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Detecting and measuring market power in the Philippine wholesale electricity market

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During the first quarter of commercial operation of the Philippine wholesale electricity market, an unexpected surge in clearing prices led to an investigation of public utilities accused of collusion. The paper examines the regulatory response to the first antitrust case in the electricity market. Using actual offers submitted by generators to the market operator and applying a variant of competitive benchmark analysis, the paper traces the price surge to strategic bidding and capacity withholding by public generators.

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1. Introduction

Early in the commercial operation of the Philippine wholesale electricity market in 2006, regulators were faced with the challenge of arresting an unexpected surge in spot prices. Observers then were quick to take a page from the 2000 California electricity crisis, which many blamed to the exercise of market power by large electric utilities and the sluggish and ineffective responses of the regulators. Given the Philippines' own tumultuous experience with power crisis in the early 1990s, they clamored for immediate response from the regulator to foil alleged abuses of market power by some participants. The regulator did not oblige; instead it dismissed the claims that anti-competitive behavior had been the cause of the unexpected price movement.

This was the first, and to date the only, antitrust challenge in the electricity market. It may have been eclipsed now by other regulatory challenges that attend the continuous restructuring of the industry. On balance, the power industry reform is fairly on track, notwithstanding some missed deadlines and the still-elusive goal of cheap and reliable electricity supply. Yet the case is unique and instructive on at least two levels. First, the suppliers under scrutiny are public utilities suspected of colluding to raise market price. When public and private agents compete in the same market, the former is expected to safeguard competition and pursue public interest foremost. Indeed, most anti-competitive cases involve private agents pursuing private interests. This case suggests, however, that in practice, the objectives and behavior of public enterprises may not be different from those of their private counterparts.[1] Second, the regulator's refusal to recognize the ostensible signs of a market problem may have left an indelible impact on market governance. Was the price surge despite relatively stable demand and fuel costs merely a blip or a result of exercise of market power by some suppliers? What should have been the proper regulatory response to allegations of anti-competitive behavior? Are there metrics that could have helped the regulator detect and measure market power abuses? That these questions remain unanswered may have allowed abuses of market power to continue and market inefficiencies to thrive. Nor has it helped resolve the lingering debate on whether replacing a centrally managed with a market-based system of delivering electricity services suits a developing country with weak market governance structure.

Until the 1980s, the provision of electricity was considered inherently monopolistic, requiring either government ownership or tight government control. Technological advances have changed this paradigm. In power generation, the advantage of scale has been overcome by new plant designs so that, for example, a combined cycle gas-fired plant could be competitive against a coal- or nuclear-fuelled plant more than four times its size. New technologies in transmission and distribution, on the other hand, diminish the advantages of vertical integration, allow for the decoupling of power flow from financial flow, and separate the business of distribution from supply of electricity services. The net effect of these changes is the feasibility of introducing competition in generation and supply through the establishment of a wholesale electricity market where owners of generation units compete for energy sales contracts with distribution utilities and consumers, under a pool or bilateral contract scheme. The creation of such market is expected to spawn more investments and efficient use of electricity system.

The advantages of a decentralized, market-based energy dispatch system over a centralized nonmarket system hinge, however, on either the absence of generation unit owners with market power, or the implementation of market

[1]Several theories of public enterprise posit that public managers maximize political support, instead of social welfare. Under this framework, a public enterprise is predicted to set lower price, make smaller profit margin, and overinvest in capacity to prevent shortages, compared to its private counterpart [Viscusi et al. 2005].

rules that effectively restrain the exercise of such power. Neither may be true in actual markets. Those who wield market power may be able to raise price by their bidding behavior, causing less efficient (i.e., more expensive) plants to be dispatched in the network. Where abuse of market power is uninhibited, a bid-based market system may not be a real improvement compared to a traditional centralized system.

The objective of this paper is to bring attention to some of the vulnerabilities of the restructured Philippine electricity market that allow for the exercise of market power. We analyze and compare the bidding strategies of private and public agents during the first three months of market operation. There is perhaps no better period to study market power in the Philippine electricity market other than the initial months of operation, when demand was relatively stable and no major transmission-congestion problem affected the market outcomes. In the months that followed, the operations of the power pool were punctuated by intermittent transmission infrastructure problems, which by themselves increase prices, as well as open other avenues for exercising market power apart from the opportunities presented by the market structure itself. We calculate structural and behavioral indices that reveal potentials for the exercise of market power borne by market structure and auction design. A simulation model based on competitive benchmark analysis is implemented to estimate the implicit markup on observed market prices that may be attributed to the exercise of market power. The results of the simulation model, in light of the structural and behavioral indices, constitute what we deem sufficient basis that any circumspect regulator would have considered.

The rest of the paper is organized as follows. The next two sections describe the structure and operation of the wholesale electricity market and the circumstances that led the market self-governance body to deduce anti-competitive design in the pricing behavior of some of its participants. The case was subsequently brought to the attention of the regulator, but the latter found no merit in the allegation. Section 4 presents structural and behavioral indices that support inference of the significant potential of some participants to exercise market power. We confirm in section 5 that these participants have actually used their market power to raise price by comparing observed prices and those simulated under condition that no participant attempted to exercise market power. The rationale and design of the simulation exercise are discussed. The final section evaluates the implications of the regulator's dismissal of the case in light of the empirical findings.

2. Market reform and restructuring

The Philippine Wholesale Electricity Spot Market (WESM) began operations in the second half of 2006, five years after the law restructuring the electricity market was enacted. The establishment of WESM is central to a reform agenda that provides for, among others, government divestment in the power sector and the creation of an independent regulatory institution.

Before reform, the National Power Corporation (NPC), a public utility that owned and controlled the transmission grid and had near-monopoly of generation plants, dominated the Philippine electricity industry. The distribution systems were owned by several private utilities and rural electric cooperatives, of varying sizes, profitability and generation capacity, and operating in defined territory. In the wake of the power crisis during the early 1990s, independent power producers (IPPs) were encouraged to put up generation facilities whose outputs were contracted by either NPC or private distribution utilities. Electricity prices were controlled by means of regulation applied on the costs of wholesale bulk power that NPC sold to distributors, and on retail prices that distributors levied on their customers.

The new electricity industry is envisioned to consist of four sectors: competitive generation, regulated transmission, regulated distribution, and unregulated supply. To realize this restructuring, NPC has to sell off its generation assets to demonopolize generation, as the only other entity with significant generation capacity is the Manila Electric Company (Meralco), the largest private distribution utility. It was also expedient to break up NPC to separate generation from system operation. The National Transmission Corporation (TransCo) spun off from NPC to serve as the system operator (SO); later, a private utility was contracted for this function, even as ownership of the grid remains with NPC. A special purpose vehicle called the Power Sector Assets and Liabilities Management (PSALM) was created to manage the privatization of NPC with a view to liquidating all of NPC's financial obligations and stranded costs. While facilitating the sale of NPC's assets, PSALM also administers NPC's IPP contracts until these are transferred through public bidding to private entities that shall act as IPP administrators (IPPAs).[2]

To introduce competition at the wholesale level, access to transmission lines are opened up to distributors and large consumers; at the retail level, owners of distribution lines are obliged to provide universal and nondiscriminatory access to suppliers and contestable consumers. The reform law stipulates, however, that retail competition will not take place until certain preconditions are met, including the privatization of at least 70 percent of the total generation

[2]The appointment of IPP Administrators started only in late 2009. When the WESM operations started, all NPC's IPP contracts were administered by PSALM.

capacity of NPC in the two major islands, Luzon and Visayas; and the transfer of management and control of at least 70 percent of total energy output of power plants under contract with NPC to IPP administrators. An independent regulatory institution, named Energy Regulatory Commission (ERC), has been created to oversee the implementation of open access in transmission and distribution lines and the administration of the wholesale market.

One feature that distinguishes the new electricity industry from the old is the wholesale spot market, i.e., WESM, replacing the centrally managed, regulated system of dispatching generation plants. Under a centralized system of dispatch, the SO, which was then NPC by virtue of its ownership of the transmission grid, dispatches the plants to the wires in increasing order of marginal cost, i.e., from the least to the most expensive plants, until the demand for electricity is met. The basis of the dispatch is the stack-up of generation plants constructed by the SO using its information on the costs of fuel, operation, and maintenance of each plant. Since most of the plants are also owned or contracted by NPC, the dispatch is an arms-length transaction for which there is no reward for being dispatched, nor penalty for not being called upon to deliver. This system, therefore, does not create incentives to improve plant efficiency to guarantee dispatch, nor does it provide price signal to guide investment decision.

Under WESM, NPC plants have to compete with other generation plants for the right to be dispatched. Before each trading hour, all plants submit price-quantity offers, which become the basis for the stack-up. Using this stack-up of generation plants, forecast demand, and transmission constraints, a dispatch schedule is produced, which the SO implements.

WESM is an engineered market, where the generation stack constitutes the supply function, and the forecasted consumption, assumed inelastic, is the demand function. The price and quantity that clear the market are determined by an independent entity called the market operator (MO), using an optimization model that also produces a dispatch schedule of generation plants.[3] Since the optimization utilizes the sellers' offers and forecast demand, the dispatch schedule produced by this process is neutral and transparent to all participants. Generators receive income for the energy dispatched based on the clearing price. Those bidding low have a higher probability of being dispatched. Bidding strategies also matter in getting one's generation plant to be dispatched more often and during periods when clearing prices are high. But on average, plants with lower costs have better chances; hence the pool system exerts pressure on generators to improve efficiency.

The Philippine Electricity Market Corporation (PEMC) was organized in 2003 by the Department of Energy (DOE) to serve as MO or administrator

[3]This model solves for the price and quantity that maximize the sum of surpluses of buyers and sellers of electricity.

of WESM. It was incorporated as a non stock, non profit private corporation, initially funded by public money, then by market fees imposed on trading participants when WESM commenced its commercial operations.

