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ABSTRACT

The market power analysis in electricity market is relevant for understanding the competitive development of the industry's restructuring and the liberalization process. The paper analyzes the market power exercised by power generators in the Italian wholesale electricity market. Following the approach of Wolak (2003, 2009), the extent of market power is measured using the Lerner index computed as the inverse of arc elasticity of the residual demand faced by each Cournot competitors. Then, the market supply curves have been adjusted to entail market power effects and the new market resolutions were derived. The new equilibrium prices are the competitive ones and represent the market clearing price that would have been if the electricity market was competitive and the effects of unilateral market power were removed.

JEL classification: D43

Keywords: Market Power, Residual demand, Lerner Index, Transmission Congestion

1. INTRODUCTION

The worldwide wave of power system restructuring led in Italy to the Electricity Market (IPEX) which started in April of 2004 and on 1st January 2005, the market was opened to full demand-side participation. Electricity Market has become a physical pool market where hourly blocks of electricity are traded. In Italy, the IPEX has been organized as a day-ahead market (MGP), intra-day market (MI) and ancillary service market (MSD), similar to other countries¹.

The main factors designing the structure and the degree of efficiency in the electricity market are essentially two: a technical factor, given by transmission capacity of the power grid, and an economic factor, given by the degree of market competition. Nevertheless, the Italian electricity market, as reported by Bigerna et al. (2015), recorded transmission congestions and its structure is far from being perfectly competitive: suppliers are able to exercise market power bidding prices higher than their marginal costs (see Bosco et al., 2012).

In this work we use hourly data of the Day-Ahead-Market for 2013 and 2014 and simulate the hourly market equilibrium prices in a virtual competitive market where operators' market power had been removed. The aim is finding how much the theoretical competitive prices are far from the actual recorded market clearing price.

In the new open-market context the typical activities (generation, transmission and distribution of electricity) of this system have been carried out by separate entities. Electricity generation became a liberalized activity while transmission has been preserved as a regulated activity given that electricity is an instantaneous commodity that is expensive to store. Therefore, currently electricity generation must match the demand at each instant, responding to seasonal patterns and instantaneous

¹ The MGP is a wholesale electricity market, where hourly blocks of electricity are negotiated for the next day and where prices, volumes, injection and withdrawal schedules are defined for the next day. This is a non-compulsory pool administrated by a market operator, in Italian Gestore del Mercato Elettrico (GME).

The MI market enable participants to update their demand bids and supply offers, as well as their commercial positions, with a frequency similar to the one of continuous trading, taking into account variations of power plants and consumption requirements.

MSD is the market where Terna - as Transmission System Operator - procures the resources needed to manage, operate, monitor and control the power system (relief of intra-zonal congestions, creation of energy reserve, real-time balancing).

fluctuations. In order to satisfy this fluctuating demand, electric utilities are forced to maintain different generation assets (Muratori et al. 2014). Base-load electricity is provided by extremely reliable, efficient power plants (such as plants hydroelectric and coal power plants), which take a long time to start up and are designed to work at their nominal capacity with a small degree of flexibility. On the other hand, peak power plants run only when there is a high demand for electricity, they can be started up quickly and are flexible enough to match rapid fluctuations in the demand. Peak plants are less efficient (compared to base-load power plants) due to the high cost of the underutilization results in significant maintenance and capital recovery costs.

The high complexity of the power system and the need of instantaneously coordination between the injection and withdrawal programs made imperative to identify a central coordinating entity, in charge of monitoring and guaranteeing the continuity and quality of the service under maximum security conditions. This center (Transmission System Operator) ensures that generation matches consumption at any time and that frequency and voltage do not deviate from the transmission limits on the grids and the dynamic constraints on power plants. For security management reasons, TSO divided the national grid into zones and the configuration of these zones depends on how the electricity flows are managed along the peninsula².

The structure of electricity market reflects the transmission constraints, as it is divided into portions of transmission grids (zones) where there are physical limits to transmission of electricity to/from the corresponding neighboring zones.

The day-ahead market is based on an implicit-auction model and hosts most of the transactions of purchase and sale of electricity. Participants may submit bids/offers where they specify the volume and the maximum/minimum price at which they are willing to purchase/sell in each hour of the day.

² These zones may be summarized as follows:

- 6 geographical zones (central-northern Italy, northern, central-southern Italy, southern Italy, Sicily and Sardinia);
- 8 neighboring countries' virtual zones (France, Switzerland, Austria, Slovenia, BSP, Corsica, Corsica AC and Greece);
- 4 national virtual zones representing constrained zones, i.e. zones consisting only of generating units, whose interconnection capacity with the grid is lower than their installed capacity.

TSO schedules the withdrawal and injection programs ranking the bids and the offers under the economic merit-order criterion given the transmission limits between zones. The ordered offers are then aggregated to form the hourly market supply and demand curves and the intersection between them determine the clearing price and the volume traded.

If the flows on the grid resulting from the schedules do not violate any transmission limit, the clearing price is a single one in all the zones and equal to P^* . Accepted offers are those having a selling price not higher than P^* and accepted bids are those having a purchasing price not lower than P^* .

If at least one limit is violated, the national market is split in two zones:

- one exporting zone, including all the zones upstream of the constraint, and
- one importing zone, including all the zones downstream of the constraint.
- all accepted supply offers are valued at the clearing price of the zone to which they belong. This price is determined, for each hour, by the intersection between the demand curve and the supply curve and is different from one zone to the other when transmission limits are saturated;
- the accepted demand bids pertaining to withdrawal points belonging to geographical zones are valued at the national single price (Prezzo Unico Nazionale: PUN), which is equal to the average of zonal prices weighted for zonal consumption.

If additional transmission limits within each market zone are violated, the market splitting process is repeated also within this zone until obtaining a result consistent with grid constraints. The above described market splitting mechanism represents a non-discriminatory implicit auction for the assignment of transmission rights.

Given the restructuring process involving the electricity industry, the analysis of market power (that occurs when a firm is able to affect prices because of concentration in a single step of the supply chain) has become a central issue to understand the effectiveness of the liberalization process. The exercise of market power has important implications in terms of efficiency, as described by Borenstein et al (2002). In the short-run, for example, if a supplier exercising market power restricts

its output in order to raise prices, productive efficiency can be compromised by smaller players expanding generation from more expensive plants in response to the higher prices. In the medium and in the long-run, when demand is more elastic, market power may have an impact on the level of consumption and creates allocative inefficiencies. In particular, the marginal value of the next unit of consumption will be in excess of the marginal cost of some units of withheld supply. Market power can increase the level of congestion on a network, thereby affecting efficiency and reliability of the system (Cardel et al., 1997). Finally, market power can influence long-term decisions: an increase in power prices should ideally be interpreted as a signal for investors that new capacity is needed, but this may not be the case if market power is being exercised (dynamic inefficiency).

This paper is organized as follows: section 2 describes the frequencies of market segmentation and the main configuration when Italy is split in two markets. In the third section the theoretical model underlying the measurement of market power is explained while in Section 4 shows and discusses the Lerner indexes of the main suppliers, (representing their market power) the volumes and the equilibrium prices that would occur if IPEX market was perfectly competitive while in Section 5 the main conclusions are derived.

2. DATA

Data pertain the day-ahead market and refers to the hourly bids and offers recorded in the IPEX in the 2013 and 2014 and aggregated in quarterly datasets. In all the eight datasets, offers (representing the supply side of the electricity market) roughly account for the 70 % of the total sample average and they range between 924318 and 1065778 while bid observations range from 259614 to 369661.

2.1 The Italian Market Segmentation

The Italian market is divided into six physical national zones: North, Center-North, Center-South, South, Sicily and Sardinia. When there is a congestion market is segmented in a variable number of zones ranging from two to four during the 2013 and the 2014.

The number of zones which Italian market was split in varies throughout the period. Single Market occurred for 555 hours in 2013 and 716 hours in 2014. Segmentation in five zones (recorded for 2004-2007 in Bigerna et al., 2015) disappeared, while two-market segmentation increased their occurrence becoming the most common market division³. Three-market segmentation appeared the 22% and the 33% of times in 2013 and 2014 respectively, while the frequency of four-market segmentation reduced from 631 hours in 2013 to just 97 hours in 2014.

Tab 1: Frequency of Market Segmentation, 2013.

Hour	Single Market	2 Market	3 Market	4 Market
1	29	274	59	3
2	35	273	55	2
3	37	273	54	1
4	40	277	47	1
5	44	267	53	1
6	50	263	51	1
7	34	269	60	2
8	20	281	51	13
9	15	234	69	47
10	17	202	80	66
11	14	178	103	70
12	19	146	132	68
13	23	159	129	54
14	26	156	140	43
15	24	178	116	47
16	27	173	111	54
17	19	230	77	39
18	18	265	53	29
19	11	277	53	24
20	9	248	92	16
21	5	220	126	14
22	2	260	90	13
23	16	239	98	12
24	21	271	61	11
Total	555	5614	1960	631
%	6.3%	64.1%	22.4%	7.2%

³ For a comparison with the frequency recorded in 2011, see D'Errico and Bollino (2015). Segmentation in two markets significantly increase their relative frequency, passing from 47% in 2011 to 64% in 2013 and 57% in 2014.

Tab 2: Frequency of Market Segmentation, 2014.

Hour	Single Market	2 Market	3 Market	4 Market
1	38	216	105	6
2	55	234	70	6
3	65	239	55	6
4	69	233	57	6
5	68	237	56	4
6	63	235	63	4
7	53	239	70	3
8	28	232	105	
9	26	201	137	1
10	28	196	140	1
11	19	172	173	1
12	21	156	187	1
13	15	169	180	1
14	22	175	168	
15	18	163	183	1
16	18	174	172	1
17	15	210	140	
18	22	237	106	
19	12	240	111	2
20	8	215	137	5
21	9	200	146	10
22	6	207	142	10
23	14	209	125	17
24	24	231	98	11
Total	716	5021	2926	97
%	8.2%	57.3%	33.4%	1.1%

In this paper, the computation of Lerner index pertains the hours in which there was no congestion or the market was split in two zones. When single market occurs the price resulting from the market resolution is the same as the PUN and the order in which the bid are ranked reflects the economic merit order. On the other hand, when the market is split in two zones, we are able to reconstruct the uncongested situation. Given the shape of Italy, congestion is clearly determined and follows the North-South direction⁴, then it is possible to compute the virtual clearing price as the two zones were not separated by the line congestion⁵.

⁴ Given the shape of the country, the first five zones are adjacent along the North-South direction, the direction of congestion is univocally determined because power flows in the same direction from North to South.

⁵ Following Bigerna et al., (2015) the limited production plants (which are essentially small generation islands with structural line transmission constraints) are not considered.

Focusing on two-market segmentation, the most prominent aggregation scheme is given by the Sicily as a market separate from the rest of the Italy; it appeared roughly the 84% of times in 2013 raising until the 93% in 2014. Moreover, during these hours just the 1.86% of times Sicily is an exported zone where its zonal price is lower than PUN. The North is separated from the rest of the Italy did not occur often, roughly in just 100 hours of the year and it is an exporting zone just for 25 hours.

Tab 3: Segmentation in two market, the different configuration. 2013.

Hour	Northern	Sicilia	Sardinia	CenterNorthern-Northern	CenterNorthern-Northern-Sardinia-CenterSouthern
1	5	255	1	11	2
2	1	249	0	23	0
3	2	248	0	23	0
4	2	250	0	25	0
5	0	244	0	23	0
6	0	238	0	25	0
7	12	255	0	3	0
8	5	270	1	3	2
9	0	222	1	4	7
10	2	188	2	2	8
11	4	155	1	9	9
12	6	118	0	13	9
13	15	127	0	8	9
14	22	122	0	8	4
15	15	139	0	14	10
16	2	158	0	8	5
17	3	215	0	6	6
18	2	255	0	3	5
19	1	273	0	2	1
20	2	242	1	2	1
21	3	216	0	0	1
22	6	252	0	1	1
23	3	235	1	0	0
24	1	258	2	8	2
Total	114	5184	10	224	82
%	1.8%	83.8%	0.1%	2.0%	0.7%

Tab 4: Segmentation in two market, the different configuration. 2014.

Hour	Northern	Sicilia	Sardinia	CenterNorthern-Northern	CenterNorthern-Northern-Sardinia-CenterSouthern
1	1	213	1	1	1
2	5	227	1	1	0
3	3	233	0	3	1
4	2	229	0	2	2
5	5	229	0	3	2
6	2	227	1	5	1
7	10	226	0	3	3
8	1	230	0	1	2
9	4	193	2	2	4
10	8	187	0	1	11
11	10	159	0	3	11
12	14	136	0	6	12
13	15	151	0	3	10
14	28	145	0	2	7
15	21	139	0	3	11
16	13	156	0	5	18
17	10	196	1	3	20
18	4	233	0	0	5
19	3	236	1	0	2
20	7	207	1	0	0
21	3	197	0	0	0
22	0	207	0	0	0
23	2	205	2	0	1
24	0	229	2	0	2
Total	171	4790	12	47	126
%	3%	93%	0%	1%	2%

Comparing these figures with the findings reported in Bigerna et al. (2015), it emerged that Sardinia drastically reduced its frequency as separate market and that depends on the increase in transmission capacity due to the new submarine cable (SAPEI) connecting Sardinia with the Center-South.

