DEFAULT SUPPLY AUCTIONS IN ELECTRICITY MARKETS: CHALLENGES AND PROPOSALS

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Overview

Liberalization processes of electricity markets around the world face many challenges, such as how to supply electricity to different customers at prices consistent with market circumstances. Auction mechanisms have played a salient role in many countries in the effort to match supply and demand as an alternative to other pricing systems, for instance, those based on predictions of expected spot prices during delivery periods. In particular, in deregulated markets, the way to supply electricity to customers whose contracted capacity is small and are not served by alternative suppliers is a question of particular concern to regulatory authorities. The reason is that the bulk of those customers are households and small firms. Providers of last resort, designated by the corresponding public utility commission, must get electricity from somewhere and must supply energy to those customers. Retail electricity prices contain two elements: the cost of supplying electricity and the national "government wedge" (taxes, levies, and other charges to finance public policies). In this paper, we focus on procedures for computing the first element of final electricity prices. We call this element "the cost of energy" element that has two elements: a fixed factor related with contracted capacity and a variable factor related to electricity prices.

One way of setting this variable factor is buying energy for Providers of Last Resort (POLR) by means of Default Supply Auctions (DSA). In these auctions, POLRs buy electricity forward contracts from winning bidders (WB) at prices determined by the specific auction mechanisms (e.g. sealed bid, ascending auctions, descending clock auction (DCA)). Market regulators use DSA-based prices for computing the variable factor of the cost of energy part. When choosing DSA as a method for procuring electricity to POLRs, market administrators assume at least two hypotheses: (1) DSA provides efficient generation resources at competitive prices , and (2) DSA gives agents incentives to engage in hedging activities, presumably using power derivatives. This paper studies the extent to which these two hypotheses are consistent with empirical evidence from actual experiences in Spain and in the State of New Jersey. While most regulatory agencies are required to issue analysis of intended consequences of regulations along with regulations themselves, electricity market regulators rarely did so. Even less common are reports of unintended consequences after actual application of new regulations. In this paper, we present the first try to this analysis with DSA, using data from sixty-four default supply auctions, the most comprehensive empirical evidence available, as far as we know. We document the challenges faced by DSA and propose several alternatives to meet these challenges.

The paper is organized as follows. Section 2 presents the main characteristics of CESUR and PJM-BGS auctions. Section 3 presents measures for distinguishing between hedging and speculation in derivatives markets. We report the empirical analysis in Section 4. In Section 5, we discuss alternative methods for computing the cost of energy part. Section 6 contains conclusions and policy recommendations

Methods

First, we presents an statistical analisys of prices, premiums, price risk and tail risk. Then, we apply panel data regression to explain premiums. Next, we are interested in measuring relative activity of hedgers and speculators in power derivatives markets. Extant literature agrees that key variables to be considered in this regard are daily trading volume and open interest. For a given contract, daily trading volume accounts for its trading activity and reflects movements in speculative trading because this measure includes intra-day positions. Open interest is the number of outstanding contracts at the end of the trading day and captures mostly hedging activity, because, by definition, excludes all intra-day positions . A natural step is to combine both variables to produce a measure of relative trading activity of hedgers and speculators. The volume-to-open-interest ratio, defined as follows:

$$R1(t)=(V(t))/(OI(t)) \qquad (1)$$

Notice that R1 is the ratio of a flow variable (V(t)) with respect to a stock variable (OI(t)) and so is open to criticisms on these grounds. Notice that the behavior of R1(t) depends on the whole past history of the contract up to day t, besides market activity on day t. For that reason, an alternative measure by relating two flow variables, the ratio of volume to absolute change in open interest, defined as:

$$R2(t)=(V(t))/|\Delta OI(t)|) \qquad (2)$$

In which $\Delta OI(t) = OI(t) - OI(t-1)$. Notice that the behavior of R2(t) depends only on market activity on day t. Furthermore, notice that R2(t) discriminates between short-term speculation (day trades), which impact on V(t) but do not impact on □OI(t) , and the newly taken hedging positions (held overnight) which impact equally on V(t) and on □OI(t) . The higher the relative importance of speculative (hedging) demand is, the higher (lower) the value of R1(t) and R2(t). This would imply a positive correlation between R1(t) and R2(t) .

