SUMICSID

ECOM+2
– Upcoming model developments

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Outline

Basic measures
- Official and unofficial ECOM+ scores

Comparability
- Economies of scale and scope
- Currency and inflation adjustments

Decomposition
- Cost, OpEx and CapEx efficiency
- Fox Paradox
- Directional efficiency

Dynamics
- Malmquist efficiencies
- Linkage problem and fixed base Malmquist
- Foregiveness factor

Conclusions

Basic measures

ECOM+ Structure

Benchmarked OPEX | Normalized CAPEX

UnitCost

$$UC_{ft}(w,v) = \frac{C_{ft} + \sum_{s=t_0}^{t} \varphi_s \underline{I}_{fs} \alpha(r, \underline{T}_f)}{\sum_a N_{fa} w_{fa} + \sum_{s=t_0}^{t} \sum_a \varphi_s n_{fas} v_{fa} \ \alpha(r, T_g)}$$

Standard OPEX | Standard CAPEX

ECOM+ Measures

Unit costs is cost per grid unit

$$UC = cost / grid\ size$$

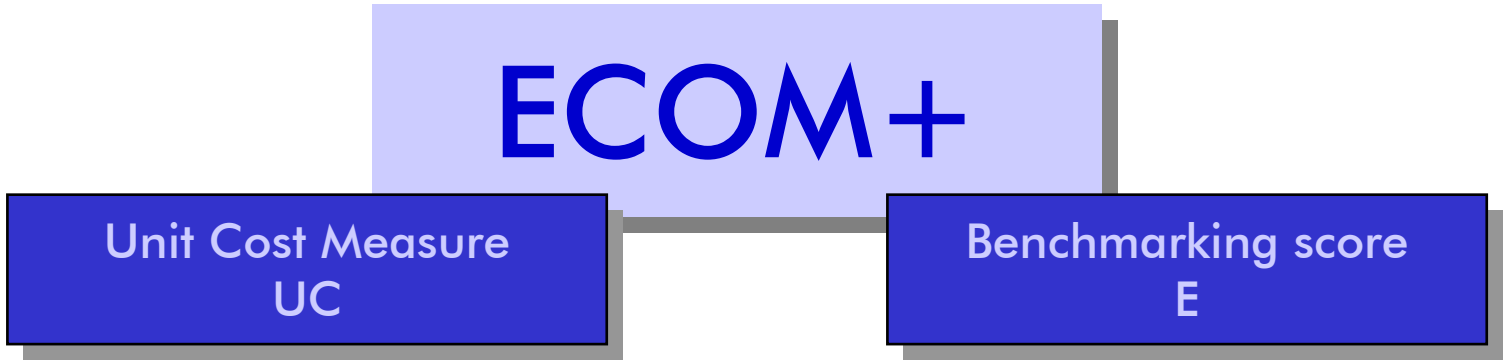
Benchmark is company with lowest unit costs

$$Benchmark = min\ \{unit\ costs\}$$

Efficiency is

$$E = benchmark / unit\ cost$$

ECOM+ is a dual method



How well are we
doing in compared to a norm?

How well are we
doing relative to the others?

Unofficial ECOM+ measures

Background

- The ECOM+ reported additional information
- TSOs and regulators studied and used
  - OpEx efficiency
  - CapEx efficiency

Motivations

- Controllability
- Regulation
- Learning
- Comparability
- .....

Partial OpEx and CapEx scores

UnitCost

$$UC_{ft}(w,v) = \frac{C_{ft} + \sum_{s=t_0}^{t} \varphi_s \underline{I}_{fs} \alpha(r, \underline{T}_f)}{\sum_a N_{fa} w_{fa} + \sum_{s=t_0}^{t} \sum_a \varphi_s n_{fas} v_{fa} \alpha(r, T_g)}$$

