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Cost functions and the electric utility industry. A contribution to the debate on deregulation

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Abstract

This study analyses the main articles that estimate cost functions in the electricity utility industry with a view to studying of the initial arguments for proposing competition and vertical disintegration. The works reviewed here, in general terms, confirm the initial arguments in favour of the deregulation process, mainly, the exhaustion of scale economies for moderate size firms in generation and the condition of natural monopoly for transmission and distribution. However, the savings obtained from undertaking different activities together should be kept in mind when restructuring the sector. On the other hand, the improvements in productivity deriving from the reforms have not translated into reductions in the price of electricity in many countries. These last two results suggest the need for appropriate market regulation for the deregulation process to translate into an improvement in how the sector works and into benefits for consumers. There is still insufficient empirical literature on these issues due to the fact that the process is still ongoing in many countries and more time will have to transpire before sufficient data is available.

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Keywords: Deregulation; Scale economies; Economies of vertical integration; Multiproduct cost functions

1. Introduction

The traditional organisational model for electricity systems assumes that there are major economies of vertical integration between the different stages of supply, giving the operation as a whole, the characteristics of a natural monopoly. The fact that it was a natural monopoly, was the justification for a single company operating all the different stages of supply and, therefore, for its economic regulation through a pricing policy. In this traditional framework, the best-known kinds of regulation are cost plus regulation, which is based on the use of rate of return regulation (ROR), marginal cost pricing and price cap regulation.

This traditional model of integration and regulation first began to be questioned in the 1980s in the industrialised countries. The first criticism was focussed on the lack of incentives for reducing costs, due to the distortions introduced by regulation, and the lack of competition in the market. The second criticism cast doubt on the assumption that the set of activities as a whole were a natural monopoly, although some of the stages do meet all the requirements.

Based on these arguments, there are many vertical disintegration experiences being carried out in countries like UK, New Zealand, Norway, the United States, Chile, Argentina and Spain. The aim of this disintegration is to foster competition in the sector, in the stages of the business where this is feasible. This way, pressure would be brought to bear on prices and costs to reduce them and the regulation failures that are characteristic of an integrated system would be avoided. On the other hand, new incentive-based regulation systems are proposed, in those stages of the business that remain subject to regulation. In this sense, in England, yardstick competition has been used for the regional distribution companies.

These changes of the organisational structure and market mechanism in the electric utilities, however, have had to face a series of difficult problems that have shown that the electricity markets present a set of characteristics that complicate the process of deregulating the sector. These proposals for deregulating[1] the electric

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[1] We use the term deregulation for the reforms related to changes in the organisational structure (disintegration) of electric utility industry and that allow a greater role to market mechanisms.

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utility industry make a series of assumptions concerning the technology and the underlying cost structure in the different stages of the sector. Knowing the industry cost function is fundamental for evaluating and discussing the pros and cons of these proposed reforms.

The objective of this study is to analyse the results of the main studies that have estimated cost functions in the electricity industry for the purpose of studying the validity of the initial arguments for proposing competition and vertical disintegration. We will also see whether the process of reforms has translated into reductions in costs and/or final consumer prices. Fundamentally, we analyse those works that have used the company as the unit of study and which use parametric methods. Parametric methods make it possible to estimate cost functions econometrically and, moreover, they give us an adequate approximations of the underlying production function through the specification of an adequate functional form. Most of these have been carried out in the context of the electricity industry in the United States of America.

This work is structured as follows. In Section 2, we briefly discuss the prior assumptions on which this proposed deregulation is based. We pay special attention to the sources of economies of vertical integration (EVI) in the sector, which is a fundamental element in the debate on deregulating the industry. In the next three sections, we analyse the results of the articles we have reviewed. In Section 3, we consider economies of scale (SE) in the different stages of the industry and the economies of density in network activities. In Section 5, we take an in-depth look at the EVIs between the different stages of the industry. To do this, a detailed study of the work done in the area of multi-output must be done, as the most appropriate framework for studying the economies of joint production. In Section 5, we study the effects of the reforms carried out in some countries on the industry. Finally, we will summarise the most important conclusions. Appendix I presents a detailed summary of the characteristics and the most interesting aspects and results of the main studies done in the single output area (Tables 1 and 2) and the multi-output area (Table 3).

2. The Competitive model and the economies of vertical integration

2.1. The competitive model

Electrical systems encompass a whole set of differentiated activities, all of which are necessary for providing or supplying the final service. These activities are: generation, transmission[2], distribution and supply (marketing) of electricity services to the end-users.[3] As against the traditional integrated model, the competitive model make a series of assumptions concerning the technology and the underlying cost structure in the different stages of the sector and how it works as a whole. In line with Landon (1983) and Joskow (1996), we can summarise these elements as follows:

1. In the generation stage, there is an exhaustion of SE related to market size, making competition among generators possible.
2. There are no major EVI between stages, that is, integration does not lead to significant cost savings, so these would be off-set by improvements in efficiency arising from market competition.
3. Their network characteristics of transmission and distribution make these activities a natural monopoly and should continue to be regulated. These activities are the key component for competition as they must guarantee access to network services without any form of discrimination. Furthermore, transmission must physically ensure the balance of the system and ensure a reliable supply.
4. Metering and billing can be separated from distribution. These activities do not have the characteristics of a natural monopoly and its possible deregulation could be one way of passing on the efficiency gains in generation arising from competition, to the final consumer.

The essential component for there to be competition in the electricity industry is to create a wholesale electricity market for generators and final energy users. Depending on the scope of the market reform, these end users are the following: the distributors that still have captive clients subject to a regulated tariff, the clients that are authorised to go directly to the wholesale market and the marketing agents (which can be the local distributor himself) that intervene as intermediaries between consumers that demand their services and the suppliers of energy.

2.2. The economies of vertical integration

In the following sections, we present empirical results on the assumptions on which this proposed deregulation is based. Here, we briefly discuss the sources of EVI in the sector. The debate on whether there are EVI in the industry is an important one, because, if these exist, they would represent a cost for the processes of reform. This discussion gives us an understanding of the existence of some of the problems that these proposals have faced

[2] Transmission encompasses the management of the high-tension transport network and also the coordination and management of generating capacity, or energy dispatch.

[3] Although traditionally considered as part of distribution, activities related with direct contact with clients like charging and billing can be considered as an independent activity.