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Mergers in Regulated Industries: Electricity

by

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Abstract

Mergers in any industry can raise complicated questions about the elimination of competition and the achievement of efficiencies. Mergers in regulated industries such as electricity raise even more complicated issues as the analyst needs to grapple with the constraining effects of regulation, multiple levels of regulation, the ability to evade regulation, and the desire for efficiency. This paper discusses the electricity industry in general and one particular electricity merger that the U.S. Department of Justice (DOJ) recently analyzed, in order to draw several lessons about the promotion of competition through electricity mergers in the United States. The purpose is to stimulate discussion with European counterparts to see what, if anything, Europe can learn from the U.S. experience with electricity mergers and regulations.

Mergers in any industry can raise complicated questions about the elimination of competition and the achievement of efficiencies. Mergers in regulated industries such as electricity raise even more complicated issues as the analyst needs to grapple with the constraining effects of regulation, multiple levels of regulation, the ability to evade regulation, and the desire for efficiency. This paper discusses the electricity industry in general and one particular electricity merger that the U.S. Department of Justice (DOJ) recently analyzed, in order to draw several lessons about the promotion of competition through electricity mergers in the United States. The purpose is to stimulate discussion with European counterparts to see what, if anything, Europe can learn from the U.S. experience with electricity mergers and regulations.

There are six main lessons that I learn from the U.S. experience:

1. Competition in the deregulated (or partially deregulated) sectors of electricity is enhanced by long-term contracts between generators and wholesale buyers.
2. Failure to expose retail consumers to variable retail prices exacerbates market power in wholesale electricity generation.
3. The usual HHI or market share analysis can be misleading as a predictor of market power in wholesale generation. A merger simulation approach can be a superior method of evaluating market power.
4. Multiple layers of regulation affect the profit maximizing choice of electricity generators.
5. When there are multiple regulatory agencies with the ability to stop a merger, complications can arise especially when objectives of the different regulatory agencies conflict.
6. The externalities that arise in electricity transmission means that a regulatory authority in one location can adversely affect consumers in another location.

In order to illustrate these points, I first present a brief (and somewhat simplified) overview of some major issues in the U.S. electricity industry. I then turn to the specifics of one proposed merger.

Overview

The supply of electricity consists of three basic elements: generation, transmission, and distribution.¹ It is widely believed that the last two are natural monopolies while the first need not be. Because of the way electricity is generated and transmitted, physics determines the effect of having an additional generator operating in one part of the transmission grid, and physical laws imply that an effect in one part of the transmission grid can affect the electricity flows in other parts of the grid. The efficient generation of electricity requires a dispatcher to coordinate the operation of the generators. Each of the three components of electricity supply, especially transmission and distribution, are typically regulated to varying degrees. A retail sector can arrange for the supply of electricity to final customers and it too can be regulated.

The demand for wholesale electricity is very price inelastic and can be highly variable, in part, because of weather. Since electricity cannot generally be stored to a meaningful degree, the supply curve (industry marginal cost curve) for electricity can be highly inelastic during peak demand periods. This combination can lead to volatile prices for wholesale electricity when wholesale electricity is sold in a market. If all electricity is sold in the spot market, then it is easy to see that if one firm got sufficient control of supply, then that firm could cut back output a little bit in peak demand periods and drive price way up during those peak periods. It is the shape of the supply (industry marginal cost) curve, which becomes very inelastic at large quantities, that creates this possibility. What matters for figuring out whether a firm can exercise market power is not necessarily its overall market share, but a firm's ownership share of the various types of units along the industry supply curve at any instant. We make this last statement precise by conducting a merger simulation.

The fact that the industry marginal cost curve for wholesale electricity is inelastic in parts of the output range may create the opportunity for a firm to cut back industry output, by restricting its own output, in order to raise price. Whether such an individual restriction of output will be profitable will depend on at least three factors: a) what other firms might do, b) the firm's inframarginal units on which it will earn a higher price, and c) the sensitivity of overall demand to price. These observations suggest three ways to enhance competition. First, forcing all firms to sell the same product (e.g., spot) makes oligopolistic coordination to raise prices easier if there are

¹ See Borenstein (2002).

several competing firms. If the contracts were more varied – as for example when long term contracting is allowed – that would lead to a more competitive outcome because oligopolistic coordination becomes more difficult when the number of dimensions upon which to compete increases. Second and related, if long term contracts are used to sell fixed amounts of output under fixed priced contracts (or at least the price and quantity terms are independent of the spot price), then one should regard the firm as essentially having sold off part of its capacity.² This reduces the gain from any price rise and thereby reduces the incentive of a firm to raise price post merger. Forward contracting therefore should be encouraged as a means of promoting competition. In the California energy crisis, such forward contracting was relatively rare, and this undoubtedly exacerbated market power problems.

