A Spatial Stochastic Frontier Model with Omitted Variables:

Electricity Distribution in Norway

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Executive summary

The unbundling of the electricity sectors around the world have led many sector regulators to use efficiency and productivity analysis as a key component of economic and incentive regulation of the distribution utilities. The sector regulators have adopted a number of parametric and non-parametric methodologies. The common thread among these methodologies is that they use relative efficiency measures to compare and incentivise the performance of the utilities.

However, the accuracy and thus the fairness of the results of such methods require a comparison of like-for-like firms. Thus, the benchmarking models used by the regulators focus on performance comparisons along controllable factors. In reality the utilities can be a heterogeneous group of firms differ and the underlying causes of such differences are not known or the data on them are not available. Therefore, an important methodological issue for the use of efficiency analysis in incentive regulation of regulated utilities is how to account for the effect of unobserved cost drivers such as environmental factors.

Our empirical strategy relies on utilising data on the geographic location of the surrounding networks as a useful source of information that has previously not been explored in the literature. The underlying idea in our empirical proposal is to utilise variables from neighbouring firms that are likely to be spatially correlated as proxies for the unobserved cost drivers. We propose a novel methodology that combines the spatial econometric approach with well-established stochastic frontier analysis techniques in order to control for the effect of unobserved environmental conditions on the efficiency of the distribution utilities.

We illustrate our approach in an empirical setting using data on Norwegian distribution utilities for the years 2004 to 2011. The advantage of using data from Norwegian networks is that there are over 120 distribution utilities in the country and these are spread over a fairly wide and varied geographic area. Moreover, the data prepared by the sector regulator on technical, economic, quality of service, and environmental aspects of the firms is extensive and of high accuracy. In addition, the electricity distribution utilities in Norway have consistently been subject to incentive regulation and regulatory benchmarking since 1997. There is therefore a useful overall consistency between the methodology used here and the actual regulatory framework under which the utilities operate.

The results obtained confirm the intuition that data on surrounding utilities contain useful information on environmental factors affecting the performance of individual utilities that can be extracted. We find that the lack of information on weather and geographic conditions can likely be compensated with spatial data from surrounding firms using spatial econometric techniques. We show that combining efficiency analysis and spatial econometric

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methods improve the goodness-of-fit of the estimated models and, hence, provide a more accurate (fair) efficiency scores are obtained.

The methodology proposed in the paper can help the sector regulators and researchers to enhance their understating of the environmental factors on the performance of individual utilities. However, the actual effect of these factors can be context dependent and vary from one country to another. Therefore, empirical analysis is needed in each case to determine the extent of these effects in each case. The regulators can then choose how to reflect the effect of the unobserved environmental factors into account in the benchmarking and incentive regulation of the utilities.

More importantly, this approach can also help regulators and researchers who recognise the importance of environmental factors but do not have reliable data on these. Assembling of such data is costly in both terms of financial resources and the time and effort required to collect them. The proposed methodology allows these regulators to extract more useful information from other data that are already available to them. The proposed methodology can have wider applications than in the electricity sector. The methodology is also relevant for and can also be used in benchmarking and efficiency analysis and regulation of other types of utility sectors and network industries such as water and gas.

Keywords: spatial econometrics, stochastic frontier models, environmental conditions, electricity distribution networks.