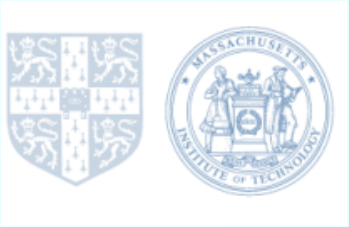

The
Cambridge-MIT
Institute

A Review of the Monitoring of Market Power

Cambridge

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Outline

- Defining, Detecting and Mitigating Market Power
- Indices and Models of Detecting Market Power
- Market Power Monitoring in Practice
- The Roles of Market Participants in the Market Monitoring Process
- Lessons and Conclusions

Defining Market Power

- Definition: The ability to profitably alter prices away from competitive levels
  - How to determine *profitable* strategies?
  - Magnitude and duration of impact?
  - Intentionality of actions?
  - High prices ≠ Market Power
- Horizontal versus vertical market power
- System-wide versus local market power

Strategies of Exercising Market Power

- Economic withholding
- Physical withholding
- Transmission related strategies

Categories of Market Power Detection Techniques

	Ex-Ante	Ex-Post
Long-Term	- Structural indices, e.g. Market share, HHI, residual supply index - Simulation models of strategic behaviour	- Competitive benchmark analysis based on historical costs - Comparison of market bids with profit maximizing bids
Short-Term	- Bid screens comparing bids to references bids - Some structural indices such as pivotal supplier indicator and congestion indicators	- Forced outage analysis and audits - Residual demand analysis

Mitigating Market Power

- Market mitigation methods
  - Structural
    - e.g. divestiture, removing entry barriers, transmission expansion, demand responsiveness
  - Regulatory
    - e.g. vesting contracts, virtual power plant auctions
  - Market Rules
    - e.g unit-specific bid caps

Applications of Market Power Mitigation Systems

	Ex-Ante	Ex-Post
Long-Term	-Merger rulings -Assessing applications for market-based rates -Determining potential must-run generators	-Litigation cases (e.g. California refund case) - Changing market design
Short-Term	- Spot market bid mitigation - Must-run activation & other system operator contracting	-Short term price re-calculations - Penalties for withholding

Indices and Models of Detecting Market Power

- **Structural Indices and Analysis**
  - Market Share and HHI
  - Pivotal Supplier Indicator and Residual Supply Index
  - Residual Demand Analysis
- **Behavioral Indices and Analysis**
  - Bid-Cost Margins
  - Net Revenue Benchmark Analysis
  - Withholding Analysis
- **Simulation Models**
  - Competitive Benchmark Analysis
  - Oligopoly Models
- **Transmission Related Issues**

Structural Indices and Analysis

Market Share and HHI

- Standard tool - in use for many decades
- Simplest version only requires sales or capacity data
- Trigger levels
  - Market share: 20%
  - HHI:

