

Illustrating Capacity Withholding Incentives with Price Caps and Demand Side Bidding in Restructured Electricity Markets

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Restructured Wholesale Electricity Markets are generally characterized by

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

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 deregulated 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.

Profitable capacity withholding requires

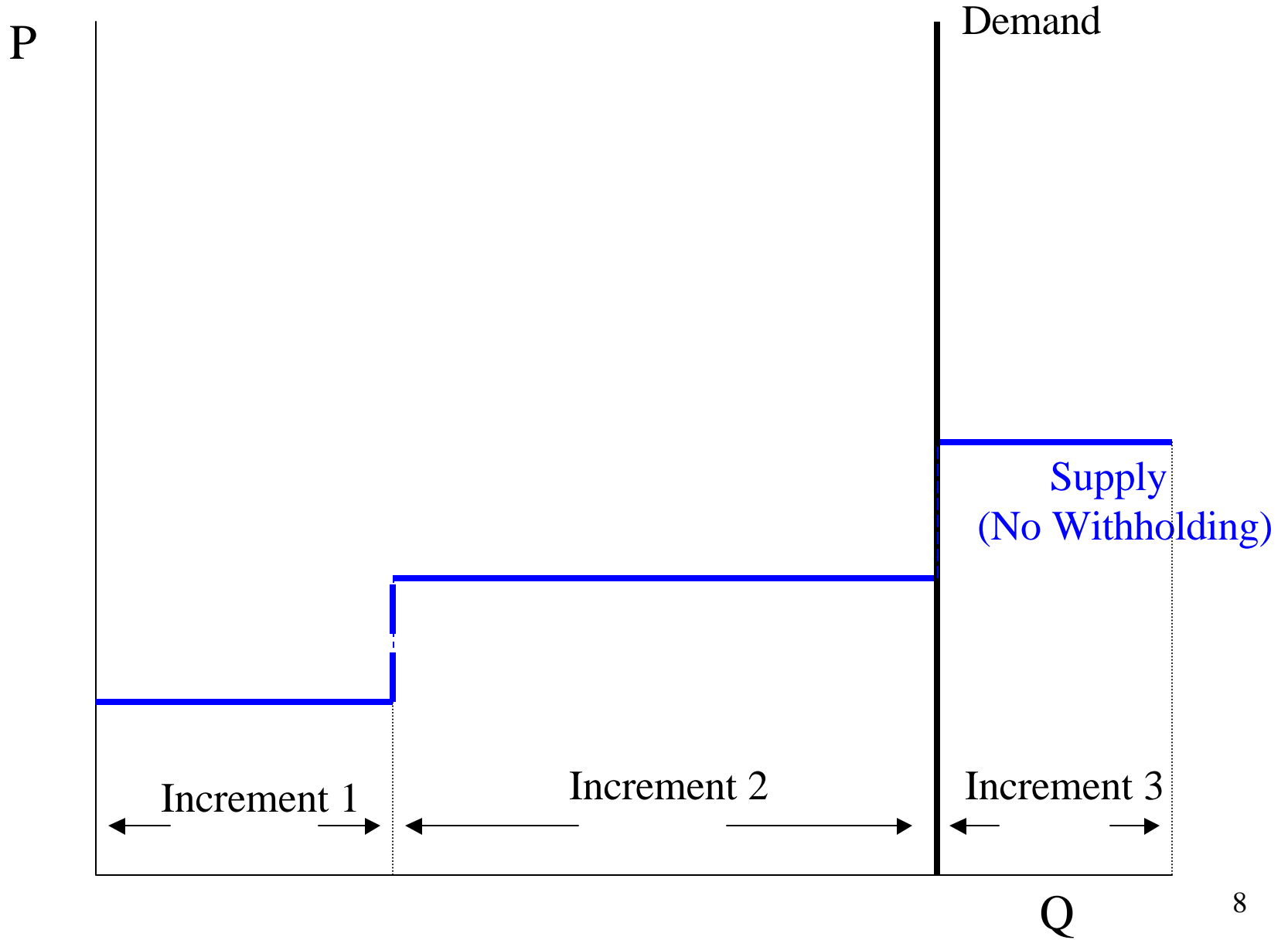
- Demand sufficiently close to an increasing portion of the supply (aggregate bid) function.
- A range of marginal costs within and/or across generators' capacity.
- The withholding firm(s) to have sufficient capacity to withhold to bring a higher cost generating unit into the market.
- The withholding 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.

