ELECTRICITY MARKET POWER MITIGATION

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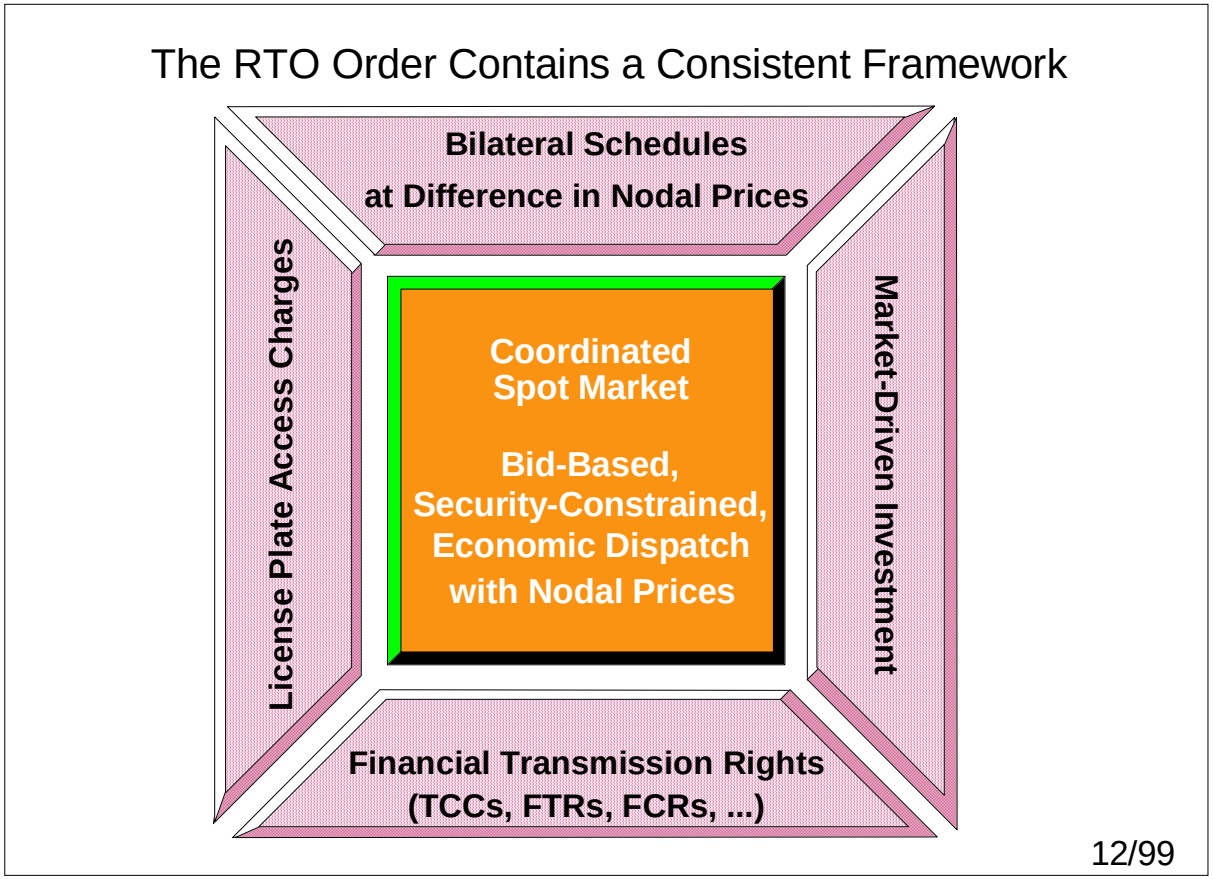
Massachusetts Electric Roundtable, XENERGY Executive Forum
Newton, MA

When Can Competition Work?

May 18, 2001

ELECTRICITY MARKET — Competitive Structure

The RTO Millennium Order defines an efficient model for a competitive electricity market.



The basic structure should be adapted to develop market power mitigation that is consistent with the transition to a competitive market.

ELECTRICITY MARKET Competitive Assumptions

The fundamental assumption is that there is workable competition in generation and some services, but there is a continuing monopoly in the case of the wire businesses of transmission and distribution.

The term "competition" means different things to different participants in the market:

- A (very) large number of generation suppliers.
- The ability to choose among suppliers at will.
- A (very) large number of customers.
- The ability to refuse customers at will.
- Non-discrimination and comparability.

The limiting assumptions of the competitive market include:

- A commodity business with no entry costs or barriers.
- Price-taking behavior by suppliers.
- Price-taking behavior by customers.
- Elimination of arbitrage opportunities under equilibrium according to the law of one price.

Unfortunately, the limiting conditions of competition between and among generators and customers do not hold in practice. There are many approximations, and we hope for workable competition.

The gap between the perfect and the real has many dimensions:

- Economic dispatch is always imperfect.
- System constraints are soft.
- Investments can be lumpy.
- Market participants seek price advantages.
- Energy and ancillary services can have dominant suppliers.