    <1000 unconcentrated

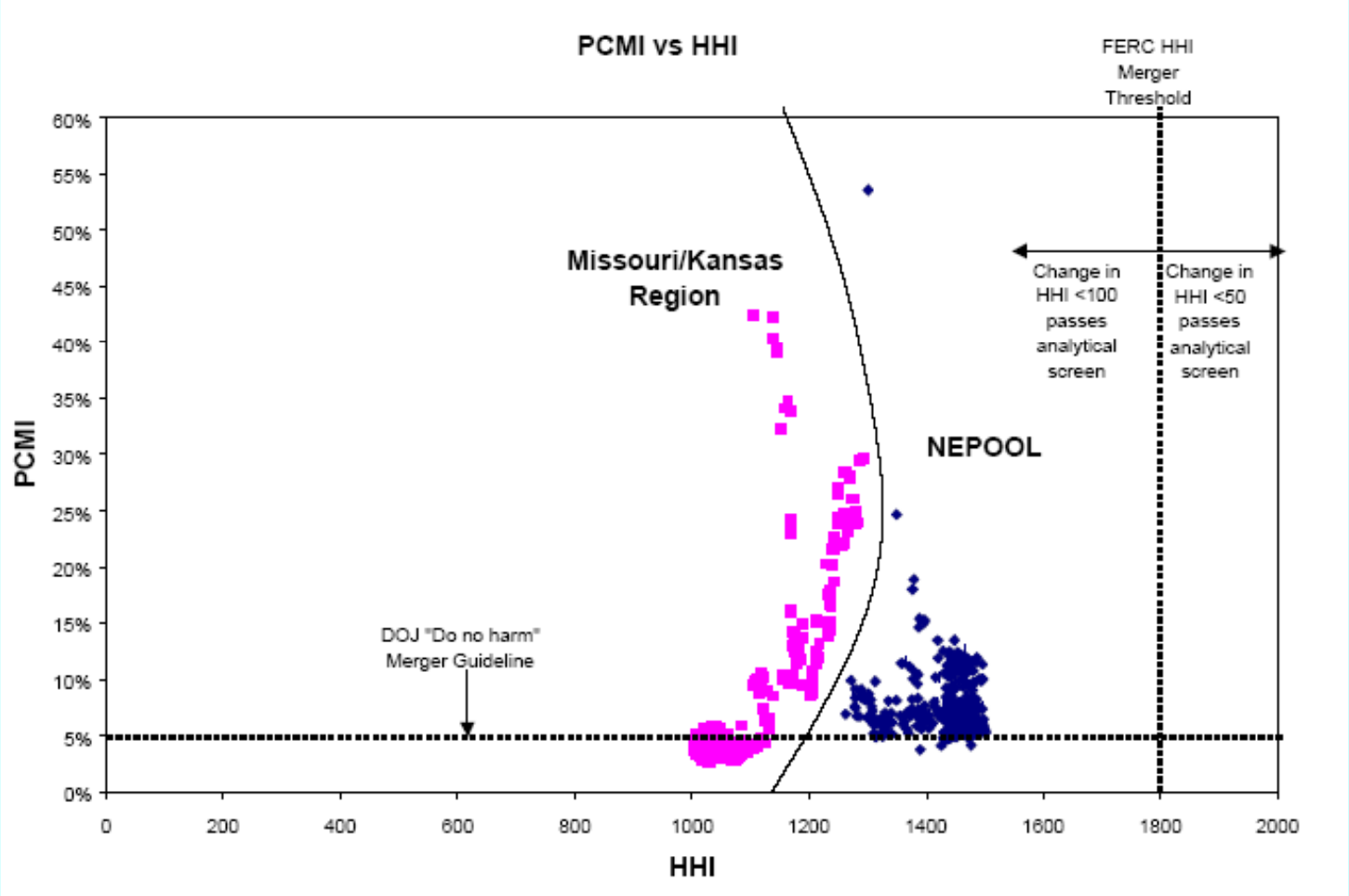
    1000-1800 moderately concentrated

    >1800 highly concentrated

Market Share and HHI

- Difficulties in determining appropriate geographic region (e.g. SSNIP test, Hub-and-Spoke)
- Ignores many factors including demand side, strategic incentives and often congestion issues
- Little empirical justification in electricity markets
- California - under certain definitions of the relevant market, no single supplier in California had a 20% market share during the California crises