WESM has its own governance structure, but the ERC retains oversight authority over the market and jurisdiction in anti-competitive cases. The Board of Directors of PEMC (hereafter PEM Board), constituted by the DOE from electricity industry participants and chaired by the DOE Secretary, is the governing body of WESM. The Board exercises its governance function through five external committees, including the Market Surveillance Committee (MSC), whose members are also appointed by the DOE. The MSC's role is to monitor the conduct of trading participants that may constitute breaches of WESM rules. The Board imposes penalties and sanctions for breaches.

At the start of WESM's operation, there are three major trading blocs: NPC, PSALM, and Meralco.[4] NPC plants are traded individually, whereas PSALM grouped the NPC's IPP contracts into four, appointing one trader for each group. In all, there are seventeen traders: ten representing NPC-owned generation plants, four under PSALM, two representing generation plants under contract with Meralco, and one representing small IPPs under contract with other distributors. The profile of generation plants represented by these traders is shown in Table 1. In terms of installed capacity, 54 percent is represented by the PSALM traders, 27 percent by NPC, and 18 percent by Meralco affiliates.

The distribution of installed capacity does not reflect, however, the distribution of market shares, in terms of actual generation delivered in the grid. This is because some plants are operated only intermittently (peaking and mid merit plants), while others run continuously with almost steady load (base load plants). Hydro plants, for example, are usually operated only during peak hours because of the variability of water supply. Thus, in terms of actual generation and depending on the type of hour, PSALM's share is 40-42 percent; NPC's, 19-23 percent; and Meralco affiliates', 35-41 percent (Table 2). PSALM and NPC have larger shares during peak hours on account of the hydro plants in their respective portfolios.

No two wholesale electricity markets are exactly the same, although their structures may be similar. WESM, like most power exchange pools, conducts uniform price auction, where all dispatched plants are compensated at the last accepted price bid. But WESM is a hybrid of pool and bilateral contracting power

[4]WESM's operation is currently limited in the Luzon island, although the market is designed to integrate the electricity systems in the three islands (including Visayas and Mindanao). To date, the three islands have separate transmission grids, and only Luzon and Visayas are partially linked by a high voltage direct current (HVDC) submarine cable. Through this cable, a maximum of 600 MW can flow in or out of the Luzon island. The specific amount is nominated by the system operator in the Visayas based on forecast demand and supply of electricity in the island.

exchange models. This means that generators, distributors, and suppliers may trade at the spot market, but may also enter into bilateral, long-term supply contracts. In addition, WESM is a gross pool where all power to be delivered in the grid, covered or not by bilateral contract, have to be offered to ensure least cost dispatch. Other power exchanges are net pool, which trades only generated power not covered by bilateral contracts.

Although all generated power is traded in WESM, those covered by bilateral contracts are settled financially outside the spot market. A generator has discretion to declare when and how much of the electricity that it delivered in the grid is covered by bilateral contract and is compensated, on the spot market price, for the residual. Thus, when the pool price is higher than the contract price, the generator's incentive is not to declare its delivery covered, so that the delivered power is deemed to have been sold to the spot market. When the pool price, however, is lower than the contract price, the generator's incentive is the opposite. In which case, it is deemed to have bought from the spot market and resold the same in the bilateral contract.[5]

All generation plants are required to offer their maximum available capacity (dubbed "must-offer" rule) in up to ten blocks of price-quantity pair; the prices must be non decreasing. One unique protocol applied in WESM is that the quantity in the first block offered by a generation plant comes after its minimum operating load, referred to in the rules as Pmin. By contrast, in other power pools, the first offered block for a generation plant usually represents the plant's minimum stable load. Because of the Pmin rule, all generation plants that submitted their offers would be able to run at their respective Pmin levels even if none of the blocks that they offered gets accepted. These Pmin quantities are registered by the traders with the MO and presumed to be based on the technical requirements of the plants. Generators are paid for their Pmin quantities at the market-clearing price for the trading hour. The rule is designed to ensure that at any time, there would be some fixed capacity available, equal to the total Pmin of all generation plants that submitted offers. If the market-clearing price exceeds the variable cost of a plant, a generator should be encouraged to make offers in the market since it is guaranteed dispatch at its Pmin. But just as well, a generator may withhold any offer if the expected market-clearing price is insufficient to cover its variable cost. However, since all generators are required to submit their bids every trading hour, exempting Pmin from competitive bidding inadvertently reduces the size of contestable demand, which should push participants to bid more aggressively.

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[5]Buyers of electricity—namely, distributors, suppliers, and large consumers—would have the same opportunity to exploit the differences between spot and bilateral contract prices when the market begins to accept demand-side bids. For now, only generators' offers are accepted in the pool; demand is presumed inelastic at the level forecasted by the MO.

Table 1. Profile of generation assets, 2006

	PSALM1	PSALM2	PSALM3	PSALM4	NPC IPPs	MERALCO IPPs	OTHERS
Capacity (MW)	1451.0	1598.0	2370.0	845.4	3209.8	2131.0	77.5
No. of plants	4.0	3.0	4.0	4.0	10.0	3.0	4.0
Min. stable load (MW)	550.5	478.2	545.0	99.8	854.6	660.0	3.0
Fuel type (MW)							
Natural gas	1250.0					1620.0	
Oil		234.0	1270.0	116.0	220.0		52.0
Coal		1294.0	700.0		1320.0	511.0	
Geothermal					851.4		
Hydro	201.0	70.0	400.0	729.4	818.4		
Wind							25.5
Spot Market Exposure (%)1/	88.8	66.1	94.6	98.2	29.2	0.0	0.0

1/Average of first three monthly billing periods

Source: Author's calculation using PEMC's data.

Table 2. Market shares of generation plants, July-September 2006
(in percent; based on actual generation)

	Fuel type	Off-peak	Peak
PSALM1		18.4	17.5
CE Casecnan	Hydro	1.9	1.9
Hedcor	Hydro	0.5	0.4
Kepco Ilijan	Coal	16.2	15.3
NIA Baligatan	Hydro	0.1	0.1
PSALM2		7.8	7.8
Bakun HEP	Hydro	1.5	1.2
Bauang DPP	Oil	0.1	0.4
Sual CFTPP	Coal	6.3	6.3
PSALM3		12.0	13.2
Limay	Oil	*a*	*a*
Malaya	Oil	0.0	*a*
Pagbilao	Coal	6.1	7.0
San Roque	Hydro	5.9	5.9
PSALM4		1.7	3.3
Botocan HEP	Hydro	*a*	0.2
Caliraya HEP	Hydro	*a*	0.5
CBK	Hydro	1.7	2.6
Subic Power Corp.	Oil	0.0	0.1
NPC IPPs		19.1	23.4
Angat HEP	Hydro	0.7	1.1
Bacman GPP	Geothermal	*a*	*a*
Batangas CFTPP	Coal	4.9	4.7
Binga HEP	Hydro	0.7	0.9
Magat HEP	Hydro	2.3	3.9
Makban GPP	Geothermal	3.4	4.9
Masinloc CFTPP	Coal	4.4	3.9
Pantabangan-Masiway	Hydro	0.9	1.2
Tiwi GPP	Geothermal	1.8	2.6
Meralco IPPs		40.9	34.8
San Lorenzo FGPP	Natural gas	10.9	9.2
Sta. Rita FGPP	Natural gas	20.8	17.5
Quezon Power	Coal	9.2	8.9

Note: *a* means less than 0.1 percent.
Source: Author's calculation using PEMC's data.

Despite the must-offer rule, however, there is a wide and intractable wedge between available and offered capacity, which dampens the competitive effect of Pmin. This can be deduced from Table 3, which shows the supply-demand conditions during the first three months of WESM operation. In the first month, when average hourly consumption was almost 4,400 MW, about 3 percent of registered or installed capacity was on outage, leaving almost 9,000 MW available for generation.[6] But less than 64 percent of available capacity was offered, thus supply (offered capacity) remained close to demand (actual load) although the installed capacity was more than twice the actual load. The narrow supply-demand margin was therefore contrived, but it created strong incentives for strategic bidding.

Table 3. Supply-demand conditions in WESM, 2006 (average, in MW)

	26 Jun – 25 Jul	*26 Jul – 25 Aug*	*26 Aug – 25 Sep*
ALL HOURS			
Supply			
Registered capacity	9,217	9,075	9,766
Available capacity	8,961	8,920	9,597
Offered capacity	5,704	5,840	6,406
Demand	4,373	4,349	4,560
PEAK			
Supply			
Registered capacity	9,288	9,116	9,790
Available capacity	9,025	8,959	9,628
Offered capacity	6,032	6,047	6,550
Demand	4,866	4,974	5,229
OFF-PEAK			
Supply			
Registered capacity	9,158	9,040	9,747
Available capacity	8,907	8,888	9,573
Offered capacity	5,436	5,673	6,296
Demand	3,967	3,846	4,049

*The trading month begins on the 26th day and ends on the 25th day of the next. Month 1 covers 26 June - 25 July 2006; Month 2, 26 July – 25 August 2006; Month 3, 26 August – 25 September 2006.
Source: Author's calculation using PEMC's data.

[6]The first month refers to the period from 26 June to 25 July 2006; the second month, 26 July to 25 August 2006; and the third month, 26 August to 25 September 2006. In the tables and subsequent discussion, the first month is also referred to as "July"; the second month, "August"; and the third month, "September".

3. A test case of governance

Almost immediately after the first quarter of WESM operation, Meralco lodged a complaint to the PEMC concerning the sharp and continuous increases in spot market price. In the first month, the average hourly price was Php 2,848/MWh; it rose by 15 percent (Php 3,276/MWh) in the next; then by 75 percent (Php 5,738/MWh) in the third (Table 4). Increases in peak-hour prices were even more pronounced, as may be gleaned from Figure 1, with the third month's average price more than twice the first month's.