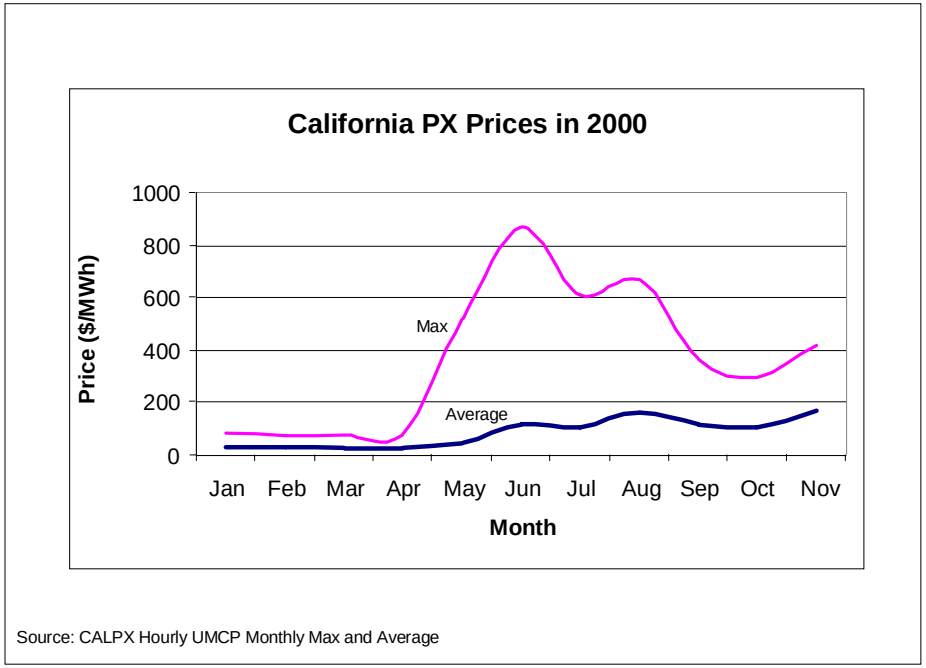
All these have implications for pricing. In practice, however, it is the presence of market power that raises the greatest concern. It is not hard to find instances of substantial market power, and regulators have been focussed on this issue. The policy response has been a mix of:

- Market monitoring and reporting. (UK, CA, PJM, NY, NE, …)
- Market power mitigation through divestiture and contracting. (UK, CA, IL, NY, PJM, …)
- Market power mitigation through market design. (UK, CA, Austral., …)

ELECTRICITY MARKET Competition and Market Experience

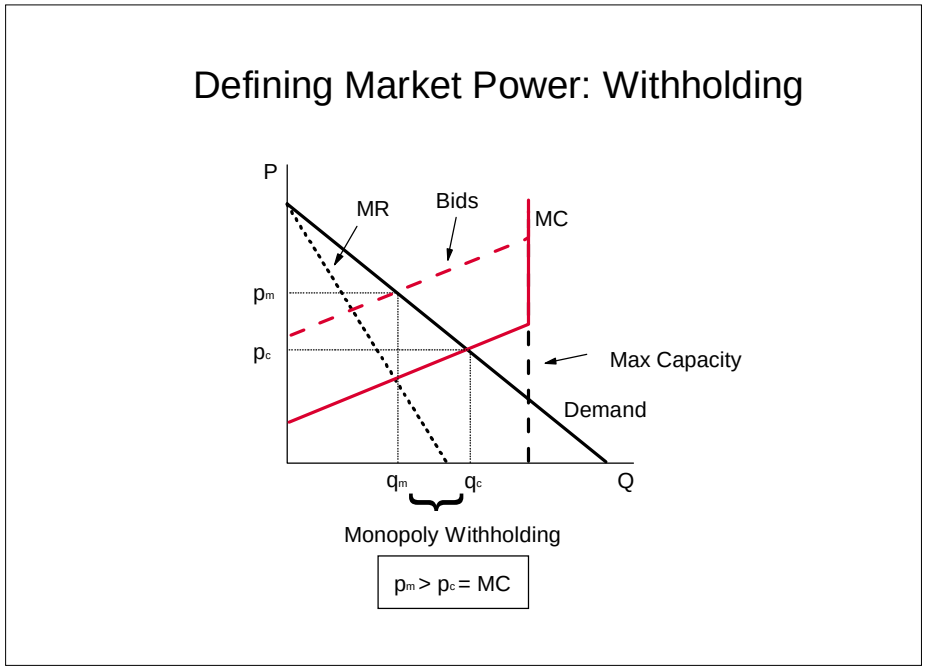
Market power is a reality and its use has been a focal point of analysis. Previous research focussed on the theory of market design, which produced no examples of designs better than the canonical competitive approach. Here we address the experience with market power an high prices.

- Price spikes have been common but of short duration in most markets.
- California in 2000 saw the first example of sustained (very) high prices.
- Market power has been cited as a (the) cause of the high prices, but the evidence is subject to different interpretations.
- The theory and practice of market power mitigation are in turmoil as a result of the California experience.
- It is not easy to distinguish between high prices due to scarcity and high prices due to an exercise of market power.
- The mitigation policy depends on the diagnosis.



Source: CALPX Hourly UMCP Monthly Max and Average

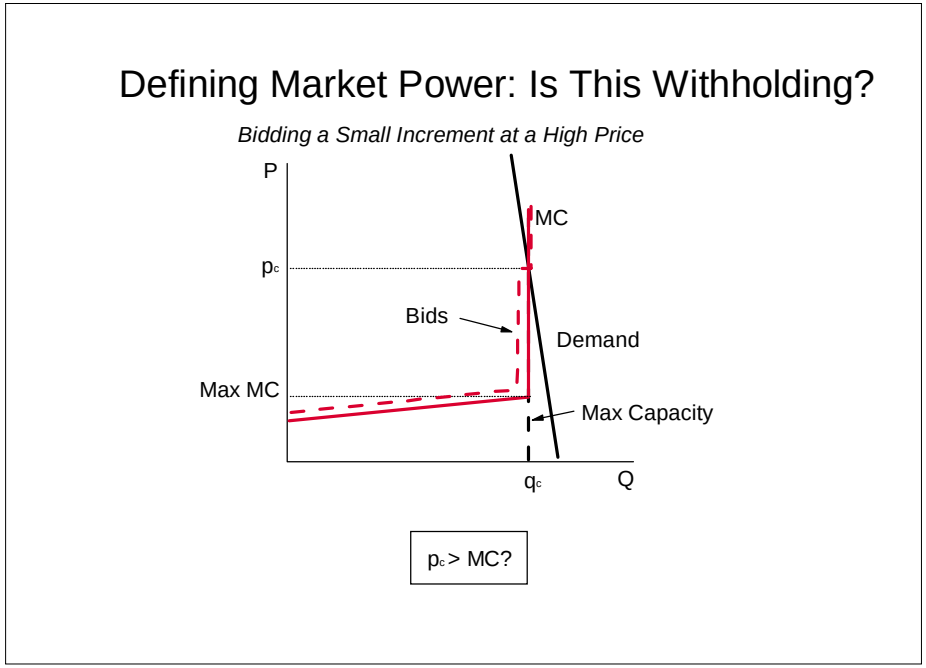
The conventional definition of market power addresses withholding some supply in order to profit from higher prices on the reduced output. This is the easy case.



