

On mitigating market power in restructured electricity markets

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Outline of Presentation

- Unilateral market power in spot electricity markets.
- Lessons from the E&W market.
- Strategic capacity withholding
- Price caps
- Demand-side bidding

Unilateral Market Power

- Firms will only sell in the market if price covers the marginal production (opportunity) cost.
- In competitive markets firms do not control prices, they react to them in making production and investment decisions.
 - however, this does not mean that they should not seek opportunities to increase profits.
- Unilateral market power exists when a firm has the ability to increase market prices through its own actions and to profit from this increase.

Sources of Market Power

Given the rules and structure of restructured electricity markets, under certain demand, capacity, and marginal cost conditions, generators may manipulate market prices and increase their profitability through their choices of

- Capacity availability and/or
- Prices at which they will make capacity available.

Wolak and Patrick (1996)

“The Impact of Market Rules and Market Structure on the Price Determination Process in the England and Wales Electricity Market”

focus on the precise mechanism by which market power is exercised in the E&W market, conclusions include :

- Most load periods the price set is not substantially in excess of the average cost of supplying electricity for both PowerGen and National Power.
- By taking advantage of the rules of the E&W pool, when circumstances largely exogenous to their behavior make it possible, these two producers are able to temporarily obtain market prices excessively higher than the average cost of supply in that load period. The vast majority of the resulting excess revenues arise from extremely large within-day price swings.
- The mechanism which yields the greatest increase in market price is the generator's selection of the total amount of capacity made available during each load period.

Lessons from the E&W market

- The Director General's recommendation of divesting both National Power and PowerGen of a substantial fraction of their generation capacity is a step in the right direction. Leaving one or two large producers each with a mixture of generation technologies and the ability to supply a large fraction of TSL provides the opportunity for these firms to exercise market power over the residual demand they face given the rules of the E&W market.
- The rules of governing the market can present opportunities for the large producers to exploit their market power and many of these modes of exercising market power are subtle, but high powered in the sense that they can yield high rates of return for short periods of time.
- These strategies can be difficult to detect and even more difficult to correct.

Lessons from the E&W market (continued)

- The availability declaration game has the advantage that the generators can disguise their intentions behind several veils.
 - First, the regulator will have a very difficult, if not impossible time telling plant unavailability from actual breakdowns, from those due to an unavailability declaration for strategic reasons.
 - In addition, the true value of lost load (VOLL) to consumers and the true relationship between the estimated reserve margin and LOLP are unknown to the regulator.
 - Consequently, the regulator overseeing the operation of the pool should view these variables, the VOLL and the function relating the reserve margin to the LOLP as instruments for obtaining the desired market outcomes, rather than as fixed constants.

Lessons from the E&W market (continued)

- The final lesson from Wolak and Patrick (1996), to be discussed here, is the necessity of getting generators to aggressively bid into the market. Options include:
 - Breaking up industry into many small generators
 - A second-best solution is to make it costly not to offer capacity to the pool or otherwise increase the incentives generators have to make capacity available, e.g.,
 - penalties on generators for not offering capacity ,
 - availability payment could be substantially increased.

Restructured Wholesale Markets

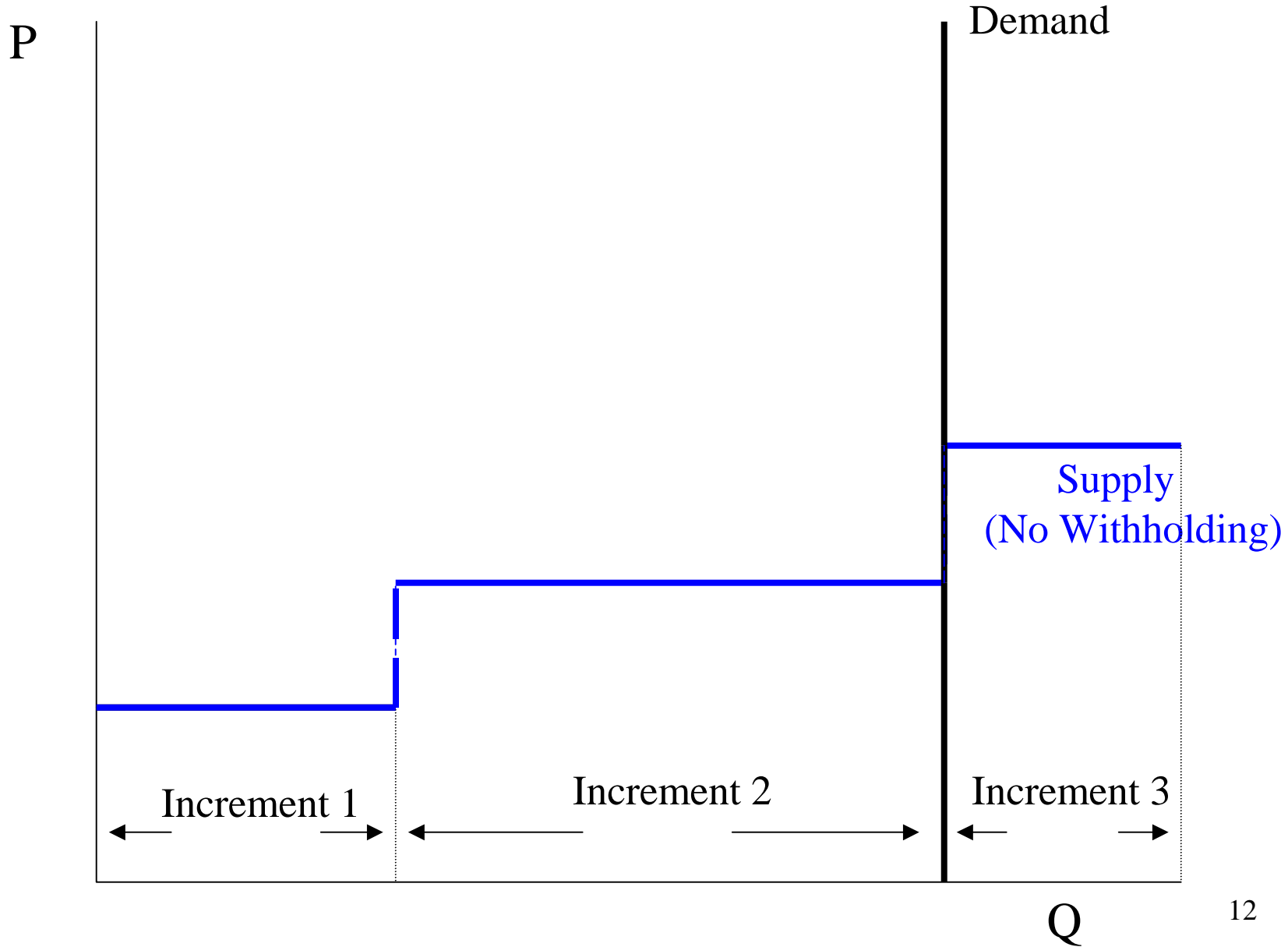
- Uniform (nondiscriminatory) price auction.
- Demand is at least close to perfectly inelastic.
- Each generator bids prices and the level of capacity it will make available at these prices.