Third, the shape of the demand curve influences the ability of a firm to raise price by cutting back output. The firm has a greater ability to raise price the less responsive demand is to price. When regulation fixes retail price, the final consumer is insulated from underlying increases in wholesale electricity prices. This causes the demand curve for wholesale electricity to be more inelastic than it would be if retail consumers faced variable prices. Alternatively put, fixed price retail regulation promotes the exercise of market power at wholesale.³

Regulators will examine a merger for the likelihood that prices will rise post merger. Although regulators have many tools at their disposal, they should definitely use non-regulatory tools to minimize the likelihood of anticompetitive acts. Based on the foregoing discussion, regulators should not impede the use of varied contracts between wholesale buyers and sellers, the use of long-term contracts that transfer effective ownership of capacity to others, or the use at retail of pricing that, at the margin, makes consumers face actual cost. In this way, regulators are likely to lessen the anticompetitive effect of any proposed merger compared to the case where the use of these tools is impeded.

² I note that a purchaser of such a contract can often resell its capacity to others.

³ One objection to having consumers face variable prices is that such prices impose large risks on the consumers. But, a consumer can face a variable marginal price yet not face the prospect of huge fluctuations in his bill. For example, a consumer could pay the average price he paid last year for say 90 percent of his purchases on any day, but a variable price for the last 10 percent.

An Example of an Electricity Merger

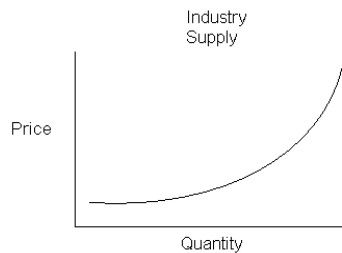
In 2004, two utilities, Exelon and Public Services Enterprise Group (PSEG), proposed to merge.⁴ The 16 billion dollar transaction would have created one of the largest energy utilities in the United States. Each company owned several generators that produced electricity at wholesale and each also had contractual or regulatory obligations to serve retail customers at fixed prices. The focus of the investigation was in states in the Mid-Atlantic region. In those states, wholesale electricity generation is coordinated by PJM Interconnection, LLC. PJM runs an auction each day in which suppliers of electricity bid their willingness to supply electricity at various prices.⁵ PJM then finds the price that equates supply with final demand and each unit of electricity receives that price, with locational adjustments reflecting transmission congestion. There are certain caps that are imposed on the range of prices that can prevail.

Let us think about what the marginal cost curve for the industry looks like. There are several different types of plants that can generate electricity. There are some plants – called base load plants – that operate most of the time. These plants have very low marginal costs and accordingly are almost always running. Nuclear plants would be an example. There are other plants – called peakers – that have high marginal cost and operate only when needed because of demand peaks. Oil powered combustion turbine plants would be an example. It is very expensive to build a nuclear plant, while it is much cheaper to build a peaker. Hence, it is efficient to have a mix of plants in order to meet a fluctuating demand. I have oversimplified a bit because there are in fact a range of plants that differ in their marginal cost. If Figure 1 represents the industry marginal cost curve, as one produces more output, one moves from low marginal cost hydroelectric and nuclear plants, to coal units to combined cycle plants and finally to peaking units that use combustion turbines.

4 See Armington et al. (2006), Gilbert and Newberry (2007), and Wolak and McRae (2007).

5 There are actually a spot and day ahead auction market, but we ignore these operational details in this exposition.

Figure 1



In order to assess market power created by merger, one needs to understand which assets are controlled by each firm. For example, suppose that demand is always large enough so that the nuclear plants always run at full capacity whether or not they are owned by one or two firms. But, suppose further that Exelon and PSEG owned only nuclear plants, then the merger is unlikely to have any effect on price. The reason is that the merged company would not alter its supply and, therefore, could not influence price. Notice that this statement remains true regardless of size of the inframarginal nuclear capacity or in other words, regardless of the market shares of the merging firms.