When congestions occur the accepted offers do not reflect the economic merit order. Some bids (pertaining the importing zones) with higher price may be included in the market supply while more efficient plants (bidding lower prices and belonging to the exported zone) are excluded from the injection schedules and can not sell their

production to the importing zones, as they can not violate the transmission constraints. In order to get rid of the effects of transmission constraints from the equilibrium market, we constructed a new supply curve where the offers are ordered according to the increasing price, while the demand curve is constructed aggregating the bids in a decreasing order price.

The volumes and the clearing prices derived from the intersection of the two curves represent the market equilibrium purged of the effect of congestions. This procedure has been executed for all the hours in which national market has been split in two zones (roughly the 60% of the hours).

With this method the efficient plants (belonging to the exporting zone) having effective marginal costs that actually were rejected from the grid, are reinserted in order to form the new supply curve. Offers pertaining exporting zone with price lower than PUN are reinserted while offers related to the import zone with price higher than PUN are excluded from the new order.

Given the hourly new supply curves, where the rank depends just on the economic merit order, we computed the residual demand faced by the companies of interest. The chosen firms differ in market share.

Tab 5: Share of main Suppliers - Single Market, by Quarter, 2013.

Quarter	A2A	EDISON	ENEL	ENI	GDF SUEZ	GSE	SORGENIA
1	2.83	4.34	21.74	0.32	2.06	17.25	2.48
2	3.32	4.83	24.63	0.09	2.12	23.53	1.46
3	3.63	4.27	16.59	0.08	1.15	19.75	1.63
4	2.98	4.28	8.20	0.28	1.69	15.97	1.82
Average	3.19	4.43	17.79	0.19	1.76	19.12	1.85

Tab 6: Share of main Suppliers - Two-Market, by Quarter, 2013.

Quarter	A2A	EDISON	ENEL	ENI	GDF SUEZ	GSE	SORGENIA
1	3.86	4.72	21.26	0.47	2.28	14.13	2.86
2	3.65	4.74	24.63	0.12	2.18	20.18	1.47
3	4.00	4.61	16.50	0.10	1.30	17.40	1.68
4	3.82	4.55	8.89	0.20	1.77	13.45	2.08
Average	3.83	4.66	17.82	0.22	1.88	16.29	2.02

Tab 7: Share of main Suppliers - Single Market, by Quarter, 2014.

Quarter	A2A	EDISON	ENEL	ENI	GDF SUEZ	GSE	SORGENIA
1	4.15	4.66	9.77	0.05	1.46	15.18	1.33
2	3.24	6.72	13.92	0.03	1.50	20.08	1.26
3	2.55	7.24	9.46	0.02	2.26	17.55	1.25
4	3.01	6.46	5.93	0.11	1.93	13.69	1.73
Average	3.24	6.27	9.77	0.05	1.79	16.62	1.39

Tab 8: Share of main Suppliers - Two-Market, by Quarter, 2014.

Quarter	A2A	EDISON	ENEL	ENI	GDF SUEZ	GSE	SORGENIA
1	4.26	4.67	9.83	0.06	1.52	14.93	1.34
2	3.27	6.75	13.87	0.03	1.55	19.88	1.25
3	2.57	7.24	9.58	0.02	2.23	17.63	1.24
4	3.01	6.47	5.91	0.11	1.92	13.72	1.79
Average	3.28	6.28	9.80	0.06	1.81	16.54	1.41

Enel, the former state-owned monopolist, had a market close to 18% (both, in 2013 and 2014). GSE, the state-owned company promoting renewable energy sources (RES) in Italy, held similar shares and in 2013 GSE reported the higher share (near to 19%) that is ascribable to the fact that GSE resells electricity generated by renewable-energy sources which dispatching priority is recognized to. Then, all the GSE's bids can be deemed as offers with price equal zero and, given their economic merit order, the GSE's bids are always accepted in the injection schedules.

The remaining firms whose the Lerner index was computed are A2A, Edison, Eni, Gdf Suez and Sorgenia. Although the Eni's share would lead to deem that company operate as a price-taker firm, its history and its degree of integration across the energy industry activities, legitimate the choice to include Eni in the analysis of market power.

3. THEORETICAL MODEL

Different methodologies have been proposed to measure market power: these include concentration measures, the competitive benchmark approach and the NEIO approach, models of optimizing behavior and direct measures of unilateral market power.

The first approach to measuring market power focuses on observable dimensions of the industry structure such as market shares and related indices like the Herfindahl-Hirschman index (HHI)⁶. This is given by the sum of squares of the market shares of the firms in an industry. However, this concentration measure is considered inappropriate to assess the level of market power in the electricity industry because it ignores key factors such as demand elasticity, transmission constraints, forward contracts and the inter-temporal variation in the exercise of market power. The largest suppliers may in fact exercise market power by withholding production once competitive firms had reached their full output generation capacity. As a result, the concentration of the market and the HHI index would reduce as the main firm was decreasing its market shares by withholding production, but the resulting equilibrium market-clearing price would raise above its competitive levels⁷.

An alternative way to measure market power is based on the comparison between the actual prices and the simulated competitive benchmark price. This approach relies on simulation models to derive the competitive benchmark and provides an ex post measure of the mark-up. The comparison is often made through the Lerner index (LI):

$$LI = \frac{p - MC}{p} \quad (1)$$

The index would be close to zero in competitive markets and to one if significant market power is exercised⁸.

⁶ The Herfindahl- Hirschman Index (HHI) ranges from zero (representing a perfect competitive market) to one (pertaining a monopolist market).

⁷ This strategic behavior was adopted by Borenstein et al. (2002) in order the market power of main suppliers in the California electricity market.

⁸ This is an approach taken by Sweeting (2007), Borenstein et al. (2002) and Wolfram (1999).

The weakness of this approach is that inaccurate simulation models could produce erroneous estimates of marginal costs and competitive prices by ignoring commitment costs, ramping/must-run/transmission constraints and reliability.

In the 1980s the New Empirical Industrial Organization (NEIO) developed a new empirical approach to measure market power (Bresnahan, 1989). The empirical models developed in NEIO literature estimate the level of market power exercised in an industry exploiting both the information given by empirical data (market-clearing prices and quantities) and the theoretical assumptions concerning the functional form of demand and cost curves, the type of strategic interaction among firms and on their expected profit maximizing behavior. Despite the great number of applications these models have the problem that their estimates of market power crucially depend on the assumption of the strategic interaction among firms and on the assumed functional form of demand and cost curves⁹.

If bids of the wholesale markets are available, a more direct approach is the optimizing behavior model that makes possible deriving a measure of market power in electricity markets without assuming the specific functional form for the demand and the marginal cost curve. The relationship between price and quantity bid by each firm is analyzed through the response of all the other competitors. Supporting for this interpretation is provided by market rules in Italy, which do not restrict the ability of operators to submit bids. Accordingly, suppliers and purchaser can submit bids any time before market closure and revise bids freely for the entire daily span as many times as they deem necessary to adjust their injection and withdrawal programs.

⁹ Relying on simulated data, Corts (1999) shows that a static oligopoly model may return biased estimates. If firms' underlying behavior does not come from a non-collusive static game but it results from a game of dynamic or tacit collusion, their first order conditions will differ from the ones predicted by the static NEIO models.

3.1 Model of optimizing behavior

We assume that the model underlying the electricity market is an oligopolistic Cournot model: for any period h , firm chooses the bidding strategy maximizing its profit function, given the bids submitted by all other competitors¹⁰.

On the supply side the profit function faced by a generator is defined as:

$$\Pi_{ih}(p_{ih}) = RD_{ih}(p_h)(p_h - MC_h(q_{ih})) - F_i \quad (2)$$

where $RD_{ih}(p_h)$ is the residual demand faced by the generator i in period h , while $MC_i(q_i)$ is the marginal cost of output level q_i and F_i is the fixed costs¹¹.

Assuming the generator acts unilaterally given the bids placed by other competitors, in any load period his goal is to find the quantity q_i that maximizes the profit. The best response bidding quantity is given by the output level at which the marginal revenue associated with that period's residual demand equals the firm's short-run marginal cost.¹²

Regardless of the actual residual demand realization in a given hour, a generator maximizing profits unilaterally would face the following first order condition:

$$\frac{p_h - MC_{ih}}{p_h} = \frac{1}{\varepsilon_{ih}} \quad (3)$$

where p_h is the market-clearing price in hour h , MC_{ih} is the marginal cost of generation of firm i in hour h , and ε_{ih} is the absolute value of the elasticity of the residual demand curve facing firm i in hour h , evaluated at p_h . This empirical measure represents the amount by which each firm is able to raise prices above its marginal cost of generation in a given hour. The right hand side of the previous

¹⁰ The number of periods in which bids can differ, in a given day, varies by market and is defined by market rules; for example, in the IPEX market participants can submit different bids on every hour of the day.

¹¹Lo Prete (2015) and Wolak (2000) proposed a variation of profit function that entails for each period i the forward contract quantity and their corresponding price held by generator.

¹² Wolak estimates a model of best-response bidding to recover the marginal cost function of the largest Australian power generator.

formula can be used to estimate an empirical “Lerner index” and the firm’s unilateral incentive to exercise unilateral market power.

Since the empirical residual demand is a step function, computing its elasticity at a given point requires a finite difference approach; we use the arc elasticity whose inverse can be considered the empirical Lerner Index:

$$\varepsilon_{ih} = \frac{RD_{ih}(P_h(\text{high})) - RD_{ih}(P_h(\text{low}))}{P_h(\text{high}) - P_h(\text{low})} \cdot \frac{RD_{ih}(P_h(\text{high})) + RD_{ih}(P_h(\text{low}))}{P_h(\text{high}) + P_h(\text{low})} \quad (4)$$

where $p_h(\text{high})$ and $p_h(\text{low})$ are the respectively the prices below and above p_h , while $RD_{ih}(p_h(\text{high}))$ and $RD_{ih}(p_h(\text{low}))$ are the quantities associated with those prices on the residual demand curve. The range where the arc elasticity was computed $[p_h(\text{low}), p_h(\text{high})]$ includes market-clearing price.

Following Wolak (2003) we compute the Lerner index as the inverse of residual demand elasticity for each suppliers of interest.

3.2 The competitive Fringe

We have implemented the standard Cournot model introducing a variant: the competitive fringe. In the both side of market (demand and supply) firms were divided into two categories: operators with small market share that it seems could not credibly attempt to affect the market price are treated as price-takers and they represent the competitive fringe price takers. On the other hand, larger firms are deemed to behave strategically. Generators that operate under inflexible, non-market based agreements are also treated as price-taking and added into the competitive fringe. Larger deregulated generators that it appeared could affect the market price under some conditions were assumed to follow Cournot strategies.

We start constructing the supply and the demand step function. Given the sample distribution of the recorded prices, we recover 30 quantiles (which divide the price observations in 30 group of the same size) and we use them as the break point for the supply and the demand step function.

Secondly, we control for the effect of the fringe by subtracting the aggregate supply of these firms from the market demand at any given market price. Then, we subtract from the market demand the quantity supplied by the fringe firms at every price and the resulting curve is the net demand faced by Cournot price-maker players.

Formally, the resulting demand curve faced by Cournot players can be written as:

$$D_h^*(p_h) = D_h(p_h) - S_f(p_h) \quad (5)$$

Where $D_h(p_h)$ is the market demand function, S_f represents the fringe supply curve and h is the index used for denoting the hour of the day which the offers refers to.

Finally, we construct the residual demand curves for the Cournot players given the assumption that, at the Cournot equilibrium, each firm is producing its profit-maximizing quantity given the quantities that are being produced by all other Cournot participants.

For each competitors we construct its supply curve by horizontally summing the hourly single offers (ranked in a non-decreasing price order), then we derive the residual demand for competitor i using the following formula:

$$RD_i(p_h) = D_h^*(p_h) - \sum_{j \neq i} S_j(p_h) \quad (6)$$

where $D_h^*(p_h)$ is the net demand defined in (5), j indexes firms that are Cournot players and $S_{jh}(p_h)$ with $j \neq i$ is the supply curve of the Cournot players different from i .

Then we compute the Lerner Index for each operator for the price interval corresponding to the quantile where the market clearing price lies using the formula (4) of the arc elasticity.