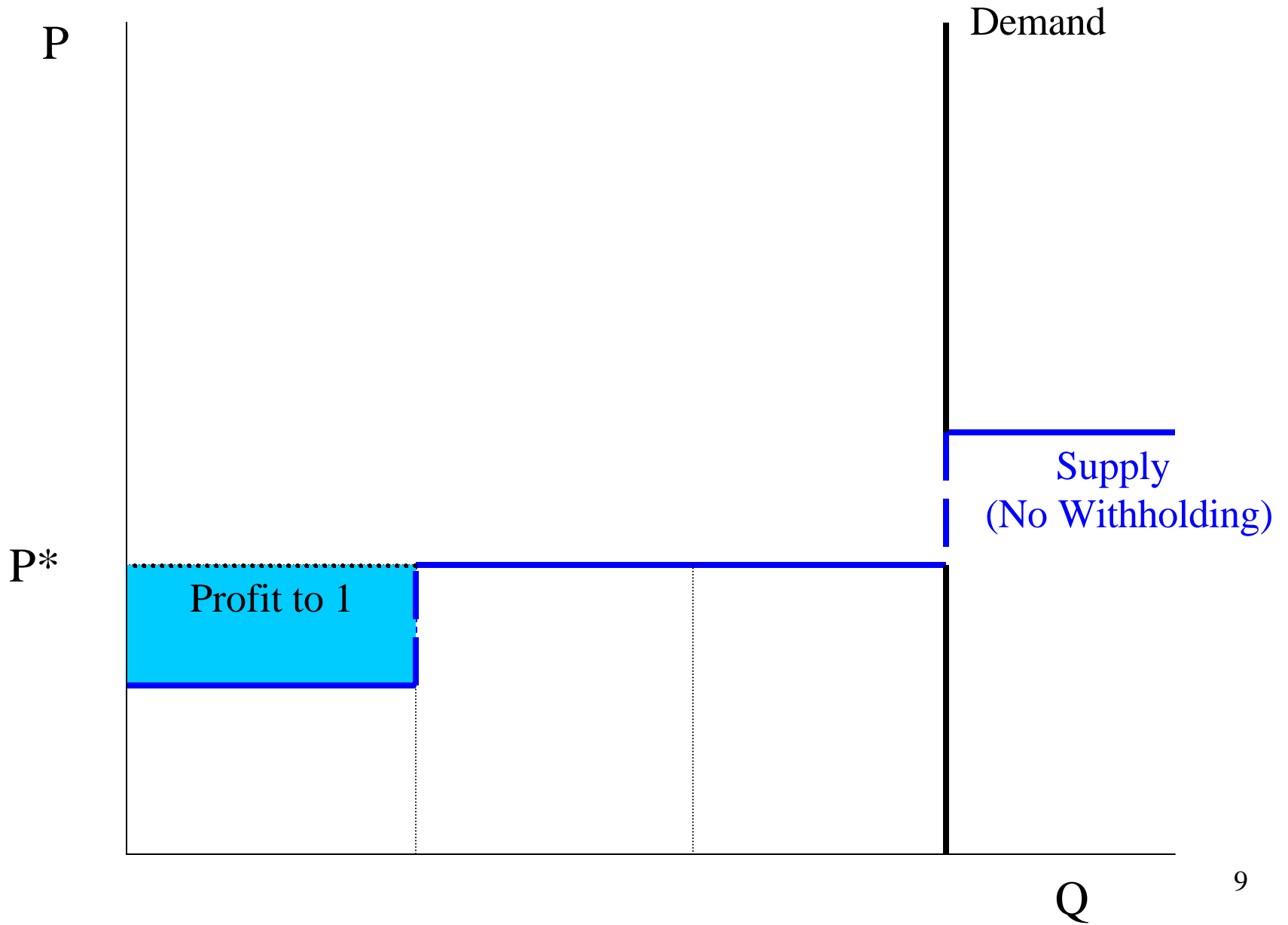
Two Commonly Proposed Solutions to the Market Power Problem

