ASSESSING DYNAMIC EFFECTS OF CAPACITY REMUNERATION MECHANISMS ON GENERATION INVESTMENT: COMPARISON BETWEEN STRATEGIC RESERVE MECHANISM AND CAPACITY MARKET

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Overview

Since power reforms in recent decades, the ability of liberalized markets to provide satisfactory incentives for capacity investments has become a major concern of the energy system. The current energy markets are facing several kinds of market failures which make investment signals too weak to provide optimal incentives for investments in generation capacity and in particular in peak-load technologies (known as missing money problem (Joskow, 2006) (Rodilla & Batlle, 2012)). The energy markets are also prone to a phenomenon of investments cycles – known as boom and bust cycles – due to, among other causes, long lead time in investment, high uncertainty and investors behavior (Ford, 1999). Therefore, new mechanisms, called capacity remuneration mechanisms (e.g. capacity market, strategic reserve mechanism, capacity payment…), have been implemented (or will be) with the objective of providing optimal investments and solving adequacy issue (De Vries, 2007) (Finon & Pignon, 2008).

As several types of capacity remuneration mechanisms have been proposed, the current literature focuses on the assessment and comparison of the different mechanisms' performances with regard to economic criteria (provision of adequate incentives, feasibility, risks of market power abuse, capacity to control investment and avoid cycles, costs, etc.). (Finon & Pignon, 2008) have studied this from a theoretical point of view. Furthermore, as energy market will rarely be in a state of equilibrium, different authors have assessed and modeled the dynamic aspects of these mechanisms and studied the mechanisms' ability to correct the investment cycle issue (Hasani & Hosseini, 2011) (De Vries & Heijnen, 2008) (Cepeda & Finon, 2011) (Eager, 2012). However, capacity market representation can still be improved to reflect possible designs (e.g. centralized or decentralized market) and the strategic reserve mechanism is still rarely studied, though they are two of the main solutions considered and developed in Europe. In addition, comparisons between capacity remuneration mechanisms are limited in the current literature. For instance, as power plants are often decommissioned at a fixed age and mothballing is rarely modeled in existing studies, comparisons of investment and maintenance generation costs under each market design are limited.

The purpose of this paper is to assess the dynamic effects of different capacity remuneration mechanisms, namely the capacity market and the strategic reserve mechanism, and to compare them with regard to the effectiveness and efficiency criteria. To do so, a model of an electricity market which simulates expansion decisions in a liberalized market regime is developed under different market designs.

The comparison will provide insights into the best choices of capacity remuneration mechanism to adopt, in particular in Europe where these two mechanisms are deployed (or will be).

Methods

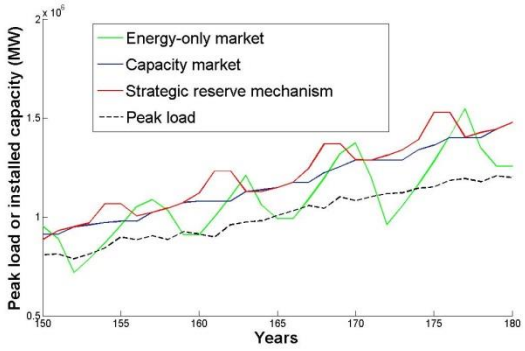
The model has been developed using concepts and tools from system dynamics, which is a branch of control theory applied to economic and management problems. This method is one of the main solutions to study investment issues in electricity markets (e.g. (Ford, 1999), (De Vries & Heijnen, 2008)). Contrary to other methods, it enables the study of dynamic evolution of investments and the more precise representation of market design characteristics and investors behavior.

The model is based upon (Hobbs, 2006) and is expanded to include the energy-only market and the strategic reserve mechanism, while preserving the essential elements of the model (investment decision process, demand uncertainty, revenues calculation…). Moreover, simulation is improved by modelling more accurately power system characteristics (power plant closure decisions and mothballing in particular). This model is run under three market designs: energy-only market, capacity market and strategic reserve mechanism.

The objective of the model is to study to what extent the capacity market and the strategic reserve mechanism can limit investment cycles and to compare these two mechanisms with regard to efficiency (i.e. total costs of generation capacity) and effectiveness (i.e. providing enough capacity to avoid load shedding). Sensitivity analysis is undertaken to assess cases under different scenarios (demand growth, risk aversion, generation costs, etc.)

Results

The results highlight the benefits of deploying capacity remuneration mechanisms to solve the investment cycle issue. By controlling generation investments, the capacity market and the strategic reserve mechanism provide enough capacity to avoid load shedding.



In addition, the results show that the capacity market is more efficient and effective than strategic reserve mechanism. In most scenarios, capacity market reduces investment costs and experiences less load shedding.

Conclusions

To solve investment cycles and potential shortage in energy-only market, capacity remuneration mechanisms should be deployed. Moreover, the capacity market seems to be more effective and efficient than the strategic reserve mechanism. This result has important implications in Europe, where the implementation of capacity remuneration mechanisms should comply with State aids or State intervention guidelines, having as main criteria the effectiveness and efficiency of the mechanism.

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