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Supply adequacy in electricity markets based on hydro systems—the Brazilian case

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Abstract

This article examines the practical perspective for introducing the deregulation model in systems with a strong predominance of hydroelectric generation, such as the Brazilian electricity system. In order to do this, the article describes the process of establishing short-term prices in systems with such characteristics, concluding that this economic signal is inefficient for stimulating a sustained generation expansion. As a result of this analysis, the article proposes, as a regulatory policy, a competitive process of energy contracting that favors the making of decisions with long-term horizons, ensuring the adequacy of supply, and, additionally, permitting a satisfactory management of market risk by generation and distribution companies.
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Keywords: Hydrothermal systems; Deregulation; Supply adequacy

1. Introduction

In recent decades, the electric energy industry has undergone drastic changes in its organization, seeking, in one way or another, to reach the deregulation paradigm. For deregulation to be effective, some basic principles must be adopted, among which are the opening of the market to new participants, the introduction of competition in generation, with free choice on the part of consumers, and the unbundling of activities that can be developed under a competitive model of monopolistic activities.

International experience has shown cases of success and failure in the deregulation process, the study of these experiences falling outside the scope of this work (Gabriele, 2004; Flatabø et al., 2003; Hesmondhalgh, 2003). Nevertheless, it has been observed that in the face of difficulties encountered in the process of implementing deregulation, the response given by the formulators of regulatory policies has been towards a greater liberalization of the market. In some cases, the problems encountered refer to the exercise of market power (Joskow and Kahn, 2001), while other concern the expansion of generation that does not materialize, as occurred in Brazil (Gabriele, 2004), or that occurred in excess, as in New England (Oren, 2000).

According to economics, prices, upon reflecting short-term equilibrium between supply and demand, create market signals sufficient to provide the expansion of generation. However, in practice, the reality of some restructured systems, mainly those with a hydroelectric base, have not resulted in high enough prices to cover the capacity costs of the generators, providing adequate investment, there being many reasons for this to occur. Among them, it can originate from the suppression of prices through intervention of the regulator, even though they legitimately reflect the scarcity, or from a deficient market structure.

As we will show, in the case of systems with strong dependence on hydroelectric generation, in which the dispatch has as its objective the minimization of the thermoelectric generating cost, the short-term price tends to be low most of the time, not stimulating the

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expansion of generation. Therefore, the establishment of a market structure accompanied by incentive mechanisms are crucial elements for ensuring the adequate remuneration of the existing generation and, consequently, the creation of favorable conditions for the expansion of generation.

Keeping in mind the peculiarities of systems with a strong participation of hydroelectric resources and that the study of the deregulation experiences of systems with these characteristics is relatively scarce, this article has these systems as its focus. Therefore, analyzing the peculiarities of hydroelectric systems, it seeks to evaluate the practical possibilities of these systems moving towards deregulation in a sustained way over the long term with an appropriate expansion of generation. As a reference for this study, the Brazilian electricity sector (BES) is used, keeping in sight the difficulties faced by Brazil in the process of deregulating its electricity industry, which culminated with a severe rationing in 2001, stimulating an intense debate over the feasibility of this system to operate under the deregulation paradigm.

In the next section, an analysis of the deregulation process in BES is presented, highlighting the principal aspects of this restructuring, its evolution, the obstacles encountered in its implementation that did not allow an adequate and sufficiently coherent regulation. In Section 3, the process of short-term pricing in hydrothermal systems is described, concluding with the inadequacy of these prices to sustain the expansion of generation. In Sections 4 and 5, observing the peculiarities of hydrothermal systems, the means for introducing competition in generation and free choice on the part of consumers are described. Section 6 proposes a model for energy trading that makes the deregulation of hydrothermal systems feasible, preserving the adequacy of supply of the system in the long term and ensuring an adequate management of market risk for generators and distribution companies (DISCOs). Finally, in Section 7, the main conclusions of the article are presented.

2. The Brazilian electricity sector towards the deregulation

Fig. 1 illustrates the evolution of the generation capacity and demand of the National Interconnected System (NIS), concluding that in order to guarantee an adequate supply, it is necessary to increase generation by an average of 2500 MW per year for the next 10 years, requiring almost US$4.5 billion for generation. Transmission and distribution require US$1 billion and US$1.1 billion, respectively. Therefore, from this point of view, it is a promising market, especially if we consider that the current per capita consumption is 1.988 kWh/inhabitant, comparatively low with respect

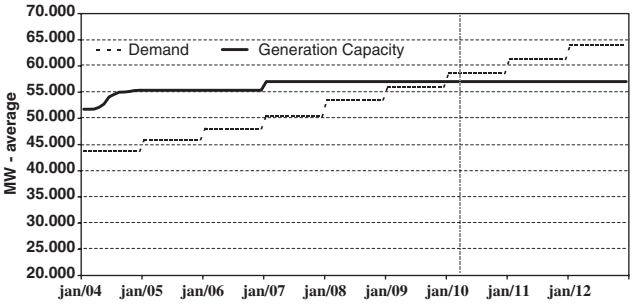

Fig. 1. Balance between generation capacity and demand of the BES.

to the standards of developed countries such as Italy and Spain, whose indices are close to 4.000 kWh/inhabitant.

The BES embarked on a restructuring process in 1995, whose original concept foresaw a reduction of the role of the state-owned companies in the sector, relying, therefore, on private capital to make the expansion of generation feasible. It envisioned competition in generation and freedom for large consumers to choose their suppliers. Thus, it would be indispensable that the rates charged for supplying the final consumers have their energy and transmission components separated in order to avoid obstacles placed by DISCOs to avoid hinder the migration of consumers to the free market. In addition to these measures, it would be necessary to have unbundling of generation, transmission and distribution activities, ensuring free access to the transmission and distribution networks.

Currently, 73% of the electricity production capacity comes from the state-owned companies, the unbundling was partial, competition in generation is practically nonexistent and the consumers that could choose their suppliers did not do so on a large scale because of the existence of cross subsidies that do not stimulate this option.[1] Therefore, it can be concluded that the model designed for the BES sector was not implemented in a complete manner, there being an enormous distance between the concept and the current reality.

Even though having a significant participation of private companies in the expansion of the sector since the beginning of the restructuring process, it was not sufficient to free the system from a severe rationing in 2001. In 2002 alone, the expansion of generation reached 5600 MW, compared to the nearly 1200 MW per year in the period 1991 to 1995. It is worth emphasizing that the first bidding for the construction of hydroelectric plants was only carried out in 1996, when the imbalance between generation capacity and demand for electric energy was already visible, making it

[1]International experience shows that in successful electric energy markets, consumers able to effectively choose their suppliers represent close to 30% of the demand.

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