Table 4. Market price vs. excess supply, 2006

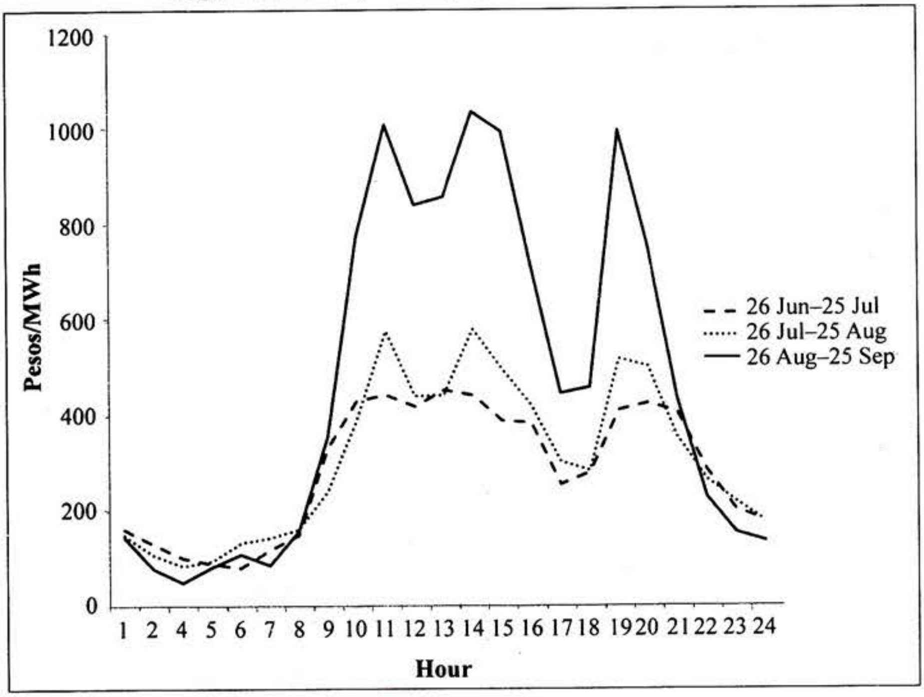
	26 Jun – 25 Jul	*26 Jul – 25 Aug*	*26 Aug – 25 Sep*
LOAD-WEIGHTED AVERAGE PRICES (PESOS)			
All hours	2,848	3,276	5,738
Peak	4,000	4,590	8,472
Off-peak	1,640	1,696	1,735
TIME-OF-USE RATES (PESOS)			
All hours	3,607	3,557	3,504
Peak	5,630	5,571	5,567
Off-peak	1,943	1,933	1,930
EXCESS OFFER (MW)			
All hours	1,331	1,491	1,846
Peak	1,166	1,073	1,321
Off-peak	1,469	1,827	2,247
CONTESTABLE CAPACITY (MW)			
All hours	1,954	2,162	1,449
Peak	2,388	2,720	2,050
Off-peak	1,421	1,629	913

Source: Author's calculation using PEMC's data.

Meralco's complaint prompted the MSC to analyze the price movement and bidding behavior of the generators that may be causing it. Offhand, prices could be expected to be erratic during the early stage of trading as participants are still "learning" the market. Competing generators are likely to underbid at first, until they understand the market behavior. It would then set off adjustments in offers—most likely in the upward direction—to manage variations in demand (peak vs. nonpeak) and recoup earlier losses. As it turned out, some generators attested that during the first month, their offers were based mainly on their variable costs. That changed quickly in the following month; henceforth offers were adjusted to cover total production costs (fixed and variable) as well as losses incurred during off-peak hours when market-clearing prices were low.

Granting that the bids were initially below cost and therefore had to be adjusted in subsequent periods, the price spikes were still conspicuous. First, the market-clearing prices were significantly below the regulated time-of-use (TOU) rates during the first two months, but suddenly exceeded the TOU rates in the third month by 64 percent on average (Table 4). TOU rates are approved by the ERC based on NPC's submission of the average costs of its generation plants. These rates apply to power sold by NPC to non-WESM participants. Second, as shown also in Table 4, the excess offer, representing supply-demand gap, was actually increasing, during both peak and off-peak hours. The average supply margin in the third month was 39 percent more than in the first month. More significantly, the contestable capacity in the third month, i.e., load less Pmin, was 26 percent smaller than in the first month. The increasing supply margin, combined with shrinking contestable capacity, would have normally induced aggressive bidding and depressed clearing prices. Instead, prices rose precipitously.

Figure 1. Hourly average prices in WESM, 2006



Besides the unexpected surge in prices, the MSC found suspicious the apparent influence of certain generation plants in the market-clearing prices. The load weighted average price (LWAP) hovered at about Php 10,000/MWh during peak hours for most of the trading intervals during the third month. Three generators were frequent price setters—namely, KEPCO Ilijan, Pagbilao CFTPP, and Sual, which were traded by different teams under PSALM. The structures of offers for these plants were distinctly different during the first two months of trading; Sual's offers consisted of just two blocks; Kepco Ilijan, four; and Pagbilao, seven to nine. The minimum and maximum offered prices were also different, even between the two coal-fired plants, Sual and Pagbilao. But for trading intervals from 1100 to 2100 hours of 30 and 31 August 2006, the three plants made the same first-block offers of Php 10,000/MWh. This pattern of making the same first-block offers during peak hours continued, with only few small variations, until September 9.

The MSC deemed the identical first-price offers for the three generation plants too unusual to be explained by chance. They noted that while both Sual and Pagbilao are coal-fired and source their fuel from NPC (as stipulated in their IPP contracts), Ilijan uses natural gas obtained from a different supplier. Since generation costs depend largely on fuel cost, the three plants could not have had the same changes in costs to explain the sudden convergence in their offers. Moreover, the MSC found it also highly improbable for the generators' offers to be uniform for consecutive hours and days if they were acting independently. Consequently, they raised suspicion of collusion and requested an investigation from the PEM Board, which the latter granted.

What the Enforcement and Compliance Officer (ECO) discovered in the course of its investigation only bolstered suspicions of price-fixing. It happened that before the alleged incident of price-fixing occurred, Cyril del Callar, then-NPC president, wrote his PSALM counterpart twice to raise the issue of trading losses incurred by NPC and to suggest that the trading teams of the two institutions adopt a common bidding strategy. Specifically, the NPC president attributed the company's losses of nearly Php 2 billion, barely two months into WESM trading, to the low offers of PSALM's trading teams, which caused the NPC-owned plants not to be dispatched. He noted in a letter dated 23 August 2006 the following:[7]

> the average clearing price of electricity of NPC IPPs traded by PSALM is 56.23% lower than their average production costs and 55.29% lower than ERC-approved average TOU rates. This is due to zero clearing prices in the market during off-peak period and Sundays and lower clearing prices during peak period which was

[7]NPC President Cyril del Callar's letter to PSALM President Nieves Osorio, dated 23 August 2006, as quoted in the Investigation Unit (IU) Report, 4 June 2007, pp 10-11.

> the direct result of lower or even negative bid offers from the PSALM trading teams.
>
> ... [As a result] NPC IPPs have an estimated total revenue of P3.819B as compared to a total production cost of P5.672B or a net loss of P1.853B. This excludes the consumption of Kalayaan during pumping which accounts to P91.0M. The resulting loss is attributable to the maximized generation objective of the PSALM trading teams even if such objective results in lower clearing prices in the market and losses to NPC. The PSALM trading teams are bidding at below the ERC-approved TOU rates, below the production costs of the IPPs they are bidding or even at zero if only to maximize the generation and dispatch of the IPPs even if such result in losses to the government.

To stem the financial bleeding of NPC, its president admonished PSALM on how offers should be made:[8]

> WESM bidding policies should be based on the true pricing of electricity. NPC and PSALM trading teams should be made responsible for delivering, at the end of the month, the minimum revenue required to cover for the production costs of their respective plants. In this regard, NPC and PSALM should enter into an agreement on the revenue requirement for each trading team.
>
> PSALM trading team should bid based on the established merit order of both NPC-owned plants and NPC IPPs. At the very least, the PSALM trading teams should bid prices that are based on the ERC-approved TOU rates ...

In a written response, the PSALM president brushed aside the suggestion of the NPC president and reminded him that any agreement between their traders to adjust bids based on some revenue target is against the principles of WESM.

> The adjustments we all have to make will not be easy. We are now operating in a different policy regime far from the highly regulated milieu that prevailed for decades. With the policy reforms that have been put in place, we are institutionalizing through WESM, a market-oriented pricing and supply mechanism for the country's electricity industry.
>
> In light of these policy reforms, we find it difficult to agree to your suggestion that National Power and PSALM should "enter into an agreement on the revenue requirement for each trading team" and that the PSALM trading teams should bid based on the established merit order of both National Power-owned plants and

[8]Ibid. Emphasis added.

> National Power IPPs. By taking that track, we would be subverting the goals and objectives of EPIRA, which we, NPC and PSALM, are supposed to champion as the lead agencies responsible for its successful implementation. We must ensure the success of the industry reforms we are currently implementing and counter accusations that government is using its market power.

But the subsequent actions of the PSALM management are suspect. On 25 August 2006, the PSALM management informed its trading teams of NPC's concerns about the recurrence of zero prices during off-peak hours and its allegations that the bidding strategies of PSALM's trading teams were depressing the prices. The managers of the trading teams later admitted that the NPC's accusations affected their bidding strategies, even as they continued to act independently. In particular, the manager of PSALM3 said that they bid at Php 10,000/MWh so that the average market price for the day could reach some target level that would allow PSALM and NPC recover their costs. He explained further that[9]

> the pricing for Pagbilao [was] based on total production cost recovery, with the rationale that to do otherwise would be to contribute to the ballooning debts of NPC and PSALM, and ultimately, of the National Government.