The DSA method for calculating the cost of energy part yields problematic results as empirical evidence suggests. In this section, we talk about other methods for computing this component. We consider that, from the point of view of a consumer, an attractive method should fulfill the following characteristics: (i) consumers should know electricity prices before actual delivery periods; (ii) the cost of energy should be based on market electricity prices if this market is liquid and efficient; (iii) suppliers may want a risk premium, and (iv) an objective criterion should be used to choose between alternative proposals. We consider each of these characteristics in turn. About point (i), the reason for favoring this characteristic is that small consumers rarely have easy access to risk management instruments and so prefer flat price contracts. This stems from consumers' aversion to price volatility and monitoring and controlling amount used. On point (ii), a crucial consideration to take into account is whether wholesale electricity markets are liquid, efficient and transparent enough to give reliable price signals. In this sense, a key point is whether firms with market power exist and are able and willing to exercise this market power. About point (iii), electricity risk premium fluctuates over time, depending on market conditions and structure, among others. Therefore, a transparent (market-based) assessment of this risk premium is desirable.

Regarding point (iv), we posit agents prefer a method that minimizes average payments and the price risk of these payments. As measures of price risk, we consider two alternatives: volatility and semivolatility of the price distribution. These ideas are embodied in the following mean-price risk specification (3):

$$F(P_i, t, k, \sigma) = \frac{1}{N}\sum_{t=1}^{N} P_i(t) + k\alpha_{P_i(t)}$$

Where $P_i(t)$ are actual payments during delivery periods 1 to N under method *i*, *k* measures price risk aversion and α can be: (1) σ, the total volatility of $P_i(t)$, and (2) σ^+, the volatility of $P_i(t)$ values higher than the mean. We posit consumers want to minimize objective function (3). This implies choosing prices (i.e. alternative *i*) minimizing (3). Function (3) has two elements, first, average costs and second, a penalty term increasing with the price risk of costs. This penalty term reflects consumer's desire for certainty as to costs. From the point of view of consumers and for a measure of parameter α, alternative *i* is more desirable than alternative *j* if $F(P_i,t,k,\alpha) < F(P_j,t,k,\alpha)$. Next, we detail several alternative methods we test. For a given period, we compute the two elements in (3), average payments and the price risk of payments. Then, we compute the overall value of (3) and report the number of periods (e.g. months) in which a method produces the lowest value of (3). We consider the following methods:

(i) Method DSA: prices are the ones got in the corresponding auction (CESUR or PJM-BSG). Here, the price risk of payments is zero, because prices are known before actual delivery periods.

(ii) Method SPOT: prices are wholesale spot daily prices. The price risk is the one corresponding to these prices.

(iii) Method M1: prices are swap prices corresponding to the contract available for the monthly delivery period (front contract), recorded on the day in which a DSA takes place. The price risk of payments is zero because consumers know prices before the delivery period.

(iv) Method M1_REC: prices are averages of swap prices of contracts corresponding to monthly delivery periods, during the life of the contract, but excluding the last week of trading. The price risk of payments is zero, for the same reason as in (iii).

(v) Method M1_15: price corresponds to day 15 of swap prices of liquid contracts corresponding to monthly delivery periods. The price risk of payments is zero, as in (iv).

(vi) Method M4_M15: prices are swap prices corresponding to the liquid contract available for monthly delivery periods from M4 to M15, recorded on the day in which a DSA takes place. This method applies to PJM-BGS because is the equivalent portfolio to products auctioned in this auction. The price risk of payments is zero because consumers know prices before the delivery period.

(vii) Method M4_M15_REC: prices are averages of swap prices of contracts M4 to M15 corresponding to consecutive monthly delivery periods, during the life of contracts, but excluding the last week of trading. This method applies to PJM-BGS because is the equivalent portfolio to products auctioned in this auction. The price risk of payments is zero, for the same reason as in (iii).