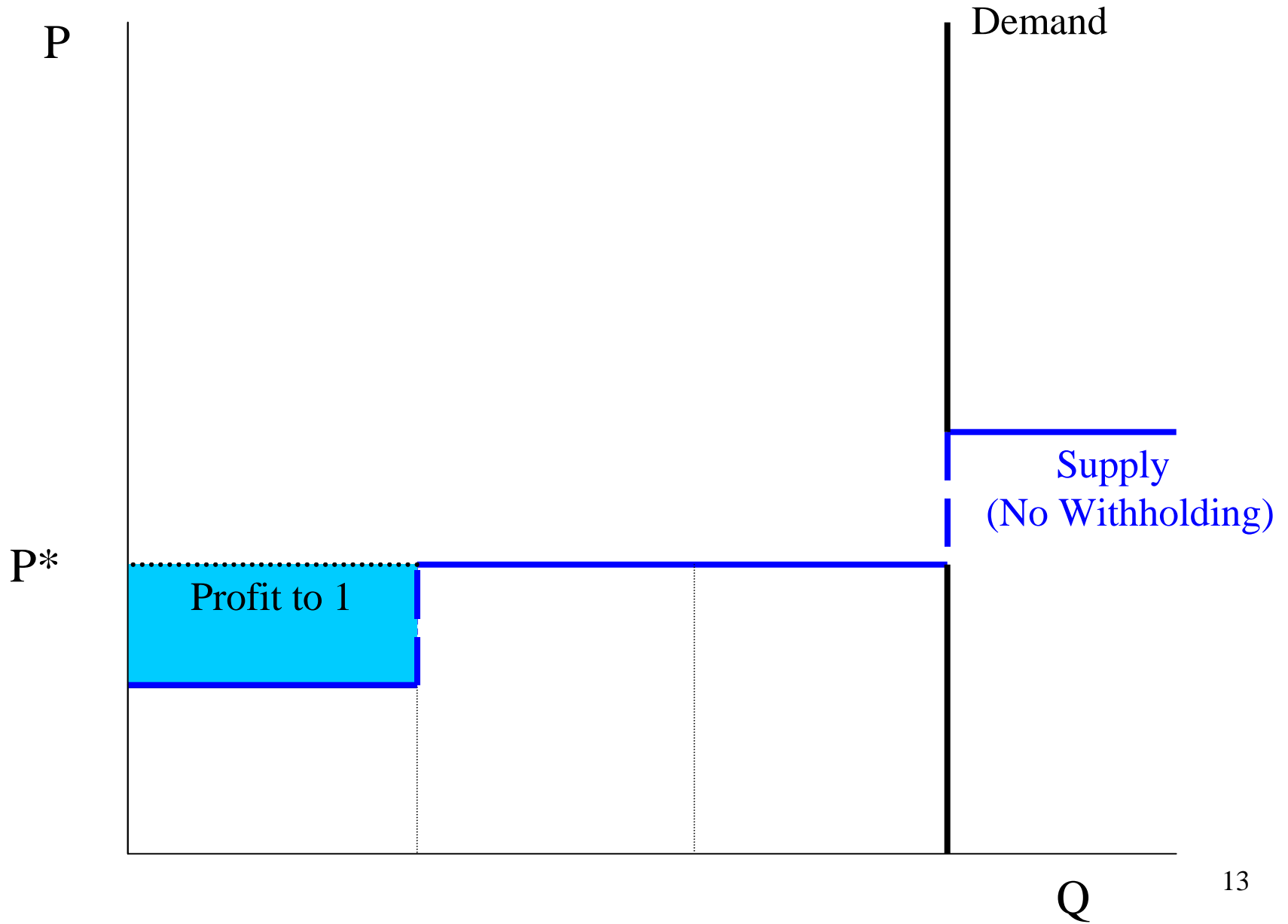
Profitable capacity withholding requires