Despite PSALM's assertion that their trading teams acted independently and that the management did not commit any breach of market rules, the PEM Board was persuaded otherwise. The Board instead adopted the ECO's findings that the uniform offers of PSALM trading teams for Sual, KEPCO Ilijan, and Pagbilao were deliberate and in response to NPC's letters and instructions from PSALM management.[10]

> Based on the events that had occurred prior to and on August 30, the investigating team concludes that the submission of increased bids to at least P10,000 during the peak hours by the 3 different PSALM trading teams occurring at the same time and at the same date, while in the realm of possibility, is not coincidental. The investigation team therefore looks at it with guarded caution, especially if the meetings with PSALM management and the NPC letters are taken into account. There was uniformity in bidding levels from a previously dissimilar level.
>
> While the traders said they were acting independently of the other teams, it is very unnatural for a trader to suddenly bid based on its

[9]Affidavit of Mr. Nestor F. Aliman, team manager of ETT3 of PSALM, as quoted in the Investigation Unit (IU) Report, 4 June 2007, p. 12.

[10]Excerpts from the ECO Report, as quoted in the Investigation Unit Report, 4 June 2007, pp. 15-16.

> production cost, which would create a swift substantial increase in its bid offer because of the possible consequence of not being dispatched. Moreover, this offer price increase happened just after the 25 August 2006 meeting where the first NPC letter alleging losses was discussed. Even assuming that PSALM Management met with the traders individually, and therefore no strategy was planned or shared by each trading team as a group, the uniformity of their acts undoubtedly reveals that an authority higher and outside the trading teams has made and caused the individual traders to act and trade as one.
>
> These factors clearly establish that the PSALM through its three trading teams acting in unity has exercised market power during the third billing month, notably starting on 30 August 2006.

The decision reflects the thinking that it is highly improbable for competing traders with different portfolios to suddenly achieve unanimity in their offers if they were not prompted. That the PSALM management chose to inform the trading teams of NPC's concerns is a reasonable basis for deducing that the management expected the teams to heed NPC's suggestions. If the PSALM management found the suggestion of adopting a common bidding strategy inappropriate, they would not have brought the matter to the trading teams' attention. To assume otherwise is to ignore the fact that the trading team managers were mere employees of PSALM; that they had access to same set of information and could easily check one another's bids; and that they were aware that their size permitted them to influence the market price.

When the PEM Board's affirmation of ECO's findings became public, the ERC was pressed to conduct its own inquiry on the case since it is primarily responsible in cases involving market power abuse and anti-competitive behavior.[11] The Investigation Unit (IU) created by the ERC took four months to gather evidence and another two months to come up with a report. The commissioners took another month to study the IU's recommendations. In all, the ERC spent a total of seven months to decide on the case. By comparison, the PEMC took only 45 days to investigate and rule on the case. With the length of time consumed by the regulator to pass judgment, it is striking to note that it did not go far into the investigation; instead it relied heavily on the ECO's report,

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[11]Section 45 of EPIRA reads:

> The ERC shall, motu proprio, monitor and penalize any market power abuse or anti-competitive or discriminatory act or behavior by any participant in the electric power industry. Upon finding that a market participant has engaged in such act or behavior, the ERC shall stop and redress the same. Such remedies shall, without limitation, include the imposition of price controls, issuance of injunctions, requirement of divestment or disgorgement of excess profits and imposition of fines and penalties pursuant to this Act.

which included sworn statements of the parties involved in the case. The IU did not find it expedient to extend the inquiry of ECO, and yet disagreed with its conclusions. It also did not find the "prima facie" case standard satisfied to pursue a complaint against PSALM. The commissioners concurred with the IU's conclusion.

ERC's different reading of the case reflects its approach to regulation that appears incompatible to the kind of interaction in the electricity industry. The commission has said that it is not inclined to dwell on mere suspicion of wrongdoing if there is no sufficient evidence that could support the allegation. But what it considers "sufficient" evidence are those that could only arise when there is explicit collusion, such as written agreement or proof of communication. Those types of evidence are difficult to come by when collusion is tacit. And yet the ERC is also not inclined to draw any inferences from observed behavior.

In the electricity market, interactions among participants are organized and repeated. Tacit collusion could easily develop because participants are able to learn and react quickly to the strategies of other participants, and even use the market processes to communicate and facilitate cooperation. To sustain competition, one needs aggressive monitoring of participants' behavior, particularly those that might involve exercises of market power.

It is not easy to distinguish acts in response to competitive pressure from anti-competitive behavior, as it is difficult to sort out factors underlying a particular market outcome. A price spike, for example, may be caused by any number of things, including coordinated responses of sellers to an observed increase in demand, capacity shortages, and deliberate withholding of supply by some participants. But then unraveling these complex and oftentimes interrelated factors is what distinguishes an economic regulator, steeped in market processes, from a sheer rate regulator.

The IU was focused on finding answers to the following: (a) whether PSALM influenced its trading teams and made them coordinate their actions; and (b) whether PSALM "profited by setting the prices above competitive levels". Not finding direct evidence on either issue led the IU to recommend dismissal of complaints against PSALM.[12]

> **Absent any other evidence** that would, **even if indirectly**, prove what transpired during the meeting or what other discussions took place between PSALM and its trading teams, particularly, that there was such an agreement or understanding, express or implied, on the trading teams' offers into the WESM, and that the trading teams' offers pushed the prices above competitive levels thereby making PSALM profit thereby, **the IU would only be speculating**

[12]IU Case No. 06-01, Investigation Report, Energy Regulatory Commission, 4 June 2007, p. 23.

> if it would say that because the three trading teams simultaneously offered similar offers of Php 10,000/MWh starting on 30 August 2006, PSALM already unduly influenced the submission of such offers and abused its market power. (emphasis mine)

Whether the two issues noted are appropriate basis for establishing a prima facie case is arguable. The IU dismissed the suggestion that PSALM profited from setting high offer levels because it said that "there had been no showing of what the competitive level of prices should have been at that time".[13] But even if it was possible to establish the competitive price, the issue is not how much the offered prices deviated from competitive level, but rather if the trading participants coordinated their offers to influence market prices. On the matter of whether PSALM management exerted influence on its trading teams, the managers of these teams admitted under oath that they adjusted their bidding strategies in reaction to NPC's concerns and suggestions to ensure that their offers would allow meeting some revenue target. That the IU chose to ignore this admission and instead focused on the lack of overt agreement between PSALM and NPC to implement the latter's proposal is plain naiveté. The IU wrote in its report:[14]

> From the tenor of PSALM's reply-letter to NPC's letter and from the fact that PEMC did not find any basis to include NPC in its market power abuse allegation, **no agreement was reached between NPC and PSALM to implement these recommendations and thus no market power abuse ... was established to have been committed by NPC and PSALM.** (emphasis mine)

The commission is of course right when it argued that mere similarity in offers does not constitute proof of collusion. One cannot deduce collusion from parallel pricing alone, nor is parallel pricing anti-competitive. But it is reasonable to infer collusion when competing entities make the same offers (or charge identical prices) and the circumstances actually permit cooperation among the parties involved. No formal agreement is necessary to constitute conspiracy to collude; often anti-competitive behavior is a matter of inference deductible from the acts and circumstances of the entities involved.

In the case of the trading teams of PSALM, the ERC acknowledged that[15]

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[13]Ibid., p. 22.

[14]Ibid., p. 20.

[15]ERC Case No. 2007-421, "Order in the matter of the investigation conducted on allegations of anti-competitive behavior and market power abuse committed by the Power Sector Asset and Liabilities Management Corporation (PSALM) in the wholesale electricity spot market," p. 4.

> while the PSALM is possessed with market power as a seller in the WESM, **the safeguards that have been put in place**, in an attempt to diminish its dominant position, **are insufficient**. The division of the entire capacity held by PSALM into four (4) trading portfolios is not sufficient. Apart from the need to reduce the influence or define the authority of upper management over these trading teams, policies and protocols must be strengthened to ensure independence of these trading teams from each other and from upper management. (emphasis mine)

Clearly, the commission recognized that the semblance of rivalry between PSALM's trading teams is deceptive. And yet it did not find merit to draw any inference from observed behavior and market outcomes. Now one may ask if a more prudent and perceptive regulator could have behaved differently. We argue that there is a range of market power detection tools that the regulator could have sought, either as a trigger for further investigation or prima facie evidence of market power abuse.

We now examine market indices that could have detected potential for market power abuse as well as methods for measuring actual exercise of market power.

4. Detecting potential for market power

The electricity market, by its nature and structure, is vulnerable to market power abuses [Synapse 2001]. In power pools, market power refers to the "ability of a firm owning generation assets to raise the market price by its bidding behavior and to profit from this price increase"[16] [Wolak 2001]. That power can arise from a firm's involvement in two or more vertically related activities, such as generation and transmission or generation and distribution. It may also be borne out by a firm's significant control over the installed generation capacity. The former, referred to as vertical market power, is mitigated by mandatory structural unbundling imposed on vertically integrated utilities, nondiscriminatory access to bottleneck facilities, and restrictions on cross-sector ownership. The latter—horizontal market power—is limited by caps on market share; specifically, no more than 30 percent of the installed generation capacity in a grid (or 25 percent of national installed capacity) may be owned, operated,

[16]The above definition requires a showing of profitability for a behavior to be considered as exercise of market power. Some regulators—for example, the US Federal Trade Commission and Department of Justice—consider this requirement onerous; instead, the ability to alter prices away from competitive level for a "significant period of time" is deemed sufficient to prove market power abuse [Twomey et al. 2005].

or controlled by any entity. Significantly, whereas NPC was made to comply with the vertical restrictions, PSALM was exempted from horizontal controls.

Yet PSALM's control in more than half of installed generation capacity does not automatically confer it with market power. In electricity industry, unlike in others, the links between market concentration, individual firm market share, and market power are tenuous, owing to the peculiar characteristics of the industry—namely, non-storable supply and inelastic short-run demand. It is possible for a firm with relatively small market share to have significant market power if any other firm, because of capacity or transmission constraints, cannot replace its supply. Just as well, a large firm may have trivial influence in market price, given the nature and location of its generation assets. Since a firm's market share does not predict the impact on market price if it withdraws its capacity or reduces its generation, it is necessary to consider other metrics that better reveal one's potential to exercise market power. We examine three of these indices below.