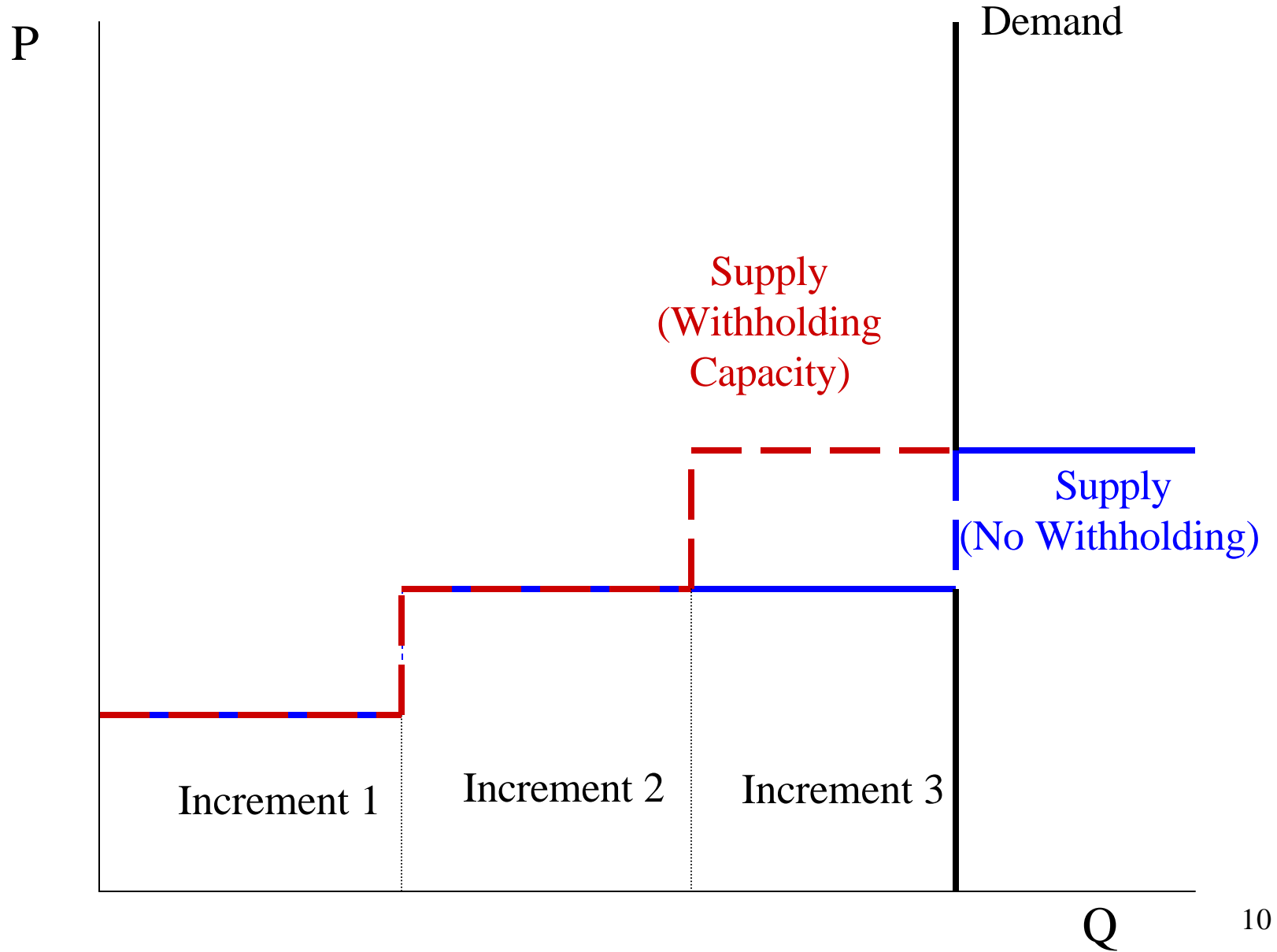
- Price Caps
- Real Time Pricing to Promote Demand Side Participation in Market Price Determination Process

