UP School of Economics
Discussion Papers

Discussion Paper No. 2009-09 September 2009

Market Power in the Philippine Power Market

by

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Abstract

The Philippine electricity market is in a period of transition as the restructuring provisions of the Electric Power Industry Reform Act (EPIRA) of 2001 are being implemented. Under current structure, the market is highly concentrated, indicating the existence of market power. In addition, many plants, including small ones, become pivotal suppliers during peak hours, creating opportunities for the exercise of market power. Concentration in the spot market is even more pronounced as a large percentage of uncontracted capacity belongs to the Independent Power Producers (IPP) with NPC contracts whose energy outputs are under the control of a single company, the Power Sector Assets and Liabilities Management Corporation. This highlights the urgency of speeding up the dominance mitigating provision of EPIRA, namely, the appointment of independent IPP administrators who will trade the IPP outputs in the wholesale market.

MARKET POWER IN THE PHILIPPINE POWER MARKET

1. INTRODUCTION

The delivery of electricity has four components: (1) generation at power plants, (2) transmission through overhead high-voltage wires to stations near population centers, (3) distribution through low-voltage wires to its users, and (4) retail consisting of metering, billing, and collection of payments[1]. These components were bundled and managed as a vertically integrated monopoly because (a) it was argued that integration could lower the costs of operations and (b) electrical equilibrium[2] required by the electrical network could be effectively managed by a single company. This meant that government regulation was necessary; in fact, the government in many countries owned the monopoly. Under this setup, the price of electricity was regulated and because electricity was regarded as a basic commodity which should be accessible to all people, some governments made electricity available with government subsidy.

This was the model of the electricity industry (with some variations in different countries[3]) until 1978 when Chile pioneered the idea of introducing competition in the generation sector. But the first substantial and wide-ranging reform of the electricity industry took place in 1990 when the United Kingdom split its power stations into two competing companies, privatized most of the industry, allowed large consumers direct access to the grid, allowed generators free entry to the industry, opened access to the transmission lines, and established the wholesale electricity pool. More countries and states soon followed, including, among others, Norway (1990), Argentina (1992), Singapore (1995), California (1996), Spain (1997), Australia (1998) and the Philippines (2001). Although reforms varied from country to country in extent and market design, they were all instituted to shift from the monopolistic to a competitive structure. A common feature of electricity industry restructuring is the establishment of the wholesale electricity market.

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[1] It is not unusual to list only three components since retail has traditionally been a part of distribution.

[2] Electrical equilibrium means that production and consumption of electricity must be equal at all times.

[3] In the Philippines, generation and transmission were operated by the state-controlled National Power Corporation (NPC) while distribution and retail were operated by privately owned companies such as MERALCO.

2. THE WHOLESALE ELECTRICITY MARKET

The **wholesale electricity market** (or **competitive pool**) was created to introduce competition in the **generation** component of the electricity industry. It is an auction market for the bulk trading of electricity where generators compete to sell electricity in a centralized pool and distributors and bulk consumers buy from the pool. The competitive pool may be organized as a gross pool (or mandatory pool), which is to say that all generators are required to sell all their electricity outputs in the pool and all buyers of electricity buy from the pool (e.g., Argentina and the Philippines). This market design allows financial bilateral contracts between buyers and sellers as hedges against the volatility of spot price outcomes but the physical flows of power are all within the pool. In contrast, buyers and sellers in a net pool (or voluntary pool) can enter into physical bilateral trading of electricity outside the pool (e.g., Spain and California). But whether the pool is mandatory or voluntary, pool price is determined by similar auction rules.

2.1. Price Determination in the Wholesale Electricity Market

In a competitive pool, generators compete to supply electricity by submitting price-quantity offers indicating the amount of electricity they are willing to generate at various prices during a trading period. The Market Operator (MO) arranges these offers in a supply curve by increasing order of price (called the merit order). The buyers compete to purchase electricity through price-quantity bids which are arranged by the MO in a demand curve by decreasing order of price. For each trading period, the MO determines the equilibrium price-quantity pair, being the intersection of the supply and demand curves. The equilibrium price, also called the market-clearing price, sets the system market price for the trading period. If the market is designed as a uniform price auction market, as in the Philippines, then all winning supply offers are paid the system market price.

In some wholesale electricity markets, (e.g., the Philippines) demand side bidding is not developed. In this case, the Market Operator (MO) forecasts total load [4], say Q_0, and uses the vertical line $Q = Q_0$ as the demand curve. The MO then proceeds to dispatch supply offers in increasing order of price and the last offer dispatched to meet the forecasted load sets the system market price. To illustrate (see Figure 1), let the forecasted load be Q_0. Starting with the lowest bid price P_1, the MO uses up all quantities offered at price P_1. Then he goes to the next lowest price P_2 and uses up all quantities offered at P_2. He continues in this fashion and ends at the highest price P_k when Q_0 is fully covered. The market-clearing price P_k is the system market price that every seller will receive and every buyer will pay.

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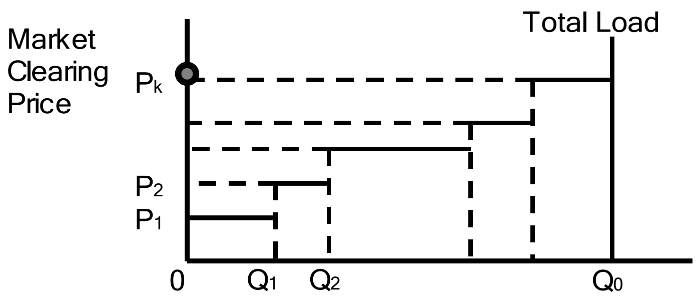
[4] "Load" is the electricity industry term for quantity demanded.

Figure 1. Price Determination in the Wholesale Electricity Market with No Demand Side Bids



The generators supplying electricity are usually located far from the demand areas. This means that the costs of providing electricity to different locations (nodes[5]) differ due to different transmission capacity constraint conditions and different transmission losses. Therefore, the system market price is adjusted to reflect transmission congestion and transmission losses, resulting in nodal prices.[6]

2.2. Special Characteristics of the Electricity Market

As a commodity, electricity has certain characteristics that other commodities do not possess. First, electricity cannot be stored (or very costly to store) in large quantities; hence, no inventory is available as an alternative supply source. Second, the production and consumption of electricity must be balanced at every point in time. Third, demand is price inelastic, i.e., there is very little real-time demand response to price changes. Fourth, supply is capacity constrained and significant additions to supply still require substantial lead times. These unusual characteristics of the electricity market make it highly susceptible to the exercise of market power.