- Bids exceed marginal cost to set higher market clearing price.
- Output is below capacity and price exceeds marginal cost.

In practice, it may be difficult to define or recognize a significant use of market power. Consider the incentives created by market clearing price rules.

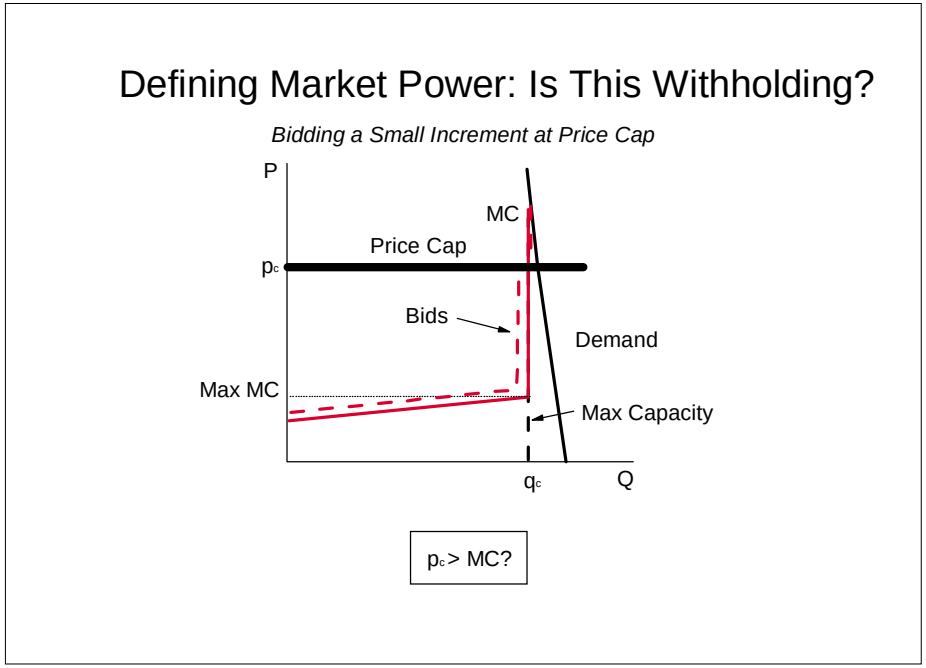
Example: Common bidding practice in ISO run markets.



- Bids exceed marginal cost for only a small quantity, to set higher market clearing price.
- Output is at capacity and price exceeds the direct marginal cost.
- Is this an exercise of market power that deserves mitigation?

In practice, it may be difficult to define or recognize a significant use of market power. Consider the incentives created by price caps.

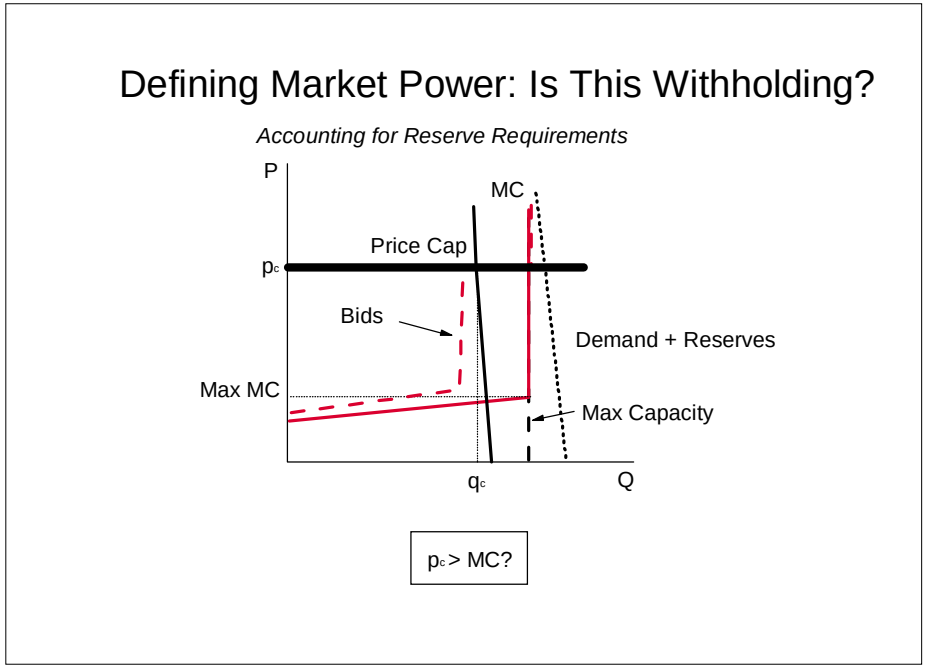
Example: Common bidding practice in California.



- Bids exceed marginal cost for only a small quantity, to set market-clearing price at price cap.
- Output is at capacity and price exceeds the direct marginal cost.
- Is this an exercise of market power that deserves mitigation?

In practice, it may be difficult to define or recognize a significant use of market power. Consider the conditions that arise with reserve requirements.