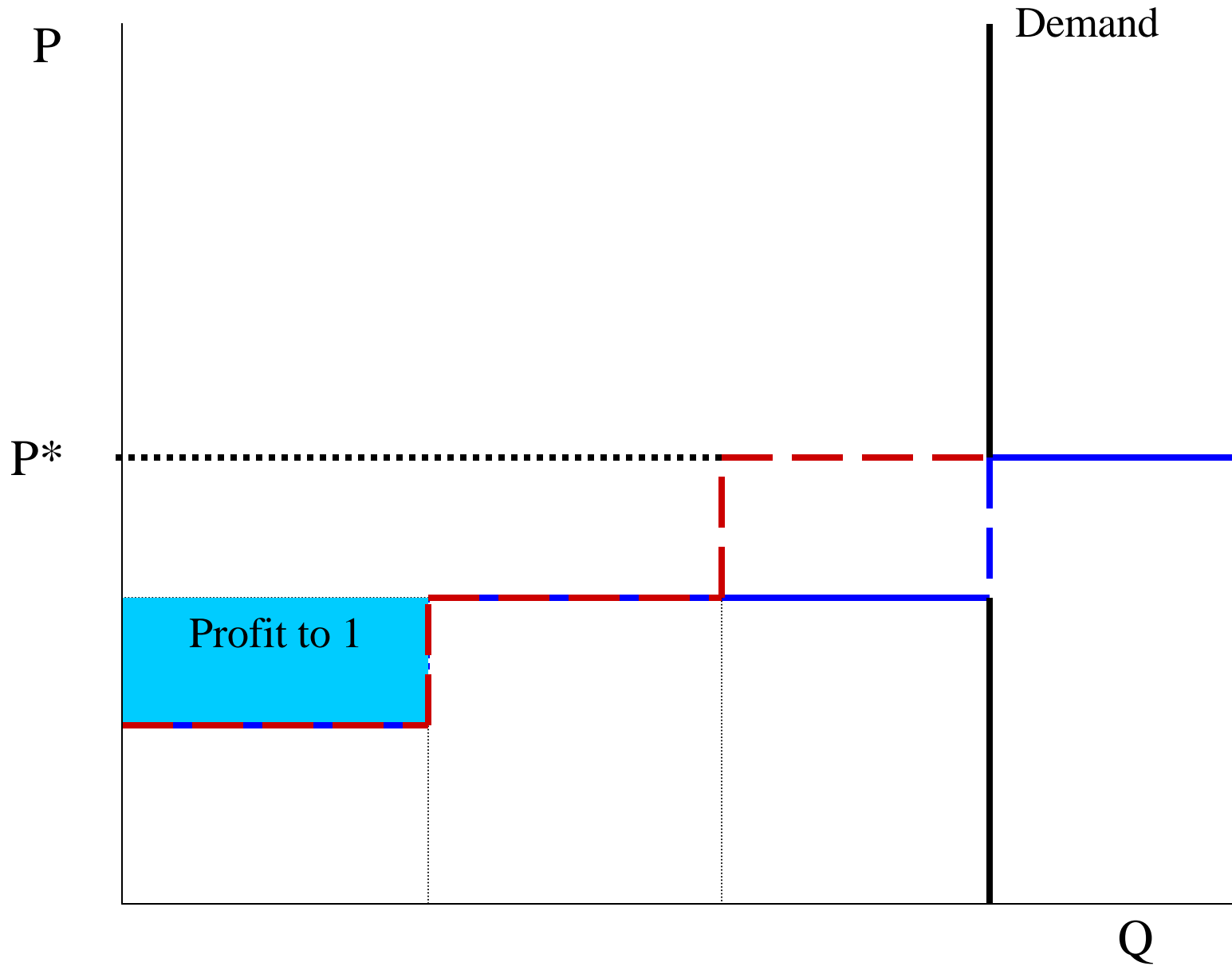
Capacity Availability and Price Caps

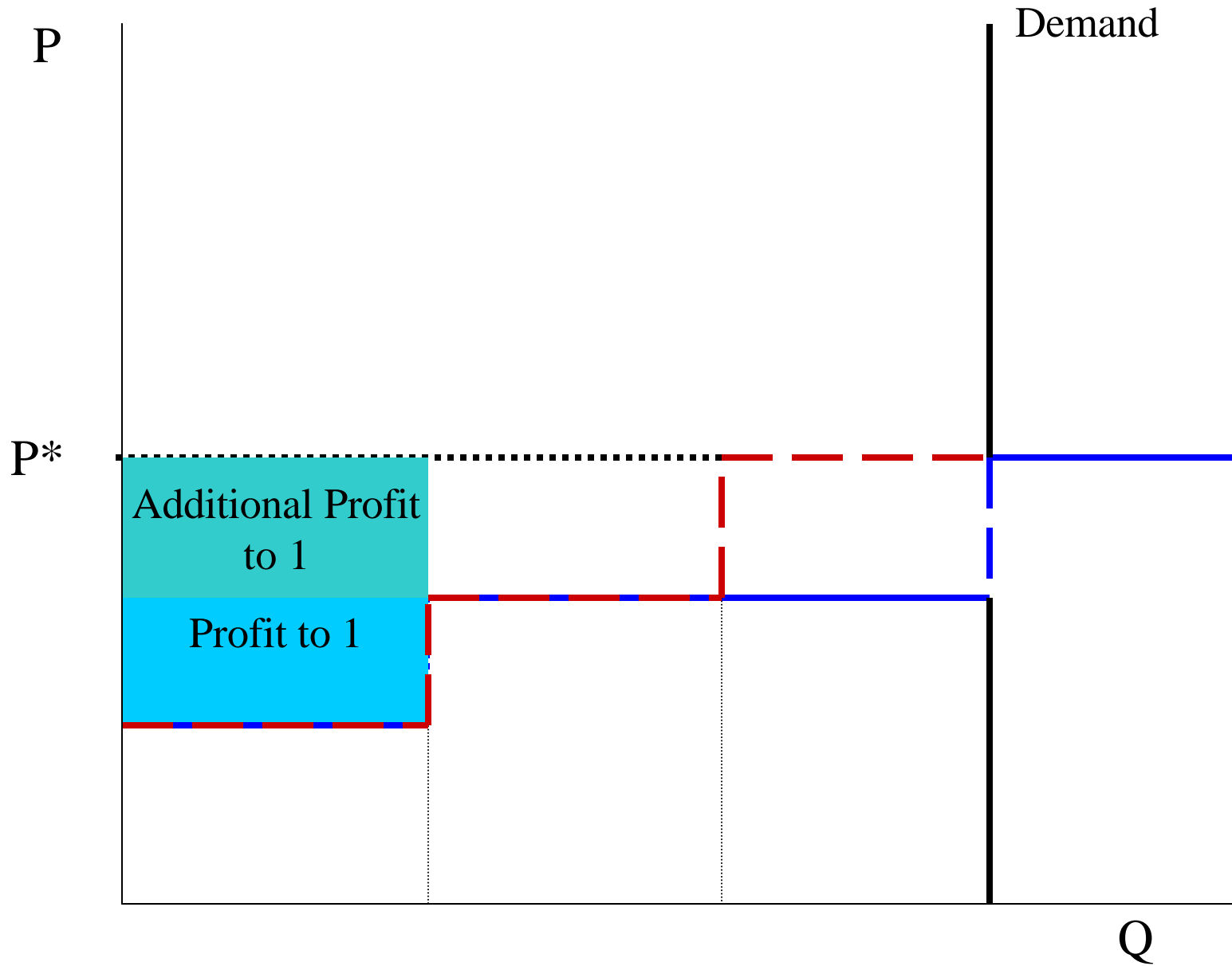
- Whether capacity is unavailable for strategic or other reasons is not observable.
- To focus on capacity withholding incentives and illustrate the effect of price caps, take prices bid by each generator as capped by the MC of each generating unit.

