Designing and Monitoring a Regional Transmission Organization (RTO)

Comments on FERC Order 2000

Frank A. Wolak
Department of Economics
Stanford University
Stanford, CA 94305-6072
wolak@zia.stanford.edu
http://www.stanford.edu/~wolak
Chairman, Market Surveillance Committee
California ISO

Outline of Talk

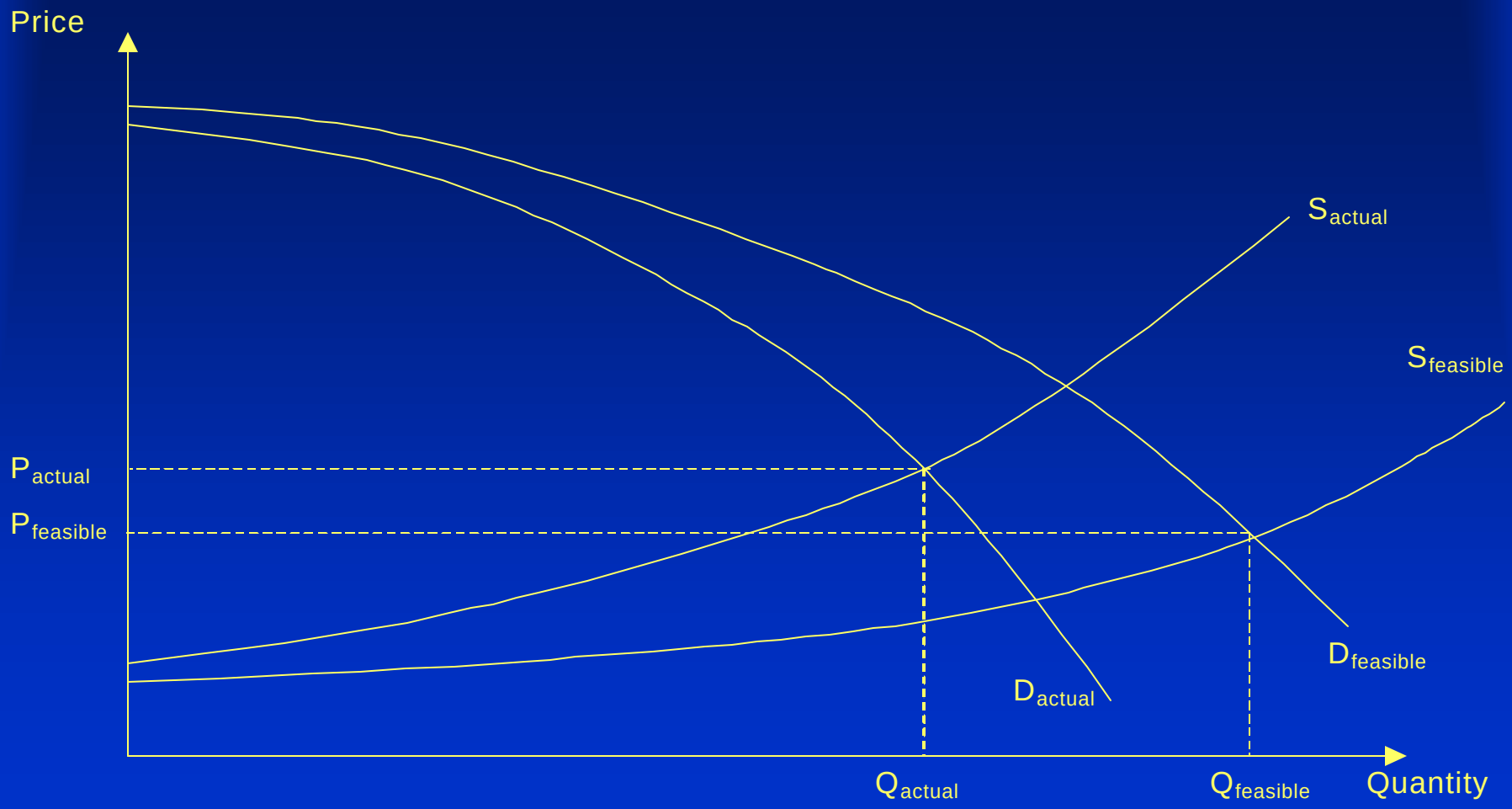
- Advantage of Flexibility of RTO Design
- Grid Reliability in Market-Based Regime
- Performance-Based Regulation of RTOs
- Measuring market performance
- Market power in competitive markets
- Missing ingredient: Demand-side of market
- Limits benefits to restructuring without demand-side involvement