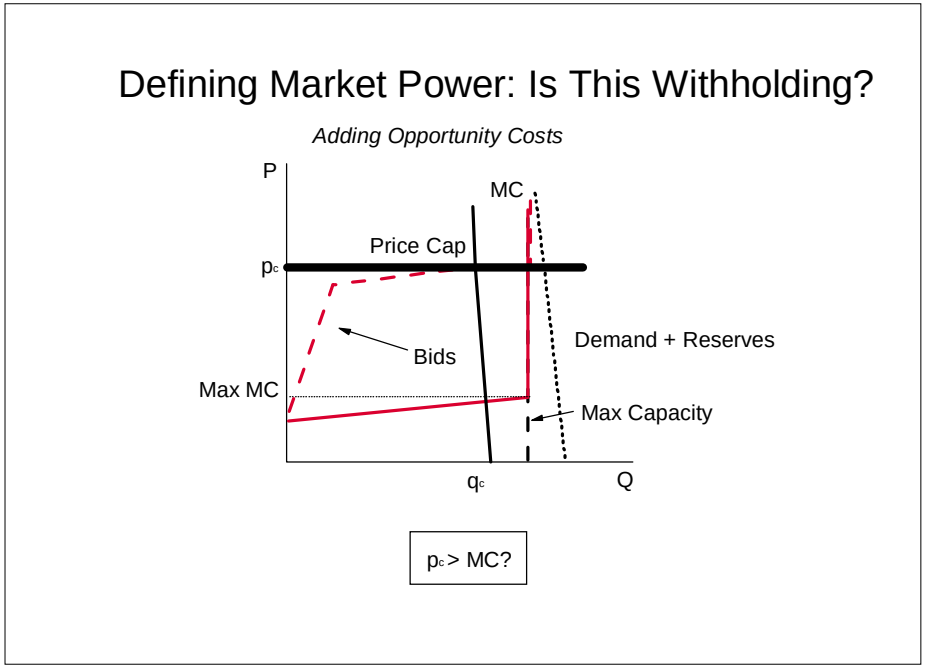
Example: Common dispatch experience in ISO markets.



- Bids exceed marginal cost to set market-clearing price at price cap.
- Output is at capacity with reserves and price exceeds the direct marginal cost.
- Is this an exercise of market power that deserves mitigation?

In practice, it may be difficult to define or recognize a significant use of market power. Consider the conditions that arise with opportunity costs.

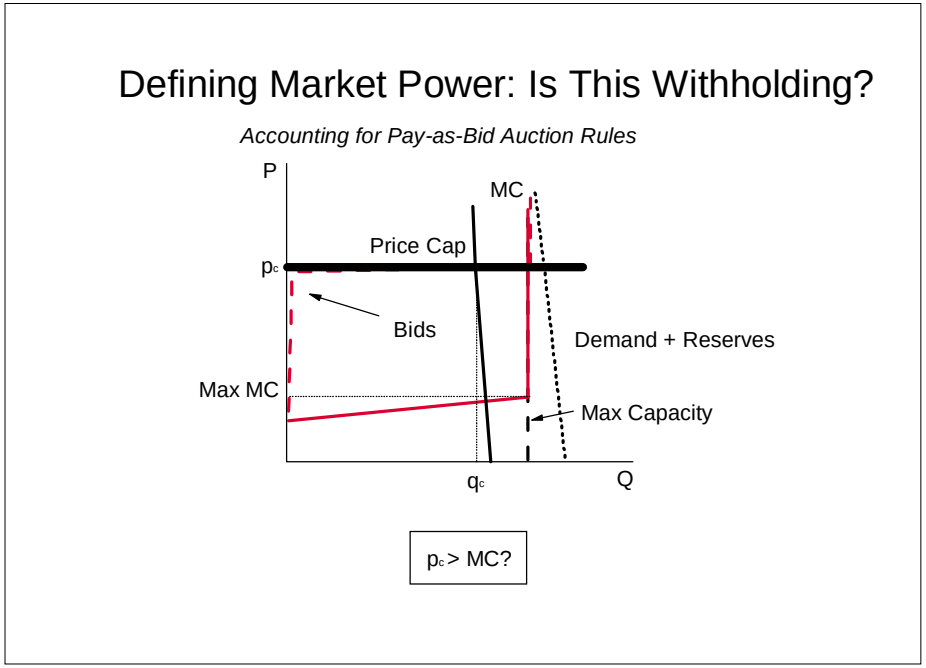
Example: Sequential ancillary service markets as in California.



- Bids exceed direct marginal cost.
- Output is at capacity with reserves and price exceeds the direct marginal cost.
- Is this an exercise of market power that deserves mitigation?

In practice, it may be difficult to define or recognize a significant use of market power. Consider the conditions that arise with auction rules to pay-as-bid.

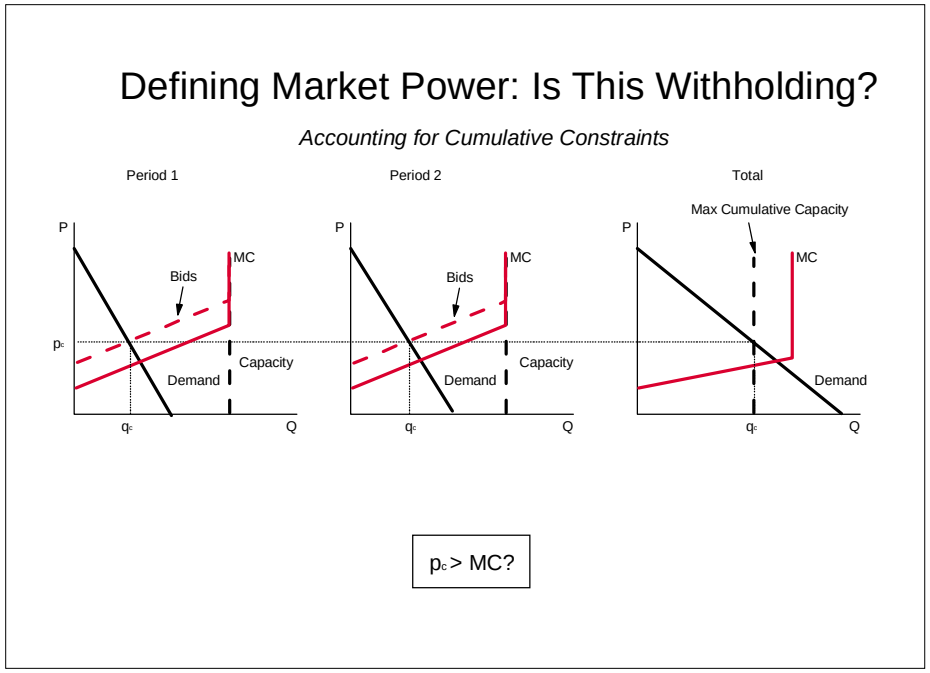
Example: FERC proposals for California.



