**Measuring Oligopsony Market Power in Italian Electricity Market**

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## Overview

In this research we analyze the unilateral market power on the demand side in the Italian wholesale electricity market. This is the first attempt in the literature to measure empirically oligopsonistic behavior in a electricity market, using individual consumers bid data.

There may exist two reasons for oligopsonistic behavior. Firstly, given the existence of generators market power on supply side (Wolak, American Economic Review, 2003; Bollino and Polinori, 2012), it is conceivable that consumers could try to achieve lower prices when there is abundance of supply. Secondly, there exists vertical integration in electricity markets, which can result in supply market power mitigation (e.g. Newbery, Energy Journal, 2005; Bushnell et al., American Economic Review, 2008). This implies that there may exist market power on the demand side, too.

Previous estimations in the literature have usually used ex post market data. This has the shortcoming that simultaneity between supply and demand hinders separate estimation of competitive behavior effect and input supply high elasticity effect. (e.g. Bergman and Brännlund, Review of Industrial Organization, 1995). Unfortunately, direct estimation of a production function (Murray, [Review of Economics & Statistics](http://ideas.repec.org/s/tpr/restat.html), 1995) doesn’t solve the problem, as measuring the input value of marginal product is not sufficient to assess oligopolistic market power.

## Methods

The novelty of our research is to estimate residual supply elasticities in an oligopsonistic market structure, using individual bids submitted to the Italian Market Operator (GME) in the day ahead energy market.

We model expected profit-maximizing bidding behavior of consumers in a wholesale electricity market, assuming that demand structure is organized as an oligopsony. Assuming a non-perfectly competitive model on the demand side, consumers determine electricity quantities as a strategy variable to procure the desired electricity from the wholesale electricity and generators determine the electricity supply to the electricity market. The market organizer determines the price by equating supply and demand. That is, consumers observe supply elasticity and it is possible that they make conjectures about other consumers behaviors. We assume that oligopsonists are motivated by profit maximization in all possible market realization, attempting to extract a lower price from suppliers.

We assume that we can measure a consumer’s expected profit maximizing bidding strategy by taking into account all possible residual supply realizations that the consumer has to consider in the market. The consumer behaves in such a way to choose the appropriate price and quantity combinations yielding ex post profit-maximization. As most of the day-ahead markets are typically hourly markets we envisage that a profit-maximizing consumer strategy is to express hourly demand bid curves for the 24 hours of the next day.

Formally, we can describe the profit maximizing behavior as follows. Each consumer j has a production function for selling output (electricity services) xj in the final market at price z using as input the quantity of electricity purchased in the wholesale market qj at price p.

This minimal structure allows to describe profit maximization as:

max πj = zxj - pqj (1)

where xj = fj(qj) is the production function; p= p(Q) is the aggregate supply function of electricity in the wholesale market; Q=[qj+DOj] is the sum of the demand of consumer j and the demand of all other participants except j. Thus, the residual supply for consumer j is SRj(q)=p(Q-DOj). The first order conditions for consumer j are:

∂πj / ∂qj = z ∂fj/∂qj - ∂SRjp/∂qj = 0 (2)

∂πj / ∂qj = z ∂fj/∂qj – [p+∂p/∂qj × qj] = 0 (3)

which can be rearranged as:

[(z ∂fj/∂qj)-p] / p = (1/εSRj) (4)

where εSRj denotes the elasticity of the residual supply facing consumer j and, therefore, the inverse of this elasticity is a Lerner-type measure of the oligopsonist mark-down over the WTP, i.e. a measure of the unilateral market power of consumer j. The elasticity of the residual supply incorporates all relevant information to characterize how a change in consumer *j*’s quantity would change market price by affecting other consumers behavior.

In our analysis we take into account the main 5 operators (out of a total of 221 listed operators) who express about half of market demand. We measure oligopsony market power as a result of individual profit maximizing behavior, computing the hourly price elasticity of the ex post residual supply curve for each consumer, which is the difference between total supply and demand of all other consumers. Obviously this direct computation avoids the simultaneity problem.

In particular, we compute arc elasticity around the equilibrium market price for each hour. Recall that in Italy market regulation sets a unique system marginal price (USMP) for all consumer. This latter is the unique price paid by all consumers, which is set as the average of different zonal supply prices received by generators, arising from market segmentation when there is transmission congestion. This simplifies our analysis because market outcomes on the demand side are insulated from transmission line congestion issues.

We interpret the inverse of the hourly *ex post* residual supply elasticity as a Lerner-type index, i.e. a measure of the potential ability which each consumer possesses to exploit its oligopsonistic market power in order to lower the hourly price below its marginal willingness to pay (WTP) the last megawatt-hour (MWh) purchased in the Italian day ahead energy market.

We think that market power of oligopsonistic consumers may be exercised only in some periods of the day in which supply is particularly abundant. In the Italian market this may happen in two distinct cases when there is: i) slackness in the market, typically during off-peak hours; ii) plentiful supply of renewable energy sources during daytime peak hours, typically displacing thermal generation. If in these periods supply structure is characterized by a positive supply elasticity (i.e. increasing marginal costs) then a consumer can attempt to reap better price behaving as oligopsonist.

## Results

We analyze the Lerner index for all 8760 hours in each year in the period 2010-2011. Our results show that there exists oligopsonistic market power which can be empirically measured on average around 3.8% in 2010 and 5.3% in 2011 (all values are statistically significant). This means that Italian consumers are able to mark down their willingness to pay for electricity on average 3-5%% with respect to market price. Results are quantitatively similar for all 5 main consumers. In addition we find that individual consumers Lerner index values are higher during working days peak hours, in the 4.5% -5% range in 2010 and 7.5% - 10% in 2011. It is interesting that oligopsony power tends to be higher in 2011 than 2010 during peak hours: this can be explained with the threefold increase of renewable supply (mainly PV) that occurred in the same period, resulting in abundant supply with priority dispatching. This situation favors consumers to exercise market power.

## Conclusions

In conclusion our analysis shows that consumers definitely bid lower prices below their willingness to pay and that this behavior, based on significantly elastic residual supply, is more likely to occur during weekdays peak hours. Futures lines of research are to test for collusive behavior, analyzing consumers conjectural variations and to perform a similar analysis taking into account explicitly the problem of transmission line congestion.

## References

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