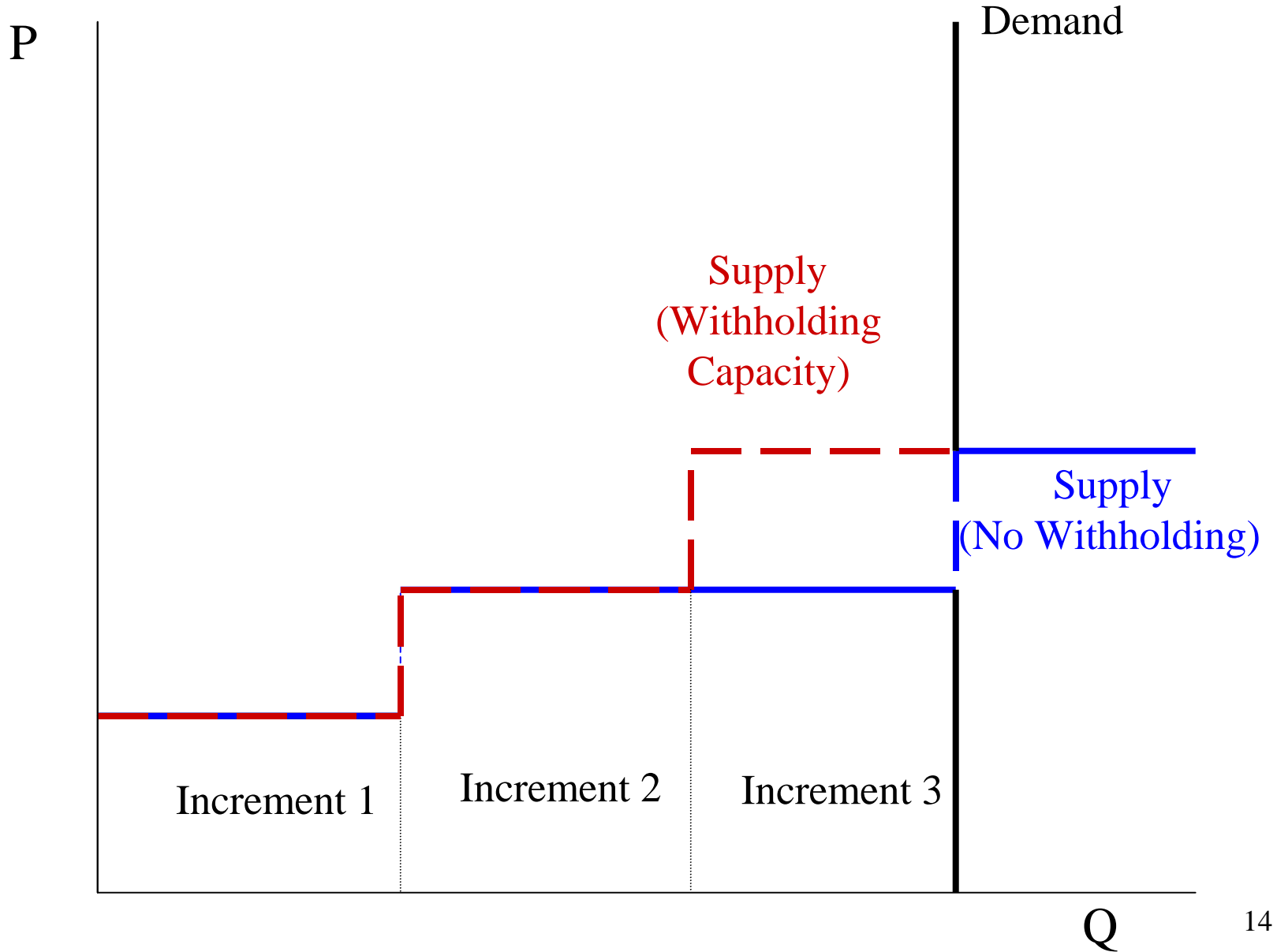
- Demand sufficiently close to an increasing portion of the supply (aggregate bid) function.
- A range of marginal costs within and/or across generators' capacity.
- The withholding firm(s) to have sufficient capacity to withhold to bring a higher cost generating unit into the market.
- The withholding firm(s) to have sufficient capacity remaining in market so that the additional profit from the increased price is greater than the forgone profit from the withheld capacity.

