Comments on "Blowing in the Wind: Sequential Markets, Market Power and Arbitrag" by Koichiro Ito and Mar Reguant

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Introduction

Summary

- This papers analyzes bidding behavior of renewable resources in the Spanish electricity market
- Structure of the market is that there is a large bidders and a number of small bidders.
- Market rules allow both day ahead and nearer term transactions, so that a given resource owner has multiple opportunities to trade.
- Theoretical model of day ahead and real-time market.
- Examines bidding behavior of wind farms in sequential markets using Spanish data. Finds a significant day-ahead price premium relative to the hour ahead market.
- Provides explanation of persistent price differentials

Introduction

Market Description

- The Spanish market .
  - Wind capacity has grown significantly in Spain - from 713 MW in 1998 to 22,788 MW in 2012.
  - In some hours wind supplies over one third of Spain's electricity needs.
  - But, wind supply is intermittent.
- The bidders
  - The suppliers consist of both integrated firms and ones who only own some wind farms.
  - The integrated firms will usually own or control other types of generation.
  - The unintegrated firms tend to be smaller fringe firms

Spanish Wind Market

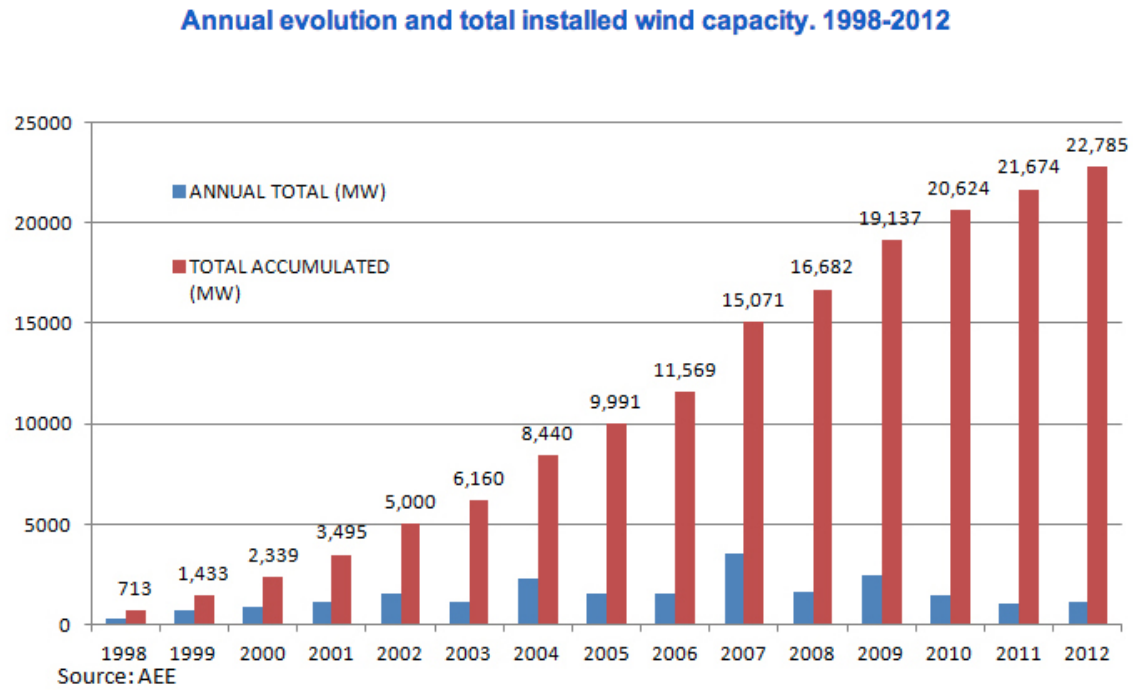


Figure 1: Wind capacity evolution in Spain

This figure shows the annual evolution and total installed wind capacity in Spain from 1998 to 2012

Bidding Process

- Bidders can bid in a day ahead market - which clears at 10 am of the previous day.
- Then at 4 pm the first, of seven, 'intra-day' markets open for the day. This market is for the 28 hours starting at 9 pm.
- Then the second intra-day market then opens for each of 24 hours starting at 1 am.
- The third, fourth, fifth, sixth and seventh intra-day markets follow. Each covers a shorter period than the last.
- The seventh intra-day market is technically the first part of the next day, day ahead market.
- Thus, bidders have more than one opportunity to bid for each hour.