4. RESULTS

Lerner indexes are computed for all the times in which single or two-market segmentation occurred; the aggregated values of estimates are averaged accordingly two main aggregation criteria: the quantile of the price distribution and the hours of the day. Tab.9-Tab.25 show for the main suppliers their average Lerner index aggregated by the quantiles of the market clearing price and the hours of the day.

Quarter	A2a				EDISON				ENEL				ENI			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	4.93	11.39	47.78	0.00	7.92	33.07	35.38	0.00	20.96	32.51	3.54	0.00	4.06	5.26	3.54	0.00
2	0.00	11.31	6.21	0.00	0.00	23.54	9.24	0.00	0.00	28.00	5.37	0.00	0.00	6.33	3.71	0.00
3	6.37	8.78	2.95	18.64	6.78	17.94	2.81	23.35	48.42	24.28	2.61	18.50	5.65	5.44	2.61	18.50
4	7.19	12.39	4.41	21.98	22.78	33.10	7.78	24.21	69.59	31.29	8.08	21.90	5.65	7.34	3.63	21.90
5	0.00	14.59	4.11	21.89	0.00	29.72	7.82	23.11	0.00	32.21	8.07	21.89	0.00	9.98	3.42	21.89
6	4.39	12.55	4.47	22.28	6.99	29.31	7.01	21.95	17.77	33.12	7.00	21.95	4.06	8.17	3.47	21.95
7	4.26	7.87	3.05	0.00	7.32	15.06	3.19	0.00	33.80	19.86	4.50	0.00	3.82	5.34	2.17	0.00
8	0.00	11.17	3.34	4.89	0.00	17.10	2.93	5.34	0.00	14.79	1.98	5.52	0.00	3.60	1.98	3.89
9	0.00	13.66	0.00	0.00	0.00	18.56	0.00	0.00	0.00	22.65	0.00	0.00	0.00	4.29	0.00	0.00
10	0.00	11.18	3.18	0.00	0.00	20.19	2.92	0.00	0.00	18.34	2.01	0.00	0.00	6.32	2.01	0.00
11	0.00	13.22	6.02	0.00	0.00	24.76	6.23	0.00	0.00	19.63	7.18	0.00	0.00	7.83	2.77	0.00
12	0.00	7.51	2.16	8.16	0.00	12.50	2.17	8.44	0.00	11.98	1.73	11.06	0.00	5.31	1.73	8.16
13	6.52	11.75	3.38	10.71	9.39	12.73	4.85	11.14	85.65	12.32	5.56	10.71	5.65	8.35	2.78	10.71
14	4.21	16.43	3.57	0.00	9.93	19.79	3.90	0.00	25.95	16.61	8.66	0.00	4.06	11.95	2.95	0.00
15	0.00	8.06	4.05	0.00	0.00	13.56	5.66	0.00	0.00	8.96	10.25	0.00	0.00	6.57	2.45	0.00
16	0.00	11.13	4.44	10.71	0.00	17.74	5.66	11.27	0.00	19.68	8.21	10.71	0.00	8.36	2.83	10.71
17	3.04	10.55	0.00	0.00	3.73	14.50	0.00	0.00	11.93	17.62	0.00	0.00	2.52	7.55	0.00	0.00
18	7.51	12.97	0.00	0.00	12.48	18.88	0.00	0.00	27.81	18.53	0.00	0.00	3.00	6.43	0.00	0.00
19	6.17	6.85	0.00	0.00	10.89	11.24	0.00	0.00	62.01	12.38	0.00	0.00	2.65	3.68	0.00	0.00
20	0.00	15.74	0.00	0.00	0.00	25.34	0.00	0.00	0.00	18.89	0.00	0.00	0.00	3.89	0.00	0.00
21	0.00	20.51	0.00	0.00	0.00	29.00	0.00	0.00	0.00	19.71	0.00	0.00	0.00	6.80	0.00	0.00
22	0.00	6.35	0.00	0.00	0.00	10.56	0.00	0.00	0.00	17.14	0.00	0.00	0.00	4.42	0.00	0.00
23	2.86	5.14	0.00	0.00	4.89	8.95	0.00	0.00	14.32	13.52	0.00	0.00	2.52	3.61	0.00	0.00
24	2.53	8.36	0.00	0.00	3.60	14.31	0.00	0.00	12.84	14.75	0.00	0.00	2.25	3.10	0.00	0.00
Average	5.00	11.23	6.88	14.91	8.89	19.64	7.17	16.10	35.92	19.95	5.65	15.28	3.83	6.25	2.80	14.72

Tab 9: Lerner Index of main suppliers, by Hour. Percentage Value. Single Market, 2013.

Quarter	GDF SUEZ				GSE				SORGENIA			
	1	2	3	4	1	2	3	4	1	2	3	4
1	4.36	16.97	3.54	0.00	4.12	5.26		0.00	4.25	6.39	34.16	0.00
2	0.00	15.43	6.27	0.00	0.00	6.33		0.00	0.00	6.81	6.83	0.00
3	5.65	9.99	2.87	19.23	5.65	5.44		4.87	8.60	5.58	4.09	18.50
4	7.05	14.93	4.91	22.39	5.65	7.34		6.09	10.94	9.43	4.98	21.90
5	0.00	16.96	4.78	22.58	0.00	9.98		6.65	0.00	10.20	4.84	21.89
6	4.11	16.99	5.04	27.13	4.06	8.17		2.60	4.84	8.40	5.59	21.95
7	4.93	11.94	2.77	0.00	3.82	5.34		0.00	4.22	7.11	3.18	0.00
8	0.00	8.35	2.80	4.90	0.00	3.60		0.26	0.00	4.73	3.99	3.96
9	0.00	12.38	0.00	0.00	0.00	4.29		0.00	0.00	5.54	0.00	0.00
10	0.00	9.83	2.67	0.00	0.00	6.32		0.00	0.00	7.61	3.67	0.00
11	0.00	10.85	2.87	0.00	0.00	7.83		0.00	0.00	8.58	3.23	0.00
12	0.00	8.22	1.78	8.57	0.00	5.31		1.58	0.00	5.53	1.98	8.16
13	9.35	14.56	2.93	11.15	5.65	8.35		3.00	5.65	8.44	2.86	10.71
14	6.43	22.02	3.30	0.00	4.06	11.95		0.00	5.32	13.97	4.61	0.00
15	0.00	12.59	2.95	0.00	0.00	6.57		0.00	0.00	6.98	3.99	0.00
16	0.00	14.60	3.05	11.28	0.00	8.36		1.08	0.00	9.37	4.35	10.71
17	3.09	11.79	0.00	0.00	2.52	7.55		0.00	3.42	8.68	0.00	0.00
18	4.60	13.81	0.00	0.00	3.00	6.43		0.00	5.62	7.27	0.00	0.00
19	3.34	7.19	0.00	0.00	2.64	3.68		0.00	3.60	4.59	0.00	0.00
20	0.00	12.55	0.00	0.00	0.00	3.89		0.00	0.00	7.07	0.00	0.00
21	0.00	16.71	0.00	0.00	0.00	6.80		0.00	0.00	10.26	0.00	0.00
22	0.00	5.40	0.00	0.00	0.00	4.42		0.00	0.00	5.27	0.00	0.00
23	2.68	4.47	0.00	0.00	2.52	3.61		0.00	3.84	4.20	0.00	0.00
24	2.75	8.77	0.00	0.00	2.25	3.10		0.00	3.12	3.66	0.00	0.00
Average	4.86	12.39	3.50	15.91	3.83	6.25		3.27	5.28	7.32	6.16	14.73

Tab 10: Lerner Index of main suppliers, by Hour. Percentage Value. Single Market, 2013.

Hour	A2A				EDISON				ENEL				ENI			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	5.07	11.68	7.15	6.64	8.17	21.32	9.66	7.51	36.48	27.35	7.38	9.04	4.73	5.45	2.71	6.46
2	7.50	11.99	5.43	15.05	11.26	21.27	8.17	15.61	42.60	26.10	5.86	15.34	7.12	7.89	3.01	14.99
3	9.04	11.94	5.41	9.45	13.19	22.27	6.78	10.85	52.89	23.81	6.93	9.38	8.97	8.37	3.47	9.38
4	12.97	12.84	5.87	22.24	18.31	22.87	8.55	23.89	53.23	22.88	8.20	22.21	12.65	9.01	3.89	22.21
5	15.24	12.58	5.81	12.15	20.78	20.44	8.10	14.49	57.89	24.03	7.71	12.04	14.93	8.43	4.00	12.04
6	8.74	14.59	4.99	14.50	13.18	21.75	7.16	16.33	45.98	25.36	7.17	14.49	8.42	9.18	3.52	14.42
7	4.65	14.17	4.00	7.54	7.34	22.25	4.83	7.31	36.84	23.53	5.86	5.90	4.30	7.33	2.48	5.90
8	4.88	11.37	4.92	0.00	7.65	17.22	4.51	0.00	27.40	14.53	8.34	0.00	3.35	4.97	2.56	0.00
9	7.62	14.04	9.00	5.99	8.71	17.28	7.39	6.28	36.48	20.03	7.06	7.49	4.66	5.10	2.76	5.78
10	7.27	13.02	9.83	4.02	8.44	15.13	7.02	3.93	35.46	18.34	7.85	3.95	4.02	5.08	2.92	3.79
11	4.58	11.45	7.32	0.00	5.74	16.59	7.91	0.00	24.75	13.72	6.93	0.00	3.35	5.69	3.74	0.00
12	4.10	10.68	7.73	32.89	5.46	16.49	7.98	32.89	26.85	15.72	9.73	32.89	3.46	6.66	4.71	32.89
13	3.73	11.29	9.85	42.04	5.54	17.61	12.62	42.36	26.88	14.40	12.90	42.00	3.63	8.00	8.09	42.00
14	4.72	12.37	12.32	7.43	6.88	17.86	13.55	7.73	35.25	19.77	14.27	8.29	4.48	7.62	10.91	7.25
15	4.48	12.19	9.40	24.38	6.60	21.57	9.71	24.55	32.57	15.49	12.50	24.28	4.32	8.19	7.41	24.25
16	4.17	10.69	10.67	75.84	6.67	16.03	12.87	75.84	33.98	15.69	11.95	75.84	4.03	6.76	7.20	75.84
17	5.38	10.54	9.58	2.44	8.79	19.33	9.64	2.52	33.10	16.13	10.24	2.39	3.91	6.55	4.28	2.31
18	10.16	13.78	7.25	0.00	12.30	18.87	6.39	0.00	33.24	25.55	5.40	0.00	3.64	6.14	2.59	0.00
19	12.97	11.61	8.84	0.00	18.22	13.03	7.09	0.00	37.91	15.27	5.74	0.00	4.20	4.27	2.56	0.00
20	10.52	14.24	16.51	4.11	14.36	17.75	16.75	4.15	31.45	18.50	7.34	4.44	4.27	3.95	3.33	3.78
21	5.29	24.23	20.73	4.01	7.18	24.40	20.75	3.99	17.88	26.61	8.06	3.85	3.39	5.06	4.17	3.69
22	3.67	18.52	11.58	4.02	5.43	22.51	11.74	4.21	19.17	20.50	6.77	3.95	3.20	4.73	3.07	3.78
23	3.63	11.01	6.75	2.61	5.68	13.45	6.10	2.61	24.37	15.66	4.45	2.56	2.74	3.71	2.57	2.49
24	4.16	9.10	5.58	5.40	6.59	13.27	5.66	5.59	29.99	15.61	4.05	5.38	3.74	4.19	2.45	5.31
Average	6.86	12.91	8.61	15.14	9.69	18.77	9.20	15.63	34.69	19.77	8.03	15.28	5.23	6.35	4.10	14.93

Tab 11: Lerner Index of Main Suppliers, by Hour, Percentage Value, Two-Market, 2013