Goal of Re-structuring

- To assess RTO order need to know its objectives
- "The Commission's goal is to promote *efficiency* in wholesale electricity markets and to ensure consumers pay the lowest possible price for *reliable* service." (p. 1, FERC Order 2000)
- Reliability takes on different definition in decentralized versus centralized market structure
- Suggested definition for efficiency--maximize number of feasible trades

Goal of Restructuring

- Maximize number of feasible trades at lowest possible price



How to obtain goal

- Market design must provide incentives for all agents to submit maximum feasible supply or demand schedules
- Agents have incentive to submit individually rational schedules
  - Profit-maximizing for suppliers
  - Utility maximizing for demanders
- Market design must make it
  - profit-maximizing for supplier to submit maximum feasible supply function
  - Diagnosing Market Power in California's Restructur feasible demand function

Advantage of Flexibility of RTO Design

- Given size and complexity of electricity network, optimal solution to market design problem is unknown at present time
- By allowing flexibility of RTO design process over time may be able to learn characteristics of optimal market design
- Need to standardize process of market performance monitoring across RTOs
  - Learn what works and what does not
  - Design change decisions based on data analysis

Dimensions of flexibility

- ISO/PX split--Competition for market-making services
  - Potential cost savings from PX/ISO integration
  - Competition for market-making services
    - reveals true cost of market-making services
    - provide diversity of services market demands
- Organizational Form-For profit/Non-profit
  - Non-profit--no financial position in market outcomes
  - For-profit--incentive to exploit profitable opportunities

Dimensions of flexibility

- Regulatory mechanism for RTO
  - Cost-based price regulation
    - Can provide incentive for firm to over-invest
  - Performance-based regulation
    - Price-cap regulation
    - Incentive for service quality degradation
- Congestion management mechanisms
  - Centralized versus De-centralized approaches
  - Physical versus Financial transmission rights
  - Level of Spatial Aggregation in Spot Prices

Grid Reliability in Market Regime

- Reliability takes on an economic dimension in competitive regime
  - In monopoly regime, grid reliability is percent of time that consumers actually receive power
  - In market regime, grid reliability is the percent of time that consumers willing to pay any price can receive power
  - Having to pay hourly price of energy may cause dramatic reduction in amount demanded
- This logic suggests revising usual protocols for determining level of generation reserves necessary for reliable grid operation.

Performance-Based Regulation

- Caution--Performance-based regulation as implemented often resembles an inferior form of cost-of-service regulation
- Examples from price-cap regulation
  - UK Regional Electricity Companies
  - UK National Grid Company
  - US Telecom Firms
- Price-cap regulation sets %) P = %) CPI - X
  - "X-factor" based on expected productivity and input price increases

Performance-Based Regulation

- In theory price is set independent of firm's actions
  - Profit-maximizing firm has maximal incentive to minimize costs, because its revenues are exogenous
  - In reality X-factor often determined from a prospective measure of cost-of-service
- More important problem--Regulator finds it extremely difficult to maintain a given of X-factor when revenue constraint begins to affect firm's profit level adversely
- Price-cap regulation becomes *de facto* cost of service regulation with the option to obtain very high profits if X-factor is set too low
- Existing performance-based regulation programs have not solved this problem of *de facto* cost-of-service regulation