Although this observation – that market share need not predict the incentive of a merged firm to raise price – is applicable to any industry, it is a particularly relevant point in an industry with multiple plants and a sharply rising industry marginal cost curve – a good description of electricity generation. It suggests that market shares of particular types of generating units may be more relevant than overall market shares. Exelon has lots of low cost nuclear and hydroelectric capacity, while PSEG has lots of higher cost capacity. That combination through merger of inframarginal plus marginal capacity can lead to a post merger price increase. But to analyze this issue one also needs to turn to the relevant geographic market.

The relevant geographic market for electricity generation will change over time in response to constraints on the transmission system. There will be times when two generators compete with each other to supply electricity, while at other times transmission bottlenecks force PJM to cease relying on one of the generators as a source of supply to customers in

particular areas. Therefore the plants will not influence each other in the sense that the price that one plant receives will not be influenced by the other plant's operations during these times of transmission bottlenecks.

The investigation revealed that there were two geographic areas that arose frequently because of transmission constraints. One ("East") consisted of New Jersey, Delaware, the Philadelphia area and parts of Maryland and Virginia. This market existed for about 1400 hours in 2005. The other market ("Central/East") included the first, but also additional parts of Pennsylvania and Maryland. This market existed for about 1900 hours in 2005. For expositional purposes, I will report results only for "East". The overall market shares of Exelon and PGES were roughly 21 and 31 percent of capacity in "East". See Table 1.

An illustrative representation of ownership of plants along the industry supply curve for East is depicted in Figure 2. From our earlier discussion, we know that overall market shares can give misleading estimates of market power. In Table 2, we present market shares by category of plant. The table illustrates that the overall share of 52 percent for the merged firm understates the merged firm's share of the super peakers, which is 57 percent.

The regulation of electricity at retail and contractual arrangements imposed on both Exelon and PSEG the obligation to serve at fixed retail prices a substantial amount of retail customers. This obligation alters the profit function that firms face when choosing how to operate in order to maximize profit. Specifically, the profit, π , of a firm can be

Table 1

PJM East Market Shares	
	Total Generating Capacity
Pre-Merger Shares	
PSEG	31%
Exelon	21%
Pepco Holdings	15%
PPL	6%
Reliant	6%
Others	19%
Post-Merger Shares	
Exelon Share	52%
Exelon Share After Proposed Divestiture	35%

written as

(1)

$\pi = P(Q) Q_1 - C(Q) + \bar{P} Q_2$, where

P = price determined by PJM to equate supply and demand,

$C(Q)$ = cost of output Q ,

Q = amount produced ($Q_1 + Q_2$),

Q_1 = amount sold at price P ,

Q_2 = amount sold at retail at price \bar{P} and is independent of P , and

\bar{P} = fixed retail price.

To simplify the analysis, one can assume that post-merger, all firms except the merged firm would behave competitively, while the merged firm would maximize profits as defined above, taking into account that its output will affect price P. This is one of the many models that the DOJ considered in its evaluation of the transaction. The residual demand curve facing the merged firm equals total demand minus the constructed supply curve for the rest of the industry. A key part of