Quarter	GDF SUEZ				GSE				SORGENIA			
	1	2	3	4	1	2	3	4	1	2	3	4
1	5.13	12.85	6.55	7.74	4.53	5.45	0.00	0.55	5.38	7.41	5.74	6.50
2	7.80	16.63	5.07	16.51	7.12	7.90	0.00	3.28	7.89	8.45	5.02	15.15
3	9.13	17.00	5.05	10.81	8.67	8.37	0.00	1.73	9.52	9.59	4.86	9.94
4	13.13	17.32	5.88	23.82	12.66	9.01	0.00	5.21	13.41	9.95	5.45	22.45
5	15.33	16.74	5.86	13.25	14.94	8.43	0.00	3.16	15.54	9.72	5.74	12.45
6	9.10	17.84	5.08	15.12	8.42	9.18	0.00	1.30	9.36	10.41	4.81	15.44
7	5.01	14.21	3.53	8.45	4.14	7.32	0.00	0.85	5.34	8.05	3.77	5.90
8	4.67	10.98	4.07	0.00	3.23	4.91	0.00	0.00	4.66	5.92	3.78	0.00
9	5.06	12.12	4.09	6.11	3.23	5.07	0.00	2.15	5.40	6.70	4.94	5.81
10	4.80	11.62	4.32	4.08	3.05	4.99	0.00	2.32	5.24	6.55	5.04	3.84
11	3.70	10.60	4.66	0.00	2.81	5.69	0.00	0.00	3.85	6.82	4.80	0.00
12	3.86	11.71	5.76	33.03	2.97	6.66	0.00	4.19	3.82	7.72	5.71	32.89
13	3.90	13.61	9.55	42.26	3.36	8.02	0.00	35.97	4.21	8.46	9.44	42.68
14	4.89	14.87	11.76	7.54	4.30	7.65	0.00	2.92	5.28	8.81	11.97	7.99
15	4.84	14.30	8.45	24.43	4.08	8.29	0.00	11.74	5.09	9.66	8.48	24.63
16	4.48	12.39	8.62	75.85	3.49	6.76	0.00	30.38	4.81	8.20	8.82	75.84
17	4.59	11.85	6.07	2.37	2.96	6.59	0.00	0.72	4.65	7.57	6.38	2.38
18	5.36	12.79	3.92	0.00	3.24	6.16	0.00	0.00	6.59	8.48	5.11	0.00
19	6.55	9.64	4.27	0.00	3.91	4.25	0.00	0.00	8.69	6.20	5.53	0.00
20	5.79	12.44	7.34	3.95	3.69	3.90	0.00	2.77	7.04	7.37	10.89	3.90
21	3.91	15.50	11.69	3.88	2.62	4.93	0.00	1.42	4.27	12.13	13.64	3.92
22	3.74	14.55	5.84	4.01	2.42	4.63	0.00	1.26	3.82	8.44	7.97	4.07
23	3.68	10.45	4.84	2.61	2.60	3.68	0.00	1.42	4.16	6.22	5.63	2.58
24	4.17	9.12	4.82	5.52	3.58	4.19	0.00	1.85	4.58	5.46	4.66	5.42
Average	5.94	13.38	6.13	15.57	4.83	6.33		5.76	6.36	8.10	6.59	15.19

Tab 12: Lerner Index of Main Suppliers, by Hour. Percentage Value. Two-Market, 2013.

Quarter	A2A				EDISON				ENEL				ENI			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
2	0.00	5.21	0.00	0.00	0.00	6.91	0.00	0.00	0.00	5.21	0.00	0.00	0.00	5.21	0.00	0.00
3	0.00	8.67	0.00	32.89	0.00	18.02	0.00	32.89	0.00	8.63	0.00	32.89	0.00	8.63	0.00	32.89
4	0.00	31.81	0.00	22.07	0.00	41.82	0.00	25.52	0.00	25.43	0.00	21.95	0.00	25.43	0.00	21.95
5	0.00	8.50	0.00	10.71	0.00	16.26	0.00	10.96	0.00	7.13	0.00	10.71	0.00	7.11	0.00	10.71
6	0.00	22.68	6.78	8.16	0.00	40.65	13.77	8.30	0.00	32.67	6.16	9.61	0.00	17.26	6.16	8.16
7	0.00	12.14	6.04	0.00	0.00	20.30	9.22	0.00	0.00	19.34	5.76	0.00	0.00	10.07	5.76	0.00
8	0.00	12.34	4.97	0.00	0.00	21.85	6.49	0.00	0.00	22.79	8.56	0.00	0.00	6.98	3.99	0.00
9	6.57	13.24	3.42	0.00	12.44	32.54	6.56	0.00	64.18	35.10	9.00	0.00	5.65	6.12	2.61	0.00
10	4.51	9.18	2.59	4.89	8.28	13.55	2.31	5.34	21.56	31.85	2.78	5.52	4.06	5.05	1.73	3.89
11	2.86	6.17	5.35	0.00	4.17	9.81	5.15	0.00	13.34	14.56	7.94	0.00	2.52	2.52	2.77	0.00
12	2.35	8.03	6.79	0.00	3.56	11.94	12.70	0.00	13.24	14.79	5.80	0.00	1.99	3.59	2.46	0.00
13	4.37	9.21	3.45	0.00	8.23	23.60	3.83	0.00	12.10	23.81	2.29	0.00	2.49	3.72	2.29	0.00
14	6.17	13.80	0.00	0.00	10.89	30.28	0.00	0.00	62.01	17.68	0.00	0.00	2.65	4.42	0.00	0.00
15	0.00	10.73	47.78	0.00	0.00	16.07	35.38	0.00	0.00	30.40	3.54	0.00	0.00	3.56	3.54	0.00
16	10.66	22.95	0.00	0.00	16.74	33.21	0.00	0.00	43.52	21.05	0.00	0.00	3.52	5.12	0.00	0.00
17	0.00	18.20	0.00	0.00	0.00	21.43	0.00	0.00	0.00	29.59	0.00	0.00	0.00	4.70	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	25.85	0.00	0.00	0.00	42.08	0.00	0.00	0.00	15.45	0.00	0.00	0.00	7.37	0.00	0.00
20	0.00	25.84	0.00	0.00	0.00	32.46	0.00	0.00	0.00	21.57	0.00	0.00	0.00	7.92	0.00	0.00
Average	5.36	14.70	9.69	15.75	9.19	24.04	10.60	16.60	32.85	20.95	5.76	16.14	3.27	7.49	3.48	15.52

Tab 13: Lerner Index of main suppliers, by Quantile. Percentage Value. Single Market, 2013.

Quarter	GDF SUEZ				GSE				SORGENIA			
	1	2	3	4	1	2	3	4	1	2	3	4
2	0.00	6.88	0.00	0.00	0.00	5.21		0.00	0.00	5.21	0.00	0.00
3	0.00	18.60	0.00	32.89	0.00	8.63		4.98	0.00	8.63	0.00	32.89
4	0.00	38.24	0.00	23.06	0.00	25.43		7.07	0.00	25.43	0.00	21.95
5	0.00	11.53	0.00	11.42	0.00	7.11		1.83	0.00	7.11	0.00	10.71
6	0.00	29.83	10.70	8.62	0.00	17.26		1.24	0.00	17.80	6.16	8.16
7	0.00	13.00	8.67	0.00	0.00	10.07		0.00	0.00	11.05	8.64	0.00
8	0.00	11.17	5.12	0.00	0.00	6.98		0.00	0.00	7.31	6.82	0.00
9	7.47	17.05	3.17	0.00	5.65	6.12		0.00	7.82	7.79	3.35	0.00
10	4.97	9.52	2.16	4.90	4.08	5.05		0.26	4.80	6.37	2.87	3.96
11	2.78	6.46	3.14	0.00	2.52	2.52		0.00	3.49	3.15	3.56	0.00
12	2.48	8.14	5.03	0.00	1.99	3.59		0.00	2.68	4.16	7.92	0.00
13	3.27	10.58	3.14	0.00	2.49	3.72		0.00	3.08	5.37	3.14	0.00
14	3.34	12.29	0.00	0.00	2.64	4.42		0.00	3.60	6.98	0.00	0.00
15	0.00	7.85	3.54	0.00	0.00	3.56		0.00	0.00	5.36	34.16	0.00
16	5.94	20.07	0.00	0.00	3.52	5.12		0.00	8.15	9.09	0.00	0.00
17	0.00	10.63	0.00	0.00	0.00	4.70		0.00	0.00	7.34	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
19	0.00	22.51	0.00	0.00	0.00	7.37		0.00	0.00	12.27	0.00	0.00
20	0.00	21.35	0.00	0.00	0.00	7.92		0.00	0.00	12.15	0.00	0.00
Average	4.32	15.32	4.96	16.18	3.27	7.49		3.07	4.80	9.03	8.51	15.54

Tab 14: Lerner Index of main suppliers, by Quantile. Percentage Value. Single Market, 2013.

Quarter	A2A				EDISON				ENEL				ENI			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
2	0.00	5.21	8.63	75.84	7.23	8.76	75.84	0.00	0.00	6.84	8.63	75.84	0.00	5.21	8.63	75.84
3	0.00	8.76	44.34	32.89	21.26	47.29	32.89	0.00	0.00	8.67	44.08	32.89	0.00	8.63	41.57	32.89
4	0.00	29.65	8.54	22.01	42.15	8.79	24.51	0.00	0.00	25.43	9.43	21.95	0.00	25.43	8.41	21.95
5	46.94	10.86	10.51	10.77	16.94	13.47	12.11	60.49	78.75	10.17	18.19	10.71	46.94	7.11	8.85	10.71
6	13.25	24.12	8.66	8.27	38.29	14.02	9.10	15.18	71.85	37.57	10.92	8.16	13.18	17.26	6.16	8.16
7	10.82	13.07	8.54	8.88	19.85	12.24	10.66	14.89	64.53	27.78	12.11	9.26	10.55	10.07	5.76	8.66
8	6.02	14.35	5.00	7.23	22.22	6.53	8.37	8.62	40.61	23.73	7.84	7.77	5.42	6.98	3.99	7.03
9	6.40	15.02	3.79	5.98	24.11	4.58	5.23	9.90	50.37	23.23	6.06	7.34	5.65	6.12	2.61	4.76
10	4.66	9.32	3.53	3.90	10.58	3.21	3.92	6.85	36.98	23.45	3.22	3.98	4.08	5.05	1.74	3.89
11	3.04	7.25	5.54	0.00	11.69	4.73	0.00	4.52	20.01	16.33	5.89	0.00	2.66	2.52	2.79	0.00
12	2.67	6.96	5.95	2.45	8.15	4.98	2.43	4.24	17.51	13.57	5.36	2.44	2.44	3.60	2.48	2.38
13	3.95	10.11	7.02	2.72	12.91	9.56	2.84	6.21	21.13	17.06	5.81	2.69	3.27	3.75	2.30	2.62
14	6.00	11.59	9.33	2.43	19.68	9.57	2.46	9.22	28.65	20.83	7.00	2.40	3.51	4.57	2.75	2.29
15	6.36	18.02	13.81	4.07	20.72	12.63	4.06	9.92	22.62	27.92	10.59	4.03	3.46	3.64	3.55	3.78
16	11.05	20.20	25.71	3.87	25.20	23.61	3.98	13.54	43.40	26.89	11.84	3.71	4.96	5.24	3.89	3.52
17	8.87	20.55	20.73	4.89	26.23	17.68	4.75	10.47	33.12	34.79	12.96	4.79	3.24	5.15	2.75	4.53
18	17.36	34.38	29.76	0.00	41.68	35.40	0.00	22.48	44.33	17.47	15.85	0.00	6.10	5.66	4.56	0.00
19	17.05	53.21	56.96	0.00	48.76	48.91	0.00	30.34	44.96	28.41	9.38	0.00	5.10	7.37	8.84	0.00
20	24.46	0.00	52.43	0.00	0.00	51.18	0.00	39.48	53.64	0.00	18.67	0.00	8.44	0.00	9.49	0.00
Average	11.81	17.37	17.31	13.08	23.20	17.74	13.54	16.65	42.03	21.67	11.78	13.20	8.06	7.41	6.90	12.87

Tab 15: Lerner Index of Main Supplier, by Quantile. Percentage Value. Two-market, 2013.

Quarter	GDF SUEZ				GSE				SORGENIA			
	1	2	3	4	1	2	3	4	1	2	3	4
2	0.00	5.96	8.68	76.30	0.00	5.23		34.41	0.00	5.21	8.63	75.84
3	0.00	18.11	42.56	33.12	0.00	8.64		3.29	0.00	9.87	43.85	32.89
4	0.00	40.11	8.75	23.97	0.00	25.43		9.41	0.00	26.40	8.43	21.95
5	46.96	10.16	10.88	11.54	46.94	7.14		2.81	46.94	7.24	10.77	11.58
6	13.42	29.01	10.40	9.02	13.18	17.30		1.85	13.32	18.56	7.74	8.33
7	10.99	15.09	8.52	10.66	10.55	10.07		2.29	11.30	10.95	6.83	9.98
8	5.79	17.01	4.88	8.29	5.43	6.98		1.04	6.35	8.07	5.10	7.29
9	6.19	15.62	3.39	5.89	5.66	6.13		1.11	6.68	7.80	3.49	4.80
10	4.40	9.87	2.32	3.98	4.06	5.05		2.68	5.08	5.81	2.35	4.06
11	3.35	6.62	4.21	0.00	2.52	2.52		0.00	3.38	3.40	3.94	0.00
12	3.12	7.24	4.40	2.42	1.99	3.59		1.21	3.01	4.48	5.75	2.46
13	3.85	9.96	4.62	2.75	2.49	3.72		1.53	3.96	6.48	5.73	2.66
14	4.64	10.07	4.71	2.38	2.64	4.42		0.99	5.14	6.59	5.84	2.34
15	4.65	16.29	7.13	3.98	2.77	3.56		1.92	5.03	9.81	8.49	3.96
16	6.16	17.00	12.24	3.74	3.52	5.12		1.00	7.16	9.81	15.79	3.77
17	4.54	16.64	7.70	4.88	2.67	4.70		2.44	5.32	9.35	10.44	4.58
18	8.48	23.94	11.43	0.00	5.29	5.66		0.00	10.67	14.96	15.12	0.00
19	8.27	35.53	33.69	0.00	5.04	7.37		0.00	10.51	20.17	42.44	0.00
20	11.31	0.00	32.40	0.00	8.43	0.00		0.00	21.45	0.00	31.18	0.00
Average	9.13	16.90	11.73	13.53	7.70	7.37		4.53	10.33	10.28	12.73	13.10

Tab 16: Lerner Index of Main Supplier, by Quantile. Percentage Value. Two-market, 2013.