- Bids exceed direct marginal cost in order to collect the market price under pay-as-bid rule.
- Output is at capacity with reserves and price exceeds the direct marginal cost.
- Is this an exercise of market power that deserves mitigation?

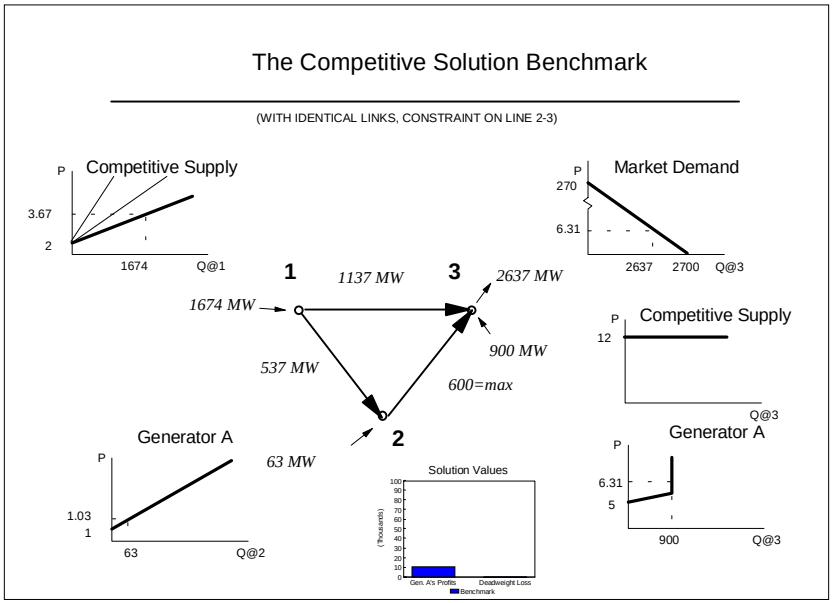
In practice, it may be difficult to define or recognize a significant use of market power. Consider the conditions that arise with cumulative output restrictions.

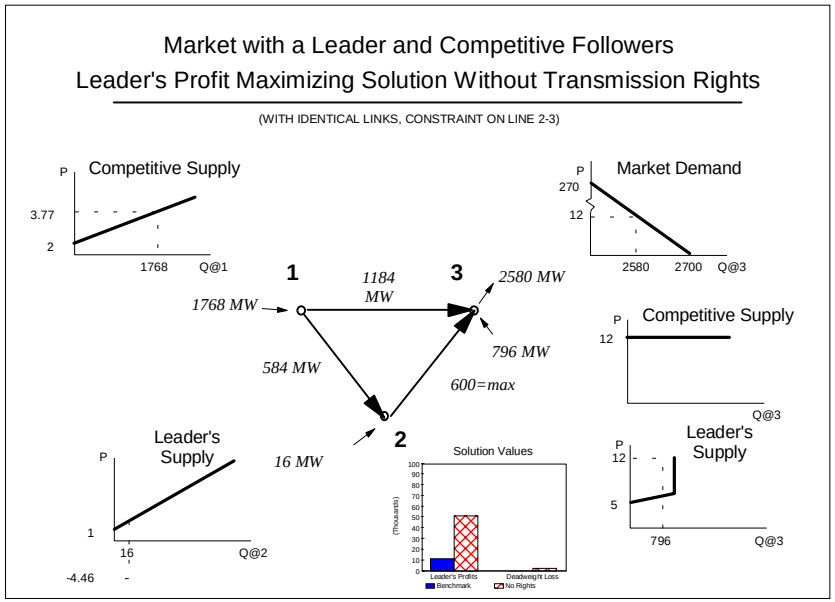
Examples: Hydro facilities with limited water storage. Environmental rules.



- Bids exceed direct marginal cost in order to reflect the opportunity cost of cumulative constraint.
- Output is at capacity and price exceeds the direct marginal cost.
- Is this an exercise of market power that deserves mitigation?

In practice, it may be difficult to define or recognize a significant use of market power. Consider the conditions that can arise with network bottlenecks.

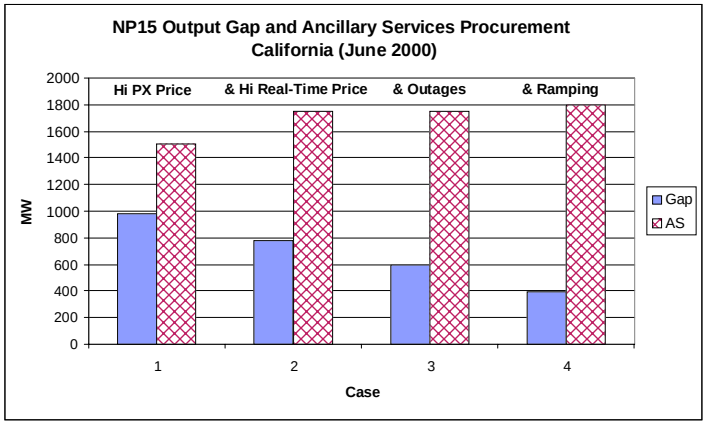




- Bids are below direct marginal cost in order to create congestion bottlenecks.
- Price exceeds or is below direct marginal cost at different locations.
- This is an exercise of market power, but it may be hard to detect.

