Why the United States Has Yet to Benefit from Electricity Industry Re-structuring

(And What Can Be Done to Change This)

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Outline of Talk

- Electricity industry re-structuring far more difficult than vast majority of observers thought
  - Even more so in the United States
- Why has it been so difficult to make electricity industry re-structuring benefit consumers in the US?
  - Lower delivered prices (consistent with long-term financial viability of industry) at equivalent or higher level of reliability than would have been achieved in the absence of industry re-structuring
- Features unique to US
- Features common to virtually all markets
- How to make US markets realize benefits

Features Unique to US

- Separate wholesale and retail market regulators
- Federal Power Act mandate for wholesale prices
- History of state-level regulation of vertically-integrated utilities
- Increasing regulatory intervention in wholesale market operation
  - AMP mechanism
  - Capacity payments
  - Restrictions on financial transactions

Federal-State Regulatory Separation

- United States one of few countries with clear separation between wholesale and retail market regulation
- Federal Energy Regulatory Commission (FERC) sets wholesale market policies
- State Public Utilities Commissions (PUCs) set retail market policies
- Wholesale and retail market policies must be coordinated or enormous consumer harm is possible
  - Designing a wholesale market assuming final load responds to real-time prices can create a disaster if retail market policies prohibit this
  - Designing retail market policies ignoring need for retailers to hedge spot price risk can create a disaster if wholesale market policies allow spot prices to fluctuate hourly or on a shorter time horizon

Federal-State Regulatory Separation

- Retail market policies consistent with wholesale market policies may appear to state PUCs like giving up regulatory authority
  - Give consumers the ability to protect themselves from price volatility
  - Allow retailers to protect themselves from spot price risk
  - Allow retail competition to set retail prices instead of state PUCs
- California's Lesson--A wholesale market with significant participation by merchant generation owners, implies turning over control of retail prices to FERC

Federal Power Act

- Wholesale electricity industry in US is still regulated despite existence of wholesale markets
- Federal Power Act requires Federal Energy Regulatory Commission (FERC) to regulate wholesale electricity prices
- Federal Power Act (FPA) of 1930 requires FERC to
  - Ensure that wholesale prices are "just and reasonable"
  - If they are not, take action to make them "just and reasonable"
    - "Whenever the Commission, after a hearing had up its own motion or upon complaint, shall find that any rate, charge, or classification, demand, observed, charged or collected by any public utility for transmission or sale subject to the jurisdiction of the Commission, or that any rule, regulation, practice, or contract affected such rate, charge, or classification is unjust, unreasonable, unduly discriminatory or preferential, the Commission shall determine the just and reasonable rate, charge, classification rule, rule, regulation, practice or contract to be thereafter observed and in force, and shall fix the same by order." (Section 206(a), Federal Power Act)
  - Order refunds for prices in excess of "just and reasonable" levels

Federal Power Act (FPA)

- What is a “just and reasonable” wholesale price?
  - Many possible definitions
  - Enormous wealth transfers can occur before this issue is resolved—Ask California
  - FPA introduces uncertainty about which transactions will be subject to refund
- No other country subjects its wholesale market to a “just and reasonable” price standard
- Creates moral hazard problem for market participants
  - If FERC must ensure that prices are just and reasonable, why take costly actions to protect against or prevent unjust and unreasonable prices

History of Effective State-Level Regulation

- Restructuring in US preceded by more than 70 years of state-level oversight of privately-owned vertically-integrated utilities
- Two tenets of state-level regulation
  - Obligation to serve all demand at regulated price
  - Regulated price allows utility the opportunity to recover all prudently incurred costs of serving its demand
- State regulators set retail prices and privately-owned, profit-maximizing utilities want to minimize production costs once these prices are set
  - Utilities owned vast major of generation units needed to serve demand
- The combination of state-level regulation and profit-maximizing behavior of investor-owned utilities squeezed out many inefficiencies in operation of vertically-integrated utilities
- Many wholesale markets in US started as tight power pools
  - Vertically-integrated utilities jointly dispatched their generation units to reduce operating costs

History of Effective State-Level Regulation

- Wholesale markets in other countries formed from government-owned national or regional monopolies
  - Government-owned companies have limited incentives to minimize production costs
  - Face other pressures besides delivering output at least cost
    - For example, regional jobs program
- Inefficiencies in industry operation before re-structuring far greater in these countries
- Conclusion—US industry had significantly less productive inefficiencies than other countries
  - Fewer sources of potential benefits in US versus Rest of World
  - Regulatory structure makes achieving these limited benefits more difficult
- Open research question—Was major source of benefits of re-structuring in these countries privatization with effective regulation rather than wholesale and retail competition?

