

Electricity Markets

Links between submarkets

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Overview

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

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Deregulation

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Expected Benefits from 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

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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

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Deregulations

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

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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

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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

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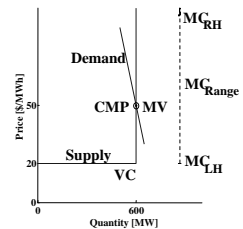
Price-Taking Behaviour (1)

- 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

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Price-Taking Behaviour (2)

- Marginal cost illustration



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Price-Taking Behaviour (3)

- 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

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Market Architecture

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Market Architecture

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

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Classifications of Markets

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

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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

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Bilateral vs Mediated

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

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Centralized vs Decentralized

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

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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

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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

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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

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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

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Linkages (2)

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

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Market Structure

Market Structure

- Ownership of production capacity
- Technology-based arrangements
- Cost structure of the industry

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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

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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

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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

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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

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Market Rules

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

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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

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List of Abbreviations



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

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