3. MARKET POWER

Market power is the ability of a firm, or group of firms acting together, to raise prices above competitive levels. Market power abuse happens when this power is exercised to raise prices through manipulation. Why is the exercise of market power of great concern?

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[5] A node is a point in the electrical network where electricity is either supplied to or withdrawn from the network.

[6] Chile, Argentina, and the Philippines use nodal pricing. In zonal pricing, nodes are grouped into zones (e.g., Norway, California).

The stakes are enormous as value added in the electricity industry is substantial. For example, in 2005, value added in the electricity industry in the Philippines was estimated at P148.1 billion which accounted for 2.7% of the Gross Domestic Product (NSO [2007]; NSCB [2008]). In such a market, any exercise of market power can result in large wealth transfers from consumers to producers of electricity. Moreover, such transfers can occur within very short periods of time (see Wolak [2000] for the California example).

3.1. Capacity Withholding: A Strategy for Exercising Market Power

One of the strategies for exercising market power is to reduce the supply of electricity through physical or economic withholding of capacity. Physical withholding refers to the reduction of the supply of electricity by declaring an outage or by simply refusing to generate electricity. To prevent physical withholding, some markets (e.g., the Philippines) prescribe a "must offer" rule which requires every generator to offer its maximum available capacity. Despite this rule, it is still possible to withhold capacity by economic withholding. This is done by offering a block of electricity at a price sufficiently high that it will not be dispatched. The effect is, of course, the same as that of physical withholding.

The following example shows how a generating company can increase its profits by withholding some of its capacity from the market. Let the total load be 5000 MW. Suppose there are only three generators and their available capacities and offered prices are as given in Table 1.

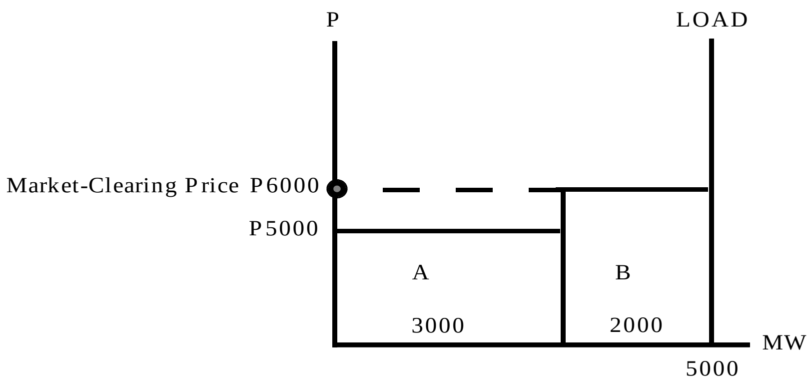
Table 1. Generators' Price-Quantity Offers (Without Capacity Withholding)

Generator	Offered Capacity* (MW)	Offered Price (Per MWh)
Genco A	3000	₱5000
Genco B	2000	₱6000
Genco C	1000	₱7000
*Without capacity withholding, offered capacity = available capacity.		

Assume that it costs Genco A ₱4000/MWh to produce electricity and the generators offer all of their available capacities. The merit order resulting from Table 1 is given by the following dispatch schedule (see Figure 2):

		Dispatched Capacity	Bid Price
1.	Genco A	3000	₱5,000/MWh
2.	Genco B	2000	₱6,000/MWh (Market Clearing Price)
3.	Genco C	0	

Figure 2. Merit Order (Without Capacity Withholding)



The market clears at ₱6,000/MWh and Genco A makes a profit of ₱2000/MWh for a total profit of (3000)(₱2000) = ₱6,000,000.

Suppose that Genco A withholds 900 MW and offers 1800 MW at the same price of ₱5,000/MWh and 300 MW at ₱10,000/MWh. The other suppliers keep the same offers. The price-quantity offers are given in Table 2.

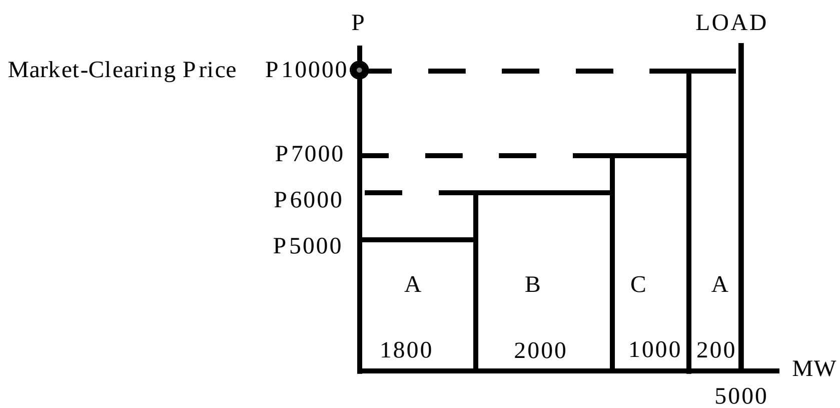
Table 2. Generators' Price-Quantity Offers (With Capacity Withheld)

Generator	Offered Capacity (MW)	Offered Price (Per MWh)
Genco A	1800	₱5000
	300	₱10000
Genco B	2000	₱6000
Genco C	1000	₱7000

The merit order resulting from Table 2 (see Figure 3) is given by the following dispatch schedule:

		Dispatched Capacity	Bid Price
1.	Genco A	1800	₱5,000/MWh
2.	Genco B	2000	₱6,000/MWh
3.	Genco C	1000	₱7,000/MWh
4.	Genco A	200	₱10,000/MWh (Market Clearing Price)

Figure 3. Merit Order after Capacity Withholding



The market clears at ₱10,000/MWh and Genco A makes a profit of ₱6000/MWh for a total profit of (2000)(₱6000) = ₱12,000,000, doubling its profit. Note that the other generators also benefit from Genco A's strategy.

3.2. Detection of Market Power

In view of the susceptibility of electricity markets to the exercise of market power, it is important to monitor the market and try to detect the existence of market power. Detection of market power distinguishes between detection of the *potential* for market power and detection of the *actual exercise* of market power.

3.2.1. Detection of the Potential for Market Power

The Single-Firm Market Share Concentration Ratio

Until 2001, concentration measures were used as the main tool for determining the existence of market power - the more concentrated a market, the more likely is the ability of its players to exercise market power. The most concentrated market is, of course, the monopoly which sells 100% of the industry's output. If the industry has more than one firm, then the firms' market shares are used to indicate concentration. The market share of a firm is called the **single-firm market share concentration ratio**. The question is: what level of market share should raise concerns about the existence of market power?

