Benchmarking
Electricity Distribution Networks

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Overview

❖ Background to benchmarking

❖ Methods and applications

❖ Strategic behaviour

❖ Lessons

❖ Conclusions

(Incentive) Regulation - History

❖ Regulation of licensing, obligation to serve, pricing, reliability, safety, theft, etc. date back to early years of the industry (House of Commons, 1882).

❖ First (incentive) regulations - UK
  • In 1855 - Sliding scale in the Sheffield Gas Act for Sheffield Company, a town gas supplier.
  • A similar plan in 1893 for the electricity industry.

❖ Canada - In 1887 - Cost-At-Service plan for Consumers' Gas Company of Toronto.

❖ US – Sliding scale scheme in Boston Plan of 1906 for price of gas (Schmidt, 2000).

Incentive Regulation

❖ Renewed interest after liberalisation

❖ Efficiency improvement – through penalty/reward

❖ **Benchmarking** – as a tool for incentive regulation
  - Information asymmetry
  - Mimic market mechanisms / non-intervention

❖ Incentives are strong and work

❖ But, Concerns about unintended consequences, e.g.
  - Fairness
  - Investments
  - Quality of service
  - Innovation
  - Security etc.

Uses of Benchmarking

❖ **Academic research**
- We do efficiency / productivity analysis to try new techniques, investigate features of the sector, and suggest new approaches
- Regulators do benchmarking to measure an X-factor or to inform the decision process

❖ **Regulators**
- Direct input in IR benchmarking
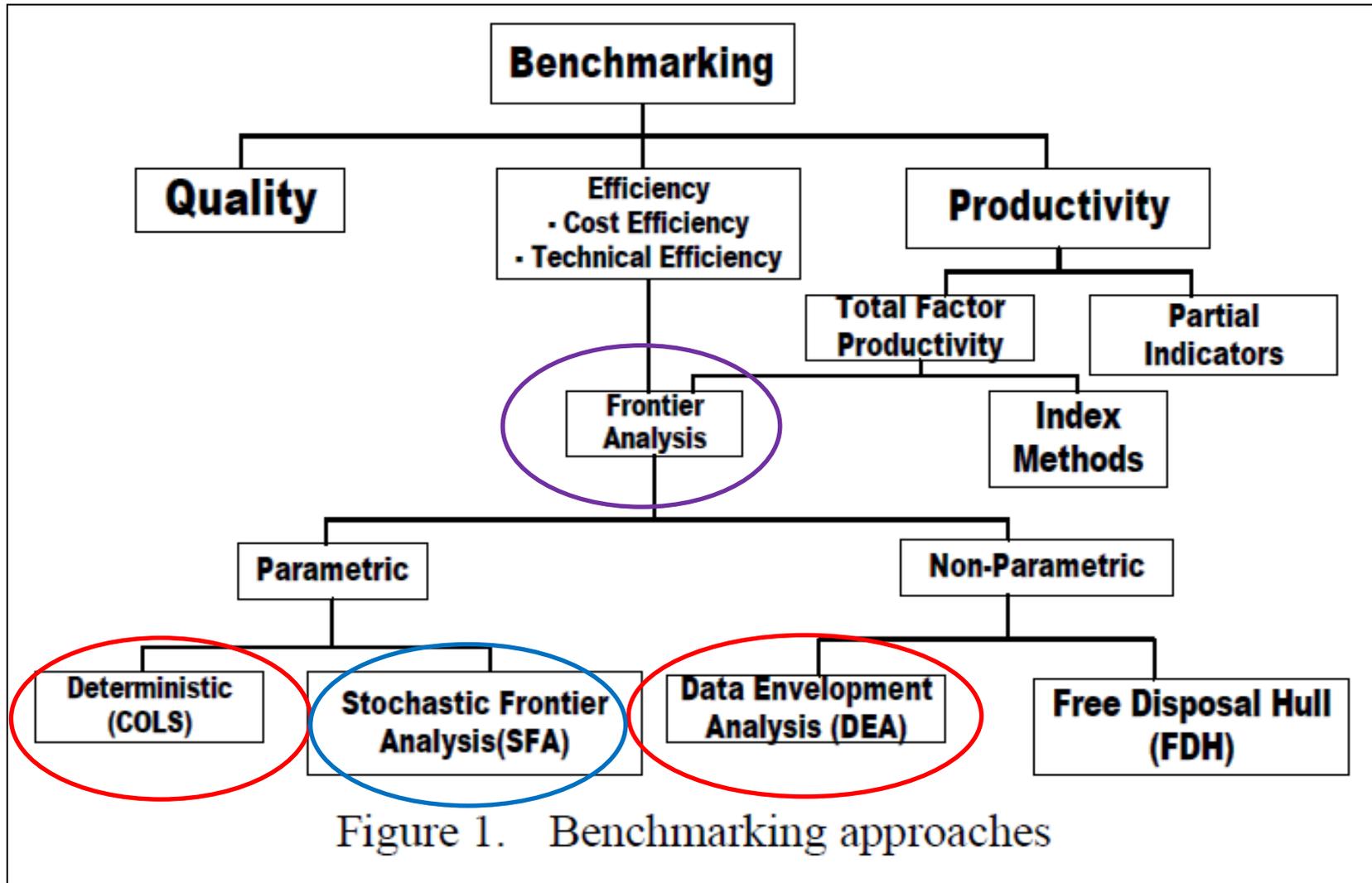- Informing incentive regulation more broadly