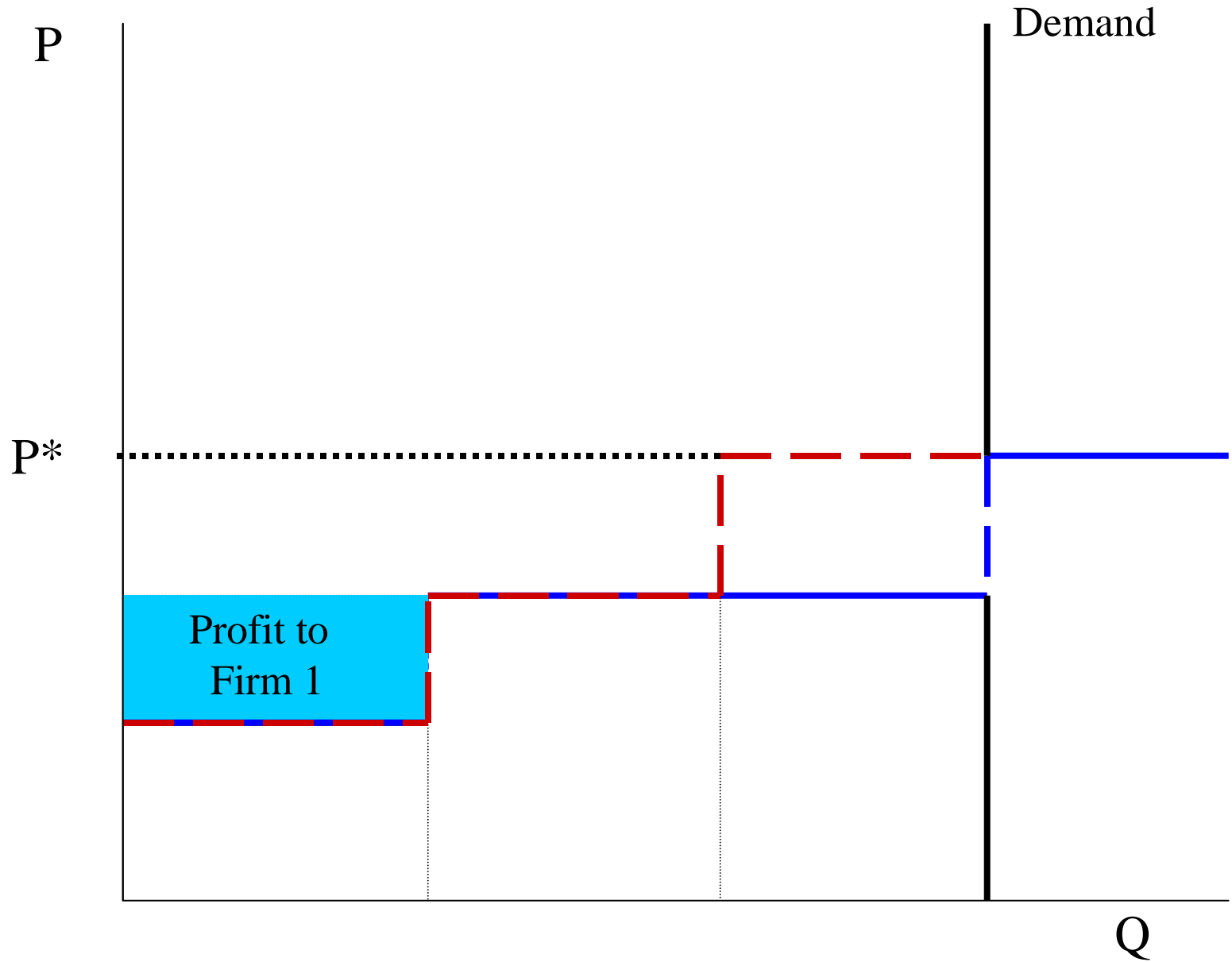
Capacity Availability and Price Caps

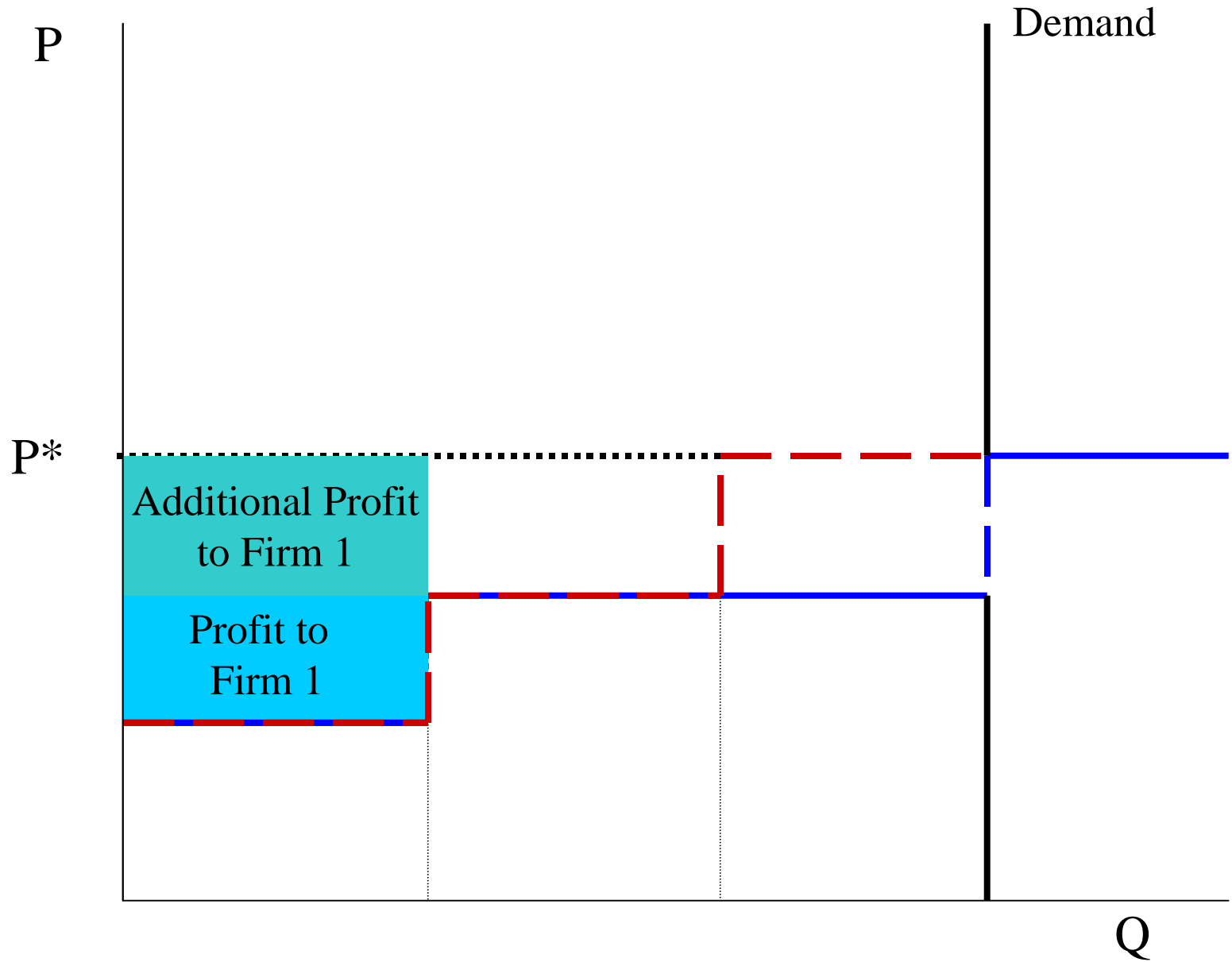
- Whether capacity is unavailable for strategic or other reasons is not observable.
- To focus on capacity withholding incentives and illustrate the effect of price caps, take prices bid by each generator as capped the MC of each generating unit.