Quarter	A2A				EDISON				ENEL			
	1	2	3	4	1	2	3	4	1	2	3	4
1	6.88	7.31	3.02	6.27	10.98	8.53	4.59	7.07	8.46	18.96	2.58	5.07
2	9.55	13.54	2.72	8.75	20.54	12.88	5.46	10.50	10.56	16.08	2.54	7.80
3	12.91	9.90	3.15	11.10	22.81	12.88	3.60	12.81	12.09	9.43	2.94	9.68
4	14.43	11.15	2.79	14.36	26.79	14.14	4.36	13.37	14.10	13.05	2.71	11.87
5	16.35	9.92	2.81	13.01	31.21	13.44	4.38	13.18	16.07	12.35	2.71	11.25
6	13.57	8.63	3.25	9.77	23.85	12.14	4.21	9.74	12.38	12.70	3.15	7.59
7	7.74	7.63	5.77	4.04	10.14	11.85	5.70	3.87	8.14	14.60	4.07	2.81
8	10.27	12.93	3.75	3.37	12.58	9.95	5.98	3.21	9.84	15.46	2.86	2.54
9	10.97	9.59	0.00	7.82	23.94	10.82	0.00	8.95	9.61	5.60	0.00	3.31
10	7.86	7.25	34.11	4.85	9.36	6.60	55.68	6.40	8.10	5.03	10.77	3.15
11	8.77	9.38	0.00	3.93	13.03	8.37	0.00	4.94	9.75	7.25	0.00	2.62
12	4.06	15.45	0.00	3.55	8.92	12.97	0.00	4.18	5.62	8.21	0.00	2.84
13	4.05	17.99	3.28	2.78	6.81	16.65	5.26	2.82	5.17	31.21	2.75	2.11
14	4.07	11.16	3.20	2.88	5.42	15.07	5.35	2.92	7.45	6.60	3.12	2.16
15	3.03	8.30	3.86	3.50	4.00	12.35	8.37	5.15	5.38	5.60	3.67	2.45
16	6.25	13.96	4.40	4.58	8.92	21.29	7.55	6.89	6.80	9.50	3.68	3.20
17	4.18	10.53	3.71	7.98	4.59	9.83	5.43	11.76	5.20	8.26	3.59	4.62
18	6.16	12.41	16.65	7.08	5.82	13.78	25.58	9.64	7.94	5.39	4.53	3.95
19	10.02	6.87	0.00	6.85	10.83	5.87	0.00	8.64	10.73	4.30	0.00	3.59
20	13.52	5.74	0.00	5.60	13.02	4.55	0.00	6.87	11.40	5.20	0.00	3.10
21	4.73	17.45	0.00	2.75	5.76	16.17	0.00	3.41	5.80	24.03	0.00	4.52
22	8.37	5.03	0.00	0.00	10.80	6.54	0.00	0.00	14.66	7.53	0.00	0.00
23	4.55	4.75	0.00	2.59	8.05	3.45	0.00	3.24	8.72	4.43	0.00	2.72
24	6.02	5.04	3.04	5.24	10.75	5.23	4.09	5.53	14.93	10.45	2.48	4.30
Average	8.26	10.08	4.15	5.94	12.87	11.06	6.48	6.88	9.54	10.88	2.42	4.47

Tab 17: Lerner Index of main suppliers, by Hour. Percentage Value. Single-Market 2014.

Quarter	ENI				GDF SUEZ				SORGENIA			
	1	2	3	4	1	2	3	4	1	2	3	4
1	5.32	3.29	2.40	5.06	6.44	3.67	10.10	6.15	5.86	3.89	2.69	5.05
2	8.24	6.57	2.45	7.81	9.68	7.12	14.44	8.62	8.68	6.60	2.77	7.81
3	10.92	7.47	2.67	9.80	11.76	7.78	8.15	11.24	11.10	7.46	3.38	9.69
4	12.10	7.64	2.71	11.82	12.73	8.04	8.14	13.89	12.44	7.56	3.11	11.86
5	13.64	6.83	2.71	11.21	14.89	7.50	8.02	13.20	14.04	6.71	3.09	11.26
6	9.90	5.89	2.84	10.86	10.96	6.73	10.43	11.07	10.08	5.80	3.25	7.64
7	6.07	4.11	3.60	3.08	7.61	5.77	9.07	5.75	6.16	4.25	3.73	3.22
8	5.80	4.86	2.86	2.25	7.40	12.78	6.70	5.04	6.46	8.43	2.99	2.55
9	7.12	4.18	0.00	3.09	8.90	6.25	0.00	7.57	8.14	5.11	0.00	4.98
10	3.77	3.19	11.61	2.67	5.74	4.96	35.77	6.14	4.41	3.93	18.22	3.81
11	5.99	5.04	0.00	2.36	6.71	5.61	0.00	5.78	6.16	6.40	0.00	3.73
12	2.94	6.37	0.00	2.57	3.70	7.66	0.00	5.70	4.43	7.80	0.00	3.82
13	3.28	7.22	2.75	2.10	3.97	9.66	4.40	4.00	3.93	7.22	3.21	2.64
14	3.47	6.58	2.90	2.15	4.43	7.38	6.86	4.14	4.16	6.83	4.50	2.85
15	2.60	5.57	3.55	2.29	3.77	6.38	9.38	4.66	3.20	5.94	7.21	3.25
16	5.17	7.86	3.55	2.65	6.58	11.52	8.37	6.12	5.93	8.68	6.17	4.27
17	2.76	5.64	2.86	3.19	3.88	6.63	6.43	9.75	3.63	6.61	2.98	7.98
18	3.33	4.19	4.81	3.21	5.75	6.12	16.61	6.57	4.29	5.01	11.51	5.29
19	3.35	3.11	0.00	3.45	4.12	5.40	0.00	5.59	6.79	4.62	0.00	5.34
20	5.25	2.56	0.00	2.96	7.12	3.55	0.00	5.77	8.84	4.25	0.00	4.87
21	2.77	8.20	0.00	2.08	5.44	8.58	0.00	3.68	3.44	13.06	0.00	2.96
22	3.07	2.65	0.00	0.00	4.46	4.26	0.00	0.00	5.98	5.66	0.00	0.00
23	3.38	2.53	0.00	2.40	4.77	2.89	0.00	3.99	4.67	2.90	0.00	2.21
24	4.56	3.27	2.40	3.95	6.39	3.34	5.99	5.34	4.96	3.96	2.69	3.96
Average	5.62	5.20	2.36	4.29	6.97	6.65	7.04	6.66	6.57	6.19	3.40	5.04

Tab 18: Lerner Index of main suppliers, by Hour. Percentage Value. Single-Market 2014.

Quarter	A2A				EDISON				ENEL			
	1	2	3	4	1	2	3	4	1	2	3	4
1	7.57	9.00	6.08	4.75	12.60	10.32	13.60	5.20	7.58	11.55	4.02	3.70
2	10.07	9.37	4.14	5.86	16.13	11.85	7.08	5.96	9.58	11.06	3.48	5.06
3	11.18	9.10	4.30	10.07	17.56	12.00	7.86	11.98	9.80	10.03	3.71	8.67
4	11.43	10.31	4.43	11.67	20.72	13.55	8.24	12.42	10.22	9.78	3.68	10.07
5	11.36	10.10	4.50	10.89	19.38	12.58	8.32	11.47	10.16	8.66	3.79	9.37
6	8.97	10.48	4.32	7.79	15.25	12.69	7.74	8.45	8.67	9.93	3.62	6.68
7	9.70	10.33	4.29	7.45	13.75	10.25	7.27	6.54	11.34	10.79	3.62	4.88
8	9.73	8.35	4.59	6.37	11.73	9.86	6.50	5.99	10.36	8.61	4.15	4.13
9	9.95	14.57	5.84	8.48	11.53	14.42	9.77	8.40	10.83	12.87	4.52	4.06
10	10.57	11.69	6.34	8.52	10.71	11.72	11.07	9.28	10.29	10.31	4.87	4.24
11	9.01	9.08	5.96	5.65	9.67	10.17	10.76	5.31	9.10	8.85	4.46	3.52
12	8.54	8.56	5.54	5.23	11.56	10.92	11.05	4.99	9.80	8.56	4.69	3.66
13	6.10	11.12	5.37	4.33	8.87	13.42	8.86	4.56	8.61	11.32	4.95	3.61
14	9.85	12.13	6.07	5.49	13.98	16.51	9.23	5.57	12.16	12.66	5.68	4.58
15	9.91	11.60	7.36	5.55	13.98	16.56	10.67	6.68	10.79	9.47	6.64	4.57
16	9.59	8.55	6.90	5.84	13.32	11.63	10.61	7.74	9.54	7.97	6.02	3.75
17	7.36	9.88	5.75	6.89	9.60	13.94	9.39	9.20	7.88	9.89	5.08	3.75
18	8.82	10.34	4.47	10.72	8.06	12.19	6.84	12.41	9.23	10.00	4.67	5.22
19	12.08	9.57	4.44	9.83	10.81	8.49	6.09	11.83	10.27	8.88	4.03	4.62
20	13.45	9.85	7.80	11.18	13.50	8.94	9.94	13.44	11.78	9.39	5.97	5.78
21	7.75	19.75	9.00	7.17	7.21	18.76	12.41	7.60	8.51	21.96	11.67	5.96
22	7.14	13.89	5.63	4.12	7.98	13.39	8.44	5.73	9.95	14.33	8.55	4.35
23	6.36	6.72	3.70	3.50	7.88	6.57	5.09	4.62	8.85	9.65	4.05	3.84
24	6.53	7.99	4.00	3.82	8.55	7.89	7.17	4.30	11.10	10.33	5.27	3.61
Average	9.29	10.51	5.45	7.13	12.26	12.02	8.92	7.90	9.85	10.70	5.05	5.07

Tab 19: Lerner Index of main suppliers, by Hours, Percentage Value, Two-Market, 2014.

Quarter	ENI				GDF SUEZ				SORGENIA			
	1	2	3	4	1	2	3	4	1	2	3	4
1	5.32	4.11	3.36	3.41	7.50	7.07	12.12	7.29	5.75	4.57	4.91	3.65
2	8.15	4.85	3.30	4.75	9.84	9.95	8.25	7.99	8.34	4.94	3.63	5.08
3	8.92	5.35	3.61	8.51	10.69	8.67	8.90	10.64	9.26	5.39	3.80	8.88
4	9.50	5.81	3.65	9.89	11.96	9.25	9.28	12.01	9.73	5.82	3.95	10.23
5	9.55	6.05	3.62	9.21	11.81	9.24	9.28	11.05	9.78	6.04	4.00	9.45
6	7.29	5.86	3.57	6.27	8.76	9.07	8.52	9.01	7.58	5.90	4.04	6.86
7	6.53	4.72	3.38	4.46	8.50	8.60	7.47	7.48	6.75	4.86	3.79	4.76
8	5.57	3.99	3.17	3.63	7.34	6.32	6.28	7.35	6.60	4.54	3.68	4.47
9	5.46	4.53	3.50	3.74	7.30	8.63	7.70	8.30	6.51	6.76	4.73	5.43
10	5.42	4.33	3.42	4.02	6.99	6.98	8.12	8.01	6.37	5.64	4.78	5.67
11	5.01	4.91	3.57	3.64	6.27	6.95	7.48	5.57	5.46	5.99	4.73	4.05
12	5.27	5.15	4.09	3.93	6.76	6.59	7.42	5.90	5.61	5.42	5.12	4.02
13	4.55	6.27	4.69	3.76	6.40	7.75	6.83	5.93	4.95	6.75	5.20	3.85
14	6.13	7.47	5.50	4.87	7.79	8.59	7.73	8.14	6.41	8.06	5.93	4.74
15	5.92	7.79	6.40	4.76	8.27	9.96	8.34	7.39	6.34	8.12	6.98	5.56
16	6.32	6.09	5.78	3.82	9.44	7.57	7.78	7.47	6.87	6.52	6.25	4.99
17	4.58	5.70	4.35	3.49	6.06	8.09	6.37	6.97	5.36	6.41	4.95	5.18
18	3.98	5.26	3.24	4.12	5.58	7.77	6.02	9.36	5.14	6.04	3.82	6.60
19	4.17	3.77	2.98	3.63	7.06	6.43	5.26	8.26	6.63	4.87	3.60	6.40
20	4.58	3.54	3.80	4.67	7.42	6.48	8.38	9.84	7.86	5.51	6.17	7.71
21	3.17	5.82	4.06	3.23	5.21	12.89	9.54	6.49	5.05	11.15	7.11	4.97
22	3.51	4.49	3.12	2.40	5.79	9.31	7.43	5.14	4.90	8.25	4.66	3.58
23	3.84	2.93	2.88	2.59	5.71	4.79	5.70	5.12	4.64	4.07	3.46	3.08
24	4.49	3.60	3.23	3.27	6.20	7.23	8.23	5.99	5.01	5.50	4.06	3.38
Average	5.72	5.10	3.84	4.59	7.69	8.09	7.85	7.78	6.54	6.13	4.72	5.52

Tab 20: Lerner Index of main suppliers, by Hours. Percentage Value. Two-Market, 2014.