❖ **Self benchmarking** –
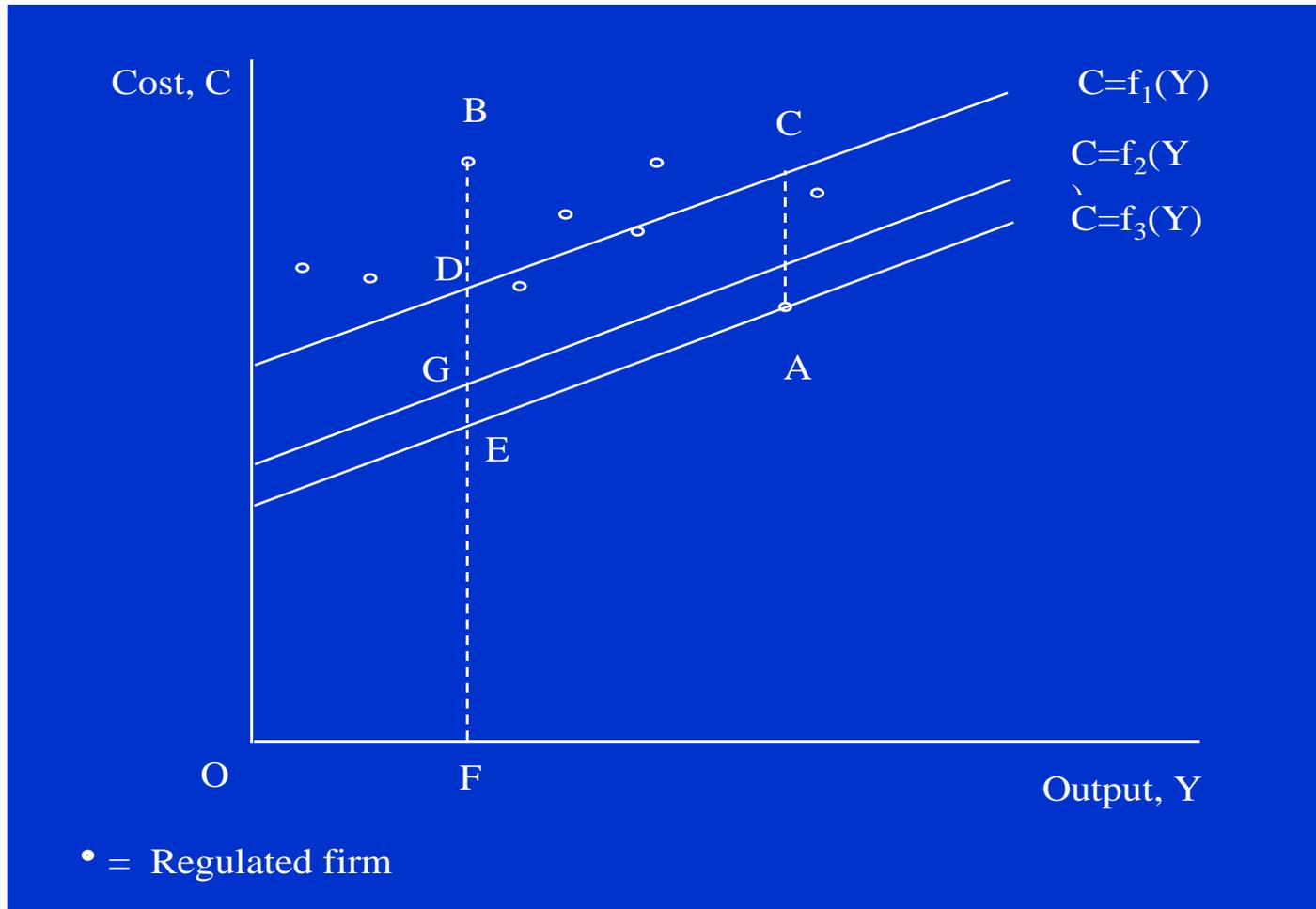- Firms benchmarking themselves