There is no widely accepted critical value for the market share level. The US Federal Energy Regulatory Commission (FERC), up until 2001, used 20% or less as market shares that indicate lack of market power (Borenstein [2002]). In 2004, FERC used a market power test based on the market share of uncommitted capacity and adopted a 20% threshold, i.e., a supplier with less than 20% share of uncommitted capacity passed the test (FERC [2004]). In the Philippines, the Electric Power Industry Reform Act (EPIRA) provides that "to promote true market competition and prevent harmful monopoly and market power abuse, the Energy Regulatory Commission (ERC) shall enforce the following safeguards: (a) No company or related group can own, operate or control more than 30% of the installed generating capacity of the grid and/or 25% of the national installed generating capacity".

These benchmarks appear to be large since there is empirical evidence that in electricity markets generation owners with small market shares (e.g., 6%-8%) have exercised market power (Borenstein [2002]). Later in this section, we give a hypothetical example of a market where a generator with 10% share of the market has market power. In fact, data from the Philippine WESM show that during peak hours a small-sized generator can acquire market power when supply is tight (see Section 5).

The Herfindahl - Hirschman Index

Market concentration does not only depend on the number of firms in the industry but also on the sizes of the firms. Ten firms with one firm controlling 50% of the market is definitely more concentrated than ten firms of equal size. Therefore, a good measure of concentration should reflect the number of firms and the distribution of the sizes of the firms. One such measure is the Herfindahl-Hirschman Index.

Let n be the number of firms in the market and s_i the percentage share of firm i. Then the **Herfindahl - Hirschman Index (HHI)** is defined as

$$\text{HHI} = \sum_{i=1}^{n} s_i^2$$

For the most concentrated industry, the monopoly, $s_1 = 100$; hence, HHI = 10,000. As the number of firms increases, HHI decreases. This is easily seen in a market consisting of n firms of equal size. In this case, $s_1 = s_2 = \cdots = s_n = 100/n$ and

$$\text{HHI} = \left(\frac{100}{n}\right)^2 + \left(\frac{100}{n}\right)^2 + \cdots + \left(\frac{100}{n}\right)^2 = n\frac{10000}{n^2} = \frac{10000}{n}$$

As *n* increases, HHI decreases. When *n* is large HHI is close to zero.

Most electricity markets have adopted the following thresholds established by the US Department of Justice and adopted by FERC to describe levels of concentration using HHI:

Table 3. Levels of Concentration Using HHI

Highly Concentrated	$1800 < \text{HHI}$
Moderately Concentrated	$1000 < \text{HHI} \leq 1800$
Unconcentrated	$\text{HHI} \leq 1000$

Remark. There is a tendency for regulators to assume that market power is absent in unconcentrated markets as defined in Table 3. This assumption is not justified as the following example shows.

Example. Consider a market with only 10 suppliers, each with a capacity of 1100 MW for a total supply of 11,000 MW. Each supplier controls only 10% of the market and HHI = $10\text{x}(10)^2$ = 1000, indicating an unconcentrated market. Suppose that at peak hours, total load is 10,000 MW. Then any 9 suppliers cannot meet the load since 9x1100 = 9900, 100 MW shy of total load. Every supplier is needed to meet the demand; consequently, every supplier has monopoly power over the 100 MW residual demand. Thus, it is possible to exercise market power in unconcentrated markets as defined in Table 3. When a supplier is needed to meet the demand, it becomes a pivotal supplier.

The Pivotal Supplier Indicator

A supplier is said to be **pivotal** if the other suppliers cannot meet the demand. Thus a pivotal supplier has monopoly power over the residual demand, that portion of the demand which cannot be covered by the other suppliers. The Pivotal Supplier Indicator was developed by Bushnell et al. [1999])[7] to indicate when a supplier is pivotal.

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[7] Bushnell et al. called this indicator the Pivotal Supplier Index.

Let

S = total supply

S_i = supply of supplier i

D = total demand

The **pivotal supplier indicator** for supplier i, denoted by PSI_i, is defined as

$$PSI_i = \begin{cases} 0, & if\ S - S_i \geq D \ (i \text{ is not pivotal}) \\ 1, & if\ S - S_i < D \ (i \text{ is pivotal}) \end{cases}$$

The Pivotal Supplier Frequency Index

Bushnell et al. [1999] also defined the Pivotal Supplier Frequency Index over a period of time (e.g., 24 hours) to indicate the frequency which a supplier achieves pivotal status. Let

S_h = total supply at hour h

S_{ih} = supply of supplier i at hour h

D_h = total demand at hour h

$h = 1,2, \ldots, H$ (H is the number of hours in the period of interest)

Define the pivotal supplier indicator of supplier i at hour h as

$$PSI_{ih} = \begin{cases} 0, & if\ S_h - S_{ih} \geq D_h \ (i \text{ is not pivotal at hour } h) \\ 1, & if\ S_h - S_{ih} < D_h \ (i \text{ is pivotal at hour } h) \end{cases}$$

Thus the sum $\sum_{h=1}^{H} PSI_{ih}$ counts the number of times i is a pivotal supplier during the period $h = 1,2, ..., H$.

The **pivotal supplier frequency index** for supplier i ($PSFI_i$) during the period ($h = 1,2, \ldots, H$) is defined as

$$PSFI_i = \frac{\sum_{h=1}^{H} PSI_{ih}}{H} \times 100 = \frac{\text{number of times } i \text{ is a pivotal supplier}}{H} \times 100$$

Thus, the higher the Pivotal Supplier Frequency Index the more frequent the supplier achieves pivotal status, providing the supplier with more opportunities to exercise market power.

3.2.2. Detection of the Exercise of Market Power

The Lerner Index

The **Lerner index**, denoted by L, is based on the price-cost margin and is defined as

$$L = \frac{P - MC}{P}$$

where P = price and MC = marginal cost. The motivation for the use of the price-cost margin is that in competitive markets, price-takers should offer at marginal cost. Hence, the difference between a generator's offer and its marginal cost is a measure of the exercise of market power. It turns out that the Lerner index is related to the HHI in a Cournot market.