4.1. Pivotal supplier index

The pivotal supplier index (PSI) is a binary measure of whether the capacity of a generator is larger than the difference between total supply and market demand. This index is particularly relevant in the electricity market where supply and demand must balance at all times and some supply surplus is required in the system to cope with unexpected variations in demand. If a generator is pivotal, it faces a positive residual demand, defined by the difference between total demand and total supply of all other generators. When a pivotal supplier withdraws its capacity from the market, some demand would be left unsatisfied and the ensuing supply shortage could render the system unstable. Knowing this beforehand, a pivotal supplier has the power to modify the market price through its offer. From a pivotal supplier's point of view, the market clears at the price that balances the residual demand and its offered capacity.

We obtain PSI for generator *i* as follows:

$$PSI_i = \begin{cases} 1 \text{ if } RD_i > 0 \\ 0, \text{ otherwise} \end{cases}$$

where

$$RD_i = Total\ demand - \left(total\ capacity\ offered + energy\ imports - capacity\ offered\ by\ i\right)$$

$$Total\ demand = metered\ load + ancillary\ services\ \left(reserves\right)$$

For a given period, the PSI can be aggregated to determine the percentage of time when a trader has a pivotal plant in its portfolio. Table 5 presents the pivotal supplier frequency index for the first three months of WESM operation.

Several observations are relevant here. First, some generation plants are pivotal during off-peak hours, suggesting that the exercise of market power is not limited to peak hours. Second, the traders having the most potential to exercise market power, as indicated by the index, are Meralco and PSALM1, reflecting their control of the two largest generation plants, namely, Sta. Rita and Kepco Ilijan, respectively. Third, the trading teams of PSALM have uneven market power potential, where PSALM1 has the greatest, and PSALM4, the least. The indices suggest that if PSALM4 trades independently of other PSALM trading teams, then its market influence is just as weak as the small generation plants (lumped under "Other IPPs" heading). Finally, a shift in market power in favor of PSALM1 during the third month is evident from the statistics. In almost 60 percent of peak hours during the third month, at least one generation plant under PSALM1 was pivotal; during the first month, PSALM1 was pivotal for only 37 percent of peak hours. By contrast, the frequency of having any of Meralco's IPPs pivotal during peak hours declined from 50 percent in July to 32 percent in September.

The pivotal supplier indices in Table 5, while already indicating significant market power potential of PSALM, may still be understating such potential. One reason for this is that the relevant market is not the entire (Luzon) grid but the load pocket in the grid delineated by transmission constraints. A generation plant may not be pivotal in the grid, but it may be in the zone where it supplies the load. Moreover, one generation plant may not be pivotal on its own, but when traded with other plants, the group itself may be pivotal. Since PSALM traders are bidding portfolios of generation plants, even as none of the individual plants in the portfolio may be pivotal, the portfolio itself could be pivotal. Thus, PSALM's market power could be more potent than the PSI conveys.

4.2. Residual supply index

The residual supply index (RSI) is a continuous-scaled version of PSI. It also measures market power based on residual demand faced by a generator, except that it admits the possibility of market power being exercised even if a generator is only nearly pivotal or as a result of coordinated action among generators.

For each generator i, the index is defined by

$$RS_i = \frac{\textit{total capacity offered} + \textit{energy imports} - \textit{capacity offered by } i}{\textit{Total demand}} \times 100$$

Table 5. Pivotal suppliers frequency index, 2006 (percent)

	PSALM1	PSALM2	PSALM3	PSALM4	MERALCO IPPs	NPC IPPs	OTHER IPPs
26 June – 25 July							
Off-peak	8.6	9.6	6.3	0.0	24.1	2.8	0.0
Peak	36.6	40.6	29.8	5.5	49.8	13.5	1.2
All hours	21.3	23.6	16.9	2.5	35.7	7.6	0.6
26 July – 25 August							
Off-peak	3.9	0.0	0.0	0.0	6.3	0.0	0.0
Peak	56.0	14.2	23.2	6.0	50.6	14.8	3.9
All hours	27.2	6.3	10.3	2.7	26.1	6.6	1.7
26 August – 25 September							
Off-peak	1.2	0.0	0.0	0.0	0.2	0.0	0.0
Peak	58.7	1.2	9.6	0.0	32.5	0.6	0.0
All hours	26.9	0.5	4.3	0.0	14.7	0.3	0.0

Source: Author's calculation using PEMC's data.

An RSI value of more than 100 indicates the existence of other plants that could fully meet the demand, thus generator *i* has minimal influence on market price. When a plant is pivotal, however, its RSI is less than 100, which implies that the generator can modify the market-clearing price either by physically withholding capacity or offering its capacity at a high price.

Table 6 identifies the generation plants with the lowest average RSI in the portfolios of the major trading blocs. As expected, these plants have also the largest capacity in the portfolios of the respective traders. If the traders were to exercise market power, it would likely be through these plants. Significantly, the three plants accused of coordinating their bids—Kepco Ilijan, Sual CFTPP, and Pagbilao CFTPP—have also the lowest RSI in the portfolios of PSALM1, PSALM2, and PSALM3, respectively.

While the individual plant's RSIs are instructive, more useful from the regulator's perspective is the market RSI, measured by the lowest RSI among all the generation plants in the market. The California Independent System Operator (CAISO), using the empirical work of Sheffrin [2002], has been using the market RSI to measure the actual exercise of market power. The basis of this inference is the statistical relationship established between hourly RSI and hourly price-cost markup. Using data of California's power pool, it was established that an average RSI of 120 percent is associated with market clearing prices that are near competitive benchmark. The RSI threshold is likely to be different in each market depending on the conditions of the transmission network and opportunities for collusion. A higher threshold means a larger reserve margin (excess supply) is necessary for the market to produce competitive results. Some regulators have devised screening rules around market RSI to trigger inquiry on market power exercise.

In Table 7, we estimated the frequency when market RSI exceeded three threshold levels: 100 percent, 110 percent, and 120 percent. At 100 percent threshold, the frequency of market RSI falling below the threshold corresponds to the intervals when a pivotal supplier exists, hence market power could have been used, and market price deviates from the competitive benchmark. The statistics show that this occurred more often in the first month, 41 percent of the time, than in the third month, 27 percent of the time. Setting the threshold at 110 percent implies that even the absence of a pivotal supplier, i.e., when market RSI is greater than 100 percent, the market outcome may still not be competitive unless the supply surplus is 10 percent or more than total demand. Market RSI was again below the competitive threshold for more hours during the first month compared to the third. At 120 percent threshold, the pattern is similar to the two previous cases. In the first month of WESM operation, it may be inferred from given RSI values that market prices were close to competitive levels in barely 9 percent of the hours, and deviated during 99 percent of peak hours. In September, RSI was below the threshold in all peak hours. But the threshold was exceeded more often, i.e., 30 percent of all hours during September, against 19 percent in August, but most of these hours were off-peak. This probably reflects the larger total offers made in September and the fact that the growth in offers outpaced the growth in demand, as may be recalled from Table 3. Nonetheless, since the hours when the threshold was not met still outnumbered the hours when it was satisfied, the indications were that despite increases in offers (supply), the market clearing prices were still above the competitive benchmark.

4.3. Price-setting frequency index

A generator is a price setter for a given trading hour if the last accepted bid price in the market coincides with the price in its offer block that was accepted last. At any trading interval, there may be more than one price setter. Some regulators—for example, in the UK power pool—are persuaded that the ability of a generator to influence market price could be demonstrated just as well by large effects on prices occurring over a short period of time, as by incremental effects on prices occurring over a longer period of time. For this reason, the high frequency of a generator's status as price setter may be viewed as indication of its market power.

Table 8 notes the proportion of time when one or several generation plants in the trader's portfolio are price setters. Frequent price setters are plants traded by either NPC or PSALM. It can be also deduced from these statistics that the private generators, specifically Meralco IPPs, have limited influence on market clearing prices considering that they are price setters mostly during off-peak hours when demand and thus prices are low.

What explains the differential price-setting behavior of public and private generators? The main source of difference is the larger spot market exposure of the former, which makes them more vested in the market. The power deliveries of Meralco and Other IPPs are all covered by bilateral contracts with distributors. By contrast, the generation plants traded by PSALM3 and PSALM4 have zero coverage since the second month of WESM operation, while PSALM1 and PSALM2 are 11 percent and 33 percent covered, respectively. The NPC-owned plants are 70 percent contracted, thus less exposed to spot market vagaries. Since the revenues of PSALM and to some degree, of NPC, are derived mainly from selling in the pool, it is understandable that high market clearing prices suit them more than private-owned plants that are fully contracted. In addition, during the first quarter of WESM, the private generators were declaring bilateral contract quantities that exceeded their actual power delivery, hence they were actually net buyers in the pool.

Table 6. Generation plants with lowest average RSI, by major market participant or trader

Major participant/trader	*Generation plant*	*26 June – 25 September 2006*		
		Off-peak	*Peak*	*All hours*
PSALM1	Kepco Ilijan	118.4	100.5	110.5
PSALM2	Sual Coal-Fired Thermal Power Plant	132.1	109.9	122.2
PSALM3	Pagbilao Coal-Fired Thermal Power Plant	129.0	108.0	120.0
PSALM4	Subic Power Corp.	120.3	113.9	114.5
Meralco IPPs	Sta. Rita First Gas Power Plant	119.9	101.7	111.9
NPC IPPs	Masinloc	134.8	113.6	125.3

Source: Author's calculation using PEMC's data.