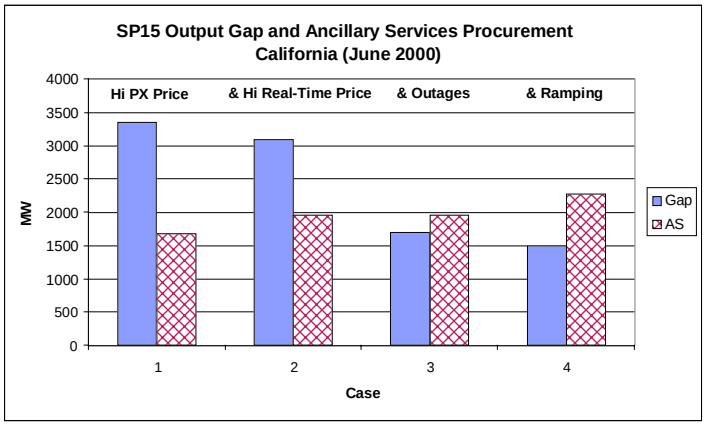
In practice, it may be difficult to detect a significant use of market power. The answer can change depending on the treatment of details like outages and ramping. Consider estimates of output gaps in California. Output gaps greater than ancillary service procurement might indicate strategic withholding. But the estimation depends on the details.

Detecting Market Power Via Strategic Withholding



Source: Harvey and Hogan, "On the Exercise of Market Power Through Strategic Withholding in California," April 24, 2001.

Detecting Market Power Via Strategic Withholding



Source: Harvey and Hogan, "On the Exercise of Market Power Through Strategic Withholding in California," April 24, 2001.

The output gap based on day-ahead PX prices reduces significantly and becomes less than ancillary services in all cases if we account for changes in real-time prices, outages, and ramping limitations.

Immediate adoption of a number of the key elements of the long-term market design would help in the transition. Introduction of better mechanisms for demand side bidding would operate to moderate price spikes. Introduction of a demand curve for reserves would better reflect the reality of how electric systems have always been operated but translating that into the context of market bidding and pricing. Within the general market structure of Order 2000, there are many proposals for mitigating market power as part of a transition to competitive markets. Here we consider the implications and experience with:

- Cost-of-service regulation.
- Divestiture.
- Forward contracts.
- Hard price caps.
- Pay-as-bid auctions.
- Soft price caps.
- Bid caps.

The transition rules must incorporate as much of the critical market design features as possible along with an internally consistent method of moving from the old to the new. Hence, any transition framework should include explicit consideration of how well it is likely to work in a market setting and how it will ensure a transition to an efficient, workable market.

Cost-of-Service Regulation.

Regulators impose a dual obligation to serve (produce) and to report the direct cost of production. The generator is protected from competition and receives the cost of production with an appropriate return on capital.

- Customers absorb the risks of high costs and enjoy the benefits of low costs.
- The obligation is an implicit forward contract, so costs change slowly and the customer is not exposed to the spot market.
- The generator has little incentive to innovate or operate efficiently.
- Regulators face an information asymmetry that leads to an expensive oversight process.
- Dissatisfaction with cost-of-service regulation precipitated electricity restructuring.
- It is difficult to go back to cost-of-service regulation once the assets have been sold into the open market.
- Calls for re-introduction of cost-of-service regulation reflect frustration with the market rather than a practical guide to action.

Divestiture.

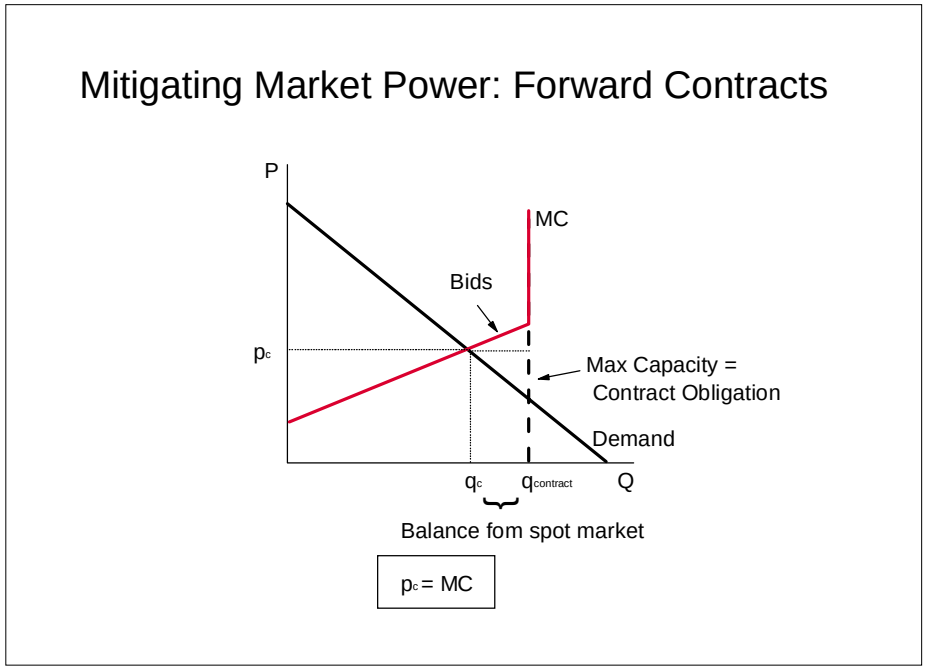
Generation is sold to many owners to reduce the concentration of control. With each generating unit in separate hands, there is less incentive for an individual generator to withhold production.

- At time of sale, there is a tradeoff in the price that buyers are prepared to pay for assets. The higher the ownership concentration going forward, the more the buyers are willing to pay.
- With highly dispersed ownership, economies of scale and scope in operating power plants cannot be exploited as easily or at all.
- The principle is simple. The practice has been riddled with examples of asset sales that left a highly concentrated industry.
- Traditional market power analysis tends to underestimate the number of suppliers required to approach competitive conditions in electricity markets.
- Regulatory procedures under traditional standards have found that suppliers do not have market power, yet prices have been very high in constrained conditions.
- Once the plants have been sold and market pricing allowed, there is little that regulators can do to force further divestiture.

Forward Contracts.

Buyers sign long-term contracts at predetermined prices to purchase power from generators. The form of the contract could be as a contract-for-differences relative to the spot price.