No correlation between HHI and Price-Cost Margin



Williams and Rosen (1999) Daily HHI based on actual delivery

Pivotal Supplier Indicator and Residual Supply Index

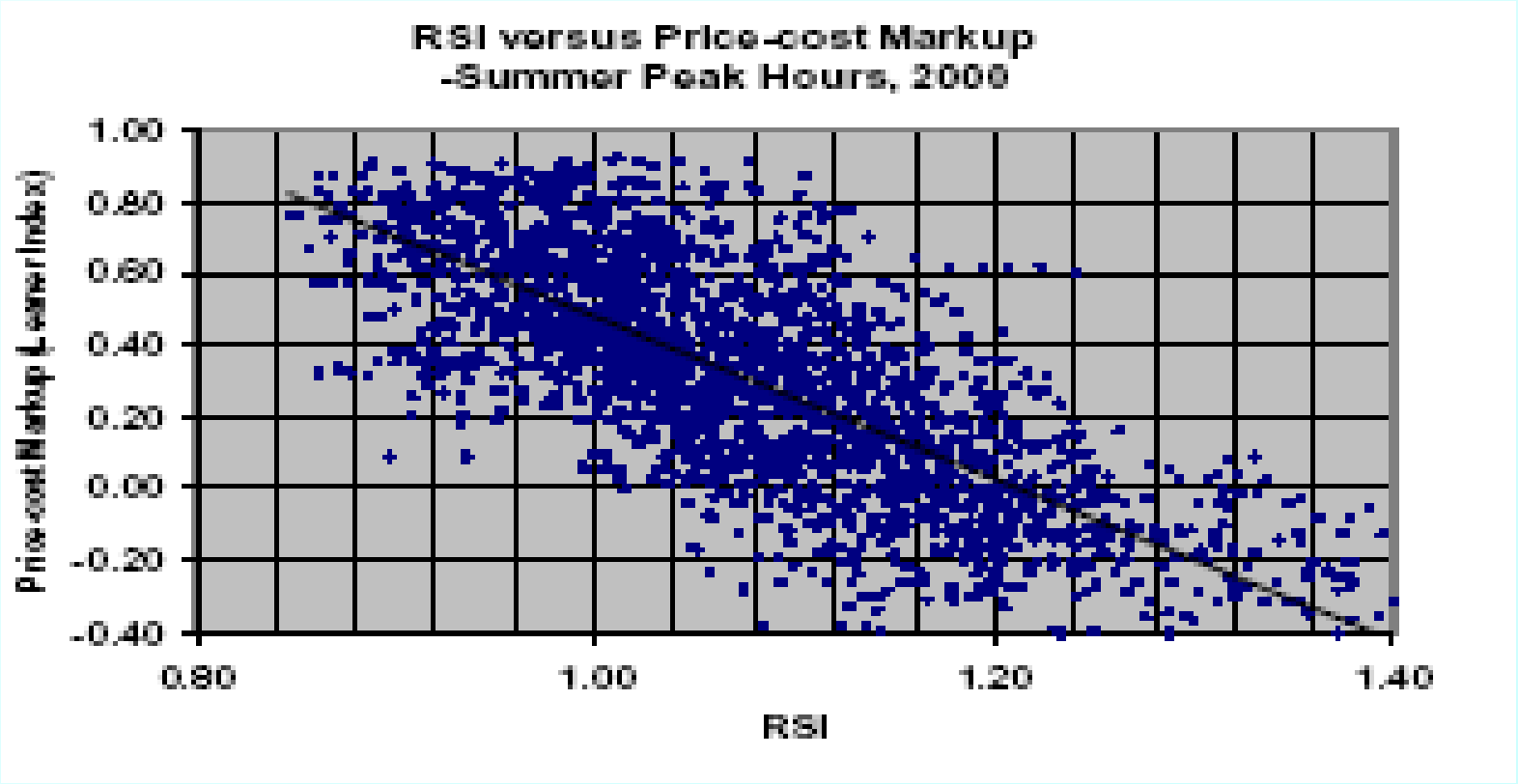
- Measures the extent to which a generator's capacity is necessary to supply demand after taking into account other generators' capacity
- Pivotal Supplier Indicator – binary variable (pivotal or not pivotal)
- Residual Supply Index – continuous variable

$$RSI = \frac{\text{Total Capacity} - \text{Company i's Relevent Capacity}}{\text{Total Demand}}$$

