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Fitting Demand and Supply Functions in the Spanish Electricity Market: Was there a Change in Bidding Behavior after Regulatory Reform Changes, July 2007

Liberalization (Electricity Sector Act 54/1997) of Spanish Electricity Market (SEM) represented a deep change of the operation of the Spanish electricity system by declaring that electricity should be freely traded and establishing the organized electricity market as the economic basis for the deregulation of the sector. Ten years have gone by since the two main steps were taken in the regulatory system of the market that helped to observe the major changes. The first step was integration of the Spanish and Portuguese networks building a common market the Iberian Electricity Market (MIBEL) and second, the pass of the renewable act that allowed entry of new competitors with support from the regulatory bodies.
My analyses focus on the study of bidding behavior in the day ahead market due to these above mentioned regulatory changes. In order to observe our hypothesis, we define two main periods; before the July 2007 and after. We defined that these two regulatory changes in the Spanish Electricity Market had two effects on bidding behavior. First, it has shifted to the right the intercept of the supply schedule in the quantity axis and second, given the demand schedule it has pushed generators to offer stepper curves.
The analysis of the study covers two main periods:

Period 1: The first period spans from January 1st 2002 until June 30th 2007. The market is organized by OMEL. At the beginning of the market, the government granted Cost of Transition to Competition (CTC) payments to incumbent generators for investment made under previous regulatory regime. The main objectives of granted these payments was due to costs arise when, as a result the alteration of the regulatory framework and in the transition to a competitive system, incumbents find it difficult to recover changes for some of the investments made in the past. The experience has shown that CTC did indeed affect the bidding behavior in the Pool and led to contradictory incentives between generators. Such as incumbent with a generation share in excess of its CTS share (Iberdrola) would intend to have higher wholesale electricity price and conversely, a firm with higher CTC share (Endesa) would tend to favour lower wholesale prices to maximize its CTC revenues (Federico and Vives, 2008).

Period 2: Spans from July 1st 2007 until December 31st 2011: During this period, there are three important market design reforms implemented in the Spanish Electricity Market. The first reform, Iberian wholesale electricity market was the operational launch of the MIBEL on July 2007. The second, enactment of Act 661/2007 was to promote installed capacity of renewable generation. This encourages new agents to enter the market as long as the system operator guarantees free and indiscriminate access to the grid to promote competition. The SR must encourage trading Increasing the share of renewable sources could mitigate collusion and increase efficiency.

Methodology

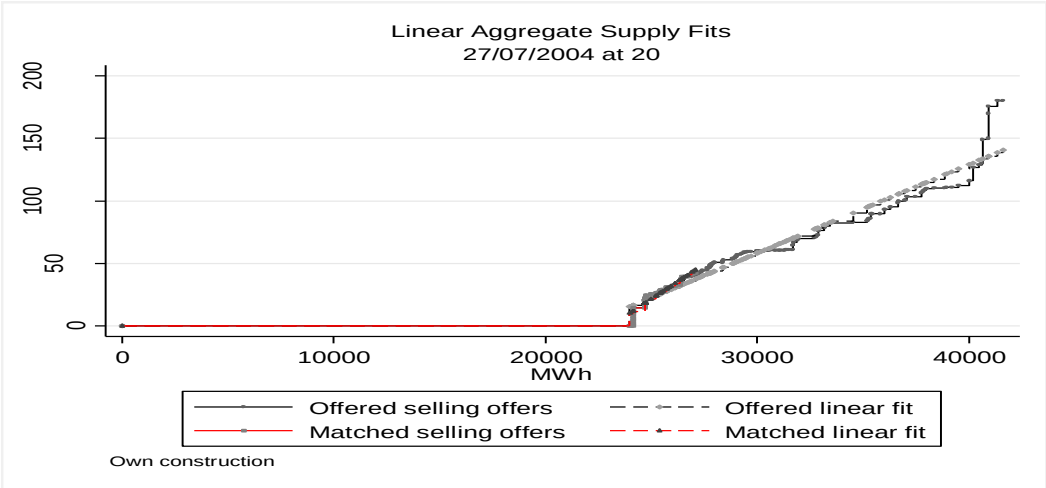
We use hourly data from the Spanish electricity market from January 1st 2002 until December 31st 2011. Thus, we have overall 87,648 hour-observations. Each hour is denoted as h where h=1…., 87,648. For each hour, the market operator constructs aggregate demand and supply schedules with the purchasing and selling offers of the different units. The market operator reveals the identity of the unit after three months.