The Lerner Index under Cournot Competition

A Cournot market is one where firms maximize their profits by choosing quantities of output and price is determined by the demand function. Suppose that there are n firms and let

Q = total industry output
$P(Q)$ = the industry demand function
Q_i = output of firm i
$C_i(Q_i)$ = cost function of firm i
L_i = Lerner index of firm i

It can be shown (Tirole [1992]; see also Appendix A) that

$$L_i = \frac{s_i *}{\varepsilon}$$

where ε is the price elasticity of demand and $s_i* = Q_i /Q$. Thus, the larger a firm's market share or the more inelastic the demand the greater is its market power. Under a monopoly ($s_i* = 1$) the Lerner index depends only on the price-elasticity of demand. Under perfect competition, $P = dC_i /dQ_i = MC_i$; hence, the Lerner index is zero. In a Cournot market, the Lerner index is positive, hence, $P > MC_i$. We also note that in a Cournot market with n firms of equal size (i.e., $s_i* = 1/n$), we have $L_1 = L_2 = \cdots = L_n = L$:

$$L = L_i = \frac{s_i *}{\varepsilon} = \frac{1/n}{\varepsilon} = \frac{10000/n}{10000\varepsilon} = \frac{\text{HHI}}{10000\varepsilon}$$

Hence, $$\text{HHI} = 10000\varepsilon L$$

In the case where firms have different sizes, HHI can be shown to be equal to the product of the price elasticity of demand and the weighted average of the Lerner indices of the firms, the weights being the market shares (Tirole [1992]; see also Appendix B):

$$\text{HHI} = 10000\varepsilon \sum_{i=1}^{n} s_i * L_i$$

We summarize the relationships between the Lerner Indices for the monopoly, Cournot oligopoly, and perfect competition:

Monopoly		Cournot Oligopoly		Perfect Competition
$\frac{1}{\varepsilon}$	>	$\frac{s_i *}{\varepsilon}$	>	0

A practical obstacle to the use of the Lerner index is that it is not easily calculated because it requires knowledge of either the marginal cost of the firm or the price elasticity of demand, both of which are not readily available.

4. MARKET CONCENTRATION AT THE PHILIPPINE WESM

Calculating measures of concentration in an electricity market can be tricky. The problem lies in the choice of the capacity measures upon which market shares are calculated. Market shares may be based on registered capacity (rated capacity), available capacity, offered capacity, or generated capacity. Registered capacity refers to the rated capacity (quantity of electricity that a generating unit can produce) as declared by its owner when the unit is registered at WESM. If a trader owns or controls several generating units, then available capacity refers to total registered capacity less capacity on outage. Offered capacity is the total quantity of electricity offered by a trader during a trading period. Generated capacity is the quantity of electricity actually produced by a generating unit during a trading period. In addition to these types of classification, it is important to monitor uncommitted capacity - the capacity left over after removing bilaterally contracted capacity - because it is the stuff of the spot market.

In calculating measures of concentration at WESM we must first clarify the role of the Power Sector Assets and Liabilities Management (PSALM) Corporation as a trader in the market. PSALM acquired the National Power Corporation (NPC) contracts with Independent Power Producers (IPPs) and is, therefore, managing (hence, trading) the energy outputs of these IPPs. So for all practical purposes, PSALM owns and controls the IPP generators' outputs[8]. We shall refer to these IPPs as PSALM IPPs.

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[8] In fact, PSALM is considered a generation company by Sec. q of the Implementing Rules and Regulations of EPIRA .

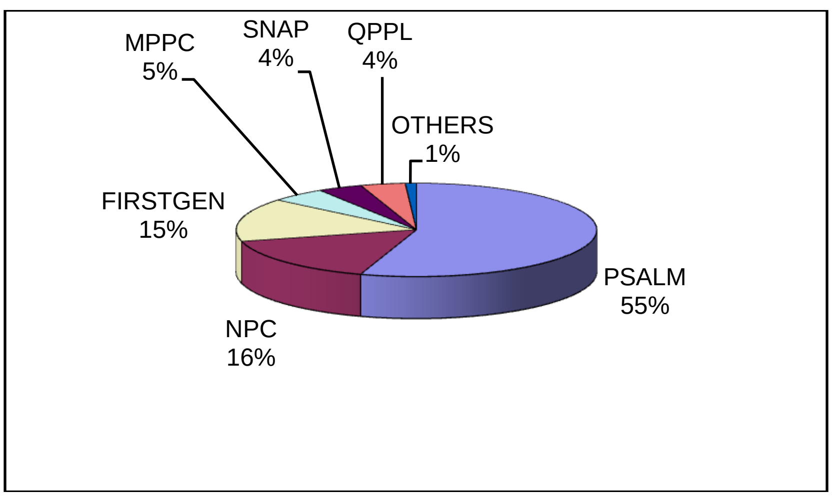
Table 4 shows the sellers at WESM as of July 21, 2008. A large part (71%) of the capacity registered at WESM was controlled by the government, represented by PSALM (55%) and NPC (16%). (In fact, under EPIRA, the generators whose electricity outputs are traded by NPC at WESM are now owned by PSALM.) The remaining 29% of the registered capacity was split among First Gen IPPs (15%), Masinloc Power Partners Corp (5%), SN Aboitiz Power (4%), Quezon Power (Philippines) Ltd. (4%) and others (1%) (Figure 4). Based on Table 4, HHI = 3549 indicating a highly concentrated market.

Table 4. Registered Capacity Controlled by Sellers at WESM (7/21/2008)

Company	Registered Capacity (MW)	Share (%)	$(Share)^2$
1. PSALM (Power Sector Assets and Liabilities Management) Corp*	6215.8	54.88	3011.81
2. NPC (National Power Corp)**	1785.7	15.76	248.38
3. FIRST GEN IPPs (Excludes BPPC, a PSALM IPP)	1699.3	15.00	225.00
4. MPPC (Masinloc Power Partners Corp)	610.0	5.39	29.05
5. SNAP (SN Aboitiz Power)	480.0	4.24	17.98
6. QPPL (Quezon Power (Philippines) Ltd.)	459.0	4.05	16.40
7. TAPGC (Trans-Asia Power Generation Corp)	50.0	0.44	0.19
8. NORTHWIND	27.0	0.23	0.05
TOTAL	11326.8	100.00	HHI = 3549
*PSALM sells the output of the IPPs with NPC contracts. **Includes Batangas (Calaca) CFTPP (660 MW), Makban GPP (454 MW), and Tiwi GPP (275.7 MW), which were privatized but have not been turned over to the winning bidders.			