Increasing Regulatory Intervention

- Wholesale market operation in US has evolved to look like very inefficient form of cost of service regulation
  - Automatic mitigation procedure (AMP) designed to limit ability of suppliers to exercise market power in spot market
  - Capacity payment mechanisms (with or without demand curve)
  - Attempts to restrict forward markets for energy to be purely “physical”

Market Power Mitigation

- Under AMP mechanism all generation owners have a reference price, typically based on accepted bids during “competitive” market conditions
  - If supplier bids in excess of this reference price by some preset limit, for example $100/MWh or 100% of the reference level, this supplier violates the *conduct* test
  - If this supplier’s bid moves the market price by some amount, for example $50/MWh, then supplier is said to violate the *impact* test
  - A supplier’s bid will be mitigated to its reference level if it violates the conduct and impact tests

Market Power Mitigation

- Profit-maximizing firms exercise all available unilateral market power all hours of the day
  - Cannot prevent the exercise of unilateral market power
    - If this was possible it would imply the existence of a perfect regulatory process
    - Existence of a perfect regulatory process implies there is no need to run a market—Regulation is best
- Market designer faces choice between two imperfect worlds
  - Imperfectly competitive markets with strong incentive for least cost production, but limited incentive for prices that reflect only these minimum costs of production
  - Imperfect regulatory process with limited incentive for least cost production but prices that reflect only incurred cost of production

Market Power Mitigation

- AMP changes mechanism suppliers use to exercise unilateral market power
  - Example--Reference price creep
    - Accepted low-priced bids can reduce reference level for conduct test, which makes it costly for a supplier to bid low during “competitive conditions”
    - Suppliers recognize that bidding low limits ability to bid high during periods when they can raise prices
  - Likely that AMP leads to reduced price volatility but higher average prices

Capacity Payments

- Making capacity payments to all generation units, even those with variable costs significantly below market price of energy,
  - Leads to higher prices to consumers relative to former vertically integrated regime
    - Limits potential benefits to consumers from re-structuring
- Energy price volatility lower because of increased generation capacity
  - Consumers must pay for additional capacity if it is to remain in market
    - Reduces likelihood consumers will benefit from re-structuring

Capacity Payments

- Capacity markets are extremely susceptible to the exercise of unilateral market power (unless purchases made far in advance of delivery)
  - "Demand curve" for capacity does not solve problem
    - Recall that perfect regulatory process does not exist
- "Demand curve" is pre-determined simplified regulatory process for setting capacity price as function of total capacity in market
  - Very likely to overpay for most capacity
    - Pays non-zero price for excess capacity
  - Further reduces likelihood of consumer benefit

Capacity Payments

- Capacity payments alone are not likely to be sufficient to attract new investment
  - Capacity payments typically recover less than half of a unit's total cost and in most case significantly less than half of this total cost
  - Long-term energy or reserve contracts are needed to finance new investment
- Capacity shortfalls have not been a source of market meltdowns in wholesale electricity markets
  - All known market meltdowns are due to inadequate energy not inadequate capacity
    - All market meltdowns—California, Chile, Brazil, New Zealand--due to energy shortfalls in hydro-dominated systems, not generation capacity shortfalls
  - Mix of generation capacity and availability of energy are main problems

Capacity Payments

- Do not limit incentives of suppliers to exercise unilateral market power in the short-term market for energy
  - Owner receiving capacity payment is able to bid to raise spot market price of energy, or more generally withhold energy from the spot market similar to supplier without capacity payment
- All markets generally acknowledged to have benefited consumers do not have capacity payment mechanisms
  - UK, Australia, Nordic countries

