Electricity Markets

Market Power

Market Power

- What is market power ?
- How can market power be exercised ?
- What limits market power ?

Definition

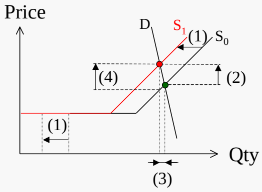
- Market power is the ability to alter profitably prices from competitive levels
- Can be decomposed in 3 steps
  - Exercise
  - Price-quantity outcome
  - Consequences
- Rational behavior, but leads to inefficiency
- Monopoly power / monopsony power

Monopoly Power : Exercise

- Goal : driving price higher
- Two components of strategy
  - Withholding of output
    (curtailing output)
  - Financial withholding
    (bidding higher)

Monopoly Power : Price-Quantity Outcome

- Quantity withheld (1)
- Price distortion (2)
  Strong if demand elasticity is low
- [Quantity distortion] (3)
- Markup (4)



Monopoly Power : Social Consequences

- All suppliers benefit when one of them exercise market power
  But costs only for the exerciser !
- Wealth transfer
  (proportional to price distortion)
- Dead-weight welfare loss
  - Part due to quantity distortion
  - Part due to bad merit order

Monopsony Power

- Strategies to lower price
  - Low bid for an expensive generator run by a load generator
  - Withholding interruptible load
  - Curtailing exports
  - Increasing imports
- An attempt to bring price back to competitive level is not an exercise of market power

Exercise occurs in RT markets

- Waiting for a better price is not possible in RT, contrary to what occurs in forward markets
- Withholding in forward markets means only arbitrage
- But in the long-run, RT price levels are reflected in forward price
- Expected forward prices play a role when assessing the profitability of RT price distortions
- That role depends on how next period’s contract prices will be determined

Proving Market Power has been Exercised

- Refusing to produce when the sale would be profitable is an exercise of market power
  - But opportunity costs must be taken into consideration (hydrogenerators, emission-limited generators)
- Setting the market price by a high bid is not an exercise of market power

Role of nonmarginal generators

- Deliberately bidding high can prevent a generator to commit
- Result is a withheld quantity, and a higher price, possibly set by another generator
- That means that even small participants can exercise market power, from which all suppliers will benefit

Key Factors to the Extent of Market Power

- Demand elasticity
- Supplier concentration
- Style of competition
- Extent of long-term contracting
- Boundaries of the market

Demand Elasticity

- Cournot competition model gives an insight on the role of demand elasticity
- Price-cost margin is inversely proportional to elasticity
- Elasticity can be used as a proxy to model any sensitivity of demand on price variation
- Assumptions of Cournot competition
  - Profit maximization by choice of output level
  - Perfect information on production costs
  - Non collusive competition

Supplier Concentration

- Oligopoly's market power is limited by the number and size of competitors
- Price-cost margin for a given supplier is proportional to its market share in the Cournot competition model
- Market share is related to actual output, not to capacity

Style of Competition

- Different styles
  - Collusion
  - Cournot
  - Supply-curve
  - Bertrand
- The style of competition is usually unknow

(Supply-Curve Bidding)

- Uncertainty on the demand level would require different Cournot bid quantities
- Supply-curve bidding allows suppliers to bid between MC and price-cap, for a given quantity
- Sale reduction caused by a high bid is greater in supply-curve competition
- Each supplier faces a residual demand curve which elasticity is greater than the total demand

Extent of Long-Term contracting

- Forward contract quantities must be subtracted from output when evaluating the price-cost margin for a given supplier, in the Cournot model

$$\frac{P(q)-MC(q)}{P(q)}=\frac{(q-q_f)/Q}{e} \qquad e=-\frac{dQ}{dP}\frac{P}{Q}$$

- A negative value of the price-cost margin indicates a net-buy position in the spot market, and an attempt to lower price

Boundaries of the Market

- Market share relies on a definition of the market boundaries
- Transmission constraints make boundaries complex

What Limits Market Power

- Long-term obligation to serve load
- Forward contracting, when contract prices are not deemed as the average level of recent spot prices
- Uncertainty in the demand level
  - Frequency of bids should reflect speed of cost changes, not fine-tuning of strategy
  - Uncertainty induces supply-curve bidding
- Fear of long-run consequences

Fear of Long-Run Consequences

- Threat of entry
  - High prices induce investment in capacity
- Restrictive actions taken by regulators
  - Unless these actions are deemed unavoidable
- Change in load behavior

Tolerance to Market Power

- Trade-off between the gravity of market power problem and the cost of alleviation
  - Average wealth transfer
  - Average deadweight loss
  - Level of withholding compared to normal fluctuations

Electricity Markets

A Small Case Study

A RT-Balancing Problem

- Our case
  - Low-cost units : 20000 MW @ 20$/MWh
  - Gas-turbine : 100 MW @ 40$/MWh
  - GT must be block-loaded (full output or nothing)
  - Load : 20020 MW
- How can the SO keep the system balanced ?

Pool Approach

- Dispatch a GT
  (+100 MW @ 40$/MWh)
- Back down a low-cost unit
  (-80 MW @20$/MWh)
- Set market price to System Marginal Cost
  But what is that SMC ?

How to induce GT to commit ?

- SMC is 20$/MWh, as low-cost generation is available for the next MW of demand
- Problem: why would the GT start up at such a price ?

Pool's Solution: Side payments

- Compensate dispatched GT for its loss
  - GT receives a side payment of
    100 MW. (40-20) $/MWh = 2000$/h
- Incremental cost of the 20 MW supplement of load can be evaluated
  100 MW@40$/MWh = 4000$/h
  -80 MW@20$/MWh = -1600$/h
  Total : 2400$/h for 20 MW
  Incremental cost : 120$/MWh ($\neq$ 40$/MWh)

Is the SMC Optimal ?

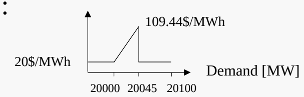
- Efficient supply in the short run ?
  No, that's why side payments are used
- Efficient demand in the short run ?
  What happens if the demand is in fact elastic ?
- Efficient investment in the long run ?
  Does the price send right signal for investment in capacity ?

Dispatch with Elastic Demand (1)

- Assume a 1 MW reduction in demand per 2$/MWh increase of price
- Wouldn't it be more efficient to increase price and keep demand at 20000 MW, as long as the value of suppressed load (net surplus) is less than the GT side payment ?

Dispatch with Elastic Demand (2)

- Cost of side payment : 2000 $/h
- Lost net surplus : $\frac{\Delta q.\Delta P}{2}$ where $\Delta P = 2.\Delta q$
  (triangle area)
- Level of demand at which GT should be commited : $20000 + \Delta q = 20000 + \sqrt{2000} = 20045\,\text{MW}$
- Price fluctuation :



Investment in the long run

- If the output of the GT were flexible, the price would be set to 40$/MWh when demand exceeds 20000 MW
- So low-cost units lose their scarcity rent when GT's are block-loaded and SMC set to 20$/MWh
- GT are compensated, so block-loading makes no difference in GT fixed cost recovery
- Thus a positive investment signal for low-cost unit is lost

Exchange Approach

- The exchange won't make side payments
- To make the GT start up, the price is set to 40$/MWh
- But then why would a low-cost unit back down ?

Solution: Parallel Markets

- Accept a decremental bid from a low-cost unit
  - Prior contracts of that unit are still paid on the basis of its full output
- (Parallel markets such as decremental energy, ramping, … are not proper to exchanges)