Institute for Transport Studies
FACULTY OF ENVIRONMENT

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Lessons from empirical studies on incentive regulation

Second economic conference of the French railway regulatory body

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Agenda

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- Top-down international benchmarking using econometric methods:
  - National data (UIC LICB data)
  - Regional international data (collected by / through ORR)
- Lessons / issues / future challenges
- Conclusions

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Efficiency assessment

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- You don’t know efficient level of costs
- How can you find out?

➢ Trends in economy-wide productivity

➢ Historic trends within the company

➢ Other utilities (unit cost trends)

Trend based comparisons

➢ Other regulated firms in the same industry

➢ **International benchmarking**

➢ Internal benchmarks within the company

➢ Bottom-up reviews (consultant; company)

Absolute efficiency comparisons

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The background

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- Re-wind to 2005 – what was the situation facing ORR?

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Rail infrastructure costs in Britain

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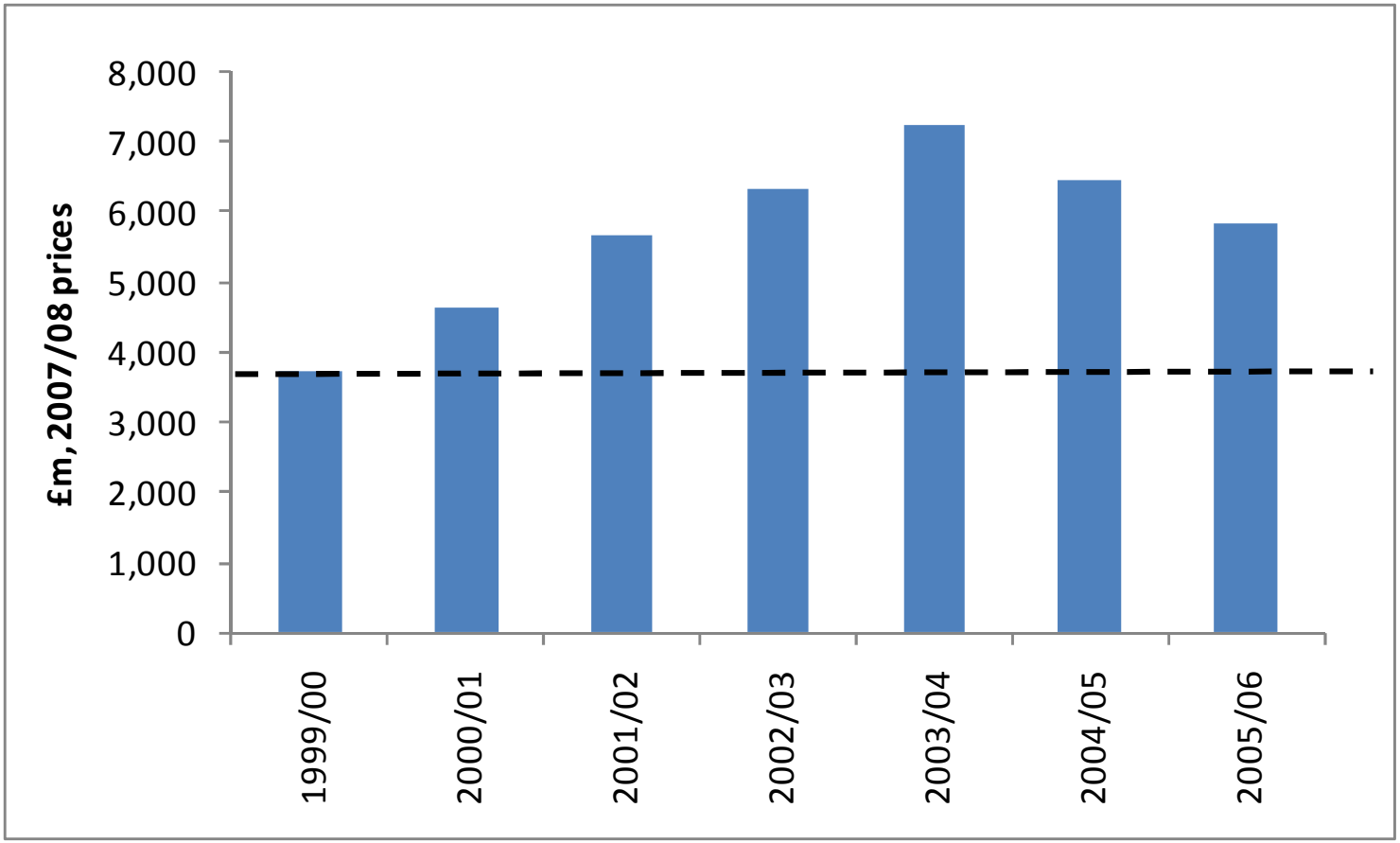

- Cost per train-km increase of 87% by the peak in 2003/04
- Costs still projected to be high at end of regulatory control period

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The background

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- Re-wind to 2005 – what was the situation facing ORR?
- Benchmarking done – bottom-up studies; internal benchmarking
- No top-down benchmarking based on external data
- Of course, lack of external domestic comparators
- International benchmarking became top of the agenda

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Two suggested approaches

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International Benchmarking: UIC National Level Data

- Ready-to-go dataset
- 13 countries, 11 years
- Maintenance and renewal costs

“Sub-company” International Benchmarking

- New data collection by ITS/ORR
- Smaller number of countries and panel length
- Sample size expanded by utilising sub-company data within each country
- Maintenance and renewal costs

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Why a statistical / econometric model?