OPEX

CAPEX

OPEX Grid Size

CAPEX Grid Size

OpEx UnitCost

CapEx UnitCost

Comparability

Economies of scale

ECOM+ evaluates and compares

- UnitCosts = Costs/GridSize

Implicit assumption is

- CRS = constant return to scale

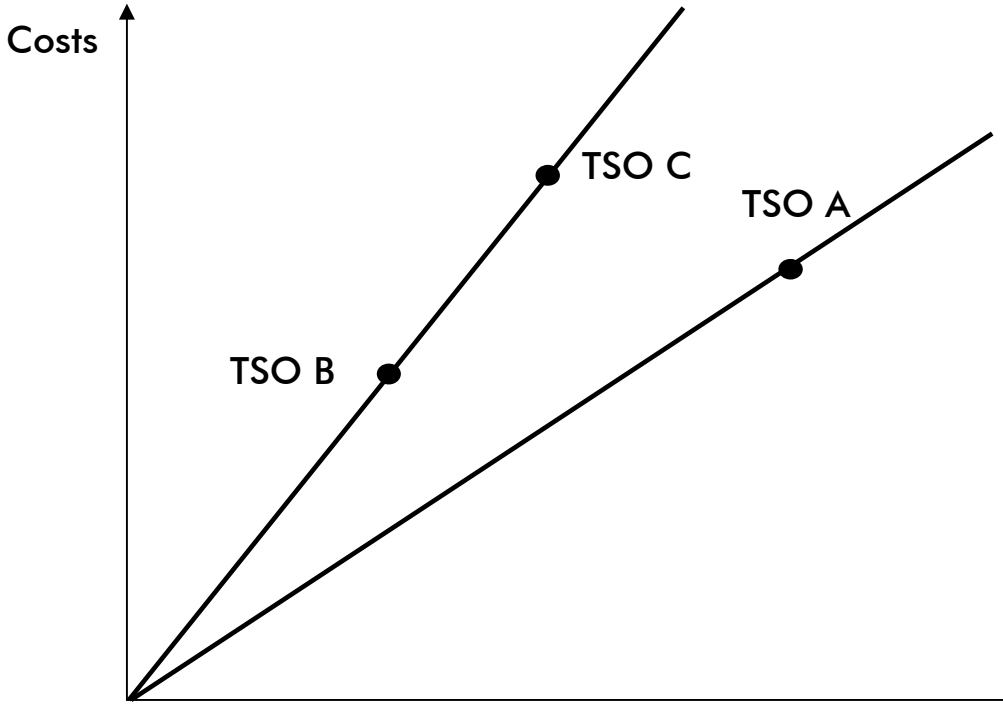
Could be relaxed

- VRS, NDRS, RCRS, FDH,.. ...

Not main priority

- ECOM+ results did not contradict crs: both small and large TSO were efficient
- Too few data points to make a full test
- Appropriate size measure could depend on asset distribution: small TSO wih few assets types could have same economies of scale as large TSO with numerous asset types.