Quarter	A2A				EDISON				ENEL			
	1	2	3	4	1	2	3	4	1	2	3	4
2	54.16	0.00	0.00	0.00	0.00	0.00	0.00	33.33	0.00	0.00	0.00	33.33
3	38.83	0.00	2.00	0.00	5.34	0.00	0.00	43.80	2.00	0.00	0.00	33.33
4	21.97	0.00	37.75	0.00	70.32	0.00	0.00	25.60	38.36	0.00	0.00	19.61
5	9.38	29.70	19.69	0.00	33.74	33.92	0.00	9.40	16.94	16.94	0.00	8.09
6	7.52	33.06	24.11	0.00	46.00	33.30	0.00	7.29	17.37	17.37	0.00	6.49
7	5.30	12.30	10.92	0.00	17.01	15.32	0.00	5.50	11.19	9.11	0.00	4.48
8	5.59	12.18	11.20	0.00	25.26	15.12	0.00	5.56	11.28	11.73	0.00	3.87
9	4.61	11.67	8.28	2.56	12.26	14.04	5.30	5.57	9.94	11.18	2.56	3.39
10	3.80	9.18	6.10	3.90	11.28	12.21	5.84	3.70	8.03	7.69	3.45	3.60
11	2.72	5.48	5.53	2.51	12.52	10.00	6.86	3.08	9.91	11.13	2.67	1.95
12	2.71	11.24	7.54	2.98	11.07	12.41	4.10	2.67	12.66	16.75	2.52	1.97
13	3.14	10.52	3.63	3.43	5.02	10.15	4.44	2.94	5.22	17.97	3.01	2.53
14	5.70	8.95	5.83	3.52	7.80	8.72	4.12	5.40	8.85	6.82	3.10	2.53
15	4.08	4.94	4.58	4.05	4.67	5.35	6.74	6.64	5.37	4.43	4.12	3.13
16	5.64	5.76	7.64	0.00	8.32	7.15	0.00	8.09	7.82	5.55	0.00	3.74
17	8.02	14.68	18.35	0.00	18.63	12.49	0.00	11.79	14.09	16.15	0.00	5.18
18	8.49	0.00	15.79	0.00	17.17	0.00	0.00	12.25	14.27	0.00	0.00	4.62
19	9.24	23.48	22.70	18.46	28.40	21.17	21.63	10.99	34.01	41.94	6.46	4.11
20	30.34	0.00	0.00	0.00	0.00	0.00	0.00	35.36	0.00	0.00	0.00	8.62
21	0.00	0.00	0.00	34.11	0.00	0.00	55.68	0.00	0.00	0.00	10.77	00'0
Average	12.17	13.80	12.45	8.39	19.70	15.10	12.74	12.58	13.37	13.91	4.30	8.14

Tab 21: Lerner Index of main suppliers, by Quantile. Percentage Value. Single Market, 2014.

Quarter	ENI				GDF SUEZ				SORGENIA			
	1	2	3	4	1	2	3	4	1	2	3	4
2	0.00	0.00	0.00	33.33	0.00	0.00	0.00	33.33	0.00	0.00	0.00	33.33
3	2.00	0.00	0.00	33.33	2.00	0.00	0.00	33.35	2.00	0.00	0.00	33.33
4	32.45	0.00	0.00	19.61	32.45	0.00	0.00	21.17	32.45	0.00	0.00	19.61
5	16.94	16.94	0.00	8.09	16.95	17.15	0.00	9.42	16.94	16.94	0.00	8.09
6	17.37	17.37	0.00	6.50	17.47	17.63	0.00	8.35	18.22	17.37	0.00	6.49
7	9.11	9.11	0.00	4.41	9.91	9.23	0.00	5.73	9.38	9.11	0.00	4.40
8	9.67	9.67	0.00	3.73	10.77	10.02	0.00	5.60	9.94	9.67	0.00	3.92
9	6.96	6.94	2.56	3.22	8.21	7.55	9.63	7.62	7.02	6.94	2.56	3.49
10	4.67	4.66	3.38	3.12	6.50	5.28	14.96	5.75	4.85	4.63	3.38	3.28
11	4.24	4.29	2.51	2.37	6.76	4.66	18.48	4.29	4.59	4.35	2.87	1.91
12	4.77	5.28	2.40	1.86	6.71	7.73	8.91	3.74	5.27	5.41	2.66	2.03
13	2.53	2.78	2.86	2.53	3.62	4.42	6.75	4.72	3.24	3.10	3.41	2.88
14	4.07	3.81	2.79	6.29	5.97	6.51	5.50	6.73	4.80	6.08	3.35	3.61
15	2.31	2.32	3.55	2.92	3.66	3.91	8.41	6.28	3.23	3.06	5.94	4.46
16	2.65	2.68	0.00	2.96	3.91	4.15	0.00	6.82	4.92	4.02	0.00	4.85
17	5.97	5.97	0.00	3.43	12.24	12.25	0.00	12.15	10.47	10.67	0.00	8.59
18	7.13	0.00	0.00	3.65	7.39	0.00	0.00	9.10	12.69	0.00	0.00	6.86
19	6.83	12.65	6.61	3.93	7.15	6.83	26.18	7.11	17.43	15.38	9.04	6.74
20	0.00	0.00	0.00	6.77	0.00	0.00	0.00	18.30	0.00	0.00	0.00	20.02
21	0.00	0.00	11.61	0.00	0.00	0.00	35.77	0.00	0.00	0.00	18.22	0.00
Average	8.22	7.46	4.25	8.00	9.51	8.38	14.95	11.03	9.85	8.34	5.72	9.36

Tab 22: Lerner Index of main suppliers, by Quantile. Percentage Value. Single Market, 2014.

Quarter	A2A				EDISON				ENEL			
	1	2	3	4	1	2	3	4	1	2	3	4
2	0.00	0.00	0.00	55.84	0.00	0.00	0.00	33.33	0.00	0.00	0.00	33.33
3	2.16	2.00	20.00	41.92	13.34	6.52	25.50	42.43	4.51	3.39	20.00	33.33
4	49.68	0.00	14.60	23.81	72.59	0.00	21.99	25.65	34.03	0.00	14.29	19.61
5	20.51	31.09	11.97	10.43	30.96	46.86	17.67	9.16	17.09	25.66	11.11	8.09
6	23.33	23.25	11.13	7.71	39.75	28.29	15.89	7.63	17.37	18.52	10.03	6.54
7	11.10	12.61	8.11	5.43	15.68	16.64	14.07	5.64	9.22	10.54	7.06	4.76
8	11.67	15.35	5.02	5.33	17.42	18.76	9.32	5.51	10.19	11.26	4.73	4.20
9	9.93	10.37	3.19	4.54	14.65	12.51	5.88	4.78	9.29	10.92	2.87	3.47
10	6.31	7.70	4.63	4.63	9.72	10.58	8.36	4.58	7.20	7.89	4.06	3.45
11	7.70	9.12	3.40	2.73	12.92	9.92	5.71	2.88	10.31	8.91	3.15	2.22
12	8.45	11.56	3.21	2.69	10.32	13.33	4.86	2.62	12.54	13.05	3.41	2.12
13	3.86	6.83	3.97	3.84	4.69	6.76	6.29	3.45	5.49	8.56	3.93	3.08
14	6.52	8.97	4.29	5.24	7.04	8.88	7.07	6.09	8.99	9.71	4.46	2.89
15	4.56	5.71	5.96	5.50	4.46	5.21	8.01	8.48	5.43	6.27	5.35	3.71
16	6.92	6.93	8.22	6.69	6.45	7.94	19.21	9.62	6.38	5.94	8.00	4.15
17	14.64	22.04	15.24	8.82	13.40	23.25	22.86	9.99	14.32	21.07	12.13	4.88
18	15.89	24.20	11.41	9.67	18.76	23.08	12.58	12.48	20.00	27.44	9.49	5.62
19	33.99	15.12	15.90	11.99	30.74	14.58	24.52	16.29	34.18	14.83	11.26	5.27
20	14.63	14.35	24.11	19.04	18.51	14.75	31.26	29.45	16.81	16.54	27.98	8.41
21	35.30	0.00	26.55	23.02	53.30	0.00	44.27	29.03	28.40	0.00	21.72	13.34
Average	14.36	11.36	10.05	12.94	19.73	13.39	15.27	13.45	13.59	11.03	9.25	8.62

Tab 23: Lerner Index of main suppliers, by Quantile. Percentage Value. Two-Market, 2014

Quarter	ENI				GDF SUEZ				SORGENIA			
	1	2	3	4	1	2	3	4	1	2	3	4
2	0.00	0.00	0.00	33.33	0.00	0.00	0.00	33.33	0.00	0.00	0.00	33.33
3	2.00	2.00	20.00	33.33	2.11	2.01	20.46	33.41	2.30	2.00	20.00	33.33
4	32.45	0.00	14.29	19.61	32.45	0.00	15.01	20.37	32.45	0.00	14.29	19.61
5	16.94	16.94	11.11	8.09	17.11	17.35	11.54	9.00	16.94	18.37	11.28	8.11
6	17.37	17.37	9.86	6.50	17.51	17.93	10.26	8.21	17.37	17.37	10.41	6.51
7	9.11	9.11	6.96	4.41	9.58	9.63	9.02	5.21	9.22	9.33	7.20	4.58
8	9.67	9.69	4.14	3.76	11.18	10.76	8.80	6.71	9.78	9.77	4.70	4.04
9	6.95	6.99	2.68	3.22	8.28	8.41	5.43	6.96	7.07	6.98	2.72	3.52
10	4.64	4.66	3.52	3.36	6.47	6.21	7.54	6.91	4.70	4.64	3.78	3.30
11	4.24	4.27	2.53	2.31	7.13	7.79	5.62	4.65	4.76	4.38	2.89	2.26
12	4.78	4.82	2.42	1.94	7.00	12.85	6.11	3.86	5.56	5.32	2.78	2.23
13	2.55	2.58	2.87	2.53	3.85	5.01	5.94	5.80	2.85	3.14	3.54	3.49
14	3.95	3.86	2.80	2.80	7.12	7.50	6.97	6.56	5.02	5.35	3.73	4.04
15	2.40	2.37	3.60	3.02	3.81	4.07	7.74	6.61	3.24	3.36	5.10	4.61
16	2.72	2.72	4.62	3.36	4.47	5.33	15.60	7.62	3.99	4.19	8.87	5.31
17	6.03	6.20	5.55	3.63	9.08	13.64	17.59	9.38	9.34	11.98	11.99	6.26
18	7.69	7.21	4.24	3.87	13.58	15.43	11.20	10.45	11.69	13.41	6.89	6.83
19	6.87	6.84	5.40	3.95	16.49	11.72	20.34	11.45	18.03	10.19	11.90	8.14
20	5.65	5.65	7.31	6.77	8.97	7.49	20.01	17.78	10.18	9.21	15.27	12.96
21	9.73	0.00	11.78	10.69	33.81	0.00	30.60	22.55	17.10	0.00	24.72	18.37
Average	7.79	5.66	6.28	8.03	11	8.16	11.79	11.84	9.58	6.95	8.6	9.54

Tab 24: Lerner Index of main suppliers, by Quantile. Percentage Value. Two-Market, 2014

The Lerner indexes derived using eq. (3) shows clearly the suppliers exercised different degree of market power; When single market occurred GSE reported the lowest values, equal to 3.27% in the fourth quarter of 2013 while ENEL recorded the highest (equal to 35.92%) during the first semester of 2013. ENEL, the former monopolist, shows a sizable market power when there is not congestion but the extent of its Lerner index decreased over the period considered.