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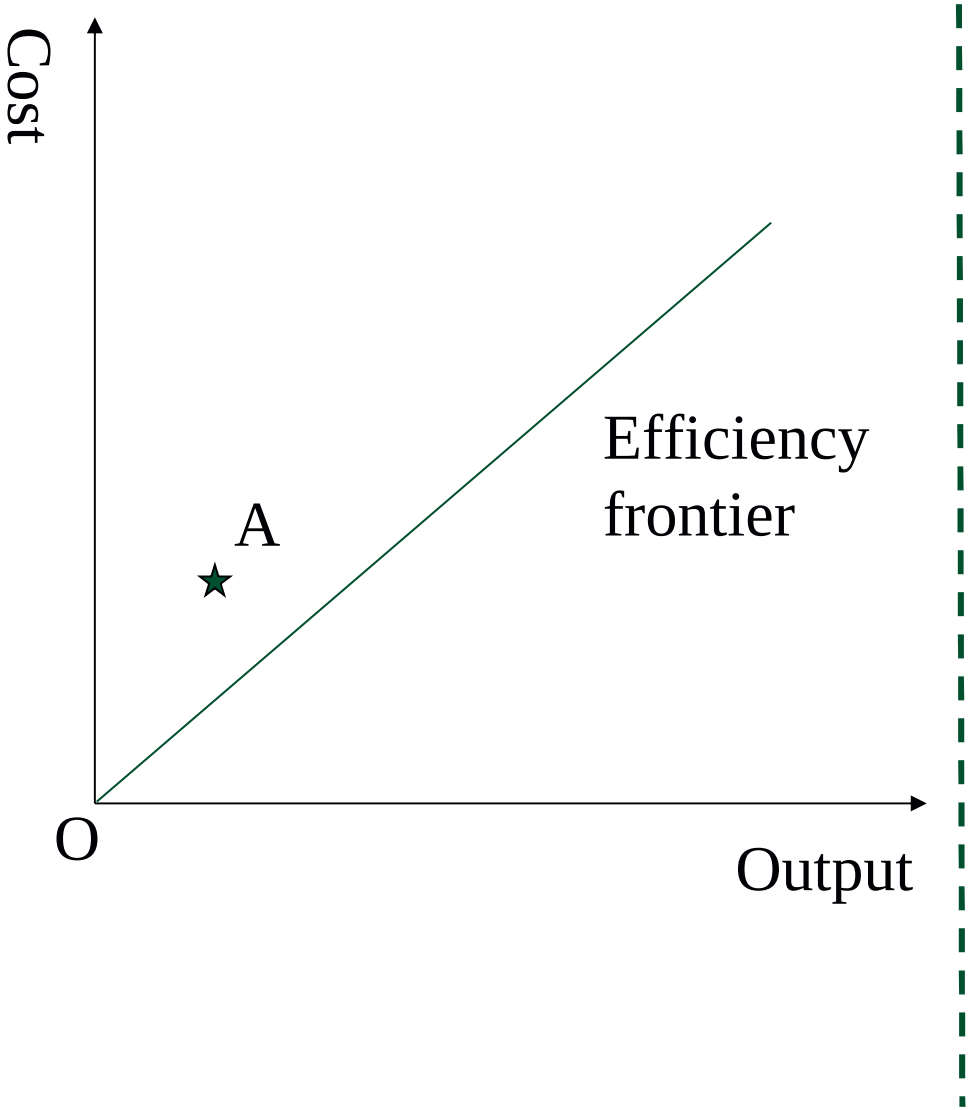

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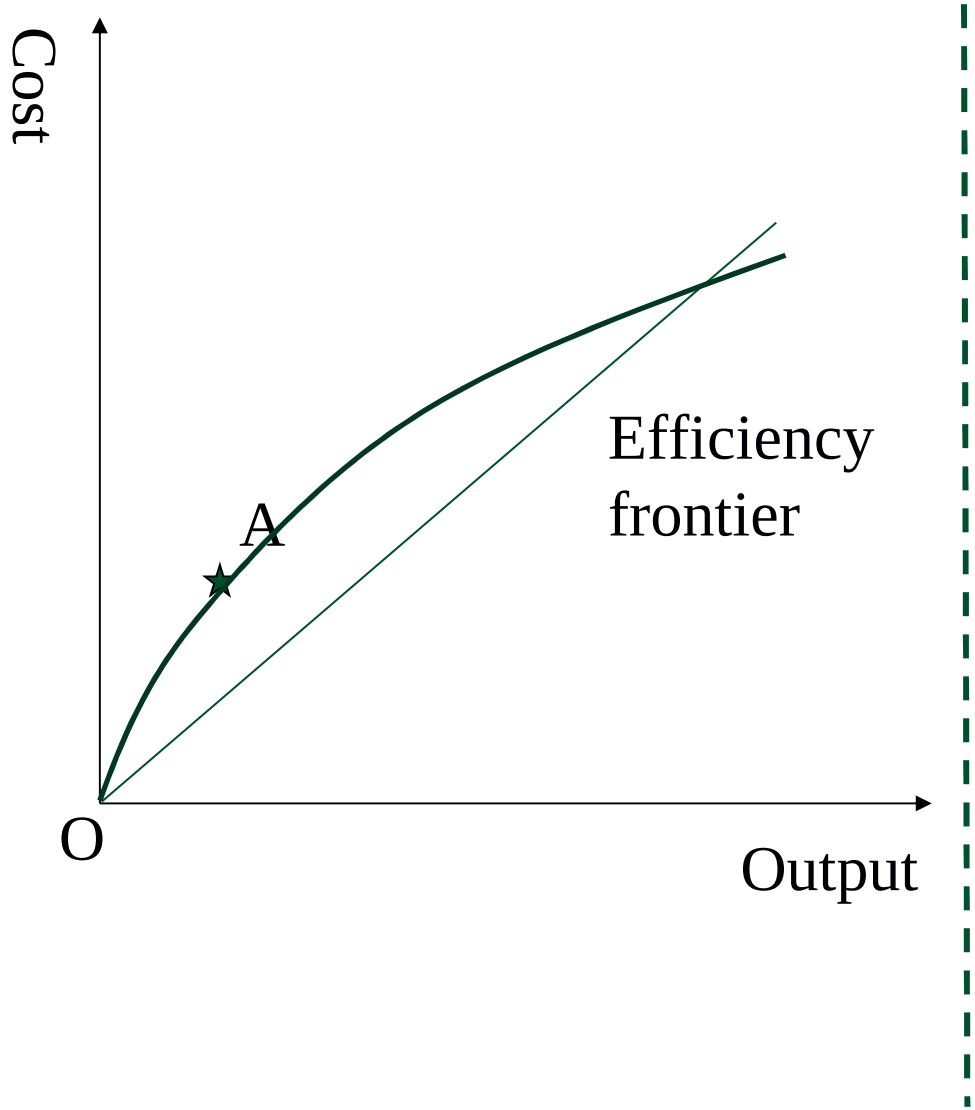