Cost of Service Regulation for RTOs

- FERC Order 2000 notes a growing scarcity of transmission capacity
- Cost-of-service regulation gives strong incentives for investment in new capacity
  - Capital in rate-base is allowed to earned a regulated rate-of-return
  - No incentive for under-provision of quality (reliability)
- Transmission costs are small fraction of delivered cost of energy
  - 25% increase in transmission prices adds only 2% to overall electricity bill (FERC Order 2000, p. 563)
  - Benefits to wholesale generation market from new transmission investments associated with 25% increase transmission prices should allow overall electricity bill reductions far greater than 2%.
- Conclusion--Cost-of-service regulation of RTOs may enhance market efficiency

Market Monitoring in RTOs

- Mandate minimal amount of public data release by all RTOs
- Require data-sharing across market monitoring units of RTOs
- Devise measures of market performance that can be compared across markets and within same market overtime
- This maximizes opportunity for PUCs, FERC and RTOs to learn what optimal market design is for a given market structure.

Market Performance Measure

- "Diagnosing Market Power in California's Restructured Wholesale Electricity Market," Borenstein, Bushnell and Wolak
- For various sets of days, D, and sets of hours ,H, compute) TC(D,H) and TC(D,H)
- MPR =) TC(D,H)/TC(D,H)x100 = percentage total cost increase due to market prices in excess of competitive pricing

$$TC(D,H) = \sum_{d \in D} \sum_{h \in H} p_{hd} (Q_{hd}^{ISO} - Q_{hd}^{MT})$$

$$\Delta TC(D,H) = \sum_{d \in D} \sum_{h \in H} (p_{hd} - pc_{hd}))(Q_{hd}^{ISO} - Q_{hd}^{MT})$$

Example Market Performance Measure

- Three major results for California Market from June 1998 to August 1999
  - MPR largest during months of July to September
  - (Average) TC(D,H))/(Average TC(D,H)) over October 1998 to June 1999 is close to zero
  - Average MPR significantly highest in July to September 1998 relative to same month in 1999.
- Over 15 month period studied total cost increase due to market prices in excess of competitive pricing was $700 million
- Some portion of cost increase due to exercise of market power

Market Performance Index and Market Power

- MRP is measure of the extent of market power exercised in a market
- Two major reasons for market power
  - Market rule design flaws
  - Market structure (Concentration of capacity holdings)
- Goal of market monitoring process is to eliminate as many market rule design flaws as possible
  - Cannot ask firm not to pursue its own self interest
    - This is what makes market work
  - Individually rational to maximize profits
- Analysis of data from existing markets in consistent manner can yield valuable insights to this process
- Large amount of data already available for analysis from US ISOs.

Missing Ingredient in RTO Design: More Sophisticated Demand

- A workably competitive market requires final demand to become far more sophisticated than it was under monopoly
- Potential for high prices is necessary to give demanders the incentives to make the market workably competitive
- A significant benefit from restructuring will not be realized unless demanders become more actively involved in the market

Involving Final Demand

- Final demand must become as sophisticated as supply in pursuing its financial interests
  - Real-time metering for final customers
  - Interruptible purchase agreements
  - Within day load-shifting capability
- Positive externalities to all other demanders from more price-responsive demand
  - Less market power and price volatility
  - Rationale for subsidizing real-time metering
  - Use of load profiles to bill customers reduces real-time price responsiveness

The Role of High Prices

- Involving demand in the market requires long-lived, irreversible investments
- Without constant threat of high prices demanders will not make necessary investments
  - May be cheaper to work to continue price caps
- Carrot and stick approach
  - Carrot--subsidies to early adopters of demand response technologies
  - Stick--promise of removal or lifting of safety nets in future