Spanish Wind Market

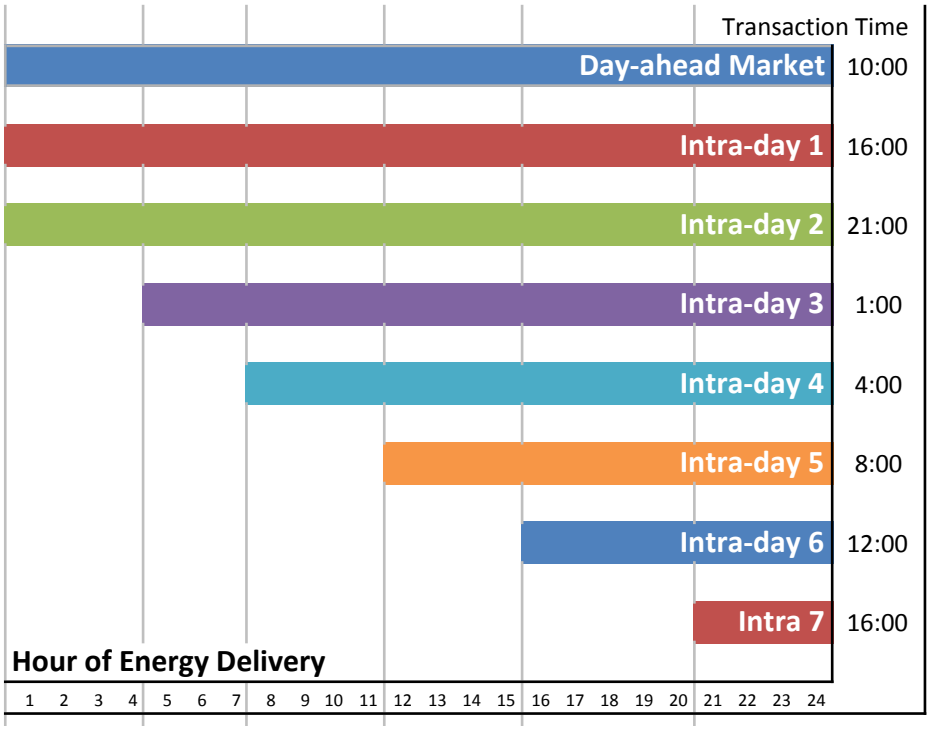


Figure 3: Sequential Markets in the Spanish Electricity Market

This figure describes the timeline of the sequential markets in the Spanish Electricity Market. For a given hour of

Introduction

Bidder Incentives

- As all bidders have 2 or more opportunities to sell for each hour, at least the smaller, price-taking, bidders will want to sell at the highest prices.
- A small bidder who contracted for some amount can decide to abstain from participating in the 2^{nd} market, or offer its capacity again into the 2^{nd} market. The small bidder can offer to purchase supply in the second market if the clearing price is above the costs for some or all of what it had agreed to sell in the 1^{st} market, or increase its supply if the price increases.
- Over-selling is limited by capacity constraints - bidders are not usually allowed to sell short, i.e., more capacity than they control.
- On the other hand, large bidders can influence price will want to adjust amount they offer across markets to maximize yield.

Large Bidder Incentives

- Consider a very simple case, a simple version of what is in the paper in which there is one large firm with zero variable costs, a fixed demand of 1, and a competitive fringe which has a supply schedule of