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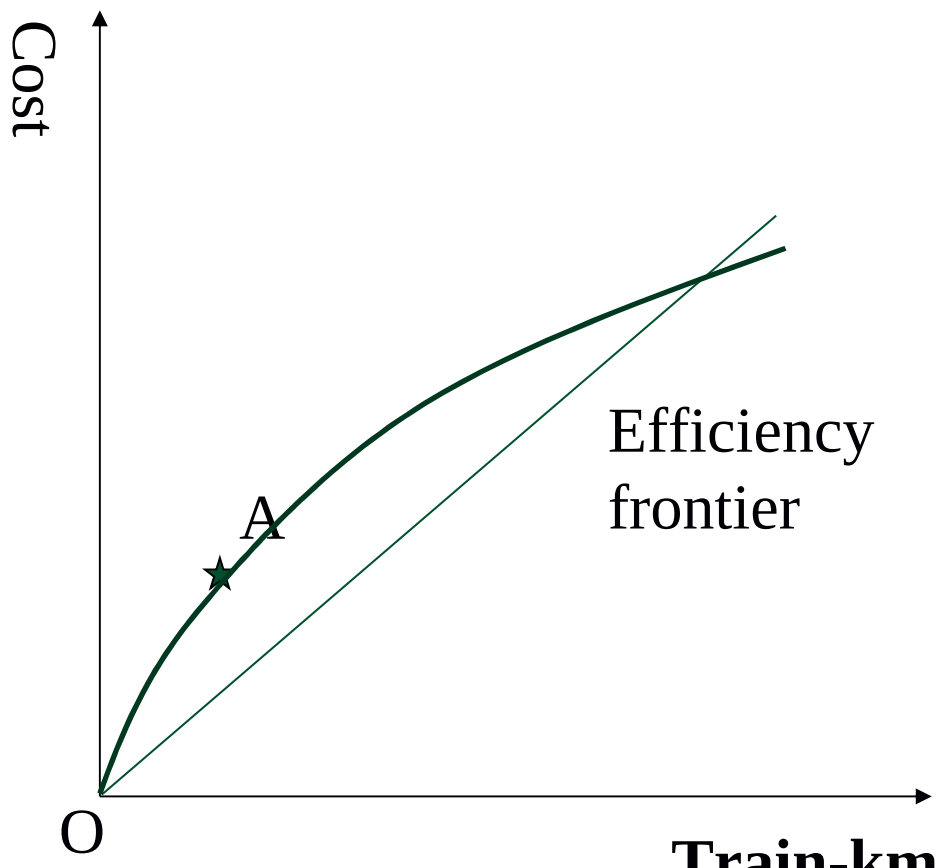

- Allow flexibility on the shape of the cost-output relationship (e.g. allow economies of scale)
- Allow multiple outputs / other cost drivers (e.g. train and track-km)