Our methodology consists of the fitting linear demand and supply functions using data on demand and supply offers submitted to the market operator. It consists of three initial steps that can be applied for periods of regulatory stability.

Step 1: For each hour we fit demand functions. We take as initial values for the intercept the amount of electricity demanded at the maximum price $P = 180.3$ Euro/ MWh, call it $\alpha_h(0)$. This is a measure of the intensity of the demand because it is the lowest possible sale of electricity to final consumers. As for the slope , we take as the initial value the estimated values when a linear demand function is fitted, $b_h(0)$ and $d_h(0) = 1$. Therefore, for each h we obtain three parameters: $\hat{a}(h)$, $\hat{b}(h)\ and\ \hat{d}(h)$.

Step 2 : For each hour h and each large generator g, we fit linear supply function as defined. We take as initial values for the intercept the amount of electricity supplied by generator g at the minimum $P = 0$ Euro/MWh, call it β_0^{gh}. This is a measure of the lowest possible generation of electricity to final consumers to avoid technical problems. As for the slope, we take as initial value the estimated values when a linear supply function is fitted$b_h(0)$ and $d_h(0) = 1$. Therefore, for each h we obtain three parameters: $\hat{a}(h)$, $\hat{b}(h)\ and\ \hat{d}(h)$

Market: Spanish Pool



Step 3: In this step we simulate equilibrium values based on theoretical predictions and compare the simulated values with respect to the observed ones. Meanwhile, we test for differences between simulated values and observed values of the system marginal price and the market clearing quantity. At the end we test the hypothesis of structural

break in the bidding behavior of agents using the Chow test on the following estimated parameters: $(\alpha_{0,h},\ \alpha_{1,h},\ \beta_{0,h},\ \beta_{1,h})$

Preliminary Results

We report empirical results of linear demand and linear supply fits. Table 1 summarizes average offered and matched demand slopes for both period. Table 2 describes average offered and matched R2 , table 3 presents average lengths of the horizontal segments of demand and supply and finally table 4 shows the results of simulate equilibrium values based on theoretical predictions and compare the simulated values with respect to the observed ones.

Table 1

	Period I (2002-2007)	Period II (2007-2011)	
Offered Demand Slopes	-0.184	SP	-0.024
		PT	-0.822
		MI	-0.016
Matched Demand Slopes	-0.886	SP	-0.162
		PT	-4.974
		MI	-0.079
Offered Supply Slopes	0.007	SP	0.005
		PT	0.016
		MI	0.003
Matched Supply Slopes	0.011	SP	0.008
		PT	0.01
		MI	0.05

Table 2

	Period I (2002-2007)	Period II (2007-2011)	
Offered Demand R2	0.760	SP	0.639
		PT	0.472
		MI	0.596
Matched Demand R2	0.704	SP	0.770
		PT	0.882
		MI	0.837
Offered Supply R2	0.926	SP	0.896
		PT	0.472
		MI	0.596
Matched Supply R2	0.838	SP	0.891
		PT	0.743
		MI	0.884

Table 3

	Period I (2002-2007)	Period II (2007-2011)	
Offered Horizontal Demand	17244	SP	21872
		PT	4418
		MI	24750
Matched Horizontal Demand	15784	SP	22984
		PT	4418
		MI	24750
Offered Horizontal Supply	18449	SP	17319
		PT	614
		MI	17263
Matched Horizontal Supply	16441	SP	16388
		PT	610
		MI	15997

Table 4

	Period I (2002-2007)		Period II (2007-2011)		
	Observed Values	Simulated Values		Observed values	Simulated Values
Offered MCQ	23664	23690	SP	25192	25274
			PT	4455	4308
			MI	28615	29102
Matched MCQ	20960	20961	SP	24630	24432
			PT	4675	4550
			MI	26955	26793
Offered SMP	31.15	31.06	SP	22.01	20.45
			PT	60.1	62.92
			MI	24.7	22.59
Matched SMP	39.20	38.53	SP	46.75	48.77
			PT	53.90	56.32
			MI	47.51	50.84