Electricity Markets

Links between submarkets

Overview
- Deregulation
- Links between markets, through the description of possible market architectures, structures, and rules

Deregulation
- Both cost minimizing incentives and prices hold down through competition
- Regulation can only make trade-offs
  - COS regulation
  - Perfect long-term price-cap regulation

Expected Benefits from Deregulation

Challenges
- Competition will not minimize costs if the market is a strong natural monopoly
- Lack of real-time metering causes customers not to respond to price fluctuations
- Lack of RT control of flow to specific consumers makes the enforcement of RT bilateral contracts impossible
- SO is the default supplier in RT and must set high prices when demand exceeds supply

Deregulations
- Demand and supply sides
  - Bulk power generation
- Supply side only
  - Ancillary services
- Demand side only
  - Transmission Rights
Competition

- Competition leads to efficiency
  - Production by cheapest suppliers
  - Consumption by those who value it most
  - Right amount produced
- Right signals lead to long-run efficiency
  - Optimal investments in capacity
  - Zero long-run economic profit
- Competition could induce RT pricing

Competitive Equilibrium

- Three conditions to reach competitive equilibrium
  - Price-taking suppliers
  - Public knowledge of the market price
  - Well-behaved production costs
  - Costs increase sufficiently rapidly

Price-Taking Behaviour (1)

- Each supplier adjust its output s.t. the CMP is between its MC_LH and MC_RH
- Suppliers adjust price to clear the market
- If the marginal cost is ambiguous, the marginal value determines the competitive price

Price-Taking Behaviour (2)

Marginal cost illustration

Market Architecture

- Aggregated supply curves won’t be strictly vertical
  - Emergency operating range
  - Old generators
- The MC just before the maximum output level is the variable cost
- The revenue minus variable cost (without start-up and no load costs) is the scarcity rent
Market Architecture

- Map of submarkets
  - Listing of designed and naturally occurring markets
  - Types of markets
  - Linkages

Classifications of Markets

- Public and private markets
  - Types of markets
    - Bilateral markets
      - Search
      - Bulletin-board
      - Broker market
    - Mediated markets
      - Dealer market
      - Exchanges
      - Pools

Public vs Private

- Role of public markets
  - Guarantee nondiscriminatory access to small participants
  - Assure completeness of provided services (UC,...)
  - Provide publically known price
    - Condition of efficiency
    - Benchmark for financial derivatives
- Advantages of private markets
  - Incentives to design well-adapted products

Bilateral vs Mediated

- Advantages of bilateral markets
  - Flexibility
- Advantages of mediated markets
  - Transaction cost
  - Speed

Centralized vs Decentralized

- Advantages of centralized markets (exchanges and pools)
  - Security of trade
  - Competition
  - Unicity of price
- Public markets are almost always centralized

Markets run by the SO

- Energy markets
  - Pricing of energy
  - Trading of energy
- Transmission-rights markets
  - Selling of rights to use the grid
- Whether or not the SO should run energy markets is controversial
Pools vs Exchanges

- **Bid format**
  - Pools accept complex bids
  - Start-up and no-load costs can be included
  - Make-whole side payments compensate for accepted losing bids
  - Correct rejection of bids difficult to ascertain
- Exchanges require convex bids
  - Bids must be gamed to avoid a loss
- Technical problems at stake
  - Unit commitment
  - Redispatching around congested lines

Example: DA Markets

- Public centralized DA market
  - Energy or TR market run by the SO
- Pool or Exchange
- Private DA Market
  - Will develop, even if a public energy DA market is provided
  - Could use combinations of centralized and decentralized markets

Linkages (1)

- **Implicit linkages**
  - Arbitrage
    - Forward prices and expectation of RT prices
  - Temporal linkages
    - Cascading markets for various qualities of reserves
  - Spatial linkages
    - Transmission rights

Linkages (2)

- **Explicit linkages**
  - Often needed to reflect real costs
    - Purchase of TR leading to activity in a bilateral energy market
  - May indicates the need for merging markets into multiproduct markets (efficiency – complexity trade-off)

Market Structure

- Ownership of production capacity
- Technology-based arrangements
- Cost structure of the industry
Effects of Reliability Requirements (1)

- Technology-based administrative decisions determine the height and frequency of price spikes
  - Reserve requirements
  - Price policies and price caps
  - Voltage and frequency quality
- Price spikes drive forward prices higher
- High forward prices stimulate investment in generation

Effects of Reliability Requirements (2)

- Interconnexions increases competition in balancing markets between system operators
- Temptation to rely on bilateral contracts and pay more than the price cap to avoid load shedding is strong without a generalized price cap

Effects of RT pricing

- Real time pricing policies brings elasticity in demand
  - Meters installation
  - RT prices implementation
  - Hedged pricing schemes
- Price elasticity reduce investment in peak capacity and market power
- Reduction of market power improve stability in investment

Effects of the extent of long-term contracts

- Competition in the spot market is increased by the extent of long-term contracts
  - Forward contracts diminishes incentives to exert market power
- Long-term obligations to load at regulated prices can be imposed to divested generation
- Amount of divested generation can be limited

Market Rules

- Goals
  - Competitive outcome
    - Competitive prices in case of competitive market structure
    - Reduction of market power in case of monopolistic market structure
  - Incentive compatibility
    - Participants find it profitable to bid honestly
  - Simplicity
Auction Rules

- Four types of auctions
- Revenue equivalence theorem doesn’t apply
- Multi-unit auctions
- Demand elastic and uncertain
- Pay-as-bid auction leads to complex gaming strategy and distorted merit order
- Market power could be reduced
- But short-run price decrease could cause long-run cost rise, by reducing scarcity rent and putting an end to investments in baseload generation

List of Abbreviations

SO : system operator
COS : cost of service
RT : real time
TR : transmission rights
DA : day-ahead
CMP : competitive market price
MC (L.H.R.H) : marginal cost (left-hand, right-hand)
MV : marginal value
VC : variable cost
UC : unit commitment