**PRODUCTIVITY GROWTH IN ELECTRICITY AND GAS NETWORKS IN**

**GREAT BRITAIN SINCE PRIVATISATION**

Victor Ajayi, Energy Policy Research Group, University of Cambridge, +44122339700, v.ajayi@jbs.cam.ac.uk

Karim Anaya, Energy Policy Research Group, University of Cambridge, +441223339700,k.anaya@cam.ac.uk

Michael Pollitt, Energy Policy Research Group, University of Cambridge, +441223339615, m.pollitt@jbs.cam.ac.uk

## Overview

This paper evaluates the productivity growth of the electricity and gas networks in Great Britain (GB) since privatisation and the introduction of incentive regulation (around 1990). For the period up until 2013 networks operated under a regulatory regime known as RPI-X. Since 2013 a new regime, known as RIIO, has been put in place. This has emphasised a wider range of outputs, around quality, for energy networks.

## Methods

The paper uses the Malmquist data envelopment analysis (DEA) method with the variable return to scale (VRS) input oriented approach (see Fare et al., 1994; Coelli et al., 2005). We use a new dataset collected with the help of the energy regulator in Great Britain, Ofgem. Our aim is to evaluate the productivity performance of the four regulated energy network sectors during different regulatory review periods.

We perform separate analyses for four network sectors: electricity and gas distribution and electricity and gas transmission. Different models are proposed for each sector with a combination of inputs/outputs and non-quality/quality variables. This work builds on earlier efficiency work on electricity networks (Giannakis et al., 2005; Llorca et al., 2016) and gas networks (Price and Weyman-Jones, 1996; Rossi, 2001; and Jamasb et al., 2008).

In each case we have a base model consisting of a number of physical outputs (including energy delivered) and two inputs (operating expenditure (opex) and capital expenditure (capex)). We report a number of other models (often estimated over shorter periods due to lack of data) which include measures of quality as additional inputs or outputs.

## Results

Electricity Distribution: We find that electricity distribution sector shows TFP grows by 34% over the whole period (1990/91-2016/17) using a base model which does not include any quality variables. Adding quality variables in general improves measured productivity growth.

Gas Distribution: We find that gas distribution has TFP growth of 13.5% over the period 2008/09-2016/17 for the base model. Adding quality variables does not improve measured productivity growth.

Electricity Transmission: We find that electricity transmission shows a large decline in productivity for the period 2000/01-2016/17 of -30% for the base model. Adding quality variables substantially improves performance over this period.

Gas Transmission: We find a significant improvement in productivity for the period 2007/2008-2016/2017 with an increase of 72% for the base model. This is driven by lower capex figures over time. Adding a quality variable improves productivity still further.

In general, the energy networks sector has performed better than the reported performance for the whole market economy in the UK. This performance is hardly surprising given that the productivity growth for the whole economy has also been slow and the headline real revenue reductions from the different energy network price control periods are to some extent consistent with this.

We discuss how the GB energy sector has been exposed to challenging conditions (which regulation has supported) in which to improve productivity since 2005, that may also contribute to low productivity growth. These include falling demand, increased pressure to improve quality of service and the rise of small scale distributed generation.

## Conclusions

The addition of quality variables generally helps improve measured productivity, suggesting that the emphasis we have seen in improving quality in the move from RPI-X to RIIO is justified.

The data was surprisingly difficult to collect given the emphasis that GB energy regulatory agencies (Offer, Ofgas and Ofgem) have had on using data within price controls to undertake benchmarking. The gas data was particularly poor.

As we look forward to the productivity impact of the next regulatory period (RIIO-2), we suggest that attention is paid by Ofgem to improving measures of customer satisfaction, measures of stakeholder engagement and the facilitation of the meeting of environmental targets (such as the addition of distributed generation to electricity distribution networks) and the valuation of the inputs and outputs of network innovation projects.

## References

Coelli, T., Prasada Rao, D.S., O'Donnell, C., Battese, G.E. (2005), *An Introduction to Efficiency and Productivity Analysis.* Spring Science+Business Media, 2nd Edition, New York.

Färe, R., Grosskopf, S., Norris, M., Zang,Z. (1994), ‘Productivity growth, technical progress, and efficiency changes in industrialised countries’, *American Economic Review,* 84(1): 66–83.

Giannakis, D., Jamasb, T. and Pollitt, M., (2005), ‘Benchmarking and incentive regulation of quality of service: an application to the UK electricity distribution networks’, *Energy policy*, 33(17): 2256-2271.

Jamasb, T., Pollitt, M. and Triebs, T. (2008), ‘Productivity and efficiency of US gas transmission companies: A European regulatory perspective’, *Energy Policy*, 36 (9): 3398-3412.

Llorca, M., Orea, L. and Pollitt, M.G., (2016),’Efficiency and environmental factors in the US electricity transmission industry’, *Energy Economics*, *55:*234-246.

Price, C.W. and Weyman-Jones, T., (1996), ‘Malmquist indices of productivity change in the UK gas industry before and after privatization’, *Applied Economics*, 28(1): 29-39.

Rossi, M.A., (2001), ‘Technical change and efficiency measures: the post-privatisation in the gas distribution sector in Argentina’, *Energy Economics*, 23(3): 295-304.