Restricting Financial Transactions

- Forward energy markets are purely financial in following sense
  - Supplier can avoid producing scheduled amount energy
  - Retailer can avoid consuming scheduled energy
- Difficult to tell if market participant undertakes purely financial transaction, or actually intends to deliver or consume energy
  - Implicit financial transactions (IFTs) are purely financial transactions that only market participant knows are financial
  - Impossible to prevent implicit financial transactions
    - Would need to read market participants mind or have a paper trail
  - Particularly problematic to prevent IFTs for imports and exports
    - Cannot identify source of imported energy
- Requiring forward markets to be “physical” (imposing large penalties on failures to fulfill forward market commitments) increases cost of short-term market participation
- With adequate forward contract coverage of final demand by retailers, allowing explicit financial transactions should increase market efficiency
  - A potential source of benefits of re-structuring is ability to transfer risks to parties able to bear them at least cost
  - Prohibiting financial transactions limits this source of benefits

Features Common to Virtually All Markets

- Asymmetric treatment of load and generation
  - Free wholesale price hedge provided to regulated retail consumers
- New role of transmission network in wholesale market regime
  - Transmission network as facilitator of competitiveness of wholesale market
- Need to distinguish between failure of market design and failure of individual investments
  - Not all generation investments need to earn a positive economic profit

Asymmetric Treatment of Load versus Generation

- Default price loads pay for wholesale energy in all US states is constant over time and space
  - Many state regulators allow consumers to switch to and from this default price at any time
- Option to buy at fixed-retail price at any time can be extremely valuable to consumers
  - Creates a enormous liability for load-serving entities that can arise with high probability during certain system conditions such as those in California from June 2000 to June 2001
- Default price generators receive in all of US markets is hourly wholesale spot price at their location
  - Generator must sign a hedging agreement to receive pre-specified fixed price for its output

How to Make Competition Benefit Consumers

- Symmetric treatment of producers and consumers of electricity
  - From perspective of grid reliability, a consumer is a supplier of "negawatts"--SN(p) = D(0) - D(p)
- Default price for all consumers should be hourly wholesale price
  - Consumer is not required to pay this price for any of its consumption, just as generator is not required to sell any output at spot price
  - To receive fixed price, consumer must sign a hedging arrangement with load-serving entity or electricity supplier
- There is nothing unusual about hedging spot price risk
  - Health, automobile and home insurance, cellular telephone
- Regulator can assist with design of standardized hedging arrangements for final consumers
  - Educate consumers on available options and which is best for them

The New Role of Transmission

- Benefits of a given transmission upgrade different in wholesale market regime relative to vertically-integrated regime
- Marginal increase in transmission network has different net benefit to consumers
  - Imperfectly competitive wholesale market whose efficiency can be improved by transmission investments that increase the number of competitors that can serve load at each location in the network
  - Imperfectly regulated vertically integrated regime where firm can benefit from economies to scope between transmission and generation to meet its load obligations
- State PUC regulation and prospect of re-structuring left the US with a significantly less transmission investment over past 30 years than comparable state-owned vertically-integrated utilities around the world

The New Role of Transmission

- Economically reliable transmission network may require far greater inter-connection capacity than network operated by vertically-integrated utility according to engineering reliability standards
- Economic reliability--All locations in transmission network are contestable--firms face substantial competition from a number of independent suppliers--a large fraction of the time
- State regulators may need to provide incentives to invest early on to overcome initially inadequate network for competition in generation
- Consider case that "over-invest" in transmission capacity to increase delivered prices by $1/MWh
  - If increased capacity of transmission network results in more competitive wholesale market, average wholesale prices may fall by $2/MWh so that consumers benefit from upgrade

Imprudent versus Prudent Investments

- All generation investments should not be guaranteed full cost recovery
- "Imprudent" investments (capacity build in advance of when it is needed) should not be rewarded
  - These investors should lose money as is the case in all other markets
  - Imagine if all dot-coms where required to recover costs
    - Many examples of poorly timed, but ex post profitable investments
- Generation units will still exist
  - Initial investor will lose money
- Assets will sell for much less than initial construction cost but they will be used according to their variable cost of supplying energy
- Clear distinction between these two types of investments is a major source of benefits from restructuring

