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VERTICAL AND HORIZONTAL ECONOMIES IN THE ELECTRIC UTILITY INDUSTRY: AN INTEGRATED APPROACH

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Overview

A typical network utility is involved in a vertical process in which intermediate outputs are produced at upstream stages and transferred to downstream stages. They are then used, together with other inputs, to obtain the final output, that generally consists in the provision of one or more services to end users. For example, in the electricity industry the power generated is conveyed into the grid and distributed to different categories of customers.

Empirical studies of the cost function of electric utilities traditionally focused on a particular stage of the vertical chain and were mainly aimed at measuring the extent of scale economies (e.g., Christensen and Greene, 1976, for generation and Filippini, 1996, and Yatchew, 2000, for distribution). By letting the cost function to accommodate for more than one output, one can investigate the presence and the extent of multi-product (or horizontal) scope economies too (e.g., Salvanes and Tjotta, 1998, Greer, 2003). Kaserman and Mayo (1991) were the first to apply the latter concept to derive a measure of multi-stage (or vertical) scope economies for a sample of US electric utilities. The methodology developed in such a seminal contribution was subsequently refined (Fraquelli et al., 2005; Gilsdorf, 1994; Kwoka, 2002; Nemoto and Goto, 2004) and applied to other network industries, such as gas (Casarin, 2002) and water (Garcia et al., 2004).

The above cited studies addressed some important policy issues, such as the optimal organization of network industries (for example, they suggested the breakdown of State-owned monopolies in order to promote more competition, or the deverticalization of the industry as an effective way to contrast the dominant position of incumbent firms). In this paper we contribute to this branch of literature by adopting an integrated approach that allows to jointly consider vertical and horizontal technological aspects. Using a sample of 25 Italian municipal electric utilities observed for the period 1994-2000, we estimate a cost function which includes two outputs at the downstream stage (number of industrial users and number of residential users) and one output (generation) at the upstream stage. To the better of our knowledge, only Ivaldi and McCullough (2001), in the context of the railways industry, have estimated a variable cost function allowing to infer simultaneously on the presence of both economies of scope and economies of vertical integration.

Methodology

The empirical strategy focuses on the Composite Cost Function model (PBC) firstly introduced by Pulley and Braunstein (1992). The latter has been widely cited (but, perhaps surprisingly, rarely used in the empirical literature as yet) and recommended as a model which is particularly suitable for the analysis of cost properties of multi-output firms (Piacenza and Vannoni, 2004). After having set several alternative functional forms

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(including the Translog and the Quadratic models) within a general specification (PBG), we carried out LR-type tests in order to select among nested and non-nested models.

Results and conclusions

The econometric results confirm the merits of the PB-type cost functions and show for the median firm the existence of global economies of scope. More interesting, we found evidence of moderate vertical integration gains and of more substantial scope economies at the distribution stage.

In the light of recent regulatory changes in the European electricity industry, which are in favour of a gradual liberalization of the sector, our results have important policy implications. The fact that electric utilities can enjoy cost savings by being active at different vertical stages and by serving different categories of users is not incompatible with vertical de-integration of the sector. The latter remains the optimal strategy as long as the loss of such cost synergies is outweighed by the benefits that restructuring is expected to bring (see Markiewicz et al., 2004, for a discussion): economic efficiency gains due to a change of incentives (i.e. a reduction of X-inefficiencies and of anticompetitive practices, which are both favoured by the presence of large vertically integrated utilities), a reduction of long run costs (i.e. the cost of purchasing power as competition among generators becomes more effective), and, ultimately, a fall in consumer prices.

From a methodological standpoint, our approach, that simultaneously considers both horizontal and vertical aspects of technology and uses a functional form which is particularly apt to undertake such an endeavour, can be easily extended to the study of other network industries, such as gas, water, railways, where firms are active at different stages and provide a set of different services.

References

Casarin A.A. (2002), "On the Efficient Structure of the Downstream Gas Industry. Empirical Evidence from Argentina and Great Britain", mimeo, University of Warwick.

Christensen L.R., Greene W.H. (1976), "Economies of Scale in U.S. Electric Power Generation", Journal of Political Economy, 84, 4, 655-676.

Filippini M. (1996), "Economies of Scale and Utilization in the Swiss Electric Power Distribution Industry", Applied Economics, 28, 543-550.

Fraquelli G., Piacenza M., Vannoni D. (2005), "Cost Savings from Generation and Distribution with an Application to Italian Electric Utilities, Journal of Regulatory Economics, 28:3, 289-308.

Garcia S., Moreaux M., Reynaud A. (2004), "Measuring Economies of Vertical Integration in Network Industries: An Application to the Water Sector", IDEI Working Paper, January.

Gilsdorf K. (1994), "Vertical Integration Efficiencies and Electric Utilities: A Cost Complementarity Perspective", Quarterly Review of Economics and Finance, 34, 261-282.

Greer M.L. (2003) "Can Rural Electric Cooperatives Survive in a Restructured US Electric Market? An Empirical Analysis", Energy Economics, 25, 487-508.

Ivaldi M., McCullough G. (2001), "Density and Integration Effects on Class I U.S. Freight Railroads", Journal of Regulatory Economics, 19(2), 161-182.

Kaserman D. L., Mayo J. W. (1991), "The Measurement of Vertical Economies and the Efficient Structure of the Electric Utility Industry", Journal of Industrial Economics, 5, 483-501.

Kwoka J. E. (2002), "Vertical Economies in Electric Power: Evidence on Integration and Its Alternative", International Journal of Industrial Organization, 20(5), 653-671.

Markiewicz, K., Rose N., Wolfram C. (2004) , "Does Competition Reduce Costs? Assessing the Impact of Regulatory Restructuring on U.S. Electric Generation Efficiency", NBER Working Paper Series, 11001, December.

Nemoto J., Goto M. (2004), "Technological Externalities and Economies of Vertical Integration in the Electric Utility Industry", International Journal of Industrial Organization, 2, 67-81.

Piacenza M., Vannoni D. (2004), "Choosing among Alternative Cost Function Specifications: An Application to Italian Multi-utilities", Economics Letters, 82(3), 410-417.

Pulley L. B., Braunstein Y. M. (1992), “A Composite Cost Function for Multiproduct Firms with an Application to Economies of Scope in Banking”, Review of Economics and Statistics, 74, 221-230.
Salvanes K.G., Tjotta S. (1998), “A Test for Natural Monopoly with Application to Norwegian Electricity Distribution”, Review of Industrial Organization, 13, 669-685.
Vuong Q. H. (1989), “Likelihood Ratio Tests for Model Selection and non-nested Hypotheses”, Econometrica, 57(2), 307-333.
Yatchew A. (2000), “Scale Economies in Electricity Distribution: A Semiparametric Analysis”, Journal of Applied Econometrics, 15, 187-210.