Source of basic data: MAG-PEMC

Figure 4. Control of Capacity in the Luzon Grid Registered at WESM (7/21/2008)



4.1. Trading Teams

When WESM started its commercial operations on June 26, 2006, PSALM and NPC controlled about 55% and 22%, respectively, of the generation capacity registered with WESM making these government agencies the dominant players in the wholesale market with considerable market power. To mitigate this dominance and enhance competition, the PSALM IPPs were to be grouped, each group being assigned to an IPP Administrator, an independent entity to be appointed by PSALM Corporation to manage the energy output of those plants. However, at the start of WESM commercial operations, these IPP Administrators were not in place, making PSALM an interim IPP Administrator controlling more than 30% of the installed capacity in the Luzon Grid. This appeared to go against Paragraph 45(a) of EPIRA which provides that "no company or related group can own, operate or *control* more than thirty percent (30%) of the installed generating capacity of a grid and/or twenty-five percent (25%) of the national installed generating capacity." But PSALM and NPC are exempt from this provision by virtue of Rule 11, Sec. 4 of the EPIRA Implementing Rules and Regulations (EPIRA IRR [2002]).

The exemption, however, does not erase the dominance of PSALM and NPC at WESM which goes against the main objective of EPIRA namely, to promote competition. This is probably the reason why the idea of independent trading teams within PSALM and NPC that compete with each other had to be devised[9]. PSALM initially split its IPPs into four trading teams. NPC outdid PSALM by creating a trading team for each plant and had nine trading teams at the start of WESM commercial operations. As of July 21, 2008, PSALM had merged its trading teams into three and NPC gave up four teams to privatization. The trading teams as of July 21, 2008 are shown in Table 5 which shows an HHI of 1353, indicating a moderately concentrated market.

Table 5. Trading Teams at WESM (7/21/08)

Trading Team	Registered Capacity (MW)	% Share	$(\text{Share})^2$
1. PSALM Trading Team 1	2021.0	17.84	318.26
2. PSALM Trading Team 2	2551.0	22.52	507.15
3. PSALM Trading Team 3	1643.8	14.51	210.54
4. ANGAT HEP (NPC)	246.0	2.17	4.71
5. BINGA HEP (SNAP Benguet)	100.0	0.88	0.77

9 There is some debate about the effectiveness of this set-up because a company's trading teams that compete with each other and the company's management have inherently conflicting objectives. Moreover, as hired traders, it is possible for trading teams to be influenced by the managers.

6. MASINLOC CFTPP (Masinloc Power Partners)	610.0	5.39	29.05
7. BACMAN GPP (NPC)	150.0	1.32	1.74
8. BATANGAS CFTPP (NPC)	660.0	5.83	33.99
9. MAKBAN GPP (NPC)	454.0	4.01	16.08
10. TIWI GPP (NPC)	275.7	2.43	5.90
11. FGHC (First Gas Holdings Corp)	1587.3	14.01	196.28
12. QPPL (Quezon Power Philippines Ltd)	459.0	4.05	16.40
13. MAGAT (SN Aboitiz Power)	380.0	3.35	11.22
14. FGHPC (First Gen Hydro Power Corp)	112.0	0.99	0.98
15. TAPGC (Trans-Asia Power Generation Corp)	50.0	0.44	0.19
16. NORTHWIND	27.0	0.24	0.06
TOTAL	11326.8	100.0	HHI = 1353

Source of basic data: MAG-PEMC

Since the generation market is still concentrated even with three PSALM trading teams, it would be interesting to find out what the concentration will be if each plant were to be regarded as a trader. Table 6 lists the plants and their shares of registered capacity and the squares of the shares. It shows an HHI of 623, indicating an unconcentrated market.

What these results suggest is that market concentration can be reduced if the management of the capacities of PSALM IPPs can be assigned to as many independent Administrators as possible, certainly more than the three teams that are currently doing the trading. Otherwise, the generation market will continue to remain concentrated.

Table 6. Trading Teams by Generating Plants

Generating Plant	Registered Capacity (MW)	% Share	$(\text{Share})^2$
1. FGHC - Sta Rita	1054	9.31	86.59
2. FGHC - San Lorenzo	533.3	4.71	22.17
3. FGHPC - Masiway	12.0	0.11	0.01
4. FGHPC - Pantabangan	100.0	0.88	0.78
5. QPPL	459.0	4.05	16.42
6. NORTHWIND	27.0	0.24	0.06

7. TAPGC	50.0	0.44	0.19
8. SNAP BENGUET - Binga	100.0	0.88	0.78
9. SNAP - Magat	380.0	3.35	11.26
10. MPPC - Masinloc	610.0	5.39	29.00
11. NPC - Angat	246.0	2.17	4.72
12. NPC - Bacman	150.0	1.32	1.75
13. NPC - Batangas (Calaca)	660.0	5.83	33.95
14. NPC - Makban	454.0	4.01	16.07
15. NPC - Tiwi	275.7	2.43	5.92
16. PSALM-IPP - KEPCO Ilijan	1200.0	10.59	112.24
17. PSALM-IPP - CE Casecnan	165.0	1.46	2.12
18. PSALM-IPP - HEDCOR	30.0	0.26	0.07
19. PSALM-IPP - NIA BALIGATAN	6.0	0.05	0.00
20. PSALM-IPP - Limay	620.0	5.47	29.96
21. PSALM-IPP - Bakun	76.0	0.67	0.45
22. PSALM-IPP - Bauang	225.0	1.99	3.94
23. PSALM-IPP - Sual	1200.0	10.59	112.24
24. PSALM-IPP - Malaya	650.0	5.74	32.93
25. PSALM-IPP - San Roque	400.0	3.53	12.47
26. PSALM-IPP - Pagbilao	763.0	6.74	45.38
27. PSALM-IPP - Subic Power	116.0	1.02	1.05
28. PSALM-IPP - Botocan	20.8	0.18	0.03
29. PSALM-IPP - Caliraya	24.0	0.21	0.04
30. PSALM-IPP - CBK (KPSPP)	720.0	6.36	40.41
			HHI = 623

Source of basic data: MAG-PEMC

Although the market may be classified by HHI and Table 3 as unconcentrated, it does not guarantee the absence of market power. As we showed in an example, pivotal suppliers can exist in unconcentrated electricity markets under tight supply and demand conditions.

5. PIVOTAL SUPPLIERS

Table 7 (see also Figure 5) shows the generating plants that were pivotal suppliers during peak hours in 2007. The Pivotal Supplier Index was calculated using the demand and the offered capacities of the generating plants for each trading hour. As expected, the larger plants achieved pivotal supplier status more often than smaller plants. The largest generating plant (KEPCO ILIJAN, 1200 MW) was a pivotal supplier for 53.6% of the peak hours in 2007. Another large plant (STA RITA, 1054 MW) was a pivotal supplier at 53.8%. Although SUAL is as large as KEPCO ILIJAN, it was a pivotal supplier for only 29.8% of the peak hours because it was on outage during the first quarter of 2007.