Pivotal Supplier Indicator and Residual Supply Index

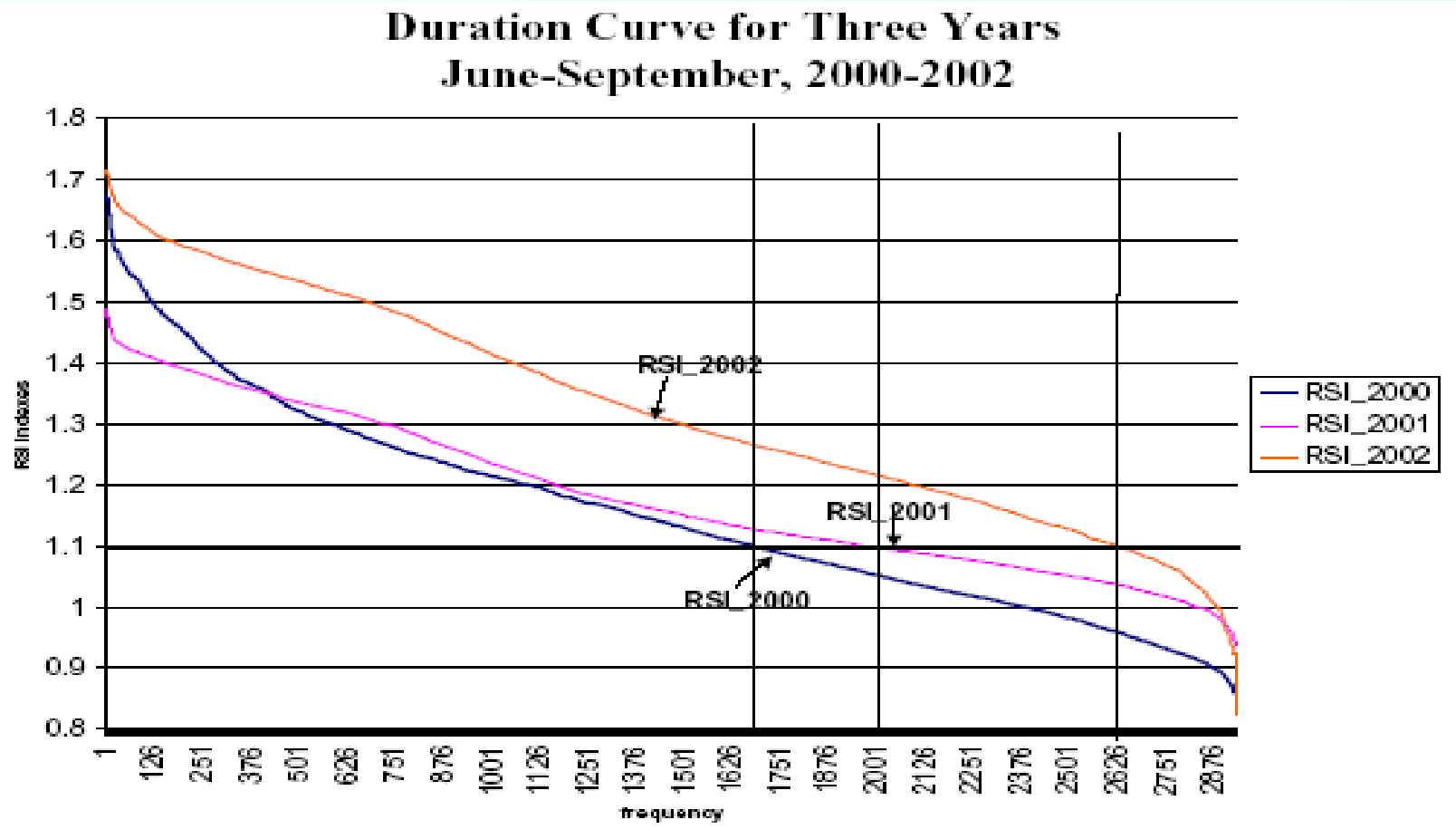
- Takes into account the demand side of market
- Suited to dynamic analysis on an hour-by-hour basis and local market power analysis
- Empirical support of ability to predict actual market power
- Recent tool and growing in popularity

Significant Correlation between RSI and Price-Cost Markup



Sheffrin (2002)

RSI – real-time analysis as well as long term analysis



Sheffrin (2002)

- Sample screening rule: RSI must be more than, say, 110% for 95% of the hours in a year

Residual Demand Analysis

- Incorporates elasticity of generator's residual demand curve as indicator of potential market power
- Theoretical justification – relationship with Lerner index
- Requires individual bid data to construct residual demand curves
- Limited empirical work so far. Mainly work of Frank Wolak.