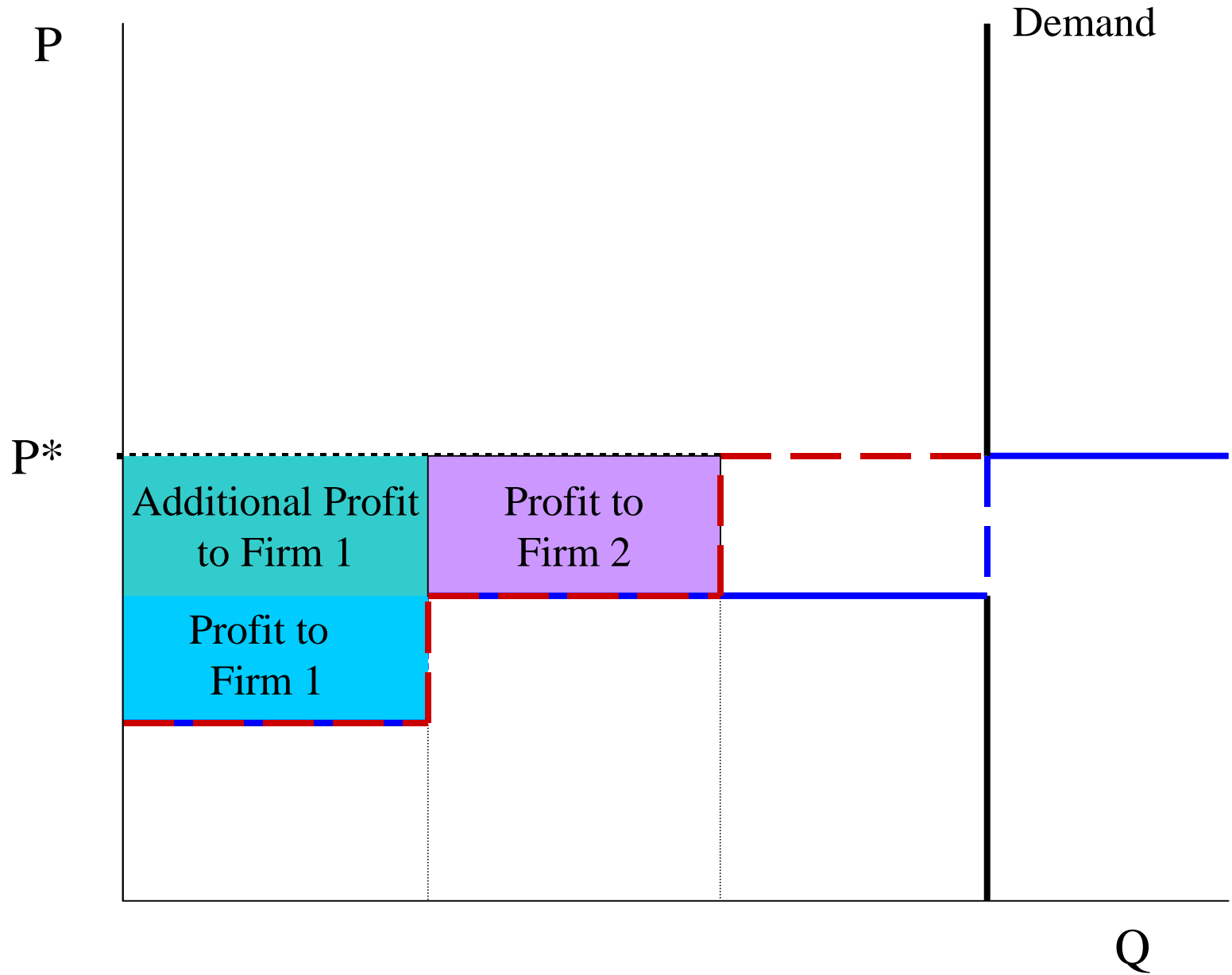


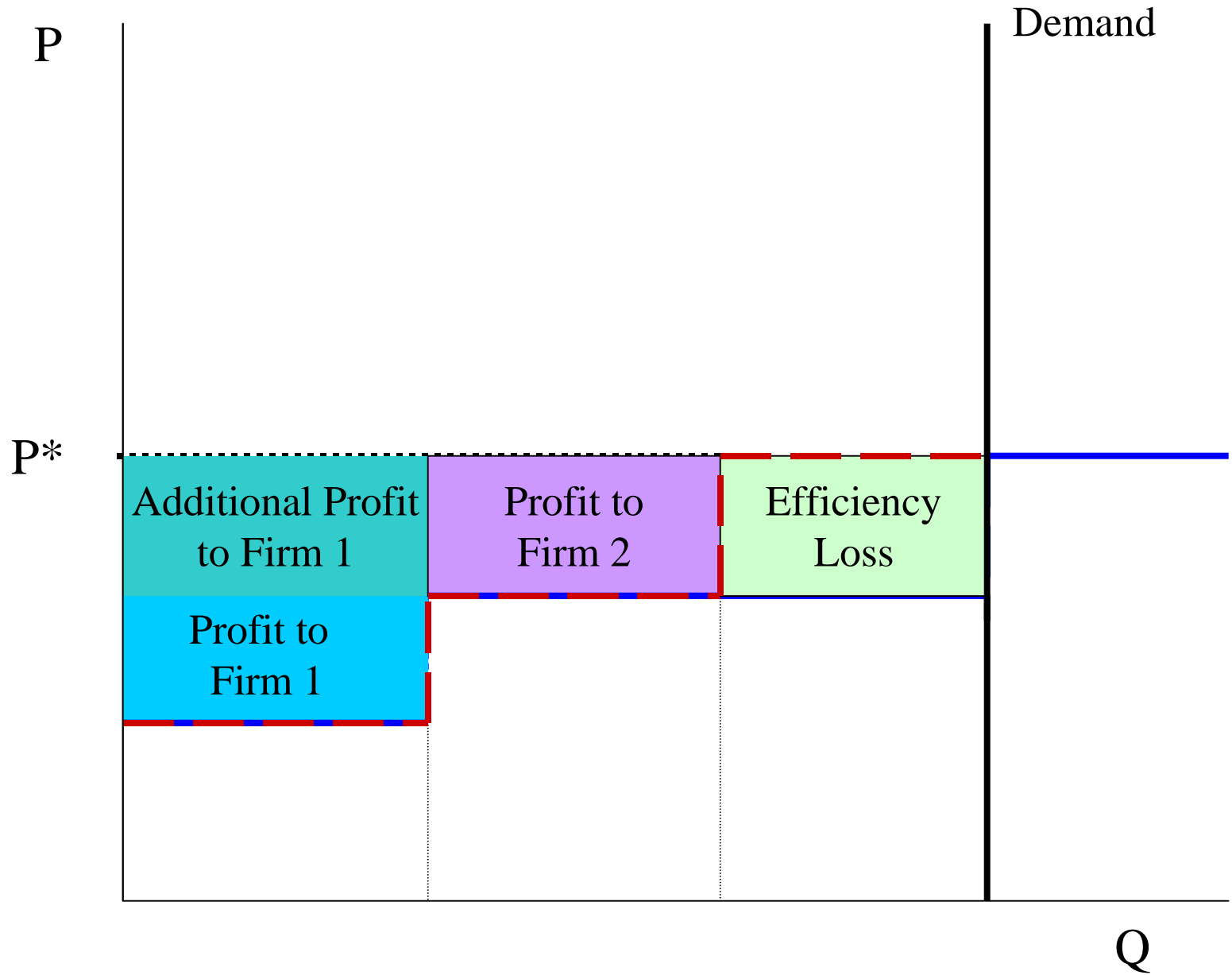












Some Implications

- Even if prices are capped at marginal cost for each generating unit, capacity withholding may yield higher than competitive prices and profits.
- All generators with marginal cost below that of the marginal (market price setting) generator may have an incentive for unilateral capacity withholding.
- The closer the market demand is to system capacity, the larger the returns from this strategy.

Some Implications (continued)

- It may only take 1 generator unilaterally reducing available capacity to raise the market price, yet all generators with marginal cost less than the market price gain from this strategy.
- Given prices are capped at MC, collusion among these generators can actually reduce the efficiency loss (as well as increase profits) by insuring that the minimum amount of capacity necessary to achieve the price increase is withheld.

A Simple Numerical Example

- Generator 1 has
 - 5 units of capacity with $MC=5$ and
 - 5 units with $MC=7$,
 - output from generator 1 is then $Q_1=Q_{11}+Q_{12}$,