Figure 2

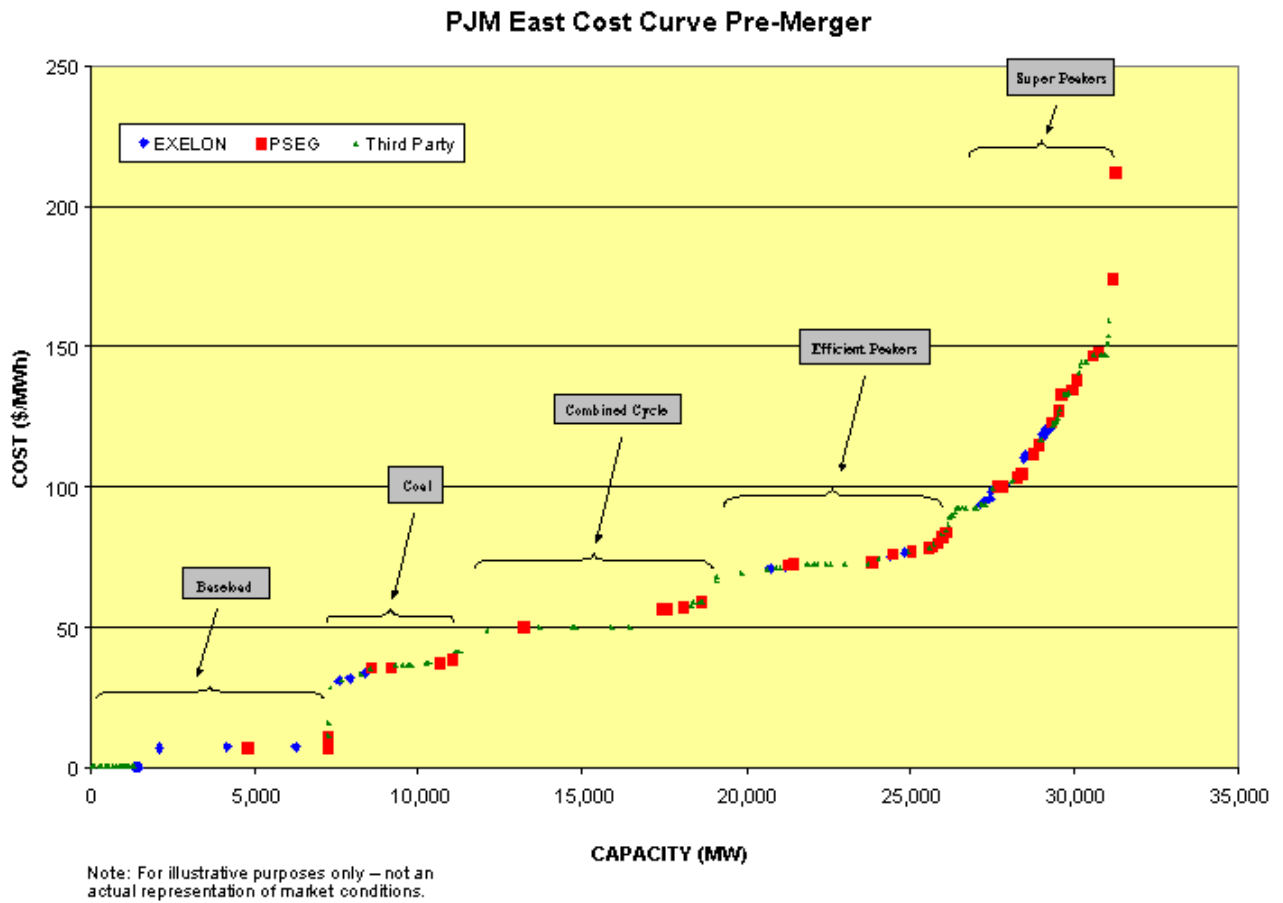

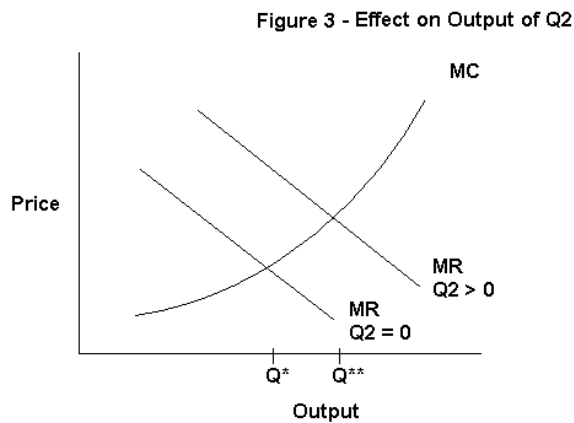


Table 2

PJM East Market “Shares” <i>within</i> Cost Categories				
	Super Peakers	Efficient Peakers	Combined Cycles	Coal
Pre-Merger Shares				
PSEG	38%	22%	43%	28%
Exelon	18%	12%	0%	16%
Pepco Holdings	12%	21%	17%	14%
PPL	0%	21%	0%	6%
Reliant	22%	2%	0%	14%
Others	9%	22%	40%	22%
Post-Merger Shares				
Exelon Share	57%	34%	43%	44%
Exelon Share After Proposed Divestiture	48%	11%	23%	0%

Higher Marginal Cost  Lower Marginal Cost

the analysis is recognition that the obligation to supply Q_2 at retail reduces the incentive of the firm to restrict output compared to the case where there is no such obligation.⁶ When there is an obligation to sell Q_2 at a fixed price at retail, the marginal revenue curve of the firm is shifted out. This shift causes the intersection of marginal revenue and marginal cost to occur at a larger output than previously so that $Q^{**} > Q^*$. See Figure 3. Intuitively, the obligation to provide Q_2



at \bar{P} causes the firm to act as if it has divested some of its capacity to others. This divestiture reduces the firm's market power, leading to an increase in output.