Table 7. Pivotal Supplier Frequency Index, Peak Hours: 12/26/2006 - 12/25/2007

Generating Plant	Trading Company/Team	Registered Capacity		Pivotal Supplier Frequency Index
		MW	% Share	
1. KEPCO ILIJAN	PSALM 1	1200.0	10.59	53.6
2. LIMAY CCGT	PSALM 1	620.0	5.47	8.3
3. CE CASECNAN	PSALM 1	165.0	1.46	3.8
4. HEDCOR	PSALM 1	30.0	0.26	1.9
5. SUAL CFTPP	PSALM 2	1200.0	10.59	29.8
6. SAN ROQUE	PSALM 2	400.0	3.53	7.4
7. BAUANG DPP	PSALM 2	225.0	1.99	6.7
8. BAKUN	PSALM 2	76.0	0.67	4.0
9. MALAYA	PSALM 2	650.0	5.74	1.4
10. PAGBILAO CFTPP	PSALM 3	763.0	6.73	42.1
11. CBK (KPSPP)	PSALM 3	720.0	6.36	5.5
12. SUBIC	PSALM 3	116.0	1.02	4.1
13. BOTOCAN	PSALM 3	20.8	0.18	2.7
14. CALIRAYA	PSALM 3	24.0	0.21	3.0
15. STA RITA FGPP	FGHC	1054.0	9.31	53.8
16. SAN LORENZO FGPP	FGHC	533.3	4.71	31.3
17. MASIWAY	FGHPC	12.0	0.11	2.8

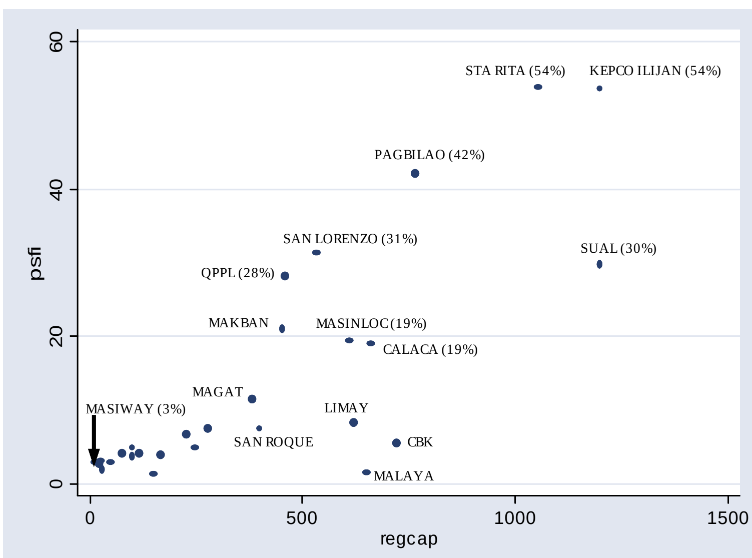
18. PANTABANGAN	FGHPC	100.0	0.88	4.8
19. QPPL	QUEZON POWER	459.0	4.05	28.2
20. MAKBAN GPP	NPC [A]	454.0	4.01	21.1
21. TIWI GPP	NPC [A]	275.7	2.43	7.5
22. BATANGAS CFTPP	NPC [A]	660.0	5.83	18.9
23. MASINLOC	NPC [B]	610.0	5.39	19.3
24. ANGAT	NPC	246.0	2.17	4.8
25. BACMAN	NPC	150.0	1.32	1.2
26. BINGA	NPC/SNAPBENGT	100.0	0.88	3.7
27. MAGAT	SNAP [C]	380.0	3.35	11.5
28. TRANS-ASIA	TRANS-ASIA	50.0	0.44	2.8

[A] Privatized but has not been turned over to the winning bidder as of 8/26/08.
[B] Turned over to Masinloc Partners on 4/16/08. [C] Turned over to SNAP on 4/25/07.

Source of basic data: MAG-PEMC

Figure 5. Pivotal Suppliers, Peak Hours: 2007

(psfi = pivotal supplier frequency index; regcap = registered capacity



What is worth noting in Figure 5 is that small generators (e.g., MASIWAY, 12 MW) became pivotal suppliers at certain times during peak hours. This indicates tight demand and supply conditions and confirms the observation that small suppliers can acquire market power under these conditions (Borenstein [2000]). This raises the following questions: Why is offered capacity barely enough to meet the demand? Is offered capacity very much less than available capacity? If so, what is the size of the gap between available capacity and offered capacity?

6. CAPACITY GAPS

We adopt the term “capacity gap” used by WESM to refer to the difference between available capacity and offered capacity. If a plant has 1000 MW of available capacity and offers only 600 MW to the market, then the capacity gap is 400 MW. This is an important issue in wholesale electricity markets because capacity withholding, as shown by the example in Section 3.1, can be used to reduce supply and raise the price of electricity. In fact, empirical evidence of this behavior exists. For example, Wolak and Patrick [1997] provide evidence that capacity withholding by the two dominant generators in the England and Wales market resulted in price increases. Joskow and Kahn [2001] find evidence that withholding of capacity to drive up price occurred in the California market during Summer 2000.

As a first cut in the analysis of capacity gaps, we look at the ratio of offered capacity to registered capacity. Table 8 presents the average monthly offered capacity as a percentage of registered capacity for 2007 and shows that average offered capacity was less than 50% of registered capacity throughout most of the year.

Table 8. Monthly Average Offered and Registered Capacity: 2007

Month	Average Registered Capacity (MW)	Average Offered Capacity (MW)	Offered Capacity/Registered Capacity (%)
January	11746	5211	44
February	11759	5333	45
March	11722	5293	45
April	11657	5230	45
May	11664	5692	49
June	11673	5565	48
July	11676	5022	43
August	11637	5618	48
September	11551	5501	48
October	11555	5668	49