 - this implies $\text{profit}_1=P*Q_1 - 5*Q_{11} - 7*Q_{12}$
- Generator 2 has
 - 10 units of capacity with a $MC=6$,
 - output from generator 2 is Q_2 ,
 - $\text{profit}_2=(P - 6)*Q_2$

Unilateral Capacity Withholding Increases Profits

Demand	P=MC	avail1	avail2	gen1	gen2	profit1	profit2
15	6	10	10	5	10	5	0
	7	10	9	6	9	10	9
10	6	10	10	5	5	5	0
	7	10	4	6	4	10	4
7	6	10	10	5	2	5	0
	7	10	1	6	1	10	1

The first row for each demand level gives the resulting market price, capacity availabilities, and profit when all capacity is bid into the market. The second row provides the values of these variables when generator 2 follows a capacity withholding strategy.

For example, when demand=7, even if firm 2 only has a capacity of 2, it can still exercise unilateral market power

Unilateral Capacity Withholding Increases Profits

Suppose firm 1 withholds one unit of capacity (MC=5) and firm 2 does not withhold any capacity

Demand	P=MC	avail1	avail2	gen1	gen2	profit1	profit2
15	6	10	10	5	10	5	0
	7	9	10	5	10	8	10

The efficiency loss is 2 since a unit characterized by MC=5 is replaced by a unit with MC=7.

If demand is 11 or less firm 1 has no incentive to unilaterally withhold capacity.