It needs to highlight that GSE's Lerner index has not been computed for the third quarter of 2013 and the whole 2014. It means that, given the dispatching priority recognized to renewable plants, TSO assumed that all GSE's bids have price equal to zero corresponding to a price-taker behavior.

Lerner indexes computed for each strategic suppliers were than aggregated between peak and off-peak hours. Not surprisingly, the indexes are higher during off-peak periods, when the electricity demand is more inelastic and wholesaler purchasers are not able to change their withdrawal programs necessary to run their production activities.

Moreover, during off-peak hours, the number of generators is lower and renewable plants, as photovoltaic plants, cannot generate electricity, reducing the degree of competition in the market.

It is significant to notice that the computed market power was higher when market was divided in two zones. It reveals that when maximum simultaneous competition was possible, that is when there was no congestion and the market was not split in two zones, competition forces worked to make other operators become more aggressive¹³. Moreover, congestions during peak hours may suggest that electricity is an essential commodity whose demand is stiff and whose consumption cannot be postponed.

¹³ These findings confirm the results reported in Bigerna et al. (2015) for the 2004-2007.

Tab 25: Average Lerner Index by Peak/Off-Peak Hours.

Year	2013		2014	
	Single	Two-market	Single	Two-market
peak	8.98	10.43	6.89	7.18
off-peak	11.03	11.17	7.94	7.63

Tab 26: Average Lerner Index by Quarters.

			1	2	3	4
2013	Single Market	Peak	6.72	11.68	5.02	10.15
		Off-Peak	9.20	12.15	16.30	6.63
	Two-Market	Peak	8.44	11.21	17.10	6.29
		Off-Peak	11.49	12.65	13.29	7.13
2014	Single Market	Peak	6.62	8.53	4.44	8.61
		Off-Peak	11.11	8.04	7.79	4.31
	Two-Market	Peak	8.11	8.70	5.85	6.04
		Off-Peak	8.94	8.96	6.63	5.80

Tab 27: Average Lerner Index, By Main Supplier.

	2013				2014			
	Single Market		Two Market		Single Market		Two Market	
	Peak	Off-peak	Peak	Off-peak	Peak	Off-peak	Peak	Off-peak
A2A	7.74	10.54	10.31	10.85	8.07	7.64	8.09	7.88
EDISON	10.98	15.88	12.17	13.71	10.56	10.55	10.13	10.33
ENEL	17.82	19.74	18.69	19.01	6.35	8.52	7.24	8.08
ENI	5.49	6.42	7.20	8.65	4.11	5.90	4.70	4.99
GDF SUEZ	8.11	9.78	9.45	10.92	7.61	8.36	7.31	8.43
GSE	5.33	4.85	5.84	7.65	-	-	-	-
SORGENIA	6.36	8.54	8.13	8.24	5.81	6.04	5.58	5.79

Following Cramton's approach (Cramton, 2004), the prices bid by the strategic firms were then adjusted using the estimates of their Lerner indexes (differing in the referring operator, quarter of the years and levels of price). The new prices are computed using the following formula:

$$p_{ihk}^{new} = p_{ihk}(1 - LI_{ik}) \quad (7)$$

Where i represents the operator, h represent the hour, while k refers to the quantile in which the price bid lies.

The formula allows to deurate the prices from the effect of market power shifting the supply down. Moreover, given different Lerner indexes, the adjusted prices change the economic merit order of suppliers: having changed the price bid by the suppliers, the new supply curves are constructed summing the offers in a non-decreasing price order different from the previous merit order.

Then, we cross the new supply curves with the demand in order to find the new market-clearing price for each hours of the 2013 and 2014. The difference between the old and the new marginal price are reported in Tab.28-Tab.31.

The differential is remarkable and, accordingly with the estimates of Lerner index, higher during off-peak hours. In the fourth quarter of 2014, for instance, at 0 a.m. this differential reached the 84%: starting from an average market-clearing price of 47 euro, if market became perfectly competitive, the new clearing price would be approximately near to 26 euro.

Tab 28: Comparison between the old and the new Market Clearing Price by Hour. Single Market. Quarter 1-2, 2013

2013						
	First Quarter			Second Quarter		
Hour	Old Market Clearing Price	New Market Clearing Price	%	Old Market Clearing Price	New Market Clearing Price	%
1	56.6	27.7	-51.2	64.3	31.0	-51.8
2	60.7	34.2	-43.6	52.4	28.1	-46.4
3	48.0	23.2	-51.6	50.5	27.4	-45.8
4	38.3	18.2	-52.5	43.8	25.1	-42.8
5	36.3	16.4	-54.9	40.8	24.9	-38.9
6	45.0	21.9	-51.4	45.1	26.3	-41.7
7	59.7	35.0	-41.4	56.2	29.8	-47.0
8	70.8	42.9	-39.4	74.3	36.0	-51.5
9	63.9	44.0	-31.1	73.9	45.9	-37.9
10	64.3	44.1	-31.3	59.3	33.3	-44.0
11	61.5	36.6	-40.6	55.1	31.6	-42.6
12	60.5	37.0	-38.7	50.6	27.4	-45.9
13	60.4	42.2	-30.0	22.2	13.5	-39.2
14	52.9	36.2	-31.6	21.7	12.2	-43.5
15	30.1	14.6	-51.6	29.2	15.3	-47.5
16	43.4	25.2	-42.0	37.0	20.4	-44.8
17	53.4	36.9	-31.0	48.1	28.2	-41.2
18	77.0	60.0	-22.0	54.6	29.3	-46.5
19	72.0	49.3	-31.5	66.1	37.4	-43.5
20	115.0	126.0	9.6	77.8	49.4	-36.5
21	80.0	57.3	-28.4	130.3	124.5	-4.4
22	72.5	43.4	-40.1	79.0	53.8	-31.8
23	64.8	42.7	-34.1	68.4	37.2	-45.6
24	60.5	39.7	-34.4	63.3	31.2	-50.7
Average	56.8	34.1	-42.1	56.8	34.1	-42.1

Tab 29: Comparison between the old and the new Market Clearing Price by Hour. Single Market. Quarter 3-4, 2013

2013	Third Quarter			Fourth Quarter		
	Hour	Old Market Clearing Price	New Market Clearing Price	%	Old Market Clearing Price	New Market Clearing Price
1	82.0	71.4	-13.0	59.4	37.6	-36.7
2	60.3	59.6	-1.2	58.1	36.3	-37.5
3	60.0	59.1	-1.6	50.2	31.3	-37.6
4	58.9	60.1	2.1	44.9	28.9	-35.7
5	58.3	59.4	1.8	43.0	28.0	-34.9
6	58.3	59.1	1.4	54.8	34.1	-37.8
7	61.1	60.9	-0.4	65.0	41.6	-36.0
8	65.5	63.8	-2.7	64.6	32.6	-49.6
9				64.2	42.4	-33.9
10	67.6	65.3	-3.3	62.3	39.3	-36.8
11	66.0	65.9	-0.2	62.0	38.9	-37.2
12	63.2	63.1	-0.2	53.7	33.4	-37.7
13	59.5	59.9	0.7	53.9	30.9	-42.8
14	60.0	60.6	1.0	54.9	31.0	-43.6
15	62.7	61.8	-1.5	61.9	39.2	-36.7
16	62.9	61.6	-2.1	61.1	40.2	-34.2
17				60.4	36.4	-39.8
18				94.0	77.3	-17.7
19				68.0	39.3	-42.2
20						
21				64.4	37.1	-42.4
22						
23				62.1	35.8	-42.4
24				57.7	30.7	-46.9
Average	63.1	62.1	-1.3	60.0	37.4	-38.2

Tab 30: Comparison between the old and the new Market Clearing Price by Hour. Single Market. Quarter 1-2, 2014

2014 Hour	First Quarter			Second Quarter		
	Old Market Clearing Price	New Market Clearing Price	%	Old Market Clearing Price	New Market Clearing Price	%
1	48.1	26.7	-7.5	49.9	23.3	-53.4
2	41.6	22.2	-11.8	38.0	16.0	-57.8
3	32.9	15.7	-14.8	33.7	14.6	-56.8
4	27.5	12.7	-18.8	32.4	14.7	-54.6
5	29.1	13.6	-17.8	33.5	14.8	-55.7
6	34.8	17.6	-15.8	41.4	18.1	-56.2
7	51.2	31.7	-10.8	46.3	18.7	-59.6
8	55.2	32.6	-3.9	65.1	38.8	-40.4
9	54.0	32.6	-6.4	59.0	38.1	-35.4
10	66.6	45.7	-1.9	54.3	28.6	-47.3
11	55.7	33.5	-4.5	43.7	18.3	-58.1
12	49.1	31.2	-14.5	44.3	18.3	-58.6
13	45.8	24.6	-7.9	39.5	16.2	-58.9
14	44.3	27.4	-17.4	36.3	16.0	-56.0
15	48.4	31.3	-16.3	39.5	16.4	-58.6
16	45.7	27.4	-14.3	38.3	15.1	-60.6
17	62.3	37.4	2.2	43.0	17.4	-59.6
18	63.6	41.9	-2.3	45.8	17.9	-60.8
19	74.0	45.9	12.0	50.9	19.7	-61.3
20	79.6	50.2	16.6	56.9	28.2	-50.4
21	63.1	40.7	-1.4	71.4	43.5	-39.1
22	62.3	37.8	1.7	55.4	23.4	-57.7
23	56.3	31.4	0.5	49.4	19.3	-60.8
24	50.2	26.9	-3.3	46.2	25.6	-44.6
Average	51.7	30.8	-6.6	46.4	21.7	-54.3

Tab 31: Comparison between the old and the new Market Clearing Price by Hour. Single Market, Quarter 3-4, 2014

2014	Third Quarter			Fourth Quarter			
	Hour	Old Market Clearing Price	New Market Clearing Price	%	Old Market Clearing Price	New Market Clearing Price	%
	1	49.1	20.4	-58.4	45.4	25.1	-81.0
	2	47.5	18.1	-62.0	41.4	22.6	-83.2
	3	50.5	17.3	-65.7	40.3	23.0	-75.1
	4	46.7	16.3	-65.0	36.5	20.5	-78.3
	5	46.2	16.3	-64.6	37.9	21.2	-78.3
	6	48.7	18.2	-62.7	41.1	22.7	-80.8
	7	58.8	34.7	-40.9	56.3	33.7	-67.0
	8	51.0	20.4	-59.9	59.6	33.3	-79.1
	9				67.1	41.5	-61.8
	10	130.0	130.0	0.0	66.2	43.4	-52.6
	11				63.6	40.4	-57.5
	12				62.6	42.5	-47.3
	13	53.4	26.7	-50.0	60.5	35.5	-70.3
	14	53.4	34.9	-34.7	59.7	35.6	-67.7
	15	57.6	46.1	-19.9	62.1	37.4	-65.9
	16	58.3	46.2	-20.6	66.5	42.8	-55.6
	17	50.6	26.7	-47.3	73.9	55.9	-32.1
	18	95.0	70.1	-26.3	77.6	54.9	-41.3
	19	135.1	135.1	0.0	80.8	56.9	-41.9
	20				73.7	47.2	-56.1
	21				60.3	37.9	-58.8
	22						
	23				54.7	30.1	-81.7
	24	49.0	20.3	-58.5	47.9	26.0	-84.4
Average		63.6	41.0	-43.3	58.1	36.1	-65.1

The graphs below show some examples of market resolutions and compare the old equilibrium with the new one, where the market supply curve shifted down by the effect of Lerner index. The comparison has been performed for all the quarters of 2013 and 2014 and focused on two hours of the day (2 a.m. and 2 p.m.), one referring to peak period and the other concerning the off-peak one.