Table 7. Market residual supply index, 2006

	Percent of trading hours when		
	RSI ≥ 100	RSI ≥ 110	RSI ≥ 120
26 June – 25 July			
Off-peak	72.4	36.2	15.9
Peak	41.8	12.0	0.9
All hours	58.6	25.3	9.2
26 July – 25 August			
Off-peak	92.0	60.9	34.5
Peak	33.7	7.2	0.3
All hours	66.0	37.0	19.2
26 August – 25 September			
Off-peak	98.1	87.0	53.6
Peak	39.4	3.9	0.0
All hours	72.2	50.8	30.4

Source: Author's calculation based on PEMC's data.

Table 8. Price-setter frequency index, 2006 (percent)

	PSALM1	PSALM2	PSALM3	PSALM4	MERALCO IPPs	NPC IPPs	Other IPPs
26 June – 25 July							
Off-peak	37.7	28.1	34.9	2.5	19.2	48.6	19.7
Peak	4.6	19.4	16.0	4.9	3.1	42.2	0.9
All hours	22.8	24.2	26.4	3.6	11.9	45.7	11.3
26 July – 25 August							
Off-peak	40.0	1.7	4.6	20.9	1.9	27.4	0.0
Peak	28.0	0.0	3.3	0.9	0.0	9.3	0.0
All hours	34.7	0.9	4.0	12.0	1.1	19.4	0.0
26 August – 25 September							
Off-peak	43.0	35.0	11.4	1.0	43.7	82.5	0.0
Peak	23.8	17.8	22.6	0.6	0.0	37.3	0.0
All hours	34.4	27.3	16.4	0.8	24.2	62.4	0.0

Source: Author's calculation using PEMC's data.

PSALM's and NPC's other plausible interest in raising spot prices is that their plants are called upon by the SO to deliver power out of merit more frequently than others. Generation is considered out of merit if dispatched by the SO even if the price offered for such quantity is higher than the system marginal price. This occurs when the least-cost ordering (merit order) of plants is not feasible for a number of reasons related to the technical requirements of the network, including line constraints, transmission redundancy requirement, and system stability. Of the total out-of-merit generation during the first quarter of WESM operation, plants under PSALM 1 accounted for 55 percent, 9 percent under PSALM3, 7 percent under PSALM4, and 27 percent under NPC. Meralco IPPs accounted for mere 1.9 percent. Table 9 shows the hourly average out-of-merit generation of the plants under the major trading blocs. That some generators are disproportionately relied upon to deliver out of merit creates at least two perverse incentives. First, out-of-merit generation is compensated at the system marginal price, thus there is incentive to raise the market-clearing price by bidding high. Second, a generation unit has incentive to physically withhold capacity if (a) the SO is likely to instruct another unit in the same portfolio and (b) the market price (with capacity withholding) minus the marginal cost of the replacing unit is greater than the market price (without capacity withholding) minus the marginal cost of the replaced unit.

Table 9. Out-of-merit generation, 2006 (hourly average, in MW)

	PSALM1	PSALM2	PSALM3	PSALM4	MERALCO IPPs	NPC IPPs
26 June – 25 July						
Off-peak	35.4		5.5	18.5		100.3
Peak	10.1		13.6	3.3		50.9
All hours	24.0		9.2	11.6		78.0
26 July – 25 August						
Off-peak	134.5		18.4	16.6	17.8	33.0
Peak	11.6	4.7	8.8	0.6	0.0	14.5
All hours	79.7	2.1	14.1	9.4	9.9	24.7
26 August – 25 September						
Off-peak	248.5		15.1	26.8	0.5	73.3
Peak	121.6		35.3	0.1	0.0	12.2
All hours	191.8		24.1	14.9	0.3	46.0

Source: Author's calculation using PEMC's data.

4.4. Synthesis

The preceding structural and behavioral metrics should address concerns on the ability and motivation of PSALM traders to exercise market power. The pivotal status of their generation plants gives them an opportunity to modify market prices through their bids or by withholding capacity. And considering the tight supply condition in the market, as signaled by market RSIs falling below the threshold for competitive market for most hours, it can only be surmised that the variance between market-clearing prices and competitive prices must be wide and possibly increasing as the opportunity to exercise market power expands. The fact that the generation plants of PSALM are not hedged by bilateral contracts makes them vested in the revenues from the pool, hence the motivation to raise market prices. But the fact that the PSALM plants have become more frequent price setters, particularly during peak hours in the third month, only confirms the market power that PSALM possesses; it cannot be taken as evidence of actual exercise of market power. Indeed, none of the simple indices that show PSALM's potential market power can be used to show that it has actually exercised that power. We therefore need to investigate further into the bidding behavior of the trading teams to find evidence of exercise of market power.

5. Measuring actual exercise of market power

5.1. Framework

Market power in the electricity market is exercised by limiting quantity or supply, either by bidding output into the market above competitive prices, or by not bidding the output at all. These are forms of capacity withholding: the former is economic, the latter is physical. Both forms of market power abuse are prevalent in pools but are not easy to distinguish from normal competitive behavior.

The task at hand is to establish that the PSALM trading teams exercised market power individually and jointly, causing the unexpected surge in market prices during the third month of WESM operation.

There are basically two empirical approaches in the literature to deal with similar issue. The first is competitive benchmark analysis where a counterfactual competitive market is simulated to estimate market-clearing price when no firm is able to significantly affect prices by its output or price offers. That price is compared to actual price, and the difference is attributed to the exercise of market power. In the hypothetical competitive market, firms are assumed to submit cost-based bids. Thus the analysis involves estimation of the marginal costs of generation, using data on technical specifications of the plants and fuel costs.[17] This is the approach taken by Wolfram [1999] in measuring market power in the UK electricity market; Bushnell and Saravia [2002] in assessing the competitiveness of the New England electricity market; and Borenstein, Bushnell, and Wolak [2002] and Joskow and Kahn [2002] in investigating the causes of the California power crisis.

An alternative approach is to construct an oligopoly model and calibrate it using actual production and cost data of all market participants, as well as market demand and transmission capacity information to predict equilibrium outcomes of a market with a given structure and design. A comparison of the simulated and actual market outcomes could reveal the degree and nature of competition in the actual market. Borenstein, Bushnell, and Knittel [1999] pioneered the application of this approach in the California electricity market to analyse the impact of divestitures on market power. A market simulation model of this type was also developed by European regulators to examine the market power potential of dominant producers in the region [Twomey et al. 2005]. This approach is regarded superior to the first, but it is vulnerable to the criticism on the actual market features and real-world constraints that may have to be omitted for the model to be empirically implemented. Where these omissions are substantial, inferences drawn from comparison of actual and simulated market outcomes may be flawed.

The approach adopted here is a variant of the competitive benchmark analysis, but it avoids estimation of cost functions.[18] The model is described in Ciarreta and Espinosa [2010] and applied to measure horizontal market power in the Spanish electricity market. For our purpose, we expand the approach to measure the impact on market prices of PSALM's bidding behavior and its physical withholding of capacity.

Underlying this approach is the principle that in a competitive market, size does not confer market advantage. A firm with several generation plants in its portfolio would make the same bid for a generation plant as a firm that has only one generation plant to trade. Put differently, a generation plant would

[17]An exemption here is Wolak [2001] who proposed to estimate a generator's cost function from the plant's past-bids profile.

[18]Estimation of cost functions requires, at the minimum, fuel prices and thermal efficiencies (heat rates); both sets of information are difficult to obtain. For example, the "true" fuel costs for hydro and geothermal plants must be based on the opportunity costs of using these resources for power generation against alternative uses. Other costs, such as equipment degradation when the plant is operated outside of designated parameter, are not readily quantifiable. In addition, there is also a question of which is more appropriate to use—long-run versus short-run marginal cost. Thus, an approach that eschews estimation of cost is preferred for practicality.

bid into the same market whether it is included in the portfolio or traded singly. On the other hand, where a multi-plant generator is allowed to use its market power, it could structure its bid to maximize the profits for its portfolio, rather than the profits of the individual plants. Thus, we define a "reference" bid for a generation plant as the bid that a trader would put in if it is maximizing the plant's profit, instead of the joint profits for n plants in a portfolio. The difference between the actual and reference bid curves is attributed to market power, and the impact on market clearing prices of using the actual, instead of the reference bid, is a measure of inefficiency arising from the use of that power.

We extend the approach to measure the impact of physical capacity withholding where the reference bid for a generation plant is constructed from the actual, with all available capacity offered. The difference in market clearing prices when capacity is offered partially versus when it is offered fully is also attributed to the use of market power.

It should be noted that compared to the traditional measure of market power, Lerner Index, our measure understates the full impact of market power since the reference bid may be higher than the marginal cost of the plant, i.e., the reference bid itself may incorporate some degree of market power. Given this, our measure can be considered the lower bound of the "true measure" of market power. Consequently, if a firm's behavior is found to have significant impact on market clearing prices by our measure, it should be even more when measured against the "true" standard.

5.2. The model

For each trading hour, every seller i has to submit an offer for every generation plant j it owns. The offer by seller i for plant j, O_{ij}, consists of blocks of (p_k, q_k) where p stands for price and q stands for quantity. The offers are ordered increasingly to build the function:

$$S_{ij}(p) = \sum_{(p,q)\in O_{ij}} \left[q_k | p_k \le p \right].$$

The offer schedule of seller i is the sum of its offers for all of its plants, $S_i(p) = \sum_j S_{ij}(p)$.

By adding the offer schedules of all sellers in the market, the aggregate supply function for the hour is obtained as: $S(p) = \sum_j S_i(p)$.

The demand function for the hour is built in similar way using buyers' bid schedules, which specify the amount of energy a buyer would buy for a given price. Bids are ordered decreasingly to construct a function representing a buyer's bid schedule, B_i:

$$D_i(p) = \sum_{(p,q)\in B_i} \left[q_k | p_k \geq p \right].$$

Adding up the bid functions of all buyers produces an aggregate demand function defined by

$$D(p) = \sum_i D_i(p).$$

The market clears at the intersection of the aggregate supply and demand functions; the system marginal price, p^*, is defined by $D(p^*) = S(p^*)$.