❖ **Third parties**
- To inform, and name and shame

Benchmarking Methods

Figure 1. Benchmarking approaches

Source: Khetrapal and Thakur (2014)
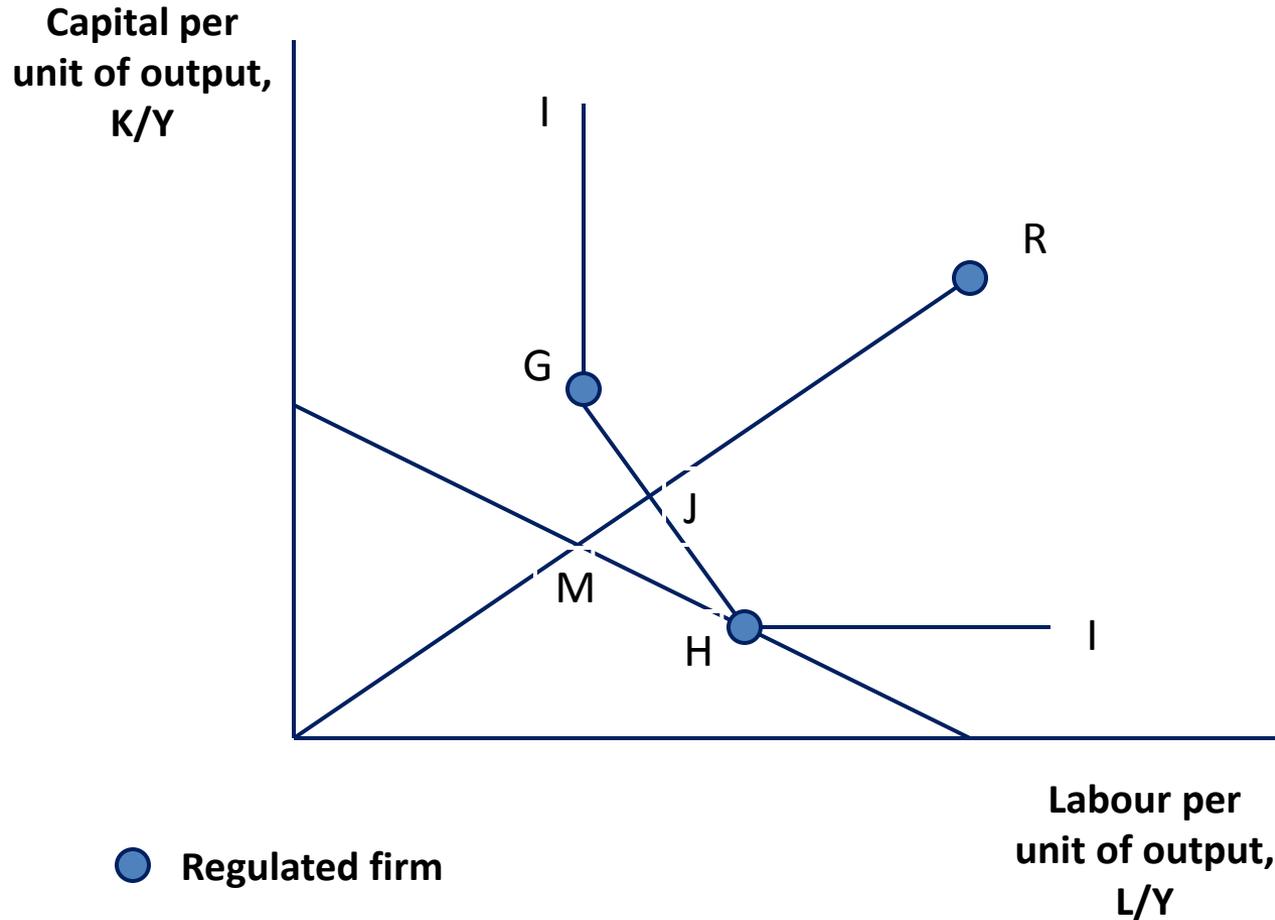
Econometric Techniques

