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Social cost-efficient service quality—Integrating customer valuation in incentive regulation: Evidence from the case of Norway

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ABSTRACT

In order to overcome the perverse incentives of excessive maintenance reductions and insufficient network investments arising with incentive regulation of electricity distribution companies, regulators throughout Europe have started regulating service quality. In this paper, we explore the impact of incorporating customers' willingness-to-pay for service quality in benchmarking models on cost efficiency of distribution networks. Therefore, we examine the case of Norway, which features this approach to service quality regulation. We use the data envelopment analysis technique to analyse the effectiveness of such regulatory instruments. Moreover, we discuss the extent to which this indirect regulatory instrument motivates a socially desired service quality level. The results indicate that internalising external or social cost of service quality does not seem to have played an important role in improving cost efficiency in Norwegian distribution utilities.

1. Introduction

The transition from cost-plus to incentive regulation of natural monopoly energy networks entails numerous new challenges for regulators and network operators. In principle, the objective of incentive regulation is to encourage network operators to improve their cost efficiency towards a given target and to reward them for over-performance and penalise them for under-performance. The underlying parameter is a regulatory formula that caps the allowed prices (price cap regulation) or the allowed revenues (revenue cap regulation) of a network operator. This stimulus may, however, create perverse incentives with regard to the level of supplied service quality. The network operator may focus solely on efficiency targets to the detriment of maintaining an adequate level of quality. Therefore, service quality regulation is being introduced in a growing number of countries.

Quality in the electricity distribution and retail sector is a multi-faceted output that comprises technical and non-technical dimensions. The aspects that are usually regulated span three main areas: commercial quality, voltage quality, and continuity of supply and/or reliability (CEER, 2008). The generic terms for these three dimensions are "service quality" and "service quality regulation", respectively. In this paper we focus on the aspect of continuity of supply in distribution networks, which is arguably the most important and widely targeted dimension of service quality by regulators (see e.g. CEER, 2008). The aspect of commercial quality in the retail sector as well as the technical issue of voltage quality is not part of our study.

From a regulatory point of view, continuity of supply appears in two dimensions: the first dimension is its availability to energy to customers (or inversely the absence of interruptions). Basically, this dimension can be measured by different (groups of) indicators,[1] either the customer minutes lost (e.g. in form of the SAIDI[2]), the number of interruptions (e.g. in form of the SAIFI[3]) or the energy not supplied (ENS), which gives the total amount of energy that would have been supplied to a customer if there would not have been any interruption. The second regulatory dimension is the customers' preference for continuity of supply. One form to measure customer preferences is to reveal their willingness-to-pay (WTP) for a certain service quality level, or for its inverse, i.e. the interruption cost (IC) customers incur due to poor quality (Fumagalli et al. 2007).

With regard to the latter dimension, incentive based penalty and reward schemes for continuity of supply performance prove

[1] For a detailed overview of the different indicators employed in European countries, please refer to CEER (2008).
[2] System Average Interruption Duration Index, which gives the amount of time per year that the supply to a customer is interrupted.
[3] System Average Interruption Frequency Index, which gives the average number of time per year that the supply to a customer is interrupted.

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to be a sophisticated regulatory instrument to excite the regulated company to deliver a desired service quality level to its customers.[4] More specifically, these schemes adjust the companies' revenues according to their performance against a predefined service quality indicator, e.g. the ENS[5] or the SAIDI combined with the customer's WTP.[6] For the company, higher quality levels are associated with higher revenues and vice-versa.

Whilst the UK, the Scandinavian countries, the Netherlands, Italy and Portugal can be considered as pioneers in this field in Europe, more and more other European regulators follow this practice and enhance or introduce regulatory approaches[7] for incentive based service quality regulation. When introducing such a scheme, the objective usually is to neutralize potential quality deterioration due to incentive regulation. Mostly, a baseline is defined to move towards the desired level of service quality. As a matter of fact, the service quality level in Europe substantially differs among the different countries and regulators employ diverse approaches to measure it. Overall, there are rather decreasing trends for customer minutes lost and the trends indicate a rapprochement of the continuity level in Europe (CEER, 2008).

From a national perspective, however, the main regulatory challenge is to define the accurate reference for the country specific, socially desired level of continuity of supply rather than targeting regulatory measures towards a maximum quality level. Therefore, the regulator needs to know the companies cost of providing service quality as well as the customers' preferences. Provided with that, the pivotal regulatory objective is to harmonize the utilities' profit incentive with economic efficiency and customers' preferences in terms of continuity of supply. In other words, the idea is to internalize the costs of (poor) quality from a customers' perspective into the profit optimisation calculus of the network operator. With it, the service quality incentive reflects the costs incurred by customers affected by a poor quality level. Thus, the network operator will aim at providing quality up to the level where the marginal cost of quality equals the reward offered and therefore aims at a socially desirable quality level (Growitsch et al., 2009). This economically efficient approach raises the question of how network operators actually respond to the introduction of such regulatory instruments in practice. We are particularly interested in the case of Norway since the Norwegian regulator NVE was the first to incorporate customer valuation of service quality in the regulatory scheme and nowadays features a state-of-the-art approach in this context.