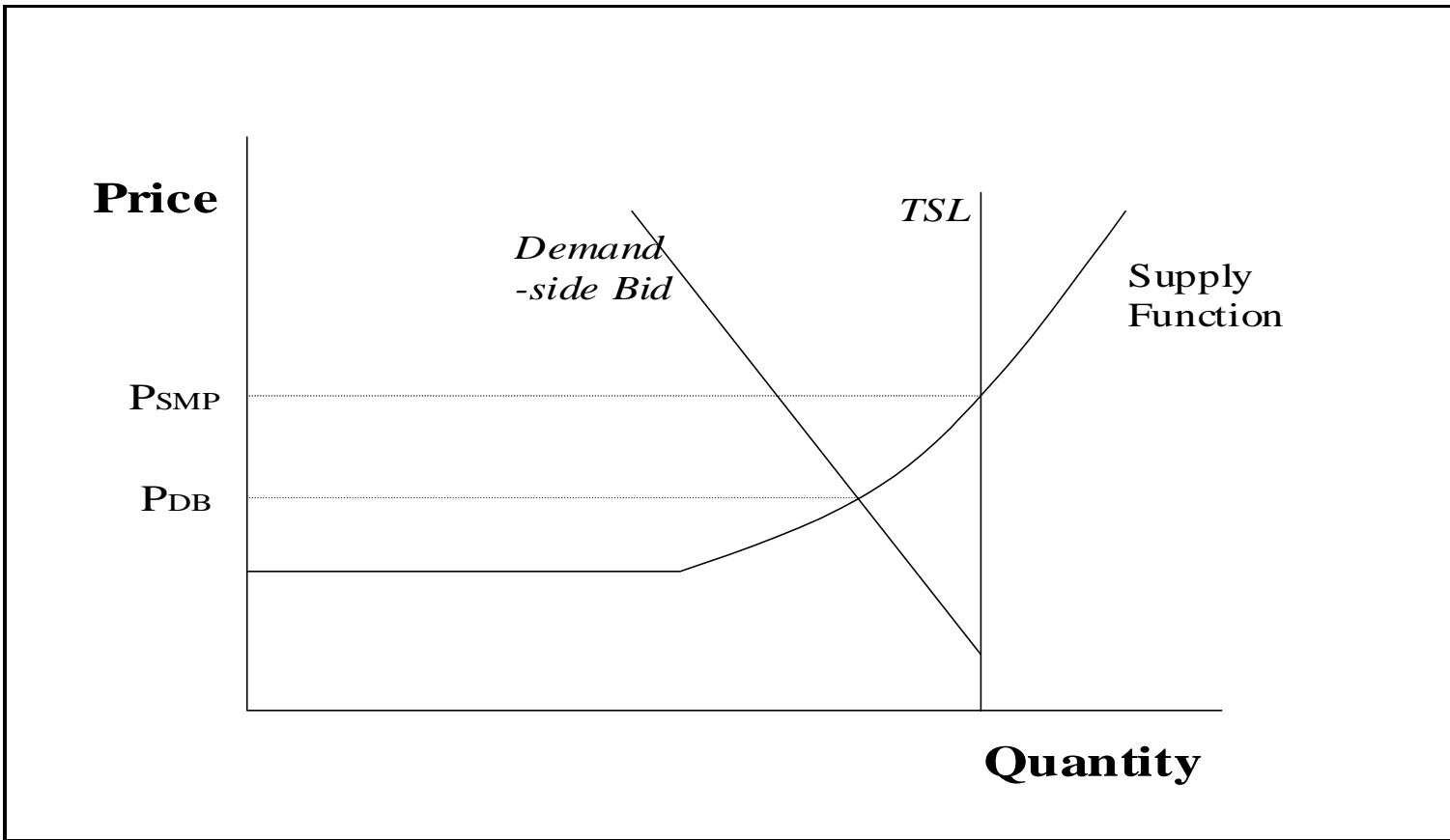
If both firms withhold one unit of capacity in this case then

7	9	9	6	9	8	9
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The efficiency loss is 3 since a unit characterized by MC=5 and a unit with MC=6 are replaced by 2 units with MC=7.

Demand-side Bidding

- Why we see little to no price response in restructured electricity markets is that few if any retail customers pay according to the market prices.
- Demand-side bids can build a price response into the market demand used to determine the market-clearing wholesale electricity and ancillary services prices.
- Potential benefits to retailers and their customers include
 - the reduced magnitude and variability of market prices
 - decreased costs of contracts protecting retailers (selling to customers at fixed prices) from relatively large market prices.



Effect of demand side bids on the market clearing spot price (Patrick and Wolak 1997).

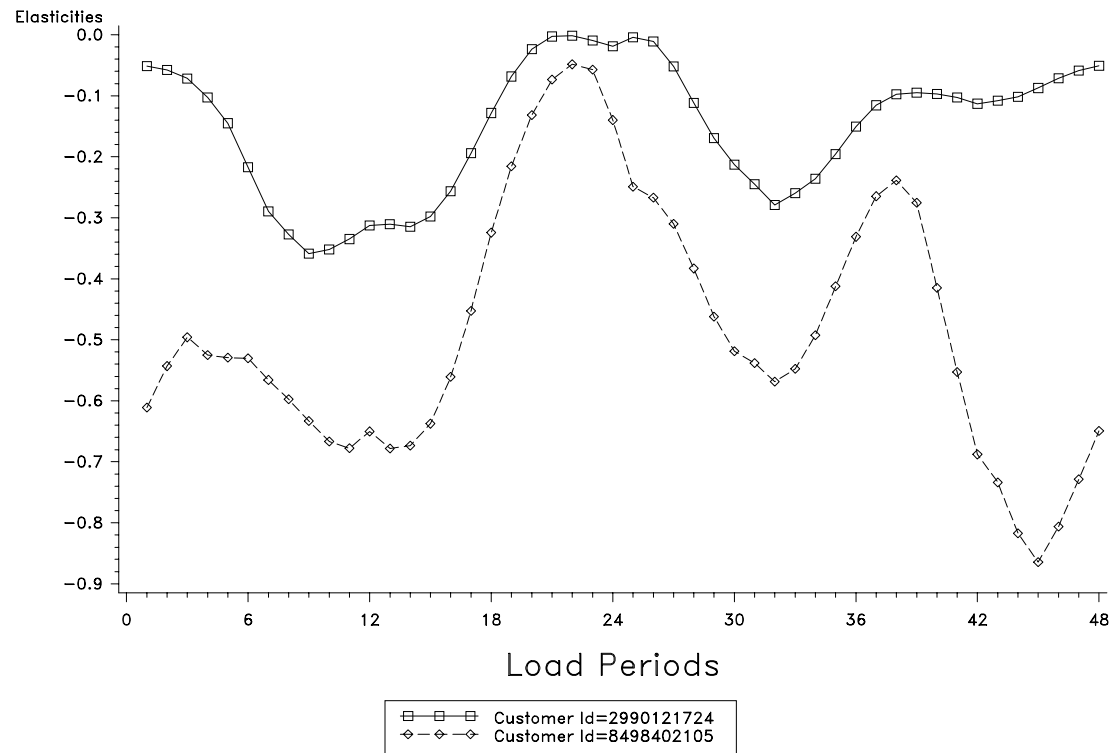
Patrick and Wolak (1997, 2001), among other things, estimate customer-level responses to RTP

Results and implications from our analyses include:

- Day-ahead price elasticity estimates vary substantially by time-of-day, industry, and firms within industries; with sample mean averages ranging from essentially zero to .86 in absolute value.
- Significant across period price effects are also found, indicating substitution possibilities exist across some pricing periods, while complementarities exist across other pricing periods.