- Like cost-of-service regulation, forward contracts fix the price and serve as a hedge against fluctuations in the spot market.
- Like divestiture, forward contracts diversify the ownership of the economic interest in the plant, reducing or eliminating the incentive to withhold. In theory, the spot market can produce a workably competitive outcome.
- Customers are better off, but only if the contract price is low enough to be acceptable. In California, forward prices in Spring 2000 were under $80 and actual spot prices were close to $250. But in New York, forward prices at the same time were $140, and spot prices turned out under $80.

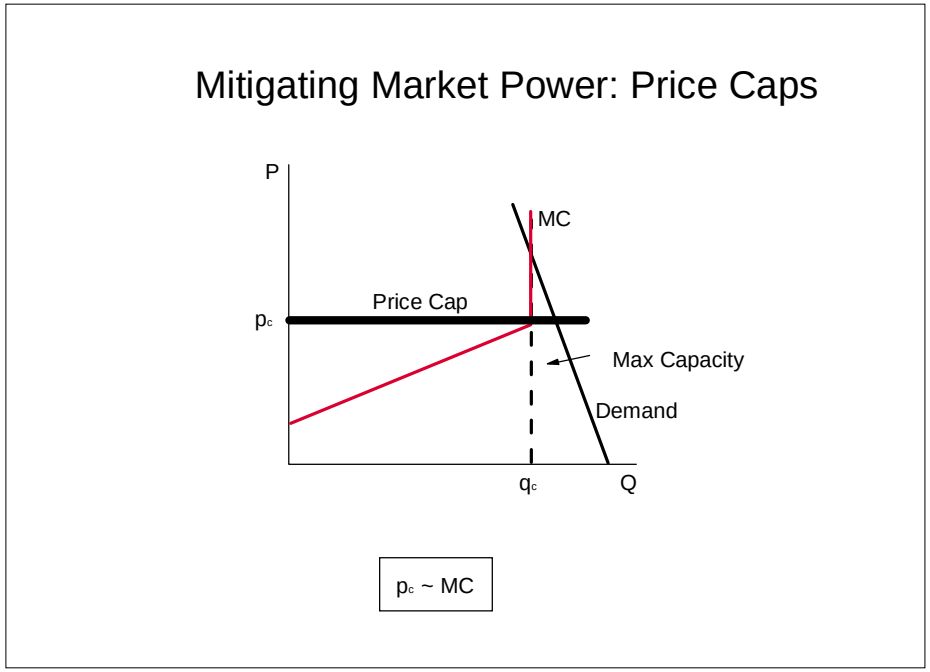


- The best experience with forward contracts has been at vesting (UK, Australia, NE), where the contract value affected the price of the generation assets sold. One the assets are sold, it is hard to get a contract price much below the expected spot market price.

Hard Price Caps.

Regulators impose a maximum price that buyers (utilities or ISOs) can pay generators. This is a form of monopsony power. Typically generators are not required to sell.

- It is hard to determine the appropriate price cap that provides a balance of cost reduction and incentives for entry. Application must extend to the entire regional market.
- A requirement is effective enforcement to ensure that generators cannot sell elsewhere or for more than the nominal price cap. No "out-of-market" purchases.
- Enforcement requires involuntary demand curtailment when supplies are tight.
- Operating incentives at the margin provide the wrong signals for supply and demand.
- Experiences in natural gas and oil indicate that price caps soon create many new problems, as enforcement becomes more difficult and more bureaucratic.
- If the price cap is too low, there is no natural transition to a workably competitive market.



Pay-as-Bid Auction.

A uniform price electricity market pays everyone the market-clearing price. The pay-as-bid auction pays not the market price but the amount bid.

- Under a uniform price auction, the incentive for price taking bidders is to bid the opportunity cost. The resulting price is above most bids.
- Under the pay-as-bid approach, the incentive for all bidders is to bid the greater of the expected market-clearing price or the opportunity cost.
- Theory predicts and experience demonstrates that the prices paid do not greatly differ on average, but real costs can be higher under the pay-as-bid approach.
- Pay-as bid problems are especially compounded in the case of electricity.

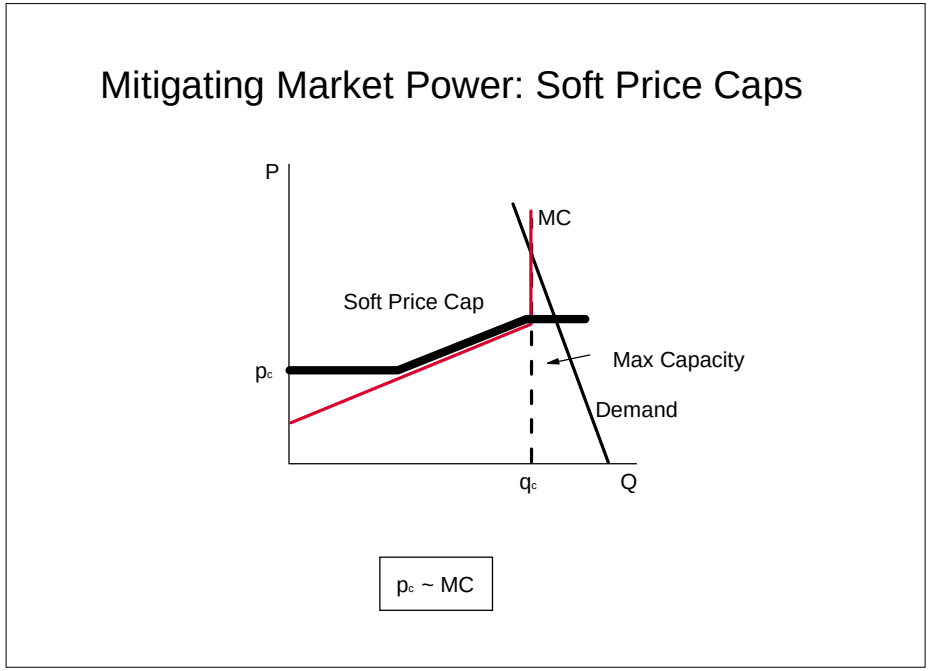
  1. Locational differences in opportunity costs and market clearing prices.
  2. Multi-part cost structure with start up, no load and energy costs.
  3. Ancillary services for spin, regulation and reactive power.