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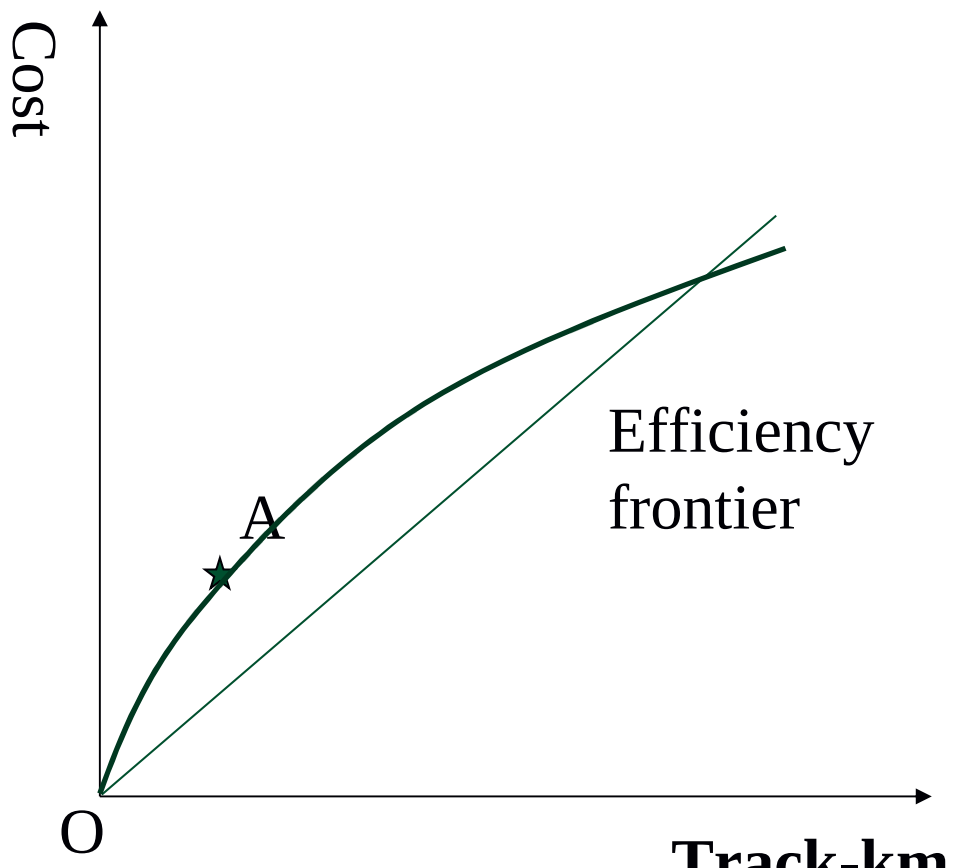

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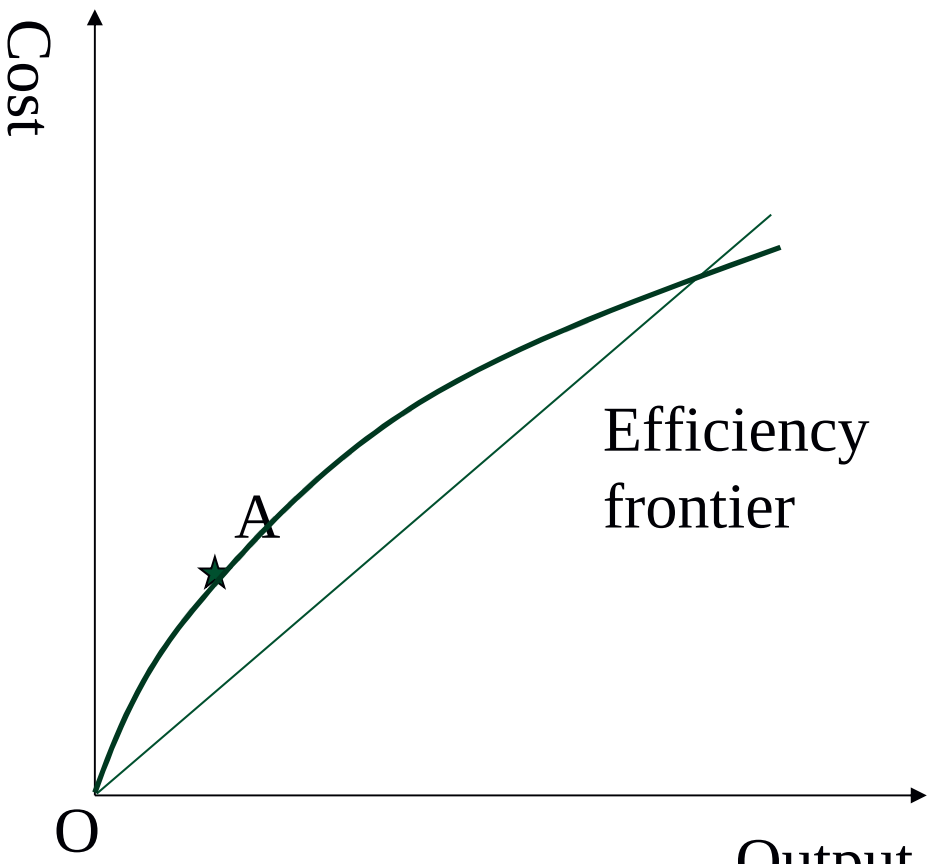

- Allow flexibility on the shape of the cost-output relationship (e.g. allow economies of scale)
- Allow multiple outputs / other cost drivers (e.g. train and track-km)
- So we can explain costs in terms of a set of explanatory factors, e.g.
  - Network size; traffic density and type; other (e.g. electrification; multiple track); potentially, others…
- Having accounted for these factors, and random noise, produce an **overall measure of efficiency**

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International benchmarking study: national data – frontier parameters

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Preferred model Dependent variable: Total costs (steady-state adjusted)	Coeff.		**Comparator model** Dependent variable: Total costs (unadjusted)	Coeff.		**Comparator model** Dependent variable: Maintenance costs	Coeff.	
Frontier parameters								
CONSTANT	6.2453	***	CONSTANT	6.2382	***	CONSTANT	5.4770	***
ROUTE	1.0743	***	ROUTE	1.0913	***	ROUTE	0.8430	***
PASSDR	0.3345	***	PASSDR	0.3115	***	PASSDR	0.1362	**
FRDR	0.1792	***	FRDR	0.1472	***	FRDR	0.1567	***
SING	-0.9181	***	SING	-0.9681	***	SING	-0.7146	***
ELEC	-0.0370		ELEC	-0.0690		ELEC	0.0733	
TIME	0.0556	***	TIME	0.0561	***	TIME	0.0469	***
TIME2	-0.0048	***	TIME2	-0.0048	***	TIME2	-0.0027	**
Efficiency parameters[1]								
λ	4.0541	***	λ	4.1810	***	λ	3.6678	***
σ_u	0.4560	***	σ_u	0.4694	***	σ_u	0.3374	***
η_{R1}	0.0585		η_{R1}	-4.5467		η_{R1}	0.1634	**
η_{N1}	0.2252		η_{N1}	0.2031	**	η_{N1}	0.2689	**
η_{N2}	-0.0570	**	η_{N2}	-0.0513	**	η_{N2}	-0.0520	***