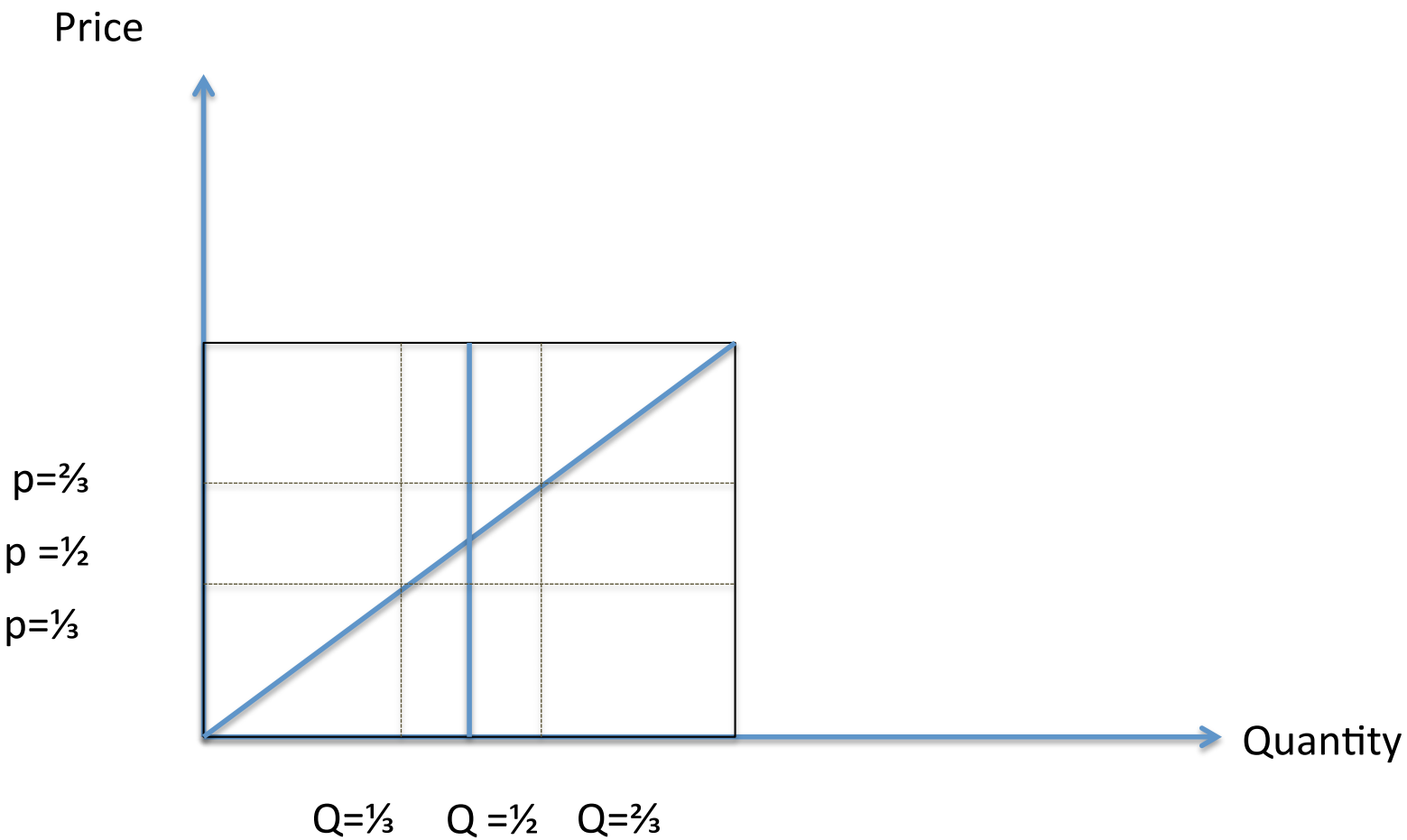
$$q^f = p$$

- Where p is price and q^f is the supply of the fringe. This means demand facing the large firm in market 1 is $Q_1 = 1 - q^f = 1 - p$.
- For simplicity, assume only two markets, and the large firm wants to choose Q_1 and Q_2 to maximize revenues.
- In the one-market equilibrium, the large firm will set $Q = \frac{1}{2}$ and the fringe will sell $q^f = \frac{1}{2}$, and price, $p = \frac{1}{2}$.
- This provides the large firm with profits of $\frac{1}{4}$.

Optimal Bidding by the Large Firm

- Now, suppose there are two markets. Suppose, the large firm has only offer $Q_1 = \frac{1}{3}$ in market 1.
- Then, the fringe would have to supply $q^f = \frac{2}{3}$ to clear, and price would be $p^1 = \frac{2}{3}$.
- In the market 2, the large firm could offer more than $\frac{1}{3}$, say $\frac{2}{3}$.
- The bidding rules are important - if firms can only offer a single price for its quantity, then two market solution is the same as the one market case.
- On the other hand, if each firm can offer a supply function - or a different price for each unit, the large firm can offer $\frac{2}{3}$ for the first $\frac{1}{3}$ units and $\frac{1}{3}$ for the next $\frac{1}{3}$ units.
- The fringe can offer buy back all their first market offers at there costs.
- In this case, the large firm would sell $\frac{1}{3}$ units at a price of $\frac{1}{3}$ and $\frac{1}{3}$ units at a price of $\frac{2}{3}$, for total profits of $\frac{1}{3}$.

Large Firm Options in Simple EG



Data

- The prices in the day ahead market tend to be higher than in the intra-day markets.
- Overbidding occurs by the fringe bidders in the day-ahead market.
- Overbidding for other farther forward markets also occurs.
- But, large bidders do not over bid. This suggests market manipulation - but unclear why based on market structure.

More of the underlying theory

- Most notable and relevant is Weber's Martingale Theorem (Weber (1981)) which states that, in a sequence of auctions for identical objects, expected price in auction t conditional on the information available at the end of auction $(t-1)$ is the realized price in auction $(t-1)$.
- Allaz and Vila (1993) illustrate the value of a quantity commitment in sequential Cournot markets. But, the model may be more like the Coase conjecture.
- Other explanations of price patterns, risk aversion (McAfee and Vincent (1993)) or asymmetric random shocks Bernhardt and Scoones (1993) or Salant (2014)), do not seem to apply here.
- Results are very sensitive to precise bidding rules, and what can happen between 10 am and the delivery hour for each hour.