- Pay-as-bid systems have appeared most prominently in California, and compounded the problems in the Summer 2000. Similar difficulties and bureaucratic responses can be seen in the forthcoming New Electric Trading Arrangements in England and Wales.

Soft Price Caps.

A default price cap on all transactions, combined with the possibility of being paid more subject to a regulatory determination that the higher bid was justified by cost considerations. There is no requirement for generators to sell.

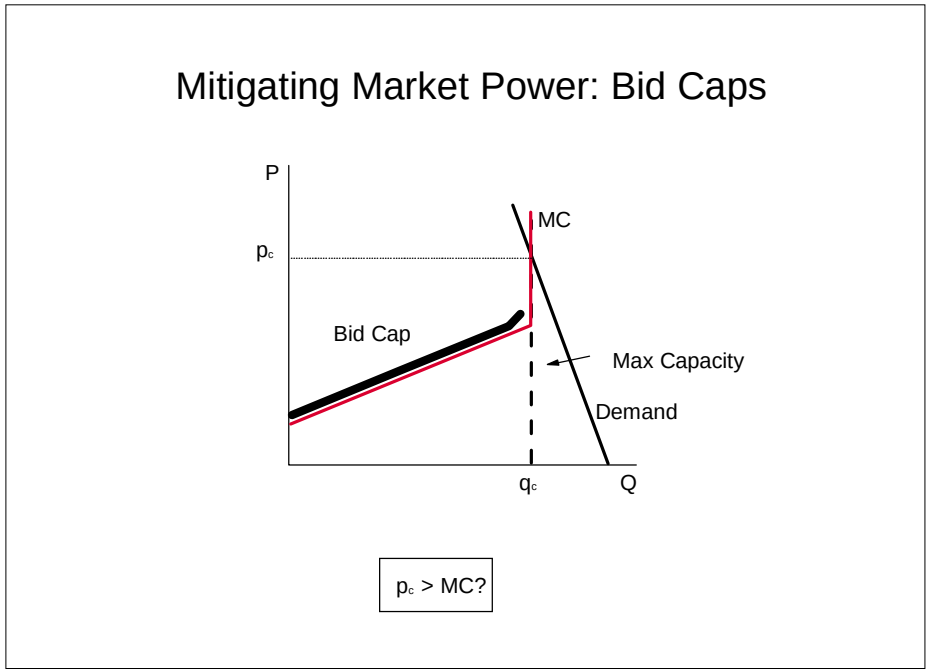
- A default hard price cap with a pay-as-bid auction above the default price level.
- The details of cost justification determine the impact of the "soft' cap. If costs must be demonstrated, it is a return to cost-of-service regulation without the requirement to sell or the guarantees to generators. If opportunity costs are excluded, it is "bid-as-told." If virtually any bids accepted, it like an expensive "pay-as-bid" auction.
- The California experience was that imposition of a soft price cap raised current and forward electricity prices.
- Enforcement remains a key issue. Sales outside the region or "out-of-market" can undermine any benefits.



Bid Caps. (e.g., FERC California Order of April 26, 2001)

Generators have a forward obligation to offer production at no more than a predetermined bid cap. Actual production compensated at the market-clearing price.

- Distinguishes between monopoly rents and scarcity rents.
- Generator has an obligation to offer at least the designated amount. Bids for additional quantities are unregulated.
- Provides the right incentives for supply and demand, for entry and operations.
- If high prices caused by withholding, the bid cap will lower market clearing price. If high prices caused by scarcity, bid cap will produce high prices.
- The information burden is greater than for price caps but less than for cost-of-service regulation.
- Bid caps are generator specific and compatible with a gradual transition to a workably competitive market.



Market power exists in electricity markets and its exercise can produce high prices. Market power mitigation is developing, but recent experience has increased the urgency of the problem

- Restructured electricity markets can experience price spikes, but California suddenly saw sustained high prices, both on and off peak.
- Useful prescription of mitigation policy depends on diagnosis of the underlying causes.
- The complexity of electricity markets precludes a simple test of the exercise of market power and creates behavior that appears similar or the same for generators with or without market power.
- The best time for design of market power mitigation policy is before restructuring and sale of generation assets.
- Price caps, both hard and soft, create as many problems as they solve.
- Pay-as-bid auctions produce no benefits relative to a uniform-price auction and create many new problems in the electricity market.
- A combination of divestiture, bid-caps and vesting contracts can provide market power mitigation during a transition, supporting a gradual move to a workably competitive market.
- The details matter, a lot.

Supporting papers and additional detail can be obtained from the author. William W. Hogan is the Lucius N. Littauer Professor of Public Policy and Administration, John F. Kennedy School of Government, Harvard University and a Director of the LECG, LLC. This paper draws on work for the Harvard Electricity Policy Group and the Harvard-Japan Project on Energy and the Environment. The author is or has been a consultant on electric market reform and transmission issues for American National Power, Brazil Power Exchange Administrator (ASMAE), British National Grid Company, Calpine Corporation, Commonwealth Edison Company, Detroit Edison Company, Duquesne Light Company, Electricity Corporation of New Zealand, GPU Inc. (and the Supporting Companies of PJM), GPU PowerNet Pty Ltd., Mirant Corp., National Independent Energy Producers, New England Independent System Operator, New England Power Company, New York Independent System Operator, New York Power Pool, New York Utilities Collaborative, Niagara Mohawk Corporation, PJM Office of Interconnection, San Diego Gas & Electric Corporation, Sempra Energy, TransÉnergie, Transpower of New Zealand, Westbrook Power, Williams Energy Group, and Wisconsin Electric Power Company. The views presented here are not necessarily attributable to any of those mentioned, and any remaining errors are solely the responsibility of the author. (Related papers can be found on the web at http://www.ksg.harvard.edu/whogan).