*** (**, *) indicates parameter significance at the 1% (5%, 10%) level

[1] Other firm specific η parameters are included in the model but not shown for confidentiality reasons. $\lambda = \sigma_u/\sigma_v$

- Source: Smith (2012)

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Efficiency estimates for Network Rail (PR08)

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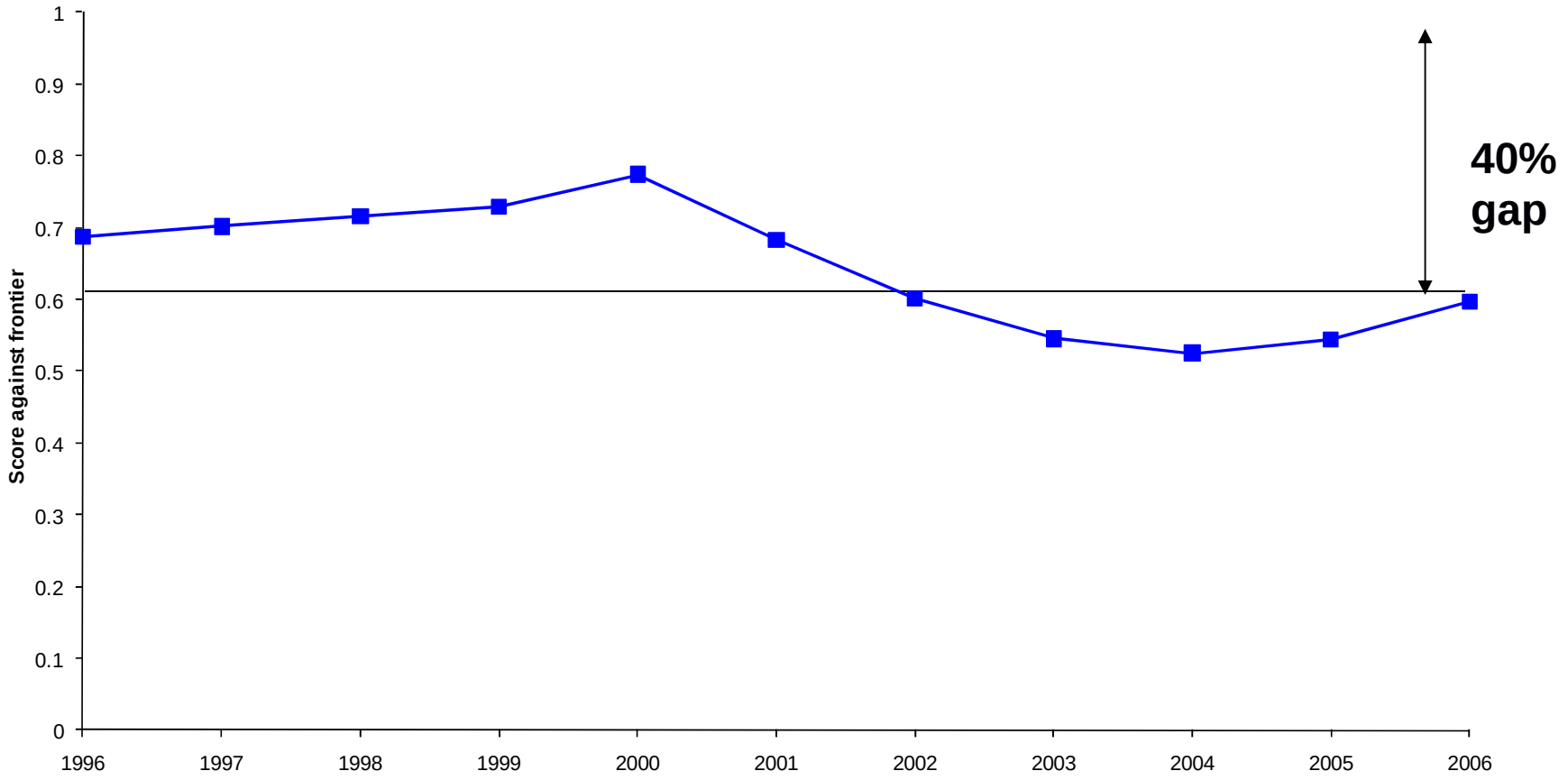
Profile of Network Rail Efficiency Scores: Flexible Cuesta00 Model



Implies a gap against the frontier of 40% in 2006

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Dual Level Inefficiency Model

