partial disallowance of capital expenditures built into the regulatory formula and benchmarking practice. However, the power of the model to detect overinvestments is limited to the case of 'out of phase' investments or non-harmonised investment behaviour.

Moreover, benchmarking capital expenditures along with the other costs facilitates strategic behaviour by the firms in the form of trading-off between Capex and Opex in order to avoid financial loss in the process of benchmarking and revenue setting. Furthermore, systematic underinvestment can give the appearance of cost efficiency while it can have a negative effect on quality of service over time. Although underinvestment will eventually be reflected in the companies' cost of energy not supplied and cost of network energy losses, it can take some time for this effect to become apparent while the cost and efficiency improvement effect of underinvestment is more immediate.