How US Can Realize Benefits

- Treat electricity like any other product
  - Default price consumers and producers face is real-time price
  - To obtain a fixed price consumer must purchase a hedge from a retailer, just like in any other market
  - Consumers can choose combination from average price and price risk frontier that best suits them
- Treat transmission network as facilitator of competitive wholesale market
  - Benefit versus cost analysis must account for market-efficiency benefits (less exercise of unilateral market power) of transmission network
- Provide opportunity for firms to recover costs not a guarantee of cost recovery
  - Similar to former vertically-integrated regime

How to Realize Benefits

- To ensure revenue adequacy for all generation units needed to meet demand, require all retailers to purchase forward contracts that hedge spot price of energy and ancillary services for all load obligations where retail price does not vary with hourly wholesale price
- Latin American market solution
  - Regulator mandates forward contract coverage of final demand a various horizons to delivery for all retailers
  - Allows suppliers to determine how much capacity and what technological mix of capacity is needed to meet energy demand at least cost
    - No need to specify capacity requirements
- Contracts must be signed sufficiently far in advance of delivery to limit opportunities for suppliers to exercise unilateral market power
  - If sign contracts more than two-years in advance of exercise date of contract then all potential new entrants can compete in this market and discipline prices

Forward Contracts Solution

- Minimum forward contracting levels must be mandated by regulator if there is
  - Bid or price cap on energy market—Higher levels for lower caps
  - Final consumers are prohibited from managing short-term price risk
    - Regulator decides not to invest in hourly meters for customers
- Retailers would be required to meet these obligations or face financial penalties—Similar to capacity obligations
  - Little spot price volatility if regulator mandates minimum contracting levels in advance of delivery very close to forecast demand
  - Preferable regulatory intervention to capacity market intervention
  - Solves problem of revenue adequacy for existing and new investment
- A sample portfolio standard and delivery horizon
  - 1 year from delivery 100% of forecast demand in forward contracts
    - Portfolio must be composed of at least 85% swaps, with the remainder in caps at average strike price less than 3 times average spot price from previous year
  - 2 years from delivery 90% of forecast demand in forward contracts
  - 3 years from delivery 85% of forecast demand in forward contracts
- Without mandated coverage and delivery horizons generation capacity may not arrive in time to meet regulator's level of comfort
  - Australian experience

Forward Contracts for Energy

- If retailers have portfolio of forward financial contracts limiting exposure to spot prices, suppliers that sold contracts have strong incentive to find the lowest cost way to fulfill these obligations at the "delivery date"
  - Least cost solution only occurs with adequate contracting by retailers
  - This information can be capture in subsequent rounds of contracting between suppliers and retailers
- Different financial contracts are best hedged on by different generation investments
  - Traders and suppliers are best ones able to figure this out

Forward Contract Markets

- Fixed-price forward contract holdings by California LSEs at current levels would have largely prevented California electricity crisis
  - Despite reduced import availability in summer 2000, sellers of forward contracts would still have had significant supply obligations to California market
  - No benefits to raising spot prices in California until these forward contract obligations were covered
  - Spot prices may have risen, but this would have caused limited consumer harm
  - Summer 2001 had lower hydro availability than summer 2000, but significantly higher forward contract coverage by LSEs
  - In a hydro-based system, LSEs should have an even larger forward contract coverage, because spot price risk is greater
    - Higher electricity prices do not cause more water to appear behind the turbines

Concluding Comments

- Electricity is a homogeneous commodity differentiated by time and location
- Treating electricity like other commodities on both the demand and supply side will maximize likelihood of benefits from restructuring
- Embrace wholesale market with retail market policies or go back vertically-integrated regulated regime
  - Hybrid solutions are unnecessarily costly
- Experience of post-June 2001 market in California with high levels of forward contracting very encouraging
  - Little turbulence in California market from June 2001 to present despite severely disabled short-term market

For more information see
http://www.stanford.edu/~wolak