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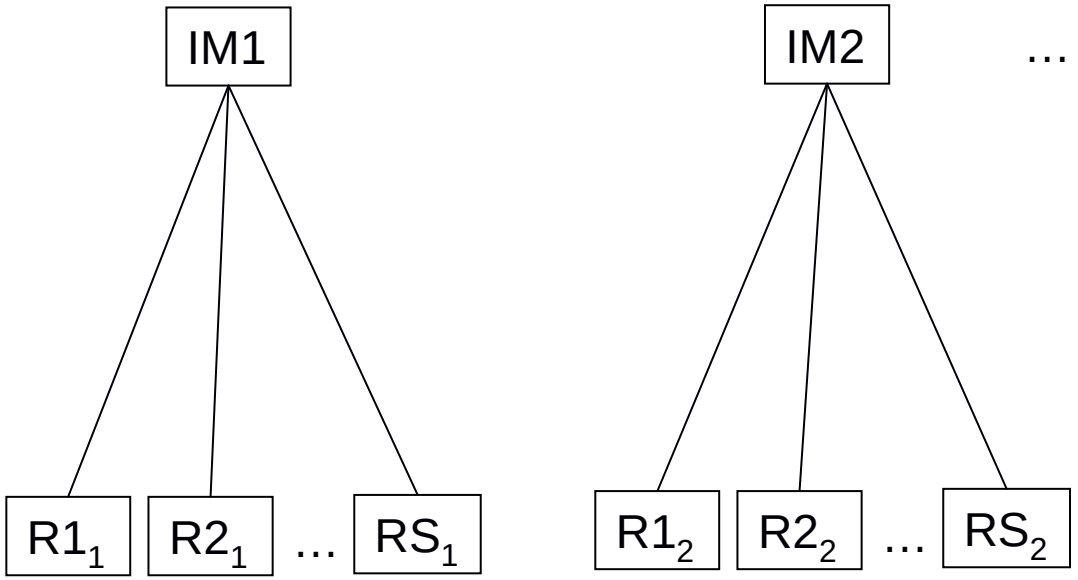
Infrastructure Manger

Region (sub-company)



Inefficiency due to systematic differences between firms – external inefficiency

Inefficiency due variation in performance at regional level – internal inefficiency

- Source: Smith and Wheat (2012)

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International regional benchmarking study: illustrative outputs

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Dataset of infrastructure managers, supplemented by regional / business unit data for each IM

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Dataset of infrastructure managers, supplemented by regional / business unit data for each IM

Investigate efficiency differences between countries as well as within countries in the same model

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Investigate efficiency differences between countries as well as within countries in the same model

Company	Internal Efficiency Score	External Efficiency Score
Company 1	0.88	0.92

Illustrative outputs only here

Could reduce costs by 12% if replicated its own best practice consistently across the network

Could reduce costs by another 8% if the company matched international best practice

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Challenges

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- Data quality / number of data points?
- How to deal with lumpy / cyclical capital costs?
- Modelling fundamental differences in characteristics and quality of railways
- Understanding uncertainty in efficiency modelling?

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Data issues

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- Regulators face small number of firms (N) usually
- Can be expanded by having several years (T): N*T data points
- Or if have regional data as well: N*T*S
- Quality and consistency of data is key (over time; between firms) – some issues found with LICB data though still used by ORR
- Time consuming to collect your own data set – requires commitment over many years from the industry

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Modelling capital costs

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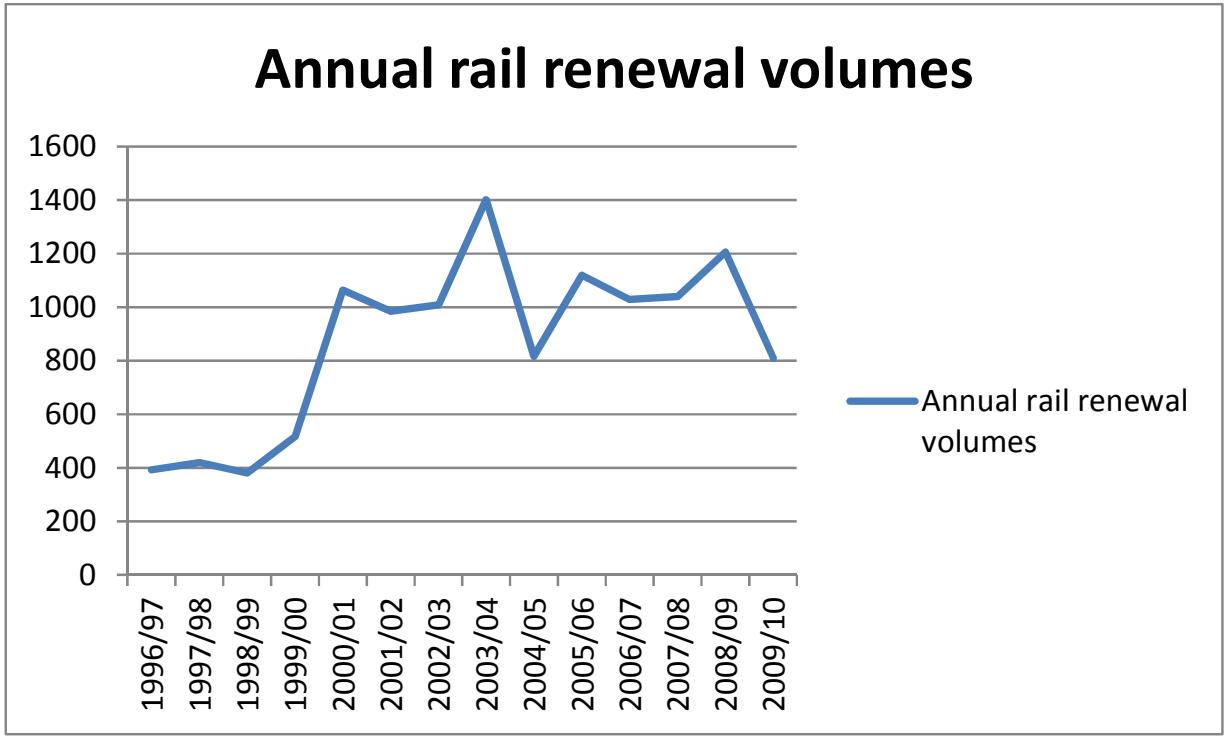

- Intermediate versus final outputs?