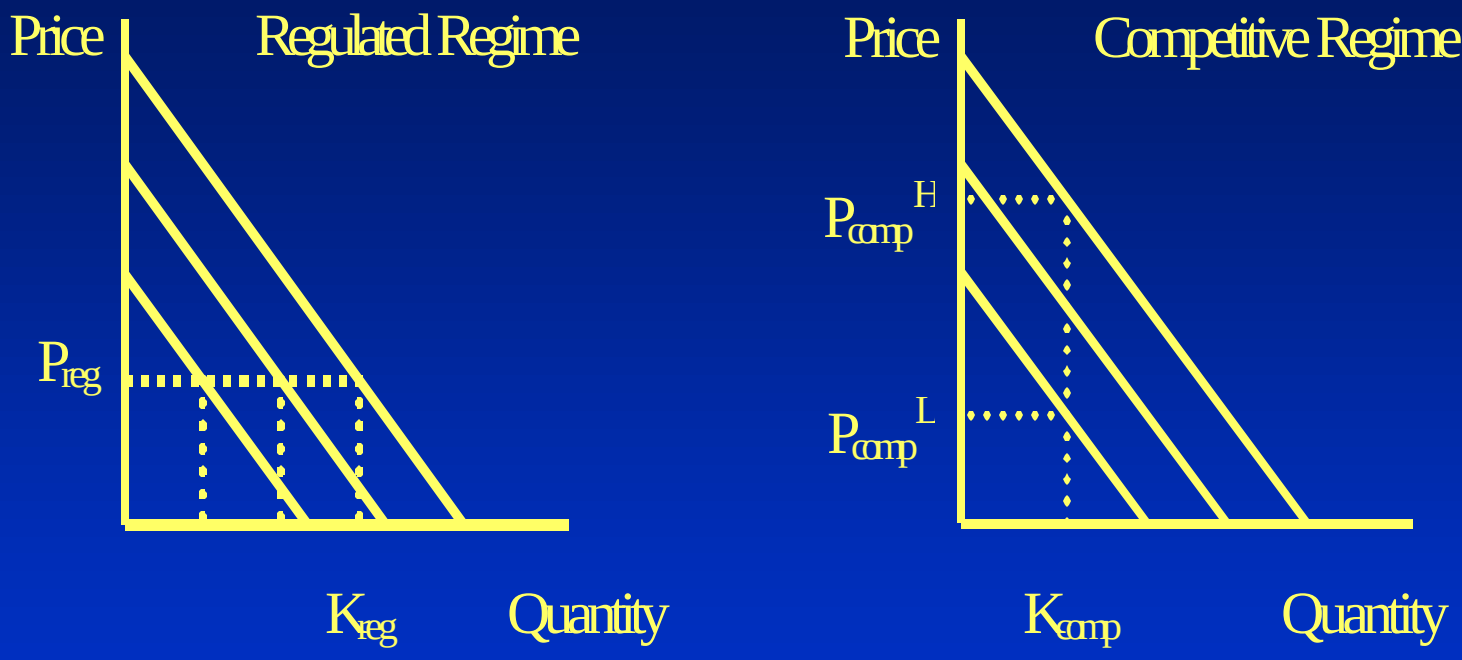
Limited Benefits of Restructuring Without Involving Demand

- US has privately-owned, profit-maximizing firms facing cost-of-service price regulation
  - Detailed prudence review of investment
  - Hard to argue there are large deviations from minimum cost production
  - Vertically integrated ownership and centralized dispatch should be able to improve on bid-based dispatch on true production cost basis

- Competitive market efficiently allocates resources using price mechanism
- Regulatory process cannot respond to changing market conditions fast enough
- Regulatory paradigm sets price and builds capacity necessary to serve maximum realization of demand at that price
- With price-responsive demand, competitive paradigm can use price to allocate fixed level of demand in short-run and produce efficient level of investment in long run

- Conclusion--Competitive market should be able to get by with lower level of capacity and serve same customers
  - This implies lower capacity costs for market at large
  - If dispatch costs are close to the same, then average price in competitive market should be less than average price in regulated market
- A necessary condition for this to occur is a sufficient number of price-responsive consumers

Optimal Capacity Choice Under Regulation versus Competition



$$K_{reg} >> K_{comp}$$

Example--US Airline Industry

- Load Factors = (Seats Filled)/(Seats Total),
  - In regulated regime highest load factors approximately 55% in 1976
  - Currently Load Factors are close to 70%
- This increased capacity utilization rate allows real average fare per passenger-mile to be significantly less than under regulated regime
- Regime works because of large number of sophisticated price-responsive consumers.