Regulation and Deregulation of Electric Power Markets

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Outline

1. Basic Mechanisms
2. Market Problems
3. California Specifics
4. Ongoing Problems
5. Potential Resolutions
Regulated versus Deregulated Markets

• **Regulated**
  – Single or few producers
  – Prices controlled by commission
  – Costs passed to consumers (eventually)
  – Little incentive for efficiency

• **Deregulated**
  – Multiple producers
  – Prices governed by market mechanism
  – Potential for market power (vary supply to manipulate price)
  – Questions about security (sufficient capacity)
Problems of Electricity Markets

- Inelastic demand
- Variable demand
- Limited transmission capacity
- Limited (unavailable) storage capacity
Inelastic Demand

- Demand increases can sharply increase prices
Variable Demand

• Demand often doubles (or more) during peak hours
Competitive Markets

$N$ Suppliers (bidders),
Each submits bid price and quantity

Power Exchange Market

Consumer

Demand

Supply bids
Market Clearing Process

Demand is 10

Problem: finding optimal bidding strategies and the resulting MCP

Supplier 1: 5MWh @ $10
Supplier 2: 10MWh @ $15
Supplier 3: 10MWh @ $20
Power Exchange Overview

• Non-sealed bid, Multi-round
  – Bidders can see each other’s bids and can adjust their prices as many times as they want
  – Market is closed when no bidder wants to adjust his/her bid price

• Selling at spot:
  – All dispatched units are traded at the same price
California Power Exchange (PX)

- **Two markets**
  - Day ahead
  - One hour-ahead

- **Independent System Operator (ISO)**
  - Coordinates supply and transmission
  - Operates energy imbalance market (spot market)
Electricity Price Example

- California Power Exchange
Electricity Price Example: Norway

- NOK Prices
Simple Market Power

- **Generators: Capacity, Cost**
  - Coal, 10, $5
  - Oil, 10, $50
  - Hydro, 10, 0
- **Demand: 15**
- **Cheapest dispatch**
  - Hydro, 10; Coal, 5; Cost to consumer: $75
- **Market power of hydro**
  - Bid only 4 into market, now oil also used
  - Coal, 10; Hydro, 4; Oil, 1; Cost to consumer: $750
Comparisons to Other Markets

• **High Volatility**
  – 10 to 100 times that of common stock
  – Prices from 0 to $10,000 per MWhr

• **Difficulty in storage**
  – Electricity close to un-storable
    • Difficulty substitution (liquidity)
Additional Problems

• **Capacity investment**
  – How to ensure enough capacity?

• **Start-up and shutdown costs**
  – How to obtain efficiency for long-run operations?

• **Colombia case**
  – Compare to “optimal”
  – Problems: multiple “optimal” choices
  – Optimal depends on future – must consider what will be available (not just what is available now)
Production Changes in Colombia (multiple possible ranges)
Colombia “Optimal” Hydro Generation
Colombia “Optimal” Thermal Generation

Thermal generation

Ballena1
Ballena2
Barranca1
Barranca2
Barranca3
Barranca4
Barranca5
Barranqui1
Barranqui3
Barranqui4
Cadafe
Cartagena1
Cartagena2
Cospique1
cospique2
Cospique3
Cospique4
Cospique5
Chinu4
Chinu5
Chinu6
Chinu7
Chinu8
Dorada
Flores1
Flores2
Flores3
Gualanday
Launion1
Launion2
Launion3
Launion4
Menced
Menchb
Mencce
Menepm
Menor
Menth
Ocoa
Oxy
Paipa1
Paipa2
Paipa3
Paipa4
Palenque3
Proele1
Proele2
Santander
Sierra1
Sierra2
Tasajero
TCentro1
TCentro2
TCentro3
Tebsa21
Tebsa22
Tebsa24
TebsaB1
Termoemcali
Termovalle
Tv1
Tv2
Zipaemg2
Zipaemg3
Zipaemg4
Zipaemg5
California Problems

• **Demand timing**
  – More rapid expansion than forecast

• **Capacity timing**
  – Long lead times
  – Large utilities sold generation

• **Transmission capacity**
  – Limited ability to take advantage of surpluses elsewhere

• **Current Situation**
  – Weather advantage
  – Voluntary conservation
Long-run Resolution

- **Additional capacity and transmission**
  - Need to know the market environment
  - Need to have instruments to hedge risks

- **Useful innovations**
  - Additional long-term contracts
  - Demand price responses
    - allow spot prices to pass through
    - can reduce monthly fluctuation with long-term contracts
Conclusions

• **Market structure**
  – Problems for electricity because of storage, inelastic demand

• **Market power**
  – Created by limited capacity, few producers

• **Resolutions**
  – Demand responsiveness and more ability to hedge risks