SFA efficiency score of B, approximately = GF/BF

COLS efficiency of B = FE / FB

DEA in Practice

Firm R: Techn. eff.= OJ/OR   Alloc. eff.= OM/OJ   Tot. econ. eff.=OM/OR

Reference Model - Sweden

- Several critical parameters derived from hyperbolic tangent functions based on customer density and 5 constants to resemble empirical data.

- Paras dependent on customer density:

  (1) Lines, (2) Back-up lines, (3) Back-up transformers, (4) Cost of land for transformers, (5) Geometrical adjustment, (6) Energy losses, (7) Interruption cost, (8) Expected interruption cost.

- For each parameter at each voltage level, functions are estimated using "reference values".

$$\mathrm{ModTanh}(x) = (k_1 + k_2 * \tanh(k_3 * (x - k_4)))^{k_0}$$

–x density (meters of line/customer)
–k0, …, k4   constants
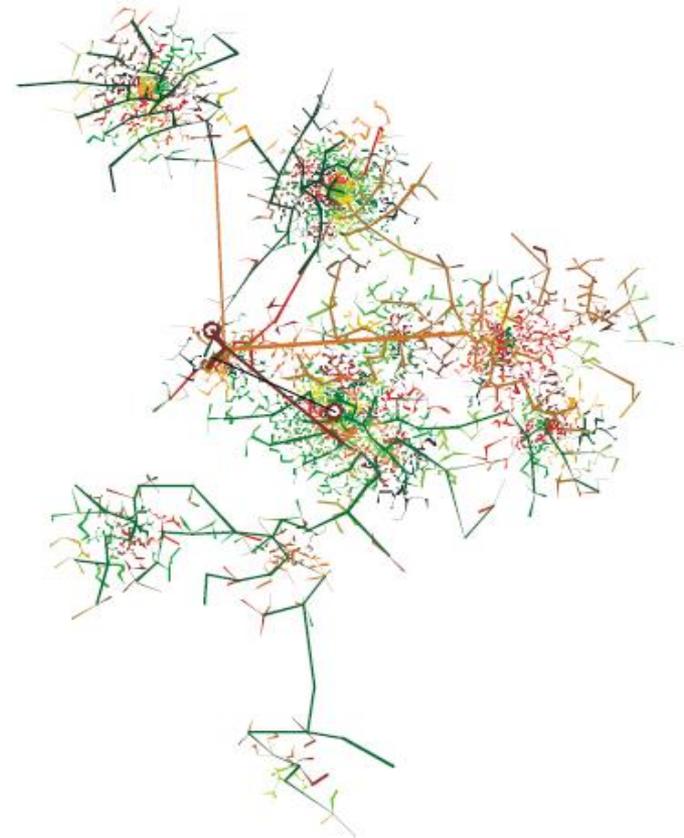
Source: Larsson (2004)

Table 1: Some European regulation regimes and cost function methodologies for electricity DSOs