To measure the market power of seller i, a reference offer, S_i^R, is substituted for the seller's offer in the aggregate supply function. S_i^R is seller i's offer schedule had it offered the individual plants as if they were separately owned, instead of treating them as part of one portfolio. Put differently, the reference offer maximizes the individual profits of the plants, instead of the joint profits of all plants traded by seller i. The market clears at a different price, p^{i^*}, defined by $D(p^{i^*}) = S_i^R(p^{i^*}) + \sum_{\sim i} S_{\sim i}(p^{i^*})$ and referred to as "competitive benchmark price".[19] The difference between the two equilibrium prices, p^* and p^{i^*} measures the power of seller i to modify the market outcome by its bidding behavior. Thus, seller i's market power is represented by

$$MP_i = \frac{p^* - p^{i^*}}{p^*}.$$

The joint market power of a group of sellers is measured in a similar way. By replacing the offers of colluding sellers with their respective reference offers in the aggregate supply function, the market clears at a different price, p^{I^*} such that $D(p^{I^*}) = \sum_{i\in I} S_i^R(p^{I^*}) + \sum_{i\notin I} S_{\sim i}(p^{I^*})$. Group I's market power is thus measured by

$$MP_I = \frac{p^* - p^{I^*}}{p^*}.$$

5.3. Implementing the model in WESM

The goal in implementing the model is to measure the market power of each of the PSALM trading teams (i = PSALM1, PSALM2, PSALM3, PSALM4), and of the PSALM bloc (I = PSALM). We also measure separately the impact of

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[19]The term "competitive benchmark price" is usually associated with marginal cost pricing, but since cost estimation is avoided here, the reference offers are deemed to reflect competitive pricing behavior, and used as substitutes for marginal cost.

market power exercised by making above (or below) competitive offers, and by physically withholding capacity.

To achieve these objectives, we analyse the market data for the period 26 June to 25 September 2006, including hourly offers for each of the 54 generation units; hourly forecast load, line losses, and power flow between Luzon and Visayas grid; and maximum available capacity of each generation unit, obtained by netting out scheduled and forced outages from installed capacity. There are 2,208 trading intervals during the study period, of which 45 percent are classified peak (high demand) hours.[20]

For each generation unit, an offer function is constructed for a trading hour. The offer functions for generation units belonging to the same trading portfolio are aggregated to obtain the offer function of a particular trader. This applies to PSALM trading teams, since each team handles three or four generation plants. NPC-owned plants are traded individually. In the case of Meralco IPPs, two are traded by First Gas, another by Quezon Power.[21] The offer functions of the 17 traders are aggregated to obtain the supply function for the hour.

Demand bids are not yet accepted in the WESM, thus aggregate demand is the sum of SO's forecast load and line losses, adjusted for Pmin of all plants that were offered during the interval and power flow between Luzon and Visayas grid.[22] Intersecting aggregate supply and demand generates a series of system marginal prices, p^*.[23]

We compute competitive benchmark prices, or market-clearing prices when reference offers are used in lieu of actual offers of PSALM generators in the aggregate supply function. Two sets of reference offers are constructed; one representing offers for generation units if they were traded individually rather than part of a portfolio; another, representing offers if the maximum available capacity were bid into the market. The former is used to estimate market power

[20]The peak demand hours are from 100H to 900H (800H in the first month) and from 2200H to 2400H on weekdays and Saturdays (excluding holidays); the remaining hours are classified off-peak.

[21]There is cross-ownership between Meralco and First Gas; none between Meralco and Quezon Power.

[22]The power that flows from Visayas to Luzon grid is considered energy imports by Luzon. It is subtracted from the sum of forecast load and line losses to obtain the aggregate demand in Luzon that will have to be satisfied by the supply in Luzon. Conversely, when the power flow is in the other direction, the energy exports are added to the sum. This is done to prevent the conditions in the Visayas grid from affecting the market price in the Luzon grid since the spot market operation is still limited in the latter. The power flow in either direction cannot exceed 150 MW at any trading interval.

[23]The "true" actual prices, i.e., those used for settling generators' sales in WESM, are sum of system marginal price and value of line losses. The latter vary for each of the four hundred nodes. Thus, the published price for the hour is the load weighted average of the nodal prices.

manifested in pricing behavior; the latter, to measure market power exercised by physically withholding capacity.

In estimating the first set of reference offers, we choose non-PSALM plants that have same technology and closest technical features as the PSALM plants. Thus, Sual and Pagbilao plants, both coal-fired, are referenced to another coal-fired plant, Masinloc, owned and traded by NPC; Kepco Ilijan is benchmarked against Sta. Rita, one of Meralco IPPs; oil-based plants—Subic, Bauang, Limay, and Malaya—are measured up against a private-owned IPP, Trans-Asia.

Energy-limited plants, like hydroelectric and geothermal, are however not referenced to any plant—as if their offers are deemed "competitive". This different treatment is compelled more by practicality than principle. First, the offers for these plants are based on some strategy of rationing the limited available energy over time. Even in a competitive market, the price offer of a hydroelectric or geothermal plant does not reflect its production cost, but rather the lost opportunity of using the energy at some later time. Thus for scheduling purposes, hydro plants are usually treated as if they have the highest marginal cost even when their marginal costs are actually the lowest. However, the offered price may also include a component reflecting the generator's ability to impact prices in different hours. Separating the opportunity cost of energy from the exercise of market power is tricky; hence, it is sensible to take the offered prices at face value. Second, comparability of plants is a problem because the location of the plant is often related to energy availability as well as to the plant design. For example, a run of river hydro plant cannot be referenced to a plant with reservoir capability since the latter's output can be varied, whereas the former is less flexible. Eight of the fifteen PSALM plants are hydro; four of these are run of river. All non-PSALM hydro plants have storage capability.

Where reference offers are relevant, a capacity factor is obtained by dividing the offered capacity of a reference plant, QR, by the offered capacity of a PSALM plant, QP. The offer profile of a reference plant is then modified by multiplying the quantity in every block by the capacity factor, QR/QP. This modified offer is the reference offer for a PSALM plant.

The derivation of the second set of reference offers is more straightforward. The capacity factor is the quotient of the offered capacity of a PSALM plant and its maximum available capacity. This factor is applied to the quantities in the blocks that were actually offered by the PSALM plant, producing a revised offer for the plant.

We replace the actual offers of PSALM plants by their respective reference offers in the aggregate supply function to produce a "reference aggregate supply". The intersection of aggregate demand and reference aggregate supply is the competitive benchmark price p^{I^*}. The difference between the system marginal price, p^*, and the competitive benchmark price, p^{I^*}, is a measure of the market power of PSALM as a bloc. We can also measure the market power of the individual trading teams by replacing only the offers of generation units belonging to a trading team and keeping the rest of the offers intact. The resulting aggregate supply intersects the aggregate demand at price p^{i^*}, whose variation from system marginal price measures the influence of trading team i on market price.

At any trading interval, the margin between the system marginal and competitive benchmark prices may be positive, negative, or nil. If a trading team or the PSALM bloc has no market power, then the two prices would only differ in the realization of a random term with zero mean. On the other hand, the existence of market power is indicated by a statistically significant positive mean difference between the two series of prices. We conduct a test of means to ascertain if market power exists. Then we compare the margins in the three trading months to determine if the market power was simply static or was exercised at any point during the period. The market power index is the proportion of system marginal price due to the margin. Since our estimation produces negative and positive margins and the market power index is not symmetric around zero, a load-weighted index is calculated.

5.4. Results

The capacity of PSALM trading teams and PSALM as a bloc to influence market outcomes through their pricing behavior is presented in Table 10. The mean differences between system marginal and competitive benchmark prices are tested statistically against a null hypothesis that market power is trivial so that the two prices are equal. The weighted average market power indices are shown in Table 11.

We find the results consistent with the inferences drawn from the market indices discussed in the previous section. In general, the differences between the system marginal prices and competitive benchmark prices are positive and statistically significant, which leads to the conclusion of the existence of market power. Where the differences are negative, they turned out to be statistically insignificant. But the trading teams have uneven market power. PSALM1 has the largest impact on price, while PSALM4 has the least. PSALM1's bidding behavior raised the average price by Php 0.29/kWh in the first month, Php 0.54/kWh in the second, and Php 1.78/kWh in the third, or by 27 percent, 28 percent, and 50 percent, respectively. Interestingly, this increase in market power coincides with the increase in the frequency that PSALM1 is a pivotal supplier. In contrast, PSALM4's contribution to the price increase was limited to the first month, which was Php 0.02/kWh or a mere 0.8 percent of average system marginal price; it had none in the following months.

It may also be surmised from the results that the size of one's market power does not reflect the size of one's generation capacity. For example, PSALM3's capacity is 63 percent larger than PSALM1's, but its market power was less than half during the first month. However, market power tends to be correlated to market share in actual generation. We observe that the size of market power of the trading teams follows their market shares in actual generation.

Even as some trading teams have limited or no market power, the market power of the PSALM bloc remains significant. The trading teams jointly raised the average price by Php 0.50/kWh, Php 0.96/kWh, and Php 2.16/kWh, respectively, in the first three months of WESM operation. Except for PSALM1, the other trading teams had only marginal contribution to these price variations. But since the market power of the bloc can be larger than the sum of the individual market power of the trading teams—as was the case during the peak hours of the first month and all hours of the second month—one team's bidding behavior could benefit all others in the bloc.