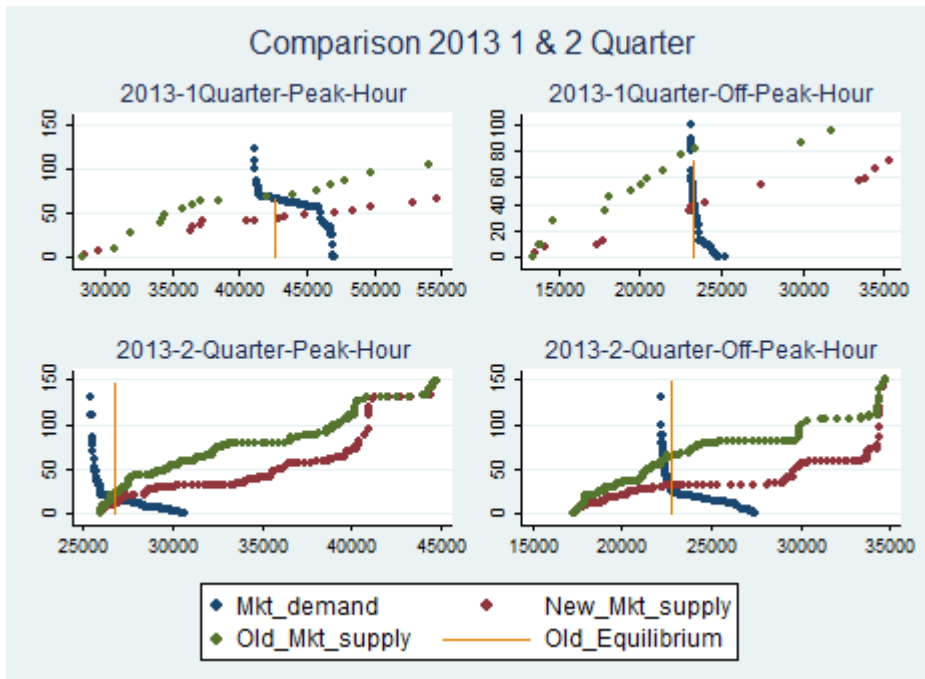


Fig. 1: Comparison between market clearing prices. Quarter 1-2, 2013.

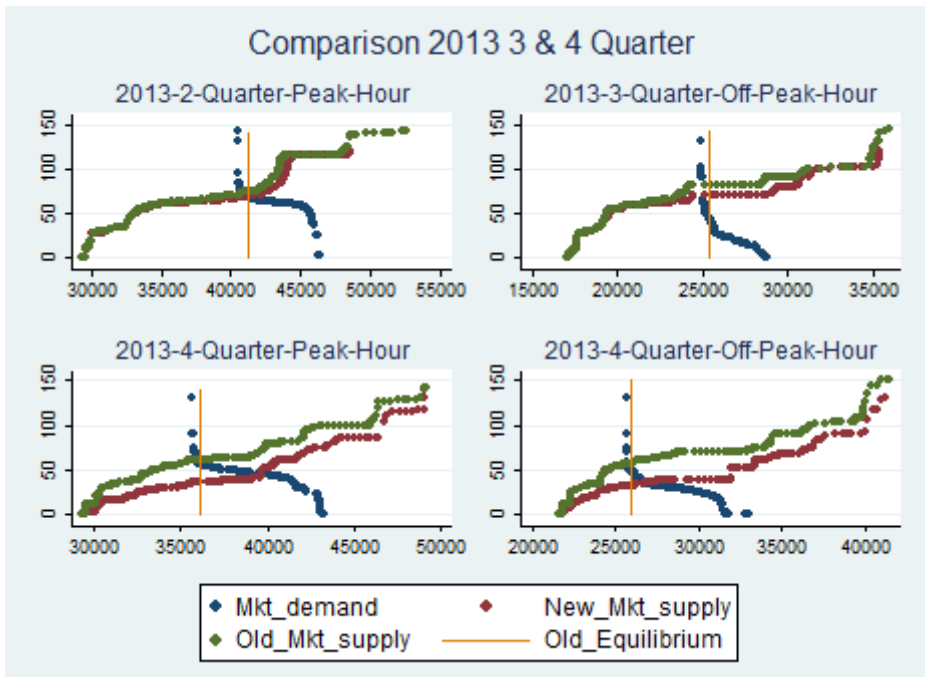


Fig. 2: Comparison between market clearing prices. Quarter 3-4, 2013.

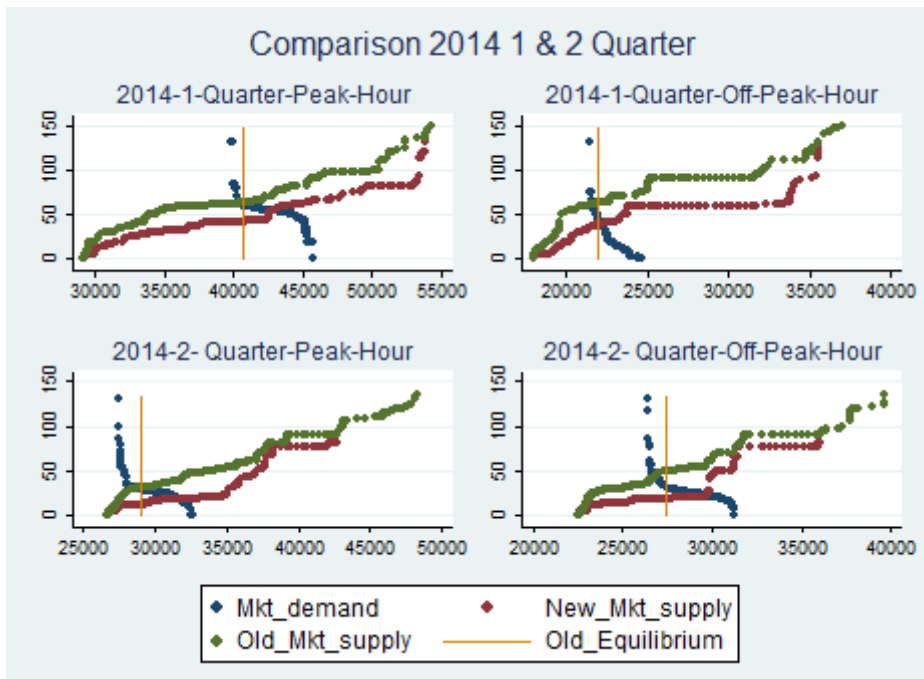


Fig. 3: Comparison between market clearing prices. Quarter 1-2, 2014.

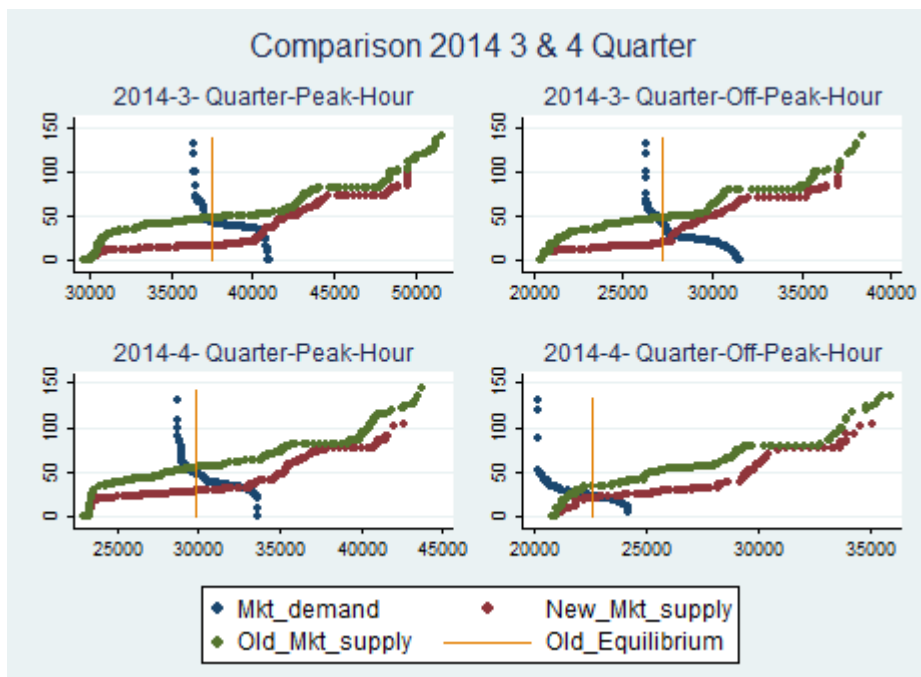


Fig. 4: Comparison between market clearing prices. Quarter 3-4, 2014.

Graphs highlight how the adjusting the market from the effect of market power results in lower equilibrium price given the shifting of supply curve. As the elasticity of market demand is not significant, the new market resolution do not involve an increase in the volumes traded.

In this paper the price differential was computed only for the hours when single market occurred, since the effects of congestion on the demand side has not been investigated and deserved to be analyzed in further researches.

5. CONCLUSION

This paper addressed the issue of computing a virtual competitive market equilibrium in the Italian wholesale electricity market for the 2013 and the 2014 using the hourly data provided by GME. Lerner index was taken as a measure of the market power exercised by the main suppliers, taking into account the effect of congestion, to compute the competitive virtual bidding behavior of the main market operators.

The results of the Lerner index computation clearly show that firms exercised different market power and ENEL, the former state-owned monopolist, reported the higher index. Moreover, market power is higher when transmission constraints are not violated and during the off-peak hours, when the number of generators is lower and consumers' demand is more inelastic since electricity is an essential commodity whose consumption can not be postponed.

The Lerner indexes were then used to adjust the prices bid by the strategic competitors and construct the new market supply curve depurated by the market power effects. The simulated market resolutions clearly show how the new marginal prices (PUN) are lower since the removed mark-up (the market power of each firm) made supply curves shift down.

REFERENCE

- Bigerna S., Bollino C.A. and Polinori P. (2015) "Market Power and Transmission congestion in the Italian Electricity Market". *Energy Journal* 37(2): 133-154.
- Borenstein S., Bushnell J. B. and Wolak F. A. (2002). "Measuring market inefficiencies in California's restructured wholesale electricity market". *American Economic Review*, 92(5): 1376-1405.
- Bosco B., Parisio L. and Pelagatti M. (2012). "Strategic Bidding in Vertically Integrated Power Markets with an application to the Italian Electricity Auctions". *Energy Economics*, 34(6): 2046-2057.
- Bresnahan T. F. Empirical studies of industries with market power, in: Schmalensee R. and Willig R., *Handbook of Industrial Organization*, vol. II. Elsevier, Amsterdam, 1989.
- Cardell J. B., Cullen Hitt C. and Hogan W. W. (1997). "Market power and strategic interaction in electricity networks." *Resource and Energy Economics*, 19(1-2): 109-137.
- K. S. Corts. (1999). Conduct parameters and the measurement of market power. *Journal of Econometrics*, 88(2):227-250.
- Cramton P. (2004). "Competitive Bidding Behavior in Uniform-Price Auction Markets". Published in the Proceedings of the Hawaii International Conference on
- D'Errico M. C. and Bollino C. A. (2015). "Bayesian Analysis of Demand Elasticity in the Italian Electricity Market. *Sustainability* 7:12127-12148.
- Kim D. and Knittel C. R. (2006). "Biases in static oligopoly models? Evidence from the California electricity market". *Journal of Industrial Economics*, 54(4): 451-470.
- Lo Prete C., Hobbs B. F. (2015). "Market power in power markets: an analysis of residual demand curves in California's day-ahead market (1998-2000)". *The Energy Journal*, 36(2): 191-218.

Mei B. and Sun C. (2008). "Assessing Time-Varying Oligopoly and Oligopsony Power in the U.S. Paper Industry". *Journal of Agricultural and Applied Economics* 40(3).

Muhammad A. "Measuring the Degree of Monopsony Power in the EU Fish Importing Industry: Implications for Ugandan Fresh and Chilled Fish Fillet Exports". *Southern Agricultural Economics Association* n. 35455. Annual Meeting, February 5-8, 2006, Orlando, Florida.

Muratori M., Schuelke-Leech B.A., Rizzoni G. (2014). "Role of residential demand response in modern electricity markets". *Renewable and Sustainable Energy Reviews* 33: 546-553.

Murray B. C. (1995). "Measuring Oligopsony Power with Shadow Prices: U.S. Markets for Pulpwood and Sawlogs". *The review of Economics and Statistics*, 77(3): 486-498.

Sweeting A. (2007). "Market power in the England and Wales wholesale electricity market 1995-2000". *The Economic Journal*, 117: 654-685.

Wolfram C. D. (1999). "Measuring duopoly power in the British electricity spot market". *American Economic Review*, 89(4): 805-826.

Wolak F. A. (2003). "Measuring Unilateral Market Power in Wholesale Electricity Markets: the California Market, 1998-2000." *American Economic Review*, 93(2):425-430.

Wolak F. A. (2000). "An empirical analysis of the impact of hedge contracts on bidding behavior in a competitive electricity market". *International Economic Journal*, 14(2): 1-39.

Wolak F. A. Identification and estimation of cost functions using observed bid data: an application to electricity markets, in: M. Dewatripont, L. P. Hansen and S. J. Turnovsky (Eds.), *Advances in Economics and Econometrics: Theory and*

applications, Eight World Congress, Vol. II. Cambridge University Press, Cambridge, 2003.

Wolak, F. A. (2009). "Report on Market Power Performance and Market Monitoring in the Colombian Electricity Supply Industry." Document available online at: http://web.stanford.edu/group/fwolak/cgi-bin/sites/default/files/files/sspd_report_wolak_july_30.pdf