Behavioral Indices and Analysis

Bid-Cost Margins

- Lerner Index:

$$LI = \frac{\text{Price} - \text{Marginal Cost}}{\text{Price}}$$

- In a competitive market LI is zero
- Easy to understand
- Do not require geographic market definitions
- Is a standard measure of market power

Bid-Cost Margins

- Difficulties in determining marginal costs:
  - Some costs are difficult to quantify (e.g. increased costs of degradation if used outside of designated parameter)
  - Variable costs do not necessarily approximate marginal costs for units with significant opportunity costs (.e.g hydro)
  - Variable costs data may be confidential and difficult to obtain
  - Questions over appropriate measure of marginal cost (long run or short run)
- Alternative ways of estimating competitive bids using past bids also involve difficulties
- Interpretation difficulties - margins are affected by factors other than market power (e.g. scarcity)

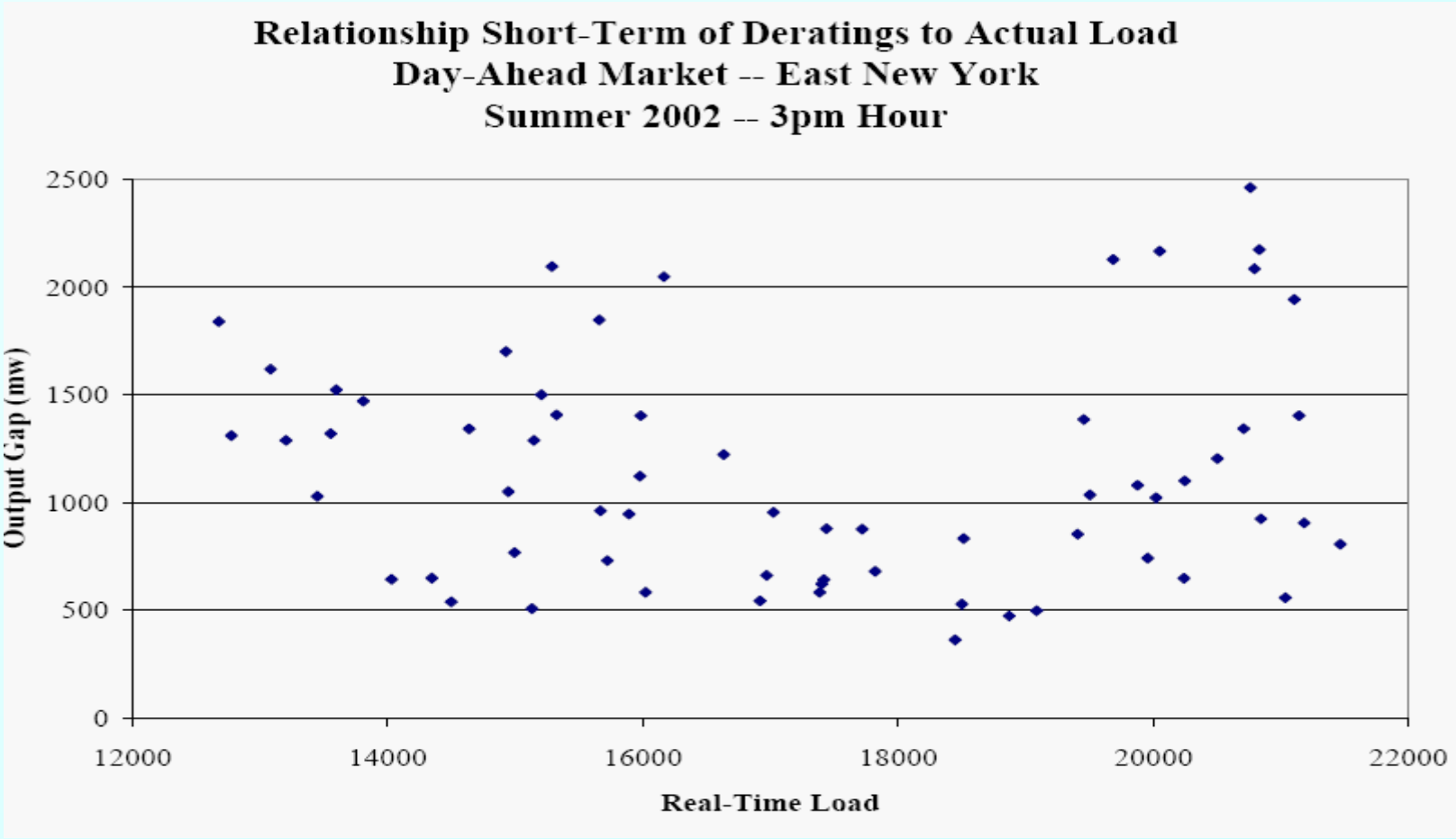
Net Revenue Benchmark Analysis

- Compares estimated revenues with estimated total costs for generation technologies– longer term analysis
- Allows for comment on financial viability of generating technologies – particularly where market design imposes price caps
- Cost estimation difficulties
- Interpretation difficulties – net revenue fluctuates for a number of reason aside from market power

Withholding Analysis

- Identify generation capacity that would have been profitable at prevailing market prices but was withheld from sale.
- Searching for ‘missed opportunities’ – the gap between the economic level of output and actual production
- Can be applied to both economic and physical withholding
- Some approaches avoid cost estimation issues by only examining high price hours
- Correlate estimated ‘output-gap’ with incentives to exploit market power
- Is a recent tool of analysis and still controversial

Deratings vs Load Analysis



Patton (2002) State of the Market Report, New York Electricity Markets

Simulation Models

Competitive Benchmark Analysis

- Simulate the competitive market in order to calculate Lerner Index of actual price over simulated competitive price
- Increasingly popular tool of analysis
- Does not identify individual generators exercising market power
- Difficulties in identifying appropriate costs
- Subsequent controversy over quantitative results

Oligopoly Models

- Integrates many factors into one framework (e.g. demand, strategic incentives, transmission constraints)