November	11502	5739	50
December	11491	5453	47

Source: MAG-PEMC

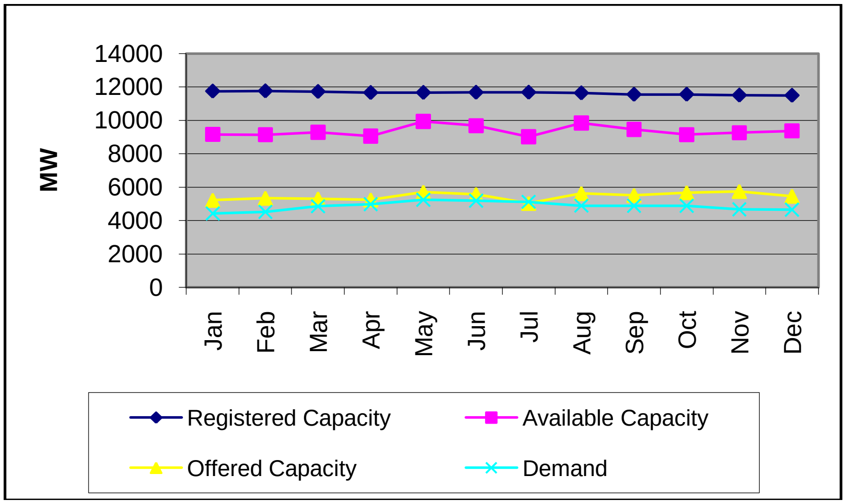
PEMC made some estimates of available capacity by subtracting scheduled and forced outages from registered capacity. Table 9 shows monthly estimates of the capacity gaps for the year 2007. Capacity gap ranged from 3,467 MW to 4,241 MW with an annual average of 3,914 MW. This is graphically shown in Figure 6, which also confirms that offered capacity is indeed close to demand. In view of this large capacity gap, it is fair to ask if there had been capacity withholding in the wholesale spot market in 2007.

Table 9. Monthly Average Capacity Gap: 2007

Month	Available Capacity (MW)	Offered Capacity (MW)	Capacity Gap (MW)
January	9153	5211	3942
February	9134	5333	3801
March	9284	5293	3991
April	9085	5230	3855
May	9934	5692	4241
June	9675	5565	4110
July	9009	5022	3987
August	9820	5618	4202
September	9449	5501	3948
October	9135	5668	3467
November	9254	5739	3515
December	9365	5453	3913
Average	9358	5444	3914

Source: MAG-PEMC

Figure 6. Registered Capacity, Available Capacity, Offered Capacity, and Demand: 2007 (Monthly Average)



7. CONCENTRATION IN THE SPOT MARKET

When a portion of a generation supplier's electricity is contracted, the supplier's share in the spot market is reduced. Only the uncommitted capacity will compete for the demand left unfilled by bilateral contracts. If a large portion of generation is contracted, the uncommitted capacity may tend to be concentrated in a few sellers. It is, therefore, important to examine the concentration of uncommitted capacity.

First, we look at the spot market share since WESM started commercial operations. Figure 7 shows the monthly split (in percent) between the amount of electricity sold through the spot market and those sold through bilateral contracts during the first 24 months of WESM operations. Approximately 56% of the of the pool purchases were made through bilateral contracts during the first month (July 2006) of WESM operations (see Table 10). Within six months the share of bilateral contracts rose to 83% and by the end of 2007 the share further increased to 88%, where it hovered up to June 2008.

Figure 7. Spot Market vs Bilateral Contracts Market: Monthly Shares

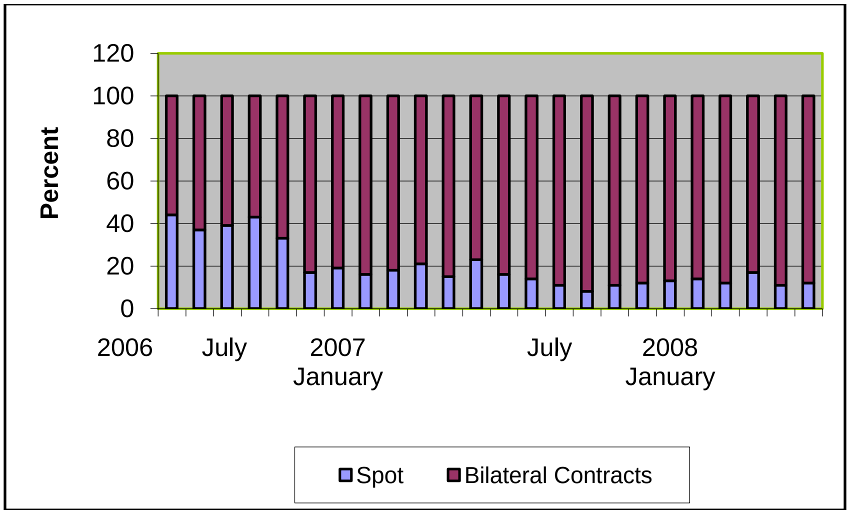


Table 10. Spot vs Bilateral Contracts

Month	Spot Market Share (%)	Bilateral Contracts Share (%)
2006 July	44	56
August	37	63
September	39	61
October	43	57
November	33	67
December	17	83
2007 January	19	81
February	16	84
March	18	82
April	21	79
May	15	85
June	23	77
July	16	84
August	14	86

September	11	89
October	8	92
November	11	89
December	12	88
2008 January	13	87
February	14	86
March	12	88
April	17	83
May	11	89
June*	12*	88*

*Preliminary

Source: MO-PEMC

7.1. Shares in the Spot Market

Figure 8 shows the spot market shares by companies for the year 2007. The data are based on actual generation. PSALM dominated the spot market accounting for 83% of actual generation. The HHI is 6894 (see Table 11A).

Figure 8. Spot Market Shares: 2007

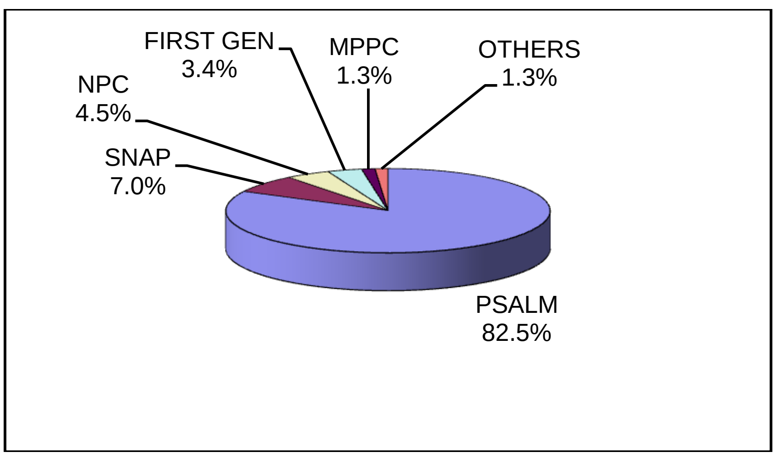


Table 11A. Spot Market Shares: 2007

Company	Share (%)	$(Share)^2$
PSALM	82.53	6811.20
NPC	4.45	19.80
FIRST GEN IPPs	3.43	11.76
MPPC	1.33	1.77
SNAP	6.99	48.86
QPPL	0.46	0.21
TAPGC	0.59	0.35
NORTHWIND	0.01	0.00
WESMTMP	0.22	0.05
TOTAL	100.00	HHI = 6894

Source of basic data: MAG-PEMC

Table 11B shows the spot market shares of the trading teams for the year 2007. One notices at once that the top three are the PSALM trading teams which account for 83% of the spot market. The spot market is still highly concentrated with an HHI of 2357.

