Idiosyncratic assets interconnected markets and arbitrage

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The views presented are the personal views of the authors and not the Federal Energy Regulatory Commission or any of its Commissioners
Market history

- Historically: pre-1990
  - Risks are borne by consumers via their agents (regulators)
  - Weak trading
  - cost-of-service pricing

- Markets: post 1990
  - Market-based rates
  - Risks shared by voluntary contracts
  - Increased trading
Idiosyncratic Bulk Power System Assets

- Sunk costs/Asset specificity
  - 10 years in planning
  - 30-50 year life
  - Location

- Risks:
  - financial,
  - Technical
  - Environmental
  - Market
  - regulatory
History of Colored Swans
twenty years ago today

- **White Swans** (known knowns)
  - Nukes: Half century of 300% cost overruns
  - Natural gas: Half century of price volatility

- **Gray Swans** (unknown knowns)
  - Climate change: what is the cheapest fix?
  - Health: Canceled and retired coal plants
  - Lower Demand: Canceled transmission assets

- **Black Swans** (unknown unknowns: outliers)
  - Shale gas paradigm shift:
    - bridge fuel
    - The bridge is getting longer
Investment decisions to products

- Start with idiosyncratic assets and contracts
  - generation: nuke, coal, natural gas, wind, solar
  - Load: industrial, commercial and residential
  - Transmission assets
- Real power is a mostly homogenous product indistinguishable from who makes it
- other products: reactive power, ramp rate, and capacity
Principles of ISO Market Design

- Maximize benefits to society
  - Demand (value) functions minus
  - Supply (cost) functions
- Distribution of benefits to incent efficient behavior
  - LMP
  - Uplift allocation
  - Capacity prices
- Mitigate market power
  - Bid marginal costs
  - Bid marginal value
ISO Auction Markets

- Market Design for all ISOs
  - Transmission rights
  - day-ahead unit-commitment market
  - Residual unit commitment
  - Real-time market
- Capacity markets: 3 of 7 ISO markets
  - Price-responsive demand/Scarcity pricing
  - Call option for advance planning
- day-ahead and real-time market risk changes from
  - Not having enough power or over contracting to
  - Price volatility, but very liquid ISO markets
  - Clean up the physical infeasibilities from bilateral trading
The ISO Day-ahead and Real-time Markets

- **LMP** is a public uniform price for homogeneous product
  - Quantities are individual (private)
  - almost clears at the ‘law of one price’
  - 95% of revenue transfers are at the LMPs

- **Market Uplift** is a private non-uniform price for non-homogeneous product
  - start-up, reactive power, loss errors
  - Quantities are semi-public (cannot directly assign costs)
  - 5% of revenue transfers; often peanut buttered
  - Need greater differentiation and better cost allocation
ISO Market Approximations

- Linear ‘DC’ model for non-convex AC flows
  - Linear model employs estimated losses
  - No reactive power; fixed voltages
  - Non-optimal topology (network)
- Markets have different time intervals
  - Financial transmission right: month or more
  - Day-ahead market: hourly
  - Real-time market: 5 minute dispatch
- What is the cost of the approximations?
Real-time market

- the non-convex physics presents arbitrage
- Can’t fool mother nature
- Approximations create
  - Greater uplift
  - inefficient LMPs
  - Greater arbitrage opportunities
- Signal for better software and market design
Losses

- Currently estimated because the market model is an approximation
- Day-ahead market with financial market participants
  - discover errors and arbitrage
  - better the price signal and dispatch
  - lower uplift
  - Make money
- Without financial market participants
  - incorrect the price signal
  - greater uplift
Time interval differences

- Financial transmission right (maybe weekly)
  - Monthly intervals
  - Outage for one week
  - What is the best network?
- Day-ahead market
  - Hourly (maybe 15 minutes)
  - No congestion in hour interval
- Real-time market
  - Congestion in some 5 minute interval
  - 5 minute pricing
- Can we shorten the intervals?
Seams

- collision of the ISO markets and contract path markets
- Arbitrage opportunities
- Should we price loop flow?
- Is ACE yesterday’s concept?
- ACE may have been good for
  - Voluntary reliability
  - 100+ control areas
Financial market participants

- Traditional risk management
  - Liquidity: the ability to trade quickly at the efficient price
  - Trade in forward bilateral markets
  - Finance projects

- ISO markets are very liquid

- Arbitrage in ISO markets
  - Check market power in the forward markets
  - Move prices to expected price in the real-time market

- Arbitrage design flaws: Incent fixes?
  - Bad loss estimates: Lower uplift
  - Time intervals
  - Contract path and TLRs
continuous trading via standard bilateral contracts

- Standardized 'bilateral' markets for faster trading
  - WSPP standardized contract
  - EEI Master Contract
  - Provide credit provisions and standard product definitions
  - basic negotiable elements, e.g., price, quantity, location, and duration

- Public exchanges: ICE, NYMEX, Nodal
  - Actual trades
  - Published prices
  - Published quantities

- Indexed pricing
combination companies

- Using the regulated utility as a source of free capital has a long tradition

- Regulated utilities are generally very risk averse with cost pass-throughs
  - Look for a published 'price' that its regulator agrees to
  - Mark bilaterals to 'market' (public exchange)
  - Thin trading on public exchange is ripe for manipulation
### ICE

**Power Delivered on Thurs., Feb. 21, 2013**

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Neo-classic financial market participant theory

- Complete markets
- Easy entry and exit
- No transaction costs
- Common knowledge of probabilities
- Risk neutral
- Infinite capital
- Complete liquid markets
- Make no profit
transactions cost financial market participant model

- Incomplete markets
- Transaction costs cause market frictions
- Rogue traders
- Common knowledge of historic information
  - Must exact useful information
  - Short-term asymmetric information
- Take advantage of asymmetric information
  - While it lasts
- Correct market design flaws
- Must have contingent capital collateral to support trading eg, margin calls
Enron et al

- 1990: regulated companies
- Market-based rates for natural gas
- Start a trading arm
  - Frogs becomes Wall Street princes
  - One eyed giants in the valley of the blind
  - Under capitalize trading
- 2001: Princes become frogs
  - Bankrupt or almost bankrupt
- 2008: Constellation (la deuxième partie?)
What are the lessons?

Have we learned the lessons?