- Introduced in early 1990s and applied widely since
- Large number of assumptions negates certitude of quantitative conclusions

Approaches to Market Monitoring Units

- Market Monitoring Units. Different approaches:
  - Regulator
  - Unit attached to Market Operator
- Desirable Features
  - Forward-looking and preemptive
  - Support from regulator to respond to recommendations
  - Consistent approach to ensure that the market monitors actions are understood by all participants
  - Transparent approach to promote confidence in the operation of the market and allow outside analysis
  - Independence from stakeholders to avoid risk that analysis is biased in anyone's favors

Data and Indices Tracked by Market Monitoring Units in Practice

- Market Prices, Demand and System Conditions
- Market Structure Indices
- Supplier Indices and Analysis
- Market Performance Indices and Analysis

Market Prices and System Conditions

	Category	Frequency	Implementation	Data Required
Price Trends	Close-to-real time, ex-post	Hourly, daily, monthly	Straightforward	Spot, forward & fuel prices
Price Comparisons	Close-to-real time, ex-post	Hourly, daily, monthly	Straightforward	Spot, forward & fuel prices
Price Setting Analysis	Ex-post	Daily, monthly	Straightforward	Spot, forward & fuel prices
Demand and Capacity Comparisons	Ex-post	Daily, monthly	Straightforward	Demand data, capacity and generation offered
Congestion Analysis	Ex-post	Daily, monthly	Considerable effort required	Transmission constraints data, Nodal prices or constrained on/off payments

Market Structure Indices

	Category	Frequency	Implementation	Data Required
Market Share	Usually ex-ante	Daily, monthly, annually	Straightforward but requires defining appropriate zone	Generator capacity or sales. Possibly transmission constraint data
HHI	Usually ex-ante	Daily, monthly, annually	Straightforward but requires defining appropriate zone	Generator capacity or sales. Possibly transmission constraint data
Demand Responsiveness	Close to real time, ex- post	Monthly, annually	Straightforward	Demand data
Pivotal Supplier Indicator	Ex ante, close to real time, ex-post	Hourly, daily	Straightforward but requires defining appropriate zone	Demand data and generator capacity. Possibly transmission constraint data
Residual Supply Index	Ex ante, close to real time, ex-post	Hourly, daily	Straightforward but requires defining appropriate zone	Demand data and generator capacity. Possibly transmission constraint data