Patrick and Wolak (2001)

Mean Own Price Elasticities of Demand for UK Industries
Bic = 17000 : Water Supply Industry

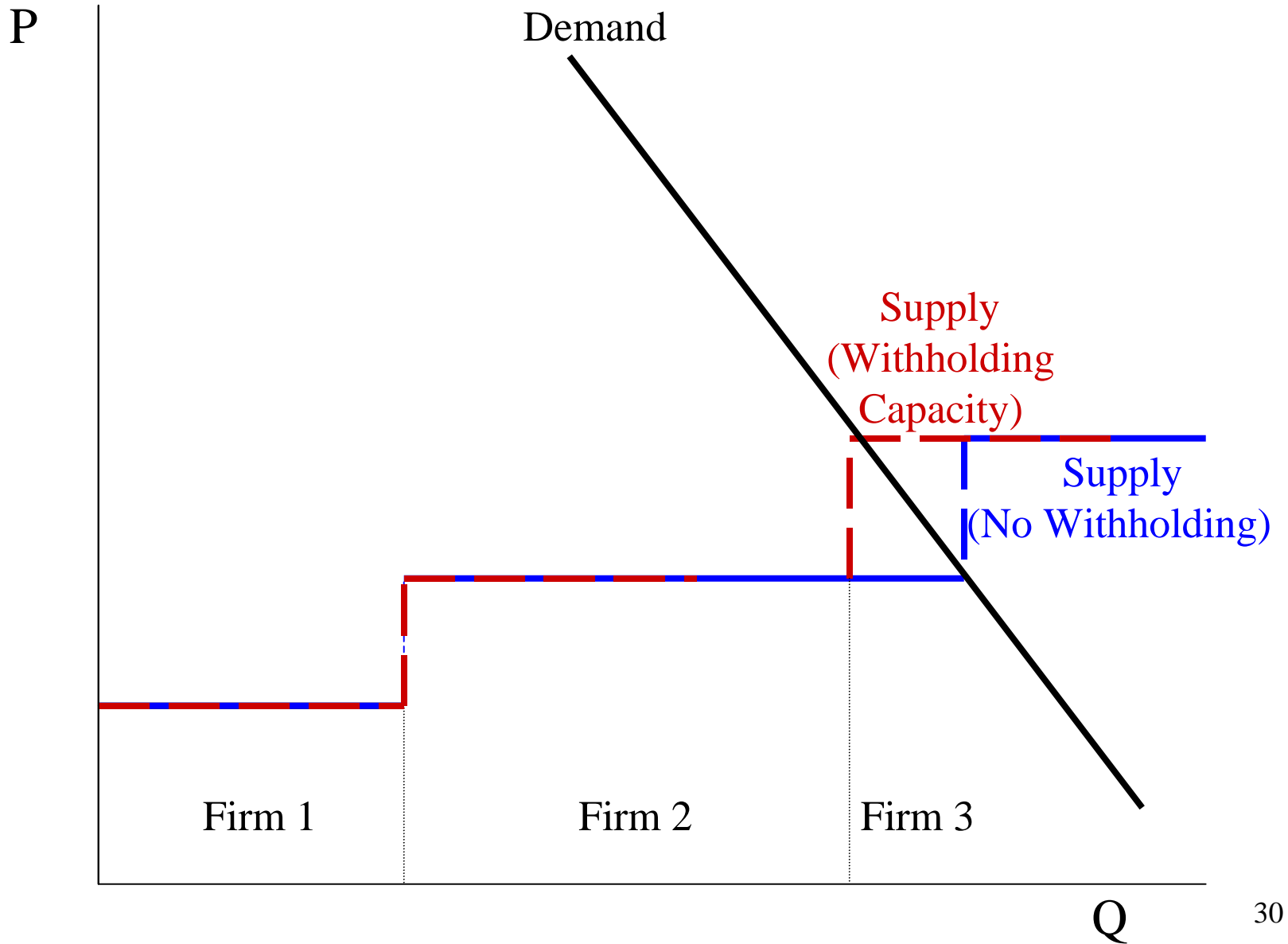


Patrick and Wolak (1997,2001) continued

- Spot price customers may provide a significant price response in restructured electricity markets.
- A significant price response in the price determination process may reduce the magnitude and volatility of spot prices in restructured electricity markets, the extent depends upon the price responsiveness of spot price customers and how demand side bids are considered in the market price determination process.

Patrick and Wolak (1997,2001) continued

- Retailer incentives for demand side management and conservation result during peak system demand periods, when the spot prices are greater than the fixed prices at which most retail power is sold. Conversely, any time the spot price is below the fixed price, the retailer has the incentive to encourage electricity consumption. Substitution of consumption from the former to the latter pricing periods increase retailer profits.
- Contracts, while allowing retailers to hedge against losses during peak system demand periods, may undermine these incentives for demand side management and conservation.



Policy Implications

- Price caps and demand-side bidding can mitigate market power to some degree but
 - Price caps will not eliminate profit incentive for capacity withholding
 - Demand-side bidding will not completely eliminate the incentives for capacity withholding