⁶ With $Q_2 = 0$, the firm operates where marginal revenue equals marginal cost. Hence, the firm operates where $P - \frac{\partial c}{\partial Q} + Q \frac{\partial P}{\partial Q} = 0$, or $MR = \frac{\partial c}{\partial Q}$, where $MR = P + Q \frac{\partial P}{\partial Q}$.

With the obligation to provide Q_2 at retail price \bar{P} , the firm operates where $P - \frac{\partial c}{\partial Q} + (Q - Q_2) \frac{\partial P}{\partial Q} = 0$,

or $MR_1 = \frac{\partial c}{\partial Q}$, when $MR_1 = MR - Q_2 \frac{\partial P}{\partial Q}$. Notice that $MR_1 > MR$, if $Q_2 > 0$. Hence MR_1 lies above MR so that output is higher in the case of an obligation to serve Q_2 at retail.

The acquisition of capacity would have the opposite effect on marginal revenue from the selling of capacity through contract. If a firm acquires say 100 units of nuclear capacity, and if it is profitable for that capacity always to be used, the profit function would become $\pi = P(Q) (Q + 100) - C(Q)$, where for simplicity, I assume the cost of nuclear is zero, and where $Q + 100$ is now total firm production and $P(Q)$ was defined below in eq. (1). In this case, it is easy to show that the marginal revenue curve shifts in, so that Q falls from its previous value.

The analysis also suggests that a firm's incentives can be altered by forcing it to hold certain positions in a forward or futures market. This analysis can get a bit tricky. Analysis of incentives to influence spot prices as a result of forward or futures commitments is related to the analysis of the manipulation of markets. That analysis requires one to specify the expectations that buyers and sellers have of future spot prices and could depend on whether the financial forward or futures commitments are known to market participants, as well as how far into the future the financial positions are for. Rolling over a one year futures contract from year to year is not necessarily the same as having one long term fixed price contract because in the former case the price at which contracts are rolled over may be influenced by the firm's post merger output decisions.

One can calculate the effect of the merger by solving for the model just described for the post merger prices taking into account the industry marginal cost, the types of plants of each of the merging firms, as well as each of the merging firms' obligations to serve retail customers at a predetermined price. One can then compare this predicted post merger price with the pre-merger benchmark.⁷ For several possible market definitions, the simulations show that the merger was likely to raise wholesale prices by 10 to 20 percent.

Using these same simulations methods, one can calculate what type and how much of a divestiture is required so that post merger prices would not rise. After a divestiture of about 30 percent of capacity of the merged firm's capacity (in Table 2), the simulation model predicts no significant price increase as a result of the merger under various plausible scenarios involving a wide variety of transmission constraints.

Overlapping Regulatory and Merger Authorities

⁷ The pre-merger benchmark could be existing prices, or alternatively one could use the model to predict the pre-merger prices as a) a check on the model and b) as a way of compensating for any bias in the model so that, for example, if the model always over predicts price by say \$10, one could avoid this bias by focusing on the change in market prices predicted by the model. In this discussion, I do the latter.

There were several regulatory and merger authorities having jurisdiction over parts of the merger. At the national level, the Federal Energy Regulatory Commission (FERC) and the DOJ both had authority to analyze and influence the merger. But each state affected by the merger also has the right to analyze certain aspects of the merger. We have already seen how the regulations amongst the various bodies can influence the merger analysis when we accounted for the requirement that the merged entity had to provide a certain amount of retail service at a fixed price. This constraint fundamentally alters the merger analysis.

More generally, the existence of various government authorities can create severe problems for efficient regulation. In this case, FERC accepted as a possible remedy a “virtual” divestiture that was to be achieved by forcing the merged firm to take certain positions in a financial forward market. In principle, such a solution could work as long as a) the forward contract is for a sufficiently long period, b) is equivalent to requiring sales each day (not just once at the end of the contract), and c) cannot be undone by offsetting positions in other financial forward or futures markets.⁸ Exactly how to evaluate the constraining effect of forward positions in short term financial futures, or forward contracts is an important and somewhat complicated issue. It depends on how and when expectations are formed, on contract length and on the information available to market participants. Although DOJ understood the constraining effect of such forward contracts, limitations regarding their equivalence to divestiture led DOJ to prefer the divestiture route.⁹ But whether FERC and DOJ agree or not on a proper divestiture is beside the point. The real question is whether it makes sense to have two national agencies analyzing the same merger to decide on the exact same issue (will price rise?). It is not at all clear why the regulatory agency should not simply

8 Rolling over short-term forward contracts is not equivalent to holding a long-term forward contract because in the former case, unlike the latter case, the price at which the future sale will occur is not predetermined.