Supplier Indices

	Category	Frequency	Implementation	Data Required
Lerner Index	Ex-ante, close-to-real time, ex-post	Daily, monthly	Moderate effort in using cost data and congestion data.	Bid data. Possibly Marginal Cost data.
Bid Correlation Analysis	Close-to-real time, ex-post	Daily, monthly	Moderate effort if using cost data and congestion data	Bid data. Possibly demand & congestion data
Load Factor Analysis	Close-to-real time, ex-post	Daily, monthly	Straightforward	Output and capacity data
Outage Analysis	Ex-post	Monthly, annually	Moderate effort required	Outage data. Possibly demand, cost & price data.

Market Performance Indices

	Category	Frequency	Implementation	Data Required
Liquidity Measures	Close-to-real time, ex post	Daily, monthly	Straightforward	Bid prices and volumes
Spot Market Exposure	Close-to-real time, ex post	Daily, monthly	Straightforward	Bid prices and volumes
Competitive Benchmark Analysis	Ex-post	Monthly, annually	Considerable effort in model development	Marginal costs, market prices
Net Revenue Analysis	Ex-post	Annually	Considerable effort in model development	Capital and operating costs, technological data
Simulation Models	Ex-ante	Periodic studies	Considerable effort in model development	Cost data, demand elasticities, transmission constraints