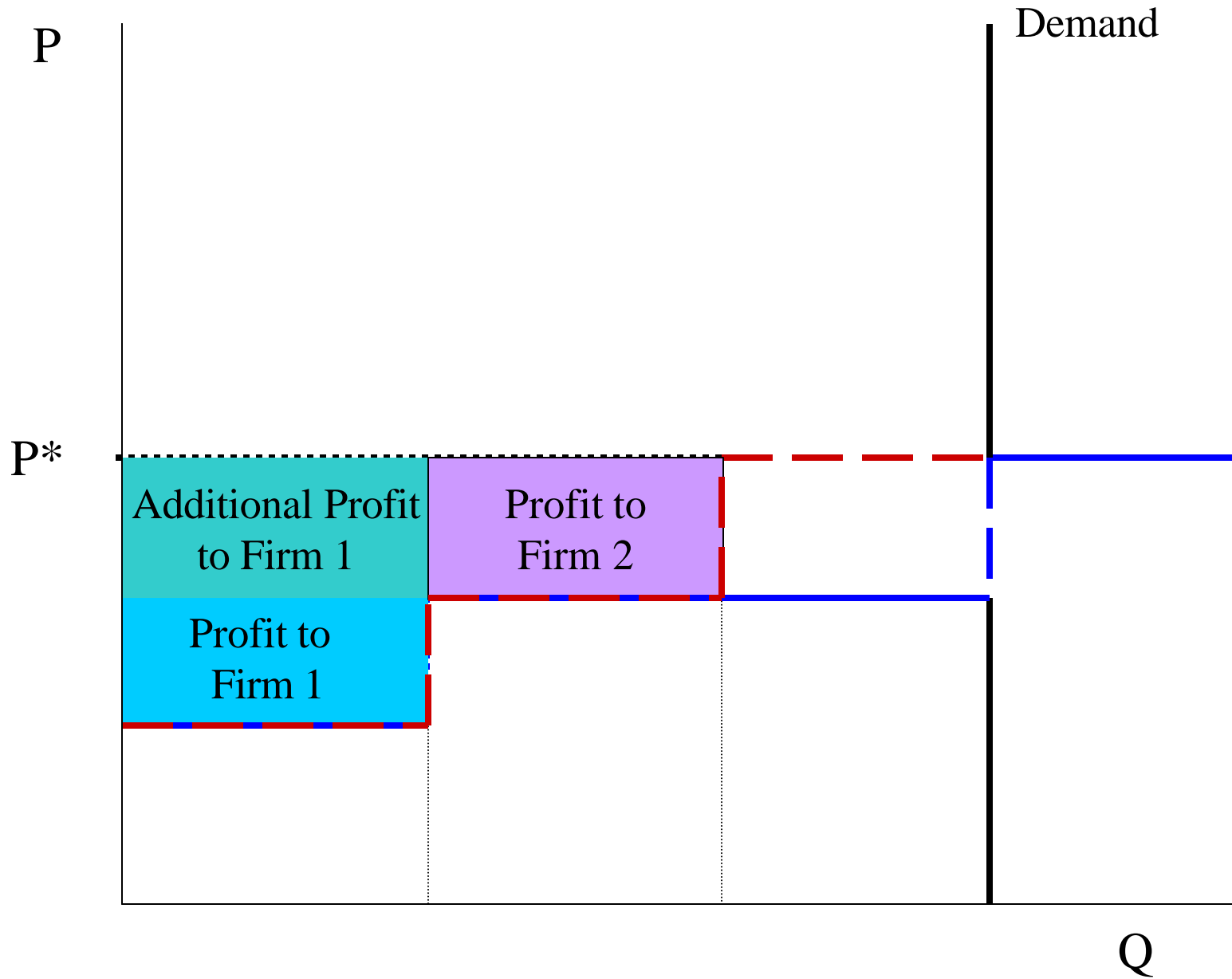


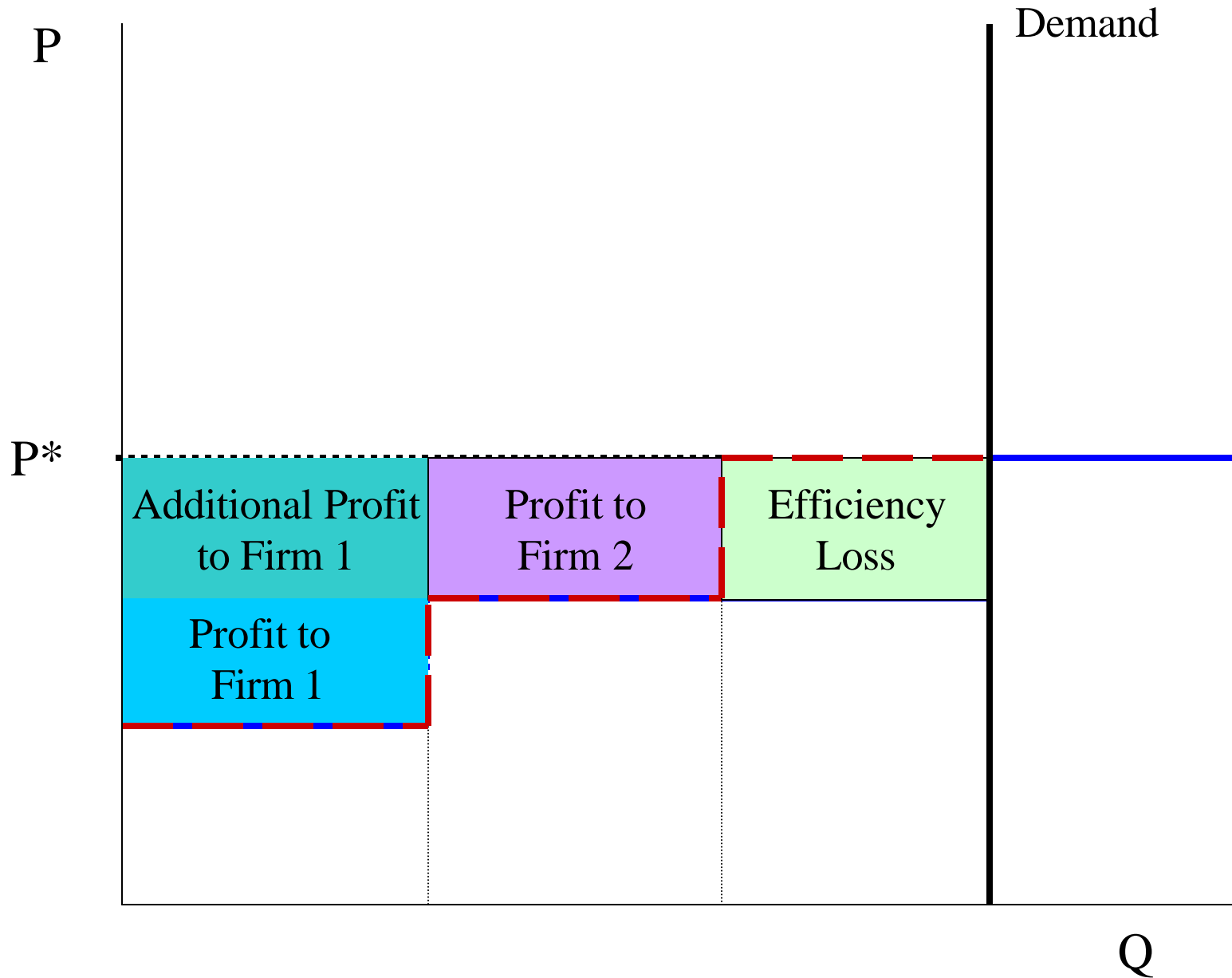












Some Implications

- 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 their 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.

When demand=7, for example, even if firm 2 only has a capacity of 2, it can still profitably exercise unilateral market power. **Implication: even when system demand is well below capacity a relatively small firm may have a profit incentive to withhold capacity from the market.**

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.