(viii) Method M4_M15_15: price corresponds to day 15 of swap prices of contracts M4 to M15 corresponding to consecutive monthly delivery periods. This method applies to PJM-BGS because is the equivalent portfolio to products auctioned in this auction. The price risk of payments is zero.

(ix) Method Q1: prices are the average of the swap price corresponding to the liquid contract spanning quarterly delivery periods. We use this method because is based on a contract equivalent to those auctioned in CESUR. The price risk of payments is zero because prices are known before the delivery period.

Results

Data comes from sixty-four auctions, those of CESUR in the Spanish OMEL electricity market from 2007 to 2013, and those of Basic Generation Service auctions (PJM-BGS) in New Jersey's PJM market from 2006 to 2015. Winning bidders got an average yearly premium of 10.15% (CESUR) and 112% (PJM-BGS) over electricity spot prices. Premiums and number of bidders are negatively related. In CESUR, hedging-driven trading in power derivatives markets is predominant around auction dates, but in PJM-BGS, speculation-driven trading prevails. We test several methods as alternative to auctions. In Spain, price risk aversion boosts consumers' preference for auctions over spot prices. New Jersey consumers never choose methods based on auction prices, preferring methods based on based on derivatives contracts or spot prices. In both markets, the higher the price risk aversion the stronger the preference for methods based on derivatives contracts.

Conclusions

Empirical evidence on the economic impact of auctions for last resort supply in electricity markets has not received the attention it deserves so far. In this paper, we study differences between spot prices during delivery periods and prices obtained by winning bidders, and speculation and hedging activities in power derivatives markets in dates near auctions. We posit two hypotheses. First, market administrators and regulators support DSA because they believe that these mechanisms are superior to others in providing efficient generation resources at competitive prices. Second, they think auctions should encourage forward contracting (i.e. hedging), presumably using electricity derivatives.

Using an extensive database of DSA in Spain (CESUR auctions) and in New Jersey (PJM-BSG auctions), we document the following facts. First, winning bidders in CESUR and PJM-BGS obtained an average yearly premium of 10.15% and 112% respectively, in excess of electricity spot prices set in OMEL (Spain) and PJM (New Jersey) markets respectively. These high premiums are difficult to justify in terms of risk management and present a challenge to DSA-based mechanisms. Price risk measures suggest PJM's volatility is double than OMEL's and PJM's tail risk is almost four times higher than OMEL's. However, PJM-BGS's average premium is eleven times higher than CESUR's. Second, we document a negative relationship between the number of bidders in auctions and ex-post premium. This fact suggests that lack of enough competitive pressure may be one reason explaining those premiums. Third, trading activity in power derivatives markets increased significantly in days surrounding CESUR and PJM-BSG auctions. Fourth, in the case of CESUR auctions, hedging-driven strategies seem to be predominant around auction dates, whereas, in the case of PJM-BGS auctions, speculation-driven trading prevails. Therefore, empirical results are consistent with the hypothesis (2) to some extent, but it is unclear whether the high and persistent premium over spot prices enjoyed by winning bidders is consistent with the hypothesis (1).

Therefore, two major challenges to DSA arise, high ex-post premium and significant speculative trading. To meet these challenges, we study several procedures to calculate the cost of energy part. We assume that agents prefer a method that minimizes average payments and the price risk of these payments. As measures of price risk, we consider two alternatives: variance and semivariance of the price distribution. Results differ in Spain and in New Jersey. In Spain, when aversion to price risk is zero, consumers prefer spot-based prices, followed by methods based on derivatives contracts, and in the last place, auction-based methods. Increases in price risk aversion imply stronger preference for methods based on derivatives contracts. Strong price risk aversion boosts consumers' preference for methods based on auctions over methods based on spot prices. Therefore, the degree of price risk aversion is a crucial concern determining consumer's choice in this market. In New Jersey, consumers never choose methods based on auction prices because these prices are high in comparison with spot or derivatives prices. When price risk aversion is zero, consumers prefer methods based on spot prices in one-third of cases and methods based on liquid swap contracts in the remaining two-third of cases. If volatility aversion is one, the corresponding proportions are ten per cent and ninety per cent. Increases in price risk aversion hint at stronger preference for methods based on liquid swap contracts.