Table 11B. Spot Market Shares of Trading Teams at WESM: 2007

Trading Team	Share (%)	$(Share)^2$
1. PSALM Trading Team 1	35.81	1282.36
2. PSALM Trading Team 2	17.92	321.13
3. PSALM Trading Team 3	26.15	683.82
4. PSALM Trading Team 4	2.65	7.02
5. ANGAT HEP (NPC)	0.48	0.23
6. BINGA HEP (SNAP Benguet)	0.37	0.14
7. MASINLOC CFTPP (Masinloc Power Partners)	1.33	1.77
8. BACMAN GPP (NPC)	0.12	0.01
9. BATANGAS CFTPP (NPC)	1.46	2.13
10. MAKBAN GPP (NPC)	1.34	1.80

11. TIWI GPP (NPC)	0.85	0.72
12. FGHC (First Gas Holdings Corp)	0.57	0.32
13. QPPL (Quezon Power Philippines Ltd)	0.46	0.21
14. MAGAT-NPC (Jan-Apr 08; became MAGAT-SNAP) MAGAT (SN Aboitiz Power)	0.20 6.62	46.51
15. FGHPC (First Gen Hydro Power Corp)	2.86	8.18
16. TAPGC (Trans-Asia Power Generation Corp)	0.59	0.35
17. NORTHWIND	0.01	0.00
TOTAL		HHI = 2357

Source of basic data: MAG-PEMC

8. SUMMARY AND CONCLUDING REMARKS

Market power in the restructured and liberalized electricity industry is of great concern because its abuse can negate the potential gains from competition. The experiences of liberalized electricity markets (think California) show that market power had been exercised and had been costly to the consumers. This means that market power has to be closely monitored, especially during the period of transition from regulation to liberalization.

Monitoring market power has traditionally relied on concentration indices based on market shares such as the Herfindahl-Hirschman Index (HHI). However, HHI is a market-wide index which, therefore, does not identify specific firms. In contrast, the pivotal supplier index identifies the firms that possess market power at every trading period.

The Philippine electricity market is in a period of transition as the restructuring provisions of the Electric Power Industry Reform Act of 2001 are being implemented. Under current market structure, the HHI indicates a highly concentrated market. The device of trading teams introduced by the government companies has diminished the concentration but the market is still concentrated. In addition, the independence of trading teams belonging to the same company may not be sustained as the purpose of competing teams (lowering the price) run into conflict with the objective of management (increasing revenues).

The pivotal supplier data show that in 2007 many plants, including small ones, became pivotal suppliers during peak hours, creating opportunities for the exercise of market power. (Another interesting empirical question is whether or not market power had been exercised unilaterally by a trader.) This is a consequence of a tight supply (offered capacity) and demand condition. In 2007 average offered capacity was only 47% of average registered capacity. PEMC estimates of unoffered capacity (available capacity less offered capacity) averaged 3,914 MW for 2007. (Another interesting empirical question is whether or not this large unoffered capacity affected the price outcomes).

PSALM, through no fault of its own, is the dominant player in the wholesale market. This dominance became pronounced when more generators shifted to bilateral contracts leaving the PSALM-IPPs with the bulk of uncommitted capacity that competed in the spot market. In 2007 the generators controlled by PSALM accounted for 83% of actual generation in the spot market, making the spot market highly concentrated. This highlights the importance and urgency of the dominance mitigation provision of EPIRA: appointing independent IPP Administrators. The good news is that bidding for IPP Administrators (IPPAs) has started; the first one was held on June 26, 2009. Although this bidding failed because the bids fell short of the reserve price, PSALM successfully conducted a second round of bidding on August 28, 2009 for the appointment of IPPAs to manage the contracted capacities of two coal-fired plants which account for roughly a third of the IPP contracts for Luzon and Visayas.

Appendix A

The Lerner Index under Cournot Competition

Suppose that there are n firms that are maximizing their profits by choosing quantities of output. Let

Q_i = output of firm i

$Q = Q_1 + \cdots + Q_i + \cdots + Q_n$

$P(Q)$ = the industry demand function

$C_i(Q_i)$ = cost function of firm i

The profit of firm i is given by

$$\pi_i = P(Q)Q_i - C_i(Q_i)$$

The first-order condition for maximum profit of firm i is

$$\frac{\partial \pi_i}{\partial Q_i} = (P)(1) + Q_i \frac{dP}{dQ}\frac{\partial Q}{\partial Q_i} - \frac{\partial C_i}{\partial Q_i} = 0$$

Rearranging terms,

$$P - MC_i = -Q_i \frac{dP}{dQ} \quad \text{(since } \frac{\partial Q}{\partial Q_i} = 1)$$

$$\frac{P - MC_i}{P} = -\frac{Q_i}{Q}\frac{Q}{P}\frac{dP}{dQ} = s_i * \frac{1}{-\frac{P}{Q}\frac{dQ}{dP}} = \frac{s_i *}{\varepsilon}$$

Hence,

$$L_i = \frac{s_i *}{\varepsilon}$$

where ε is the price elasticity of demand.

Appendix B

The Relationship between HHI and the Lerner Index in a Cournot Market

We show that, in a Cournot market, HHI is related to the price elasticity of demand and the Lerner indices of the firms. We begin with the Lerner index:

$$L_i = \frac{s_i *}{\varepsilon}$$

$$s_i * = \varepsilon L_i$$

Multiplying both sides of the equation by s_i*, we get

$$(s_i *)^2 = \varepsilon s_i * L_i$$

Taking the sum over i = 1, 2, ..., n, we have

$$\sum_{i=1}^{n} (s_i *)^2 = \varepsilon \sum_{i=1}^{n} s_i * L_i$$

Note that s_i = market share in percent, i.e., s_i = 100s_i*. Hence,

$$\sum_{i=1}^{n} \frac{s_i^2}{10000} = \varepsilon \sum_{i=1}^{n} s_i * L_i$$

$$\sum_{i=1}^{n} s_i^2 = 10000\varepsilon \sum_{i=1}^{n} s_i * L_i$$

$$\text{HHI} = 10000\varepsilon \sum_{i=1}^{n} s_i * L_i$$

Thus HHI depends on the price elasticity of demand and the weighted average of the firms' Lerner indices, the weights being the market shares.

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