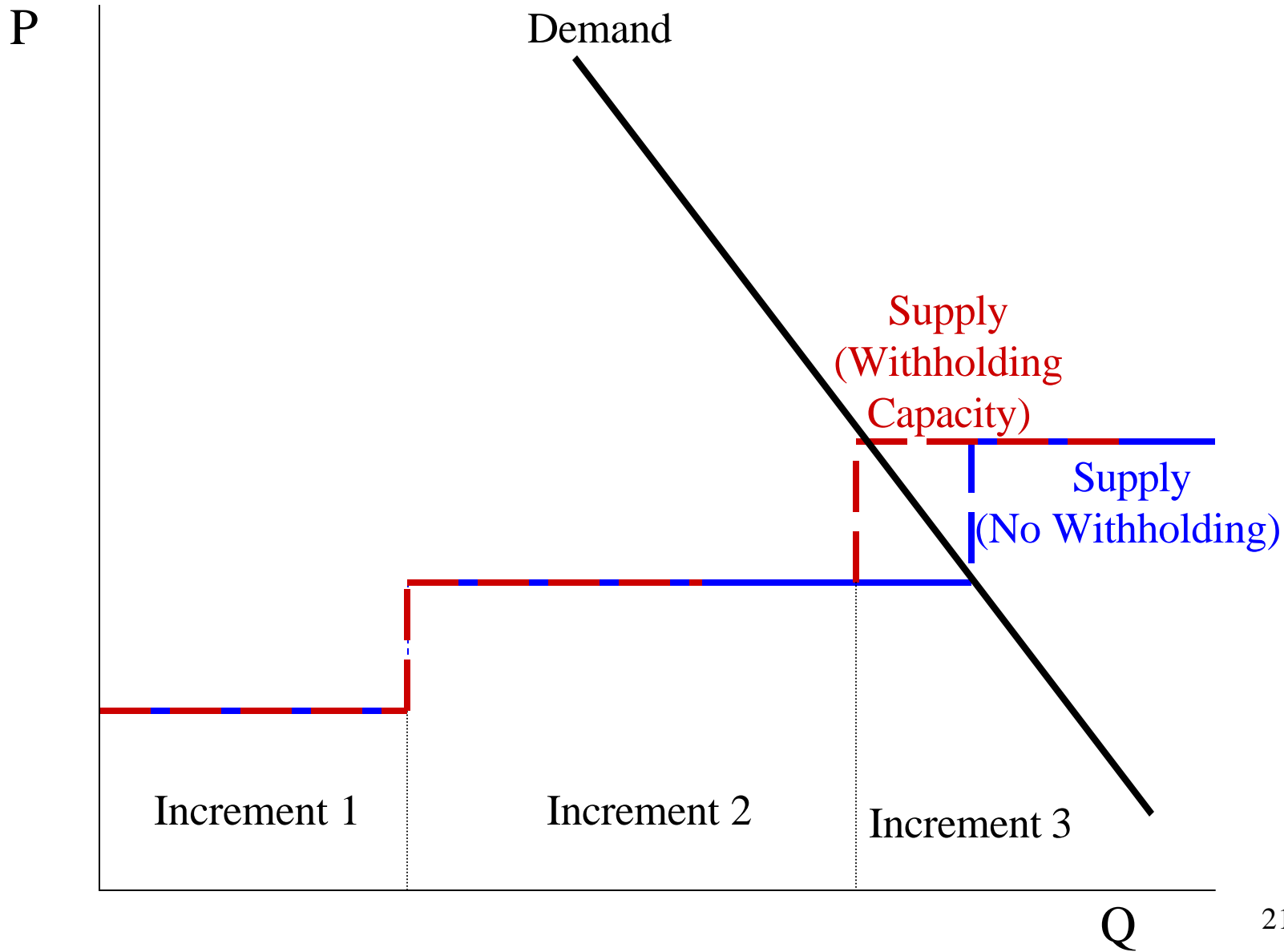
If both firms withhold one unit of capacity in this case then

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.

Effects of Demand Side Bidding on Market Power

Capacity withholding incentives may be mitigated by demand side bidding (i.e., introducing some elasticity to demand in the price-determination process) to some degree but they will not be eliminated, the problems illustrated in the examples above remain



Policy Implications

- Price caps and/or demand-side bidding can mitigate market power to some degree but
 - Although price caps may reduce rents from market power, they will not eliminate the profit incentive for capacity withholding
 - Demand-side bidding can limit the incentive to withhold capacity, but not eliminate it

Potential Solutions

- Alternative Auction Designs
- Assign Risk of Capacity Outages to Generators (rather than consumers, as is currently the case)
- Do not deregulate (at least until these problems are remedied)