Overall, empirical research on the effectiveness of service quality in distribution networks is rather scarce and findings are heterogeneous. Ter-Martirosyan (2003) analyses the impact of incentive regulation on the duration and frequency for electric outages for a panel of 78 US utilities. She finds that incentive regulation is associated with an increase of outages. Moreover, the study detects that the number of outages decreases with the introduction of explicit quality benchmarks. Korhonen and Syrjänen (2003) find an improvement in technical efficiency after introducing a continuity of supply indicator (interruption time per customer) in their Data Envelopment Analysis (DEA) of 106 Finish distribution companies. A report by CEPA (2003) applies a two-step DEA model to cross-sectional data for the UK. They find no significant correlation between technical efficiency measures and continuity of supply in terms of customer minutes lost. Ajodhia et al. (2004) apply a DEA and a Corrected Ordinary Least Square (COLS) model to a cross-sectional sample of 44 electric utilities from the UK, the Netherlands, Hungary, and Malaysia, reporting a significant efficiency increase when quality is taken into account, especially for smaller network operators. Giannakis et al. (2005) carried out a DEA-based quality incorporated efficiency study on UK electricity distribution companies. They show that technical efficiency does not necessarily also involve high service quality. Moreover, they find that quality incorporated regulatory benchmarking is superior to cost-only approaches. Jamasb and Söderberg (2009) analyse the effects of the application of norm models within an ex-post incentive regulation of electricity distribution networks in Sweden. In the examination of the companies cost and service quality performance they find that service quality regulation has not affected the relative performance of utilities.

Some recent studies performed by Edvardsen et al. (2006) and Burger and von Geymueller (2007a, b) specifically examine the efficiency of Norwegian distribution networks. Edvardsen et al. focus on the general productivity of the networks. They find a productivity improvement albeit flattening out as from 2000. They generally explain this decrease with the introduction of new regulatory requirements and a potential retention in efficiency awaiting changing regulatory parameters. Burger and von Geymueller (2007a) find that quality regulation induced Norwegian network operators to optimise their quality strategy from a social point of view based on a DEA analysis and Malmquist indices for the period 1999–2005. However, their sample covers a rather limited number of observations (31 distribution companies), which might involve an uncontrolled sample bias. Indeed, in another paper, the authors find that ENS was reduced more significantly prior to the introduction of quality regulation than afterwards (Burger and von Geymueller, 2007b).

Albeit previous empirical research addresses service quality and/or productivity and welfare related issues there is—to our best knowledge—no empirical case study that clearly focuses on the impact of WTP-based continuity of supply regulation on the efficiency of distribution networks.

Thus, the aim of this paper is to shed some empirical light on this issue by assessing whether WTP-based[8] service quality regulation has a noticeable effect on the social cost efficiency of distribution networks in Norway and to what extent this regulatory instrument motivates a socially desired quality level. We give empirical evidence by means of a Data Envelopment Analysis and associated tests based on a complete dataset of Norwegian utilities, which was prepared by the Norwegian regulator NVE for the purpose of regulatory benchmarking analysis. The results enable us to discuss the effectiveness of service quality regulation based on customers' WTP and the impact on the quality level in Norway.

The remainder of this paper is as follows: in Section 2 we explain the economics of WTP-based service quality regulation. Section 3 describes the Norwegian regulatory approach in terms of service quality regulation and gives empirical evidence. Section 4 concludes and highlights policy implications.

[4] For other instruments to regulate the different dimensions of service quality, such as publication of data on company performance, (minimum) quality standards or premium quality contracts, please refer to Fumagalli et al. (2007).

[5] In the remainder of the paper, we focus on ENS since this is the regulatory indicator employed in our case-study Norway.

[6] For further discussion on the choice of the regulated indicator, please refer to Fumagalli et al. (2007).

[7] Some of these countries such as the UK or the Netherlands also employ other instruments of service quality regulation. The Netherlands for instance additionally apply compensation payments in case a predetermined continuity of supply standard is breached, whereas the UK also sets guaranteed standards for commercial quality.

[8] In the remainder of this paper, we use incentive based service quality regulation, WTP-based service quality regulation, and CENS-regulation as synonyms.