Constant return to scale

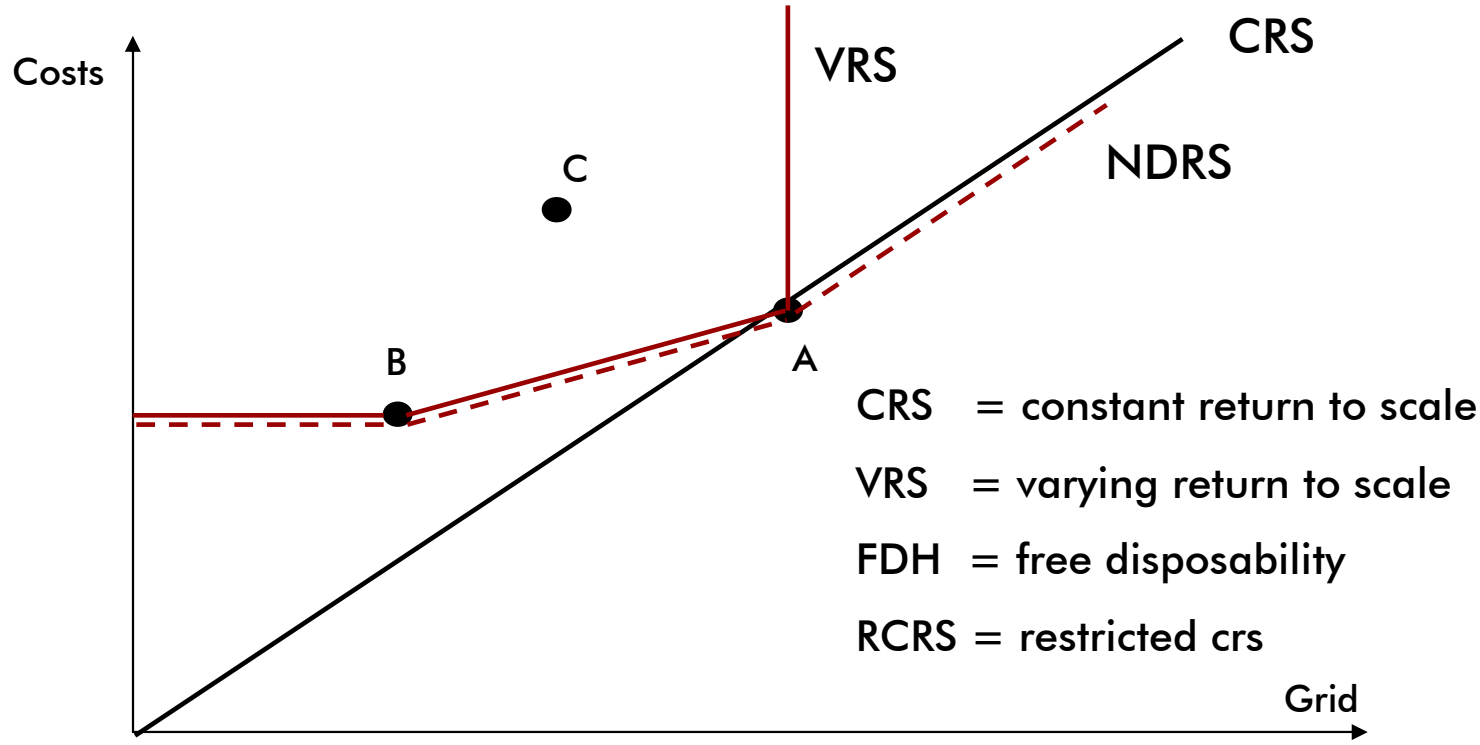


Unit Cost = Slope of line

TSO B and C same UnitCosts.

TSO A lower Unit Costs

Alternative scale models



Economies of scope

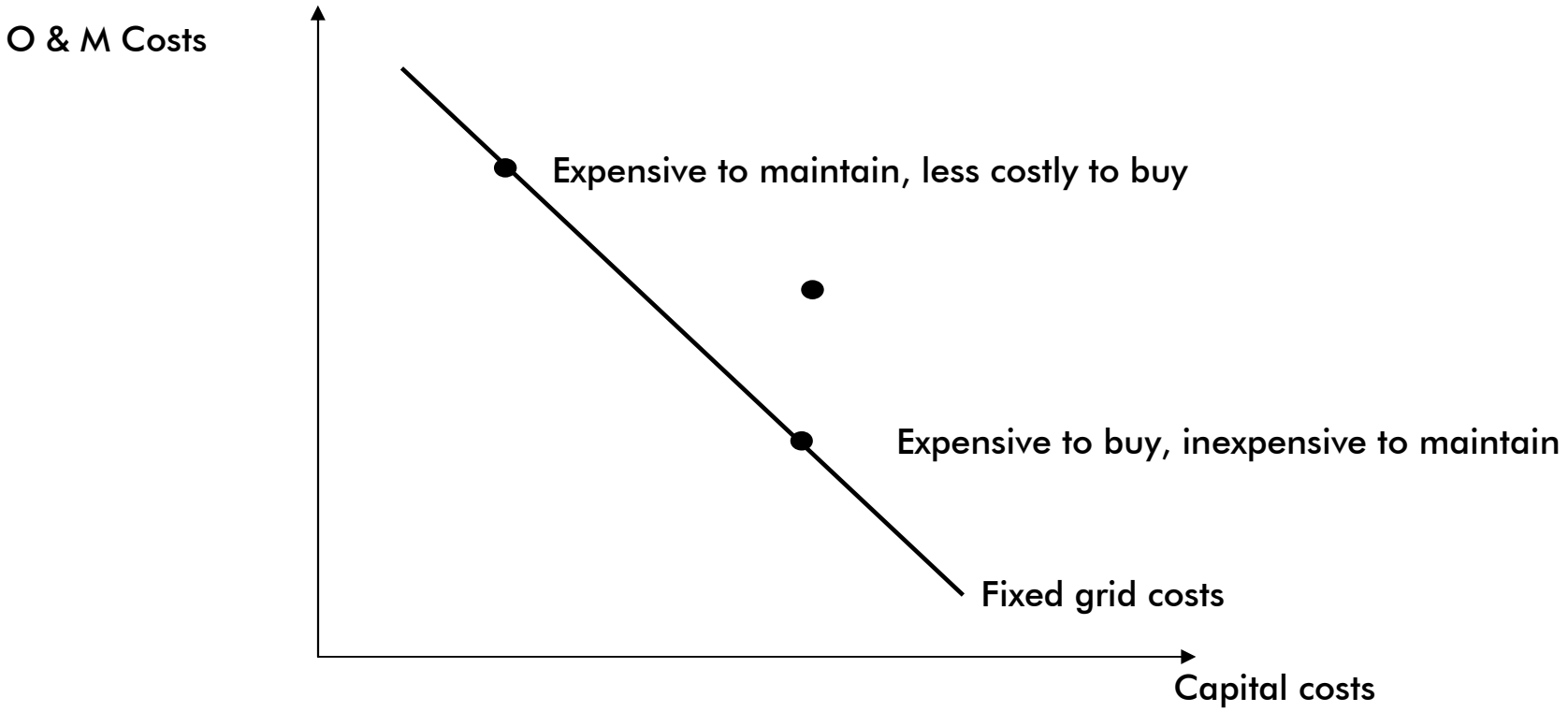
ECOM+ evaluates and compares
- OpEx+CapEx

Implicit assumption is
- Perfect cost substitution OR
- Allocative efficiency

Could be relaxed
- Limited OpEx and CapEx substitution
- FDH, Convexity, Linearity