Table 10. Impact of strategic pricing on market clearing prices

	Period	*All hours*	*Peak*	*Off-peak*
	26 Jun – 25 Jul	0.286	0.359	0.227
$p^* - p^{PSALM1^*}$	26 Jul – 25 Aug	0.536	0.647	0.449
	26 Aug – 25 Sept	1.779	3.323	0.593
	26 Jun – 25 Jul	0.074	0.131	0.027
$p^* - p^{PSALM2^*}$	26 Jul – 25 Aug	-0.009*	-0.125*	0.081
	26 Aug – 25 Sept	0.291	0.662	0.006*
	26 Jun – 25 Jul	0.135	0.315	-0.012*
$p^* - p^{PSALM3^*}$	26 Jul – 25 Aug	0.391	0.622	0.209
	26 Aug – 25 Sept	1.019	2.331	0.009*
	26 Jun – 25 Jul	0.017	0.038	-0.849*
$p^* - p^{PSALM4^*}$	26 Jul – 25 Aug	-0.014*	-0.131*	0.078
	26 Aug – 25 Sept	0.033*	0.080*	-0.003*
	26 Jun – 25 Jul	0.498	0.866	0.197
$p^* - p^{PSALM}$	26 Jul – 25 Aug	0.964	1.579	0.482
	26 Aug – 25 Sept	2.158	4.194	0.593

*Not statistically significant at 5 percent.

Table 11. Index of market power from strategic pricing (load weighted)

	Period	*All hours*	*Peak*	*Off-peak*
$\frac{P^* - P^{PSALM1^*}}{P^*}$	26 Jun – 25 Jul	0.269	0.182	0.359
	26 Jul – 25 Aug	0.282	0.129	0.438
	26 Aug – 25 Sept	0.499	0.417	0.581
$\frac{P^* - P^{PSALM2^*}}{P^*}$	26 Jun – 25 Jul	0.024	0.041	0.007
	26 Jul – 25 Aug	-	-	0.024
	26 Aug – 25 Sept	-0.006	0.032	-
$\frac{P^* - P^{PSALM3^*}}{P^*}$	26 Jun – 25 Jul	0.001	0.124	-
	26 Jul – 25 Aug	0.075	0.010	0.141
	26 Aug – 25 Sept	0.077	0.197	-
$\frac{P^* - P^{PSALM4^*}}{P^*}$	26 Jun – 25 Jul	0.008	0.012	-
	26 Jul – 25 Aug	-	-	0.021
	26 Aug – 25 Sept	-	-	-
$\frac{P^* - P^{PSALM^*}}{P^*}$	26 Jun – 25 Jul	0.257	0.359	0.152
	26 Jul – 25 Aug	0.409	0.364	0.456
	26 Aug – 25 Sept	0.536	0.490	0.581

Yet the most important inference that may be drawn from the results was the apparent exercise of market power by PSALM in the third month. The notable increases in market power of PSALM1 and of the PSALM bloc from the first to the third month are plausible grounds to find that PSALM exercised its market power. Specifically, the PSALM bloc was responsible for 49 percent increase in prices during peak hours, and 58 percent during off-peak hours, in the third month, while only 32 percent and 45 percent, respectively, in the first month. It is important to stress that the increase in PSALM's contribution to market price variation could not have been a response to demand or cost changes because their offers are referenced to their rivals' who were facing the same demand and cost conditions. If PSALM adjusted its bids in the same proportion as its rivals, then the size of its market power in the third month would just have been about the same as in the earlier months. It should also be noted that the individual bids may not have generated significant returns for the individual teams, but in combination, the impact on market price and the returns to the PSALM bloc are ostensibly large. Finally, our measure of market power is clearly a lower bound of the Lerner Index, not only because reference offers were used instead of marginal costs, but also the bids of the hydro plants were considered "competitive" at face value. Thus, the market power found using this relatively loose standard could only understate the "true" market power.

On top of the impact of PSALM's pricing strategy on market clearing prices, the trading teams also influenced the market outcomes by limiting their capacity offers. In the third month, all PSALM traders reduced their capacity offers, while the other generators, including NPC's, increased their offered capacity. Table 12 compares the capacity offers of the major trading blocs and shows the offers of PSALM traders moving in opposite direction from those of other generators during the third month. PSALM4, for example, capped its offered capacity to mere 16 percent of its available capacity during off-peak hours. The offers of the other PSALM traders were less extreme, but still below their offers in the preceding month.

Table 13 reports the mean differences between the system marginal price and the benchmark prices that would have been observed if PSALM offered its maximum available capacity. Table 14 presents the load-weighted indices of market power from capacity withholding. On average, the margins are positive and statistically significant, but smaller than those associated with strategic pricing behavior. By bidding less than the maximum available capacity, the PSALM bloc was responsible for raising the average market price by Php 0.64/kWh in the first month, Php 0.72/kWh in the second, and Php 1.40/kWh in the third, or about 30 percent of the system marginal price. The contributions of the trading teams to these price increases were also uneven. In this case, the largest contribution came from PSALM3, while PSALM1 had the least. This is because most of the capacity withheld belongs to oil-based plants. There were no capacity offers from the Malaya plant (650 MW) since about the third week of WESM operation, while capacity offers from the Limay plant (600 MW) stopped halfway into the second month. Both Limay and Malaya were traded by PSALM3.

Table 12. Average plant offer in proportion to available capacity, 2006
(in percent)

	26 Jun – 25 Jul		*26 Jul – 25 Aug*		*26 Aug – 25 Sept*	
	Off-peak	*Peak*	*Off-peak*	*Peak*	*Off-peak*	*Peak*
PSALM1	76.0	78.6	90.2	90.9	78.3	81.0
PSALM2	67.3	66.0	72.9	77.6	65.0	69.9
PSALM3	42.3	47.8	62.3	62.6	48.6	48.6
PSALM4	18.3	54.8	16.2	44.6	15.8	43.0
Meralco IPPs	90.8	90.5	92.7	92.1	96.2	96.4
NPC IPPs	62.0	62.2	62.0	65.8	68.1	75.2
Other IPPs	100.0	100.0	100.0	100.0	100.0	100.0

*Source: Author's calculation using PEMC's data.

Table 13. Impact of capacity withholding on market clearing prices

	Period	*All hours*	*Peak*	*Off-peak*
	26 Jun – 25 Jul	0.063	0.078	0.051
$p^* - p^{PSALM1^*}$	26 Jul – 25 Aug	0.026*	-0.046*	0.078
	26 Aug – 25 Sept	0.015*	0.035*	0.000*
	26 Jun – 25 Jul	0.108	0.146	0.077
$p^* - p^{PSALM2^*}$	26 Jul – 25 Aug	0.135	0.153*	0.121
	26 Aug – 25 Sept	0.549	1.202	0.046
	26 Jun – 25 Jul	0.563	0.732	0.425
$p^* - p^{PSALM3^*}$	26 Jul – 25 Aug	0.657	0.960	0.435
	26 Aug – 25 Sept	0.985	1.998	0.206
	26 Jun – 25 Jul	0.054	0.069	0.041
$p^* - p^{PSALM4^*}$	26 Jul – 25 Aug	0.085*	0.060*	0.103
	26 Aug – 25 Sept	0.249	0.534	0.030
	26 Jun – 25 Jul	0.643	0.871	0.457
$p^* - p^{PSALM}$	26 Jul – 25 Aug	0.723	1.070	0.470
	26 Aug – 25 Sept	1.404	2.807	0.325

*Not statistically significant at 5 percent.

Table 14. Index of market power from capacity withholding (load weighted)

	Period	*All hours*	*Peak*	*Off-peak*
$\frac{P^* - P^{PSALM1^*}}{P^*}$	26 Jun – 25 Jul	0.047	0.028	0.066
	26 Jul – 25 Aug	-	-	0.022
	26 Aug – 25 Sept	-	-	-
$\frac{P^* - P^{PSALM2^*}}{P^*}$	26 Jun – 25 Jul	0.057	0.052	0.061
	26 Jul – 25 Aug	-0.040	-	0.092
	26 Aug – 25 Sept	0.056	0.093	0.019
$\frac{P^* - P^{PSALM3^*}}{P^*}$	26 Jun – 25 Jul	0.334	0.256	.415
	26 Jul – 25 Aug	0.273	0.110	.431
	26 Aug – 25 Sept	0.204	0.195	.213
$\frac{P^* - P^{PSALM4^*}}{P^*}$	26 Jun – 25 Jul	0.041	0.022	,061
	26 Jul – 25 Aug	-	-	.068
	26 Aug – 25 Sept	0.013	0.026	.001
$\frac{P^* - P^{PSALM^*}}{P^*}$	26 Jun – 25 Jul	0.381	.315	.449
	26 Jul – 25 Aug	0.306	.141	.464
	26 Aug – 25 Sept	0.305	.286	.324

Our measures of market power from capacity withholding are admittedly low estimates of the actual because of the treatment of hydro plants. These plants are presumed to offer their maximum available capacity at all times, even when they offer only during peak hours. Moreover, we assume that the forced outages were random and not strategically used to withhold capacity. Yet again, any finding of the exercise of market power using our measure can only be collaborated by a stricter measure.

6. Conclusion

Proving market power abuse is still an art that evolves with every anti-competitive case. There is no definitive method yet that could detect, much less measure the impact of, market power abuse. Given this constraint, the pragmatic approach is to piece together several metrics that may be used to construct a coherent story of exercise of market power.

This paper examined the motivation and opportunities of a public utility to exercise market power, and measured the impact on market prices. We find that noncompetitive pricing raised market prices by about 54 percent, while capacity withholding, by 31 percent. It is difficult, however, to prove with absolute certainty that the pricing strategies and capacity withholding of competing traders were coordinated; unanimity or convergence of actions is not evidence of collusion. Yet it is clear that the combination of their actions—strategic pricing for pivotal plants and capacity withholding of large oil-based plants—benefited the bloc as a whole, and inevitably its individual members.

The case demonstrated the difficulty of monitoring and mitigating market power abuses in an industry that is still transitioning from decades of regulated monopolies to a competitive structure. The problem becomes more acute when market concentration remains high, but the sector is already deemed competitive and thus left out of the regulatory screen.

However re-regulation of the industry does not also work well, especially under a traditional rate-making regulator. What is needed is economic regulation that does not interfere with market processes, yet aggressive in monitoring and mitigating market power abuses.

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