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A SIMULATION MODEL FOR THE GENERATION ACTIVITY IN THE NEW SPANISH LIBERALIZED ELECTRICITY INDUSTRY

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Overview

Liberalization of the Spanish electricity industry is developed by Law 54/1997 which establishes the creation of an electricity pool as one of the key aspects to increase competition in the industry. Likewise, the binding plans of the investment in new plants are eliminated which supposes that, after liberalization, the generator enterprises assume the economic risks of the new investments.

However, the functioning of the electricity markets based on auctions have been object of important criticisms because their introduction have supposed, in various occasions, the development of reduced competitive behaviours by the generator companies. In the case of Spain, CNSE (2000) establishes that the own industrial structure, characterized by a high horizontal and vertical structure, and transition costs to the competition can limit the correct functioning of the pool. Likewise, it is necessary to consider that the generator enterprises can have, in determined time periods, a positive residual demand. In this sense, the generation capacity of an electricity company can result indispensable to supply the demand with the potential exercise of its market power.

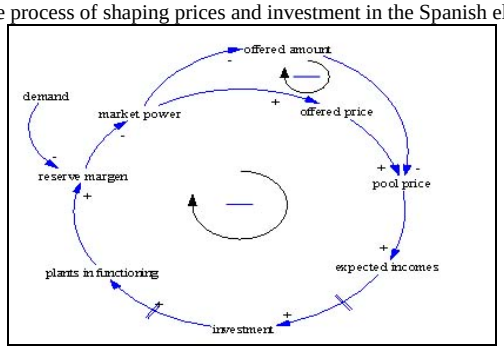
As a consequence of these limitations, the Spanish electricity generation market could suppose investment problems in new generation capacity. In this sense, the spike prices could be shaped as a consequence of the generator´s incentives to withhold generation capacity with the consequent debility of the electricity prices to indicate suitable investment signs.

Methods

We develop a simulation model of the Spanish electricity with System Dynamics. The selection of such a methodology is due to the electricity industry, in the new liberalized context, is characterized by the presence of loops[1], the non existence of linearity and the presence of delays in the relations between the variables. These three characteristics are the fundamental pillars which System Dynamics is based. Moreover, this methodology has been widely used to analyze the cycles of the electricity industry (Ford, 1999; Graham y Eubanks (2003); Olsina, 2005).

In this study, we identified the figure 1 as the basic loop of the model.

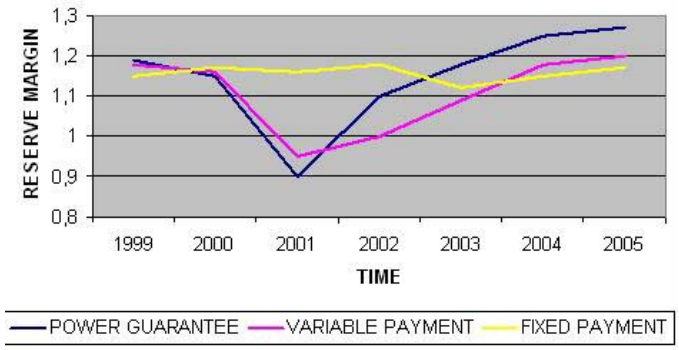
Figure 1. Loop of the process of shaping prices and investment in the Spanish electricity market



These loops show the interrelations between the formation of the pool price and the investment decision. In this sense, an increasing of demand reduces the reserve margin of the system (because the demand increases to the same generator park). This situation allows to increase the market power of the electricity companies because their generation capacity can be indispensable to supply the demand with the consequent increasing of the offered price. This action entails the expectative of a higher expected pool price which incentives the request of construction permits in new plants. After a delay of twelve months, the beginning of the construction of new plants will be increased, and after other twelve months, the number of new plants in functioning will be raised. The increasing of the capacity will allow to rise the reserve margin which will entail a downward adjust in the price.
In the second loop, an alternative strategy is shown when generators have market power. So, they can decide, when demand is increasing, to withhold available generation capacity with the objective of increasing pool price. It will entail more investment incentive and after of the delays commented before, new generation capacity will enter in the system which will supply the initial increasing of demand.

Results
Figure 2 shows the results of the simulations. With the power guarantee, current investment incentive, a reduction of the reserve margin is produced after liberalization as a consequence of the regulatory uncertainty. This tendency is specially relevant in 2001 when reserve margin has a valued lower than 1,1 (minimum value fixed by System Operator to guarantee the electricity supply). However, after 2002, an increasing of the reserve margin is developed with entails a value significantly higher than the wished.
Therefore, we analyze the effects that the application of alternative regulatory policies to incentive the investment. So, the introduction of variable capacity payments, in function with the probability of loss load, shows the presence of oscillations in the system. The motives can be derived from the incentives of companies with horizontal market power to influence in the probability of loss load (Wolak, 1997).

Figure 2. Simulated reserve margin with power guarantee (current investment incentive), variable and fixed capacity payment



Finally, we simulated a fixed capacity payment which coincides with the fixed cost of a new gas combined cycle. The introduction of this new policy entails stability in the system where the simulated reserve margin is always higher than 1,1.

Conclusions

The results of our model establish the presence of investment cycles which increasing the instability of the system. The causes of this problem are derived from the investment incentive because is not suitable due to its amount has been reduced and, besides, there is not guarantee about its maintenance in the long-term.

Therefore, we simulated alternative policies to encourage the investment in a suitable amount and time. Our results indicate that the introduction of a policy of variable capacity payment is not the solution because generator enterprises with market power have incentives to increase the probability of loss load and so the income of this incentive. However, the establishment of a fixed capacity payment, with an amount equivalent to the fixed cost of a new gas combined cycle, allows to stabilize the system by means of the development of a constant investment over time which so eliminates the formation of spike prices.

References

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[1] All simulation model, in System Dynamics, is shaped by one or various loops which show the relationship between the variables, the interaction between them and as such explain the behaviour of the latter, which sometimes is difficult through lineal relationships.