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Modelling capital costs

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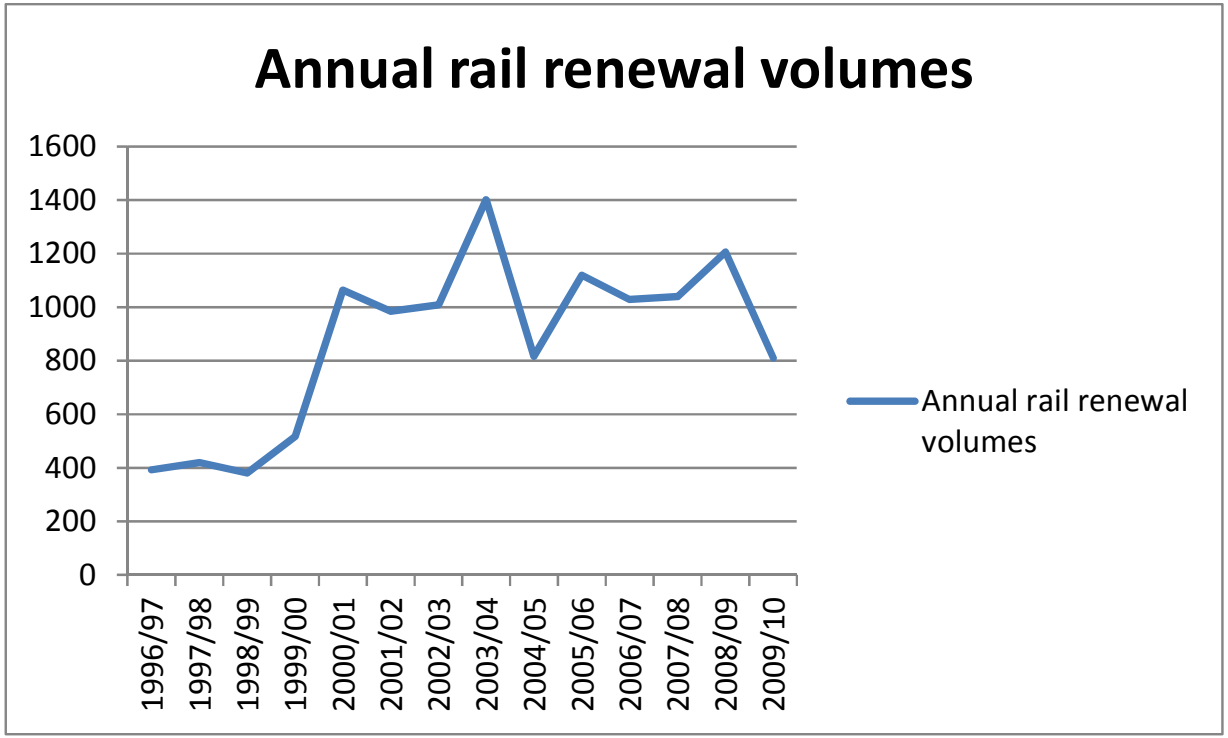

- Intermediate versus final outputs?

Options for regulators?

- Steady-state adjustments
- Averaging over time
- Depreciation measures
- Use of quality measures in cost function

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Modelling differences in characteristics and quality

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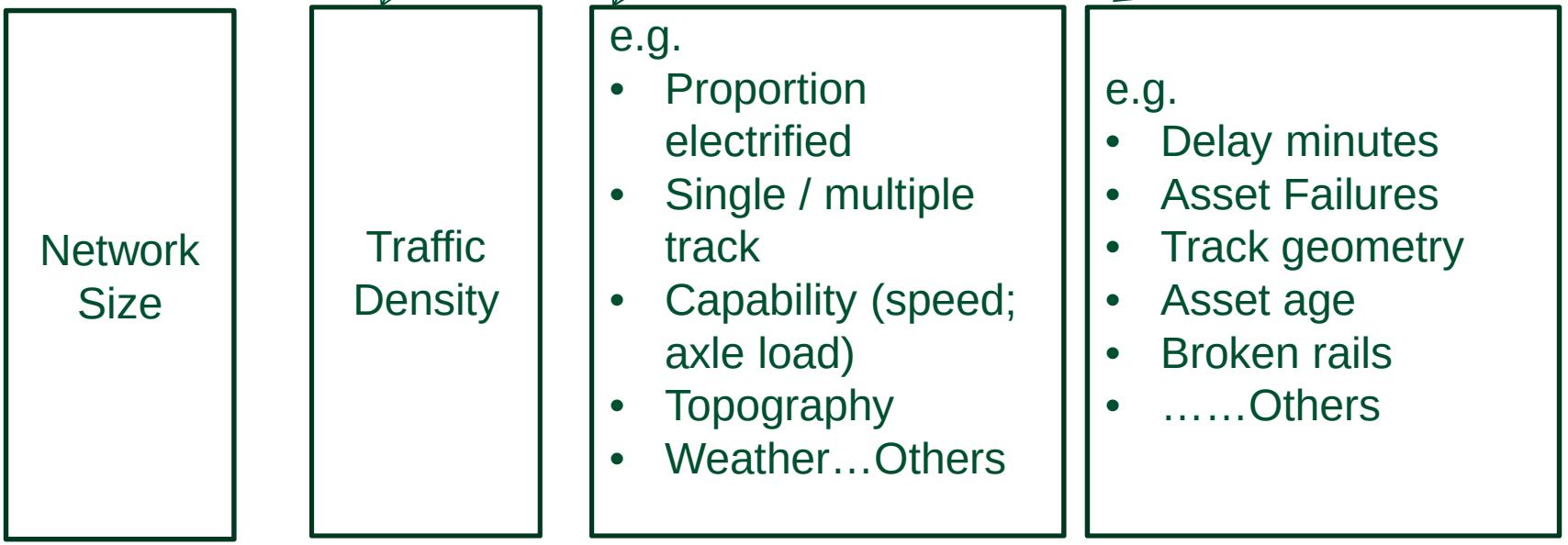
- Simplified representation:

$$C = f(N + Y/N + D + Q)$$



Can be modelled: ideally with data but for some aspects **even without!** Some challenges though…

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Understanding uncertainty

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- Sources of uncertainty in efficiency models?
- Point estimates of inefficiency are used – intervals rarely computed (this is true of the academic literature as well)
- Two sources of uncertainty in stochastic frontier models:
  - Splitting the residual into random noise and inefficiency
  - Uncertainty about the parameters estimated (e.g. the coefficient on track-km)
- Wheat, Greene and Smith (2013):
  - Developed method to capture both aspects
  - Intervals wider when take account of parameter uncertainty

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Regulatory approaches to uncertainty

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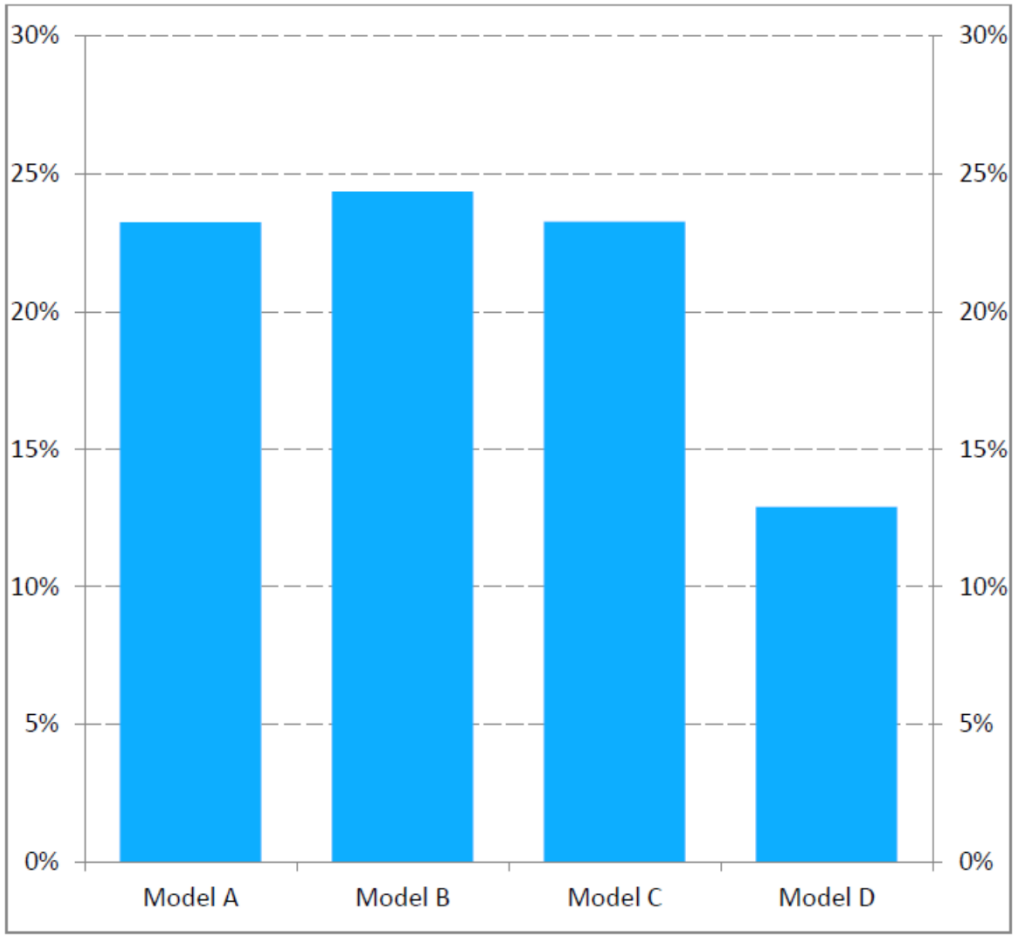
Figure 8.17: Estimates of Network Rail's efficiency gap with preferred models



- Range 13-24%
- Ignoring the extremes would suggest a gap of 23% (ORR)
- As an aside: overall assessment based mainly on bottom up studies:
  - 16% for maintenance
  - 20% for renewals

- Source: Office of Rail Regulation (2013)

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Concluding remarks

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- International benchmarking is key for rail infrastructure
- Main challenge for top-down benchmarking is data:
  - Number of data points (companies; time; regions)
  - Comparability of data over time and between countries
  - Needs to incorporate quality and other factors in the model
- Collecting good quality data takes time and commitment – ideally economic regulators / Ministries need to co-ordinate
- Other wider challenges:
  - Dealing with capital and uncertainty in analyses
  - Value and cost of resilience (e.g. to climate change)

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Concluding remarks

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- Perhaps the main challenge for economic regulation of infrastructure is changing?
  - Value and cost of resilience (e.g. to climate change)

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Thank you for your attention

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