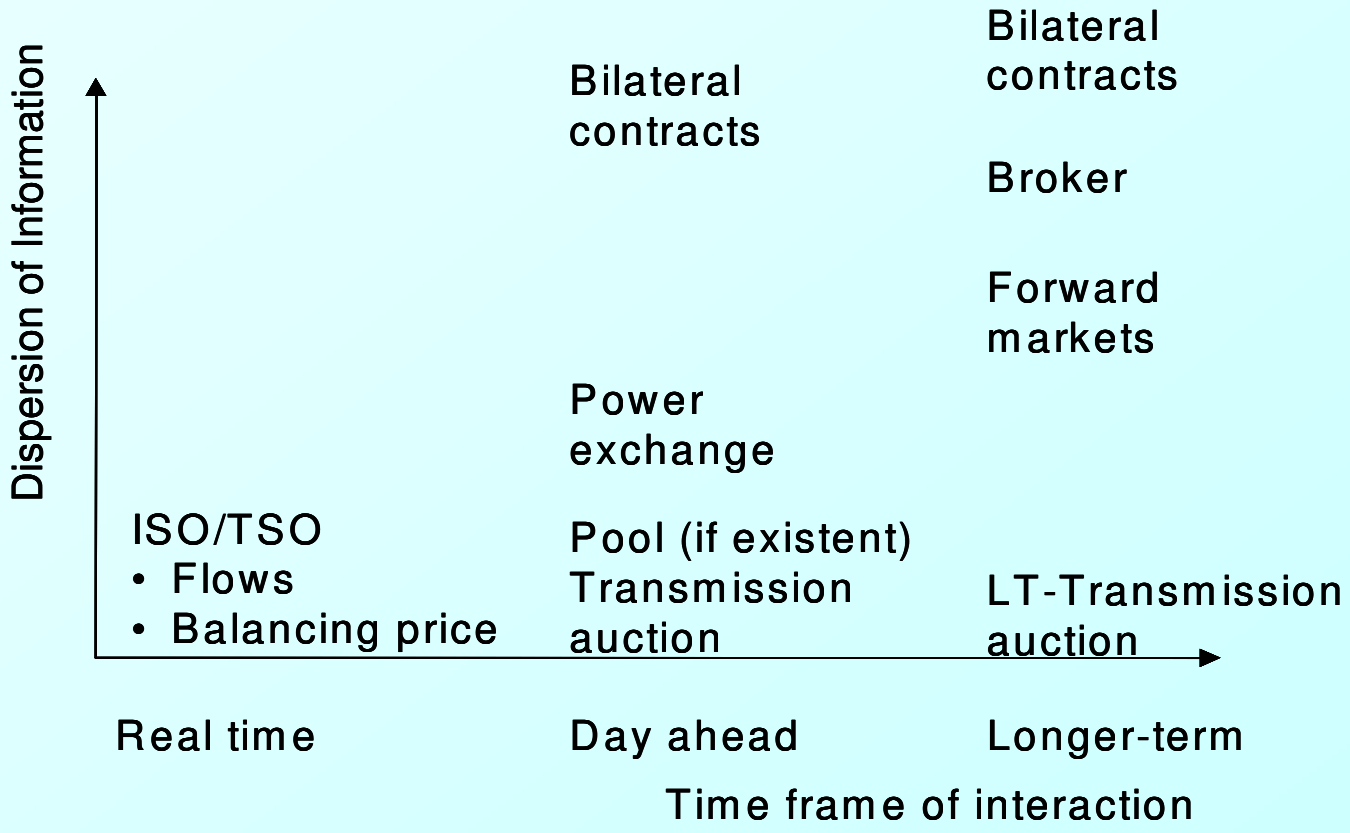
Powers of Market Monitoring Units

- Generally a monitor reports to a regulator or competition authority rather than taking action itself.
- There are exceptions (e.g. automatic bid mitigation is some US markets).
- Primary task is to produce reports and conduct investigations.

Where is the data?

- **TSO/ISO**
  - Physical flow patterns
  - Bids in balancing markets
  - Bids in pool (if run by ISO)
- **Transmission Rights Auction** (if independent of TSO/ISO)
  - Bids, market clearing prices and allocation of transmission rights
- **Power Exchanges**
  - Bids, market clearing price and allocation for spot market and forward contracts of transactions through the power exchange.
- **Brokers, market makers**
  - Information on bilateral contracts brokered
- **Market participants**
  - Information on directly negotiated bilateral contract
- **Generators**
  - Information of costs, deratings, outages and capacities.

The data is increasingly centrally located, the closer to dispatch



Data Issues

- Data closer to dispatch is easier to obtain.
  - Partly explains why spot market is the focus of market power analysis.
  - Spot market, as market of last resort, may discipline forward markets.
  - Forward contracting also reduces incentive to exercise market power in spot market.
- Data on bilateral contracts would still be very useful
  - Available at exchanges.
  - Exchanges have incentive to provide a fair and unbiased platform but also do not want to deter market players from using their exchange.

Data Issues

- TSO/ISO requires all physical transaction data and so is well placed to hold a complete, centrally stored record.
  - Confidentiality issues relating to release of data.
- Access rights to data should be clearly specified.
- Data should be held for sufficient time to allow ex-post investigations
- Homogenous format for data across all of Europe would reduce cost of analysis and increase the integrity of data.
- As much data as possible should be made publicly available to facilitate third party market analysis.

Data Issues

- Regulatory authorities should receive access to data either automatically or on request without the need for legal proceedings.
- The analysis of generator behaviour and network use requires experts familiar with the particular network and generation park of the kind that TSOs are best placed to provide -> suggests the need for close cooperation between the monitoring unit and TSO.
- Market monitoring units linked to TSOs which are not independent of generation or supplier interests do not command credibility. In these cases the monitoring function will need to be located in the regulatory office (or as an independent body) and many of the potential benefits of drawing on the TSO's expertise will be lost.

Conclusions and Lessons

- Market Monitoring is an essential part of a well functioning market.
- Simple measures have drawbacks but more complex techniques require considerably more effort to construct and often use difficult to obtain data.
- Desirable to employ a range of techniques as no one technique provides definitive results.
- Presumption should be in favour of retaining data for possible new model development and analysis.
- As much data as possible should be published to allow independent analysis to refine techniques for the detection, and hence the deterrence of market power.