9 Similarly, the effect of a physical divestiture can be undone by offsetting financial transactions.

have jurisdiction on the non-price matters (e.g., safety, reliability) and defer to the agency that is supposed to be expert at mergers to figure out the price effect.

One reason why one might be concerned about giving regulatory agencies unlimited merger authority is because we know from the economic literature that regulatory authorities may have objectives much more complicated than maximizing society's welfare. Numerous studies show that regulatory agencies can act to help various groups (including the industry they regulate) at the expense of other groups. In such a case, the regulatory authority could use the merger as an opportunity to extract a "payment" from the merging parties even though the merger will not raise price and use that "payment" to reward one of the constituents of the regulators (e.g., residential customers).

Although the DOJ and FERC would not have challenged the merger with the proposed DOJ divestiture, the state regulatory authority in New Jersey and the parties could not reach agreement on an appropriate remedy. As a result, the transaction was abandoned.

The New Jersey experience illustrates one other key insight into regulation of a network. In a network industry such as electricity, where the network extends across state lines, it is possible for one state to exert significance externalities on others. The siting of transmission lines or an electricity generator in one state can alter supply conditions in other states. Moreover, if transmission is natural monopoly, one has to decide how to pay for it. Attempts by one state to pay less could increase the burden on other states. It is not obvious that the optimal geographic scope for unified regulation necessarily follows state or country boundaries.

This problem with overlapping regulatory authorities in a network industry is illustrated by the railroad industry in the late 1890's. Individual states would set low intrastate rates, thereby forcing interstate rates to be the ones supporting the fixed costs of the railroads. Recognizing the problem, the Supreme Court in Smyth v. Ames (169 U.S. 466 (1898)) put limits on state rate-making authority.

Finally, in situations where a merger in electricity is deemed not to be anticompetitive, but only if access to certain networks is assured, one has to ask which authority should assure access and at what price. My view is that judges and courts in general are not well suited to setting (and updating) the price to be charged for access. That is likely a job better suited to a specialized agency with knowledge of the industry. See Carlton and Picker (forthcoming).

Conclusion

The need to regulate electricity as well as concerns that a merger in the electricity industry creates market power issues are reduced if one can eliminate restrictions that themselves reduce competition. For example, artificial barriers to allowing an electricity generator in one state from participating in a grid serving another state should obviously be eliminated. Moreover, retail regulations that allow the retail consumer to face a more variable retail price, combined with the allowing of long term contracts between wholesale suppliers and wholesale buyers, are desirable directions to pursue in order to promote competition.

The use of simple market shares is likely to be a very imperfect guide to whether a merger creates market power in wholesale electricity. A more detailed analysis is required that takes account of the control of both marginal and inframarginal facilities. This paper has described one such analysis. Forward contracts both physical and financial, as well as obligations to serve retail customers at fixed prices, fundamentally affect the analysis.

Regulatory agencies with overlapping jurisdictions can create severe coordination problems. The opportunity for one area of a network to impose costs on another is quite high in electricity networks, and area-wide coordination of regulations is essential for overall efficiency. Having a merger rather than a regulatory authority determine the competitive effects of a merger is likely desirable. Where access pricing is required as a remedy, assigning that task to a regulatory authority rather than the courts is also likely desirable.

Bibliography

Armington, Elizabeth, Eric Emch and Kenneth Heyer, “This Year in Review: Economics at the Antitrust Division, 2005-2006”, Review of Industrial Organization, 2006.

Borenstein, Severin, “The Trouble with Electricity Markets: Understanding California’s Restructuring Disaster”, Journal of Economic Perspectives, (2002).

Carlton, Dennis and Randal Picker, “Antitrust and Regulation”, in Economics of Deregulation”, National Bureau of Economic Research, (forthcoming).

Gilbert, Richard and David Newberry, “Market Power in U.S., and E.U. Electricity Generation”, mimeo, (2007).

Wolak, Frank and Shawn McRae, “Market Analysis in Restructured Electricity Supply Industries: The Proposed PSEG and Exelon Merger (2006),” in L. White and J. Kwoka, The Antitrust Revolution, (forthcoming).