Code	Country	Regulation	Benchmark
AT	Austria	Revenue cap	DEA-SFA, best-off
BE	Belgium	Revenue cap	DEA
CH	Switzerland	Cost recovery	Ad hoc
DE	Germany	Revenue cap	DEA-SFA best-off
DK	Denmark	Revenue cap	COLS-MOLS
ES	Spain	Revenue cap	Engineering
FI	Finland	Revenue cap	DEA w. SFA back-up
FR	France	Cost recovery	Ad hoc
GB	Great Britain	Revenue cap	COLS and Ad hoc
GR	Greece	Cost recovery	Ad hoc
HU	Hungary	Price cap	Ad hoc
IRL	Ireland	Price cap	Ad hoc
NL	Netherlands	Yardstick comp	DEA-OLS-MOLS
NO	Norway	Yardstick comp	DEA
SE	Sverige	Revenue cap	Engineering and DEA

Source: Benchmarking and regulation, Per J. Agrella, Peter Bogetoftb,
Preprint submitted to DEA Journal November 14, 2012

Evolution of Regulation & Benchmarking

Source: Viljainen (2005)
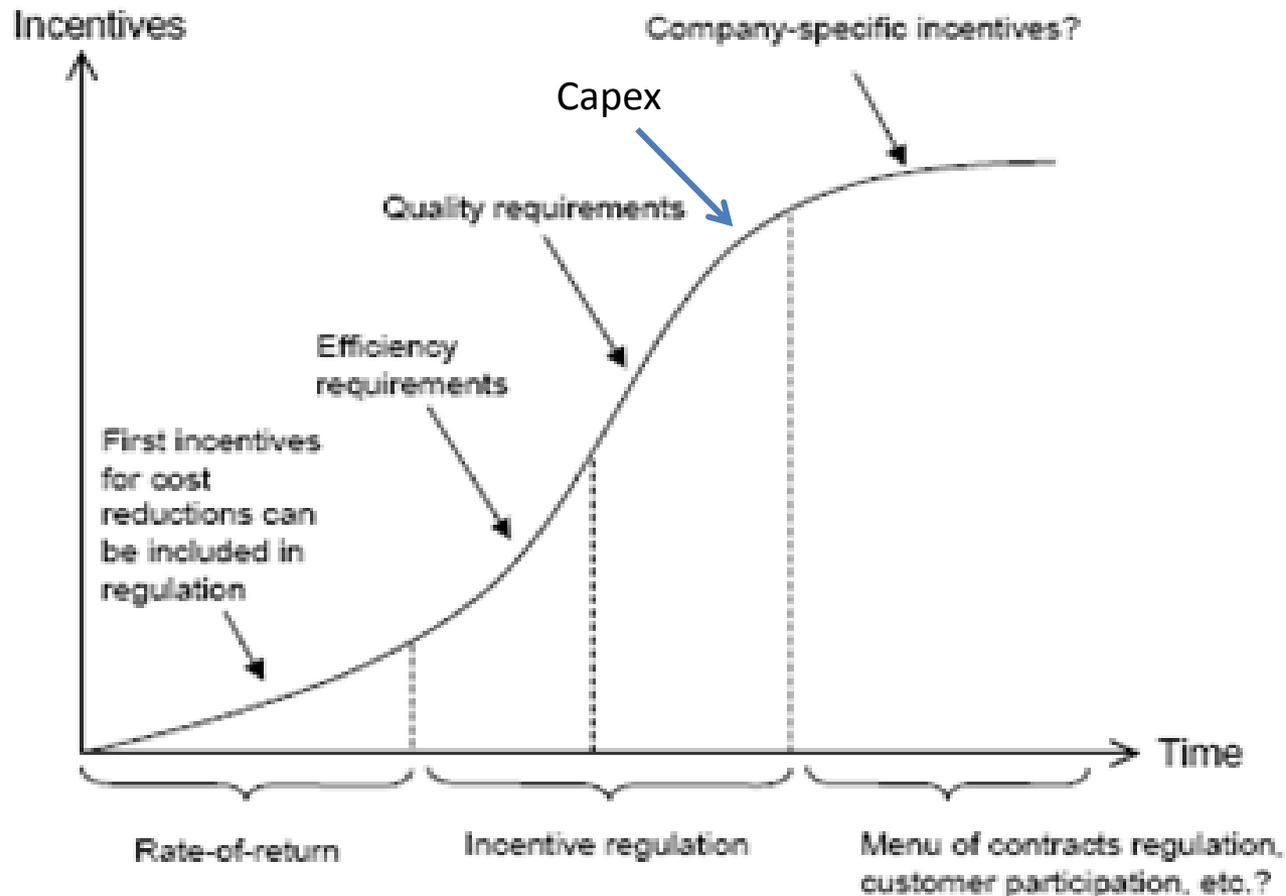
BM Example – Norway 1

Input	Output

❖ **Totex**
 	
   o O&M
 	
   o CENS - Cost of energy not supplied
 	
   o Interest on capital
 	
   o Depreciation
 	
   o Cost of network energy los
	❖ No. of customers
	❖ Leisure homes
	❖ Energy delivered
	
	❖ HV lines
	❖ Network stations
	
	❖ Forest
	❖ Snow
	❖ Wind / coast

BM Example – Norway 2

Second Stage

Efficiency scores =

b1*Island connections
b2*Transmission interfaces
b3*Distributed generation

Incentive Power

Revenue cap =

Cost Norm*p + Cost Base*(1-p)

Regulator's Background and BM Approach

❖ IR/BM as an "economic" programme, not a financial or engineering exercise

❖ But, the regulator's institutional background matters

- LAC and Sweden: Engineering ➜ norm/reference models

- UK: Financial, accounting, auditing ➜ BM as support

- Norway: Economics ➜ "Sotex" benchmarking

❖ Example - Norm model vs. DEA in Chile

Strategic Behaviour in Benchmarking

❖ **Method -** e.g. parametric vs. non-parametric
❖ **Model -** specification

❖ **Inputs -** which
❖ **Outputs -** which
❖ **Variables –** definitions, e.g. Opex

❖ **Accounting rules -** e.g. asset depreciation period

❖ **Contextual variables -** e.g. geography, weather, density, features of service area

Survey: What Did Regulators Say?
Jamasb, Nilesen, Pollitt (2003)

Costs
- ❖ Shifting assets/costs between gas and power (Netherl.)
- ❖ Including customer contributions in RAB (Netherl., Ireland)
- ❖ Shifting assets/costs from S to D (Netherlands, UK)
- ❖ Shifting assets/costs from G to D (Norway)
- ❖ Definition of OPEX and accounting rules - e.g. depr. (UK)

Outputs
- ❖ Circuit vs. route network length (Netherlands)
- ❖ No. of customers vs. no. of meters (Denmark)
- ❖ Uniqueness "comparators are inherently different" (Ireland)
- ❖ Relative weights of output variables (UK)

Mergers
- ❖ Split into several firms and then back (Netherlands)

Other Strategic Behaviour

❖ Mergers

❖ R&D cutbacks to improve short term performance

❖ Court cases and appeals

❖ Information overload

"Every four years, you feel you are going to war."
Alejandro Jadresic, former Minister of Energy of Chile

Strategic Behaviour – Information Overload

The CEO of a distribution utility:

"In the technical studies, both sides cheat - everyone does this. If you didn't cheat then you would be stuck with the superintendent's numbers which aren't fair. ... But the superintendence has poor people who don't like to do much work, so it works out. When Chilectra delivers information they use a freight truck. The guys in the regulator's office get depressed when it comes."

Di Tella and Dyck (2001)

Strategic Behaviour

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Benchmarking – Evaluation Criteria

- ❖ Model variables
- ❖ Efficient comparators
- ❖ Consistency of results
- ❖ Quality of service

- ❖ Sufficient investments
- ❖ Long-term innovation
- ❖ Uncertainty
- ❖ Transparency

Lessons for Regulators

❖ Determination of costs at unbundling is crucial (audits, technical studies, adjustments)

❖ Compare cost patterns in review vs. non-review periods

❖ Conduct sensitivity analysis of benchmarking models

❖ But, can motivate desirable behaviour (e.g. mergers)

❖ *Transparency – Cheap and helpful!*

Proof of effective benchmarking is in the outcome

Lessons for Utilities

❖ Examine the effect of regulator's choice of method, variables, X-factors for your firm.

❖ Determine effect of possible gaming by other firms on your revenues.

❖ Evaluate benefits and losses of M&A strategies of own and competitors.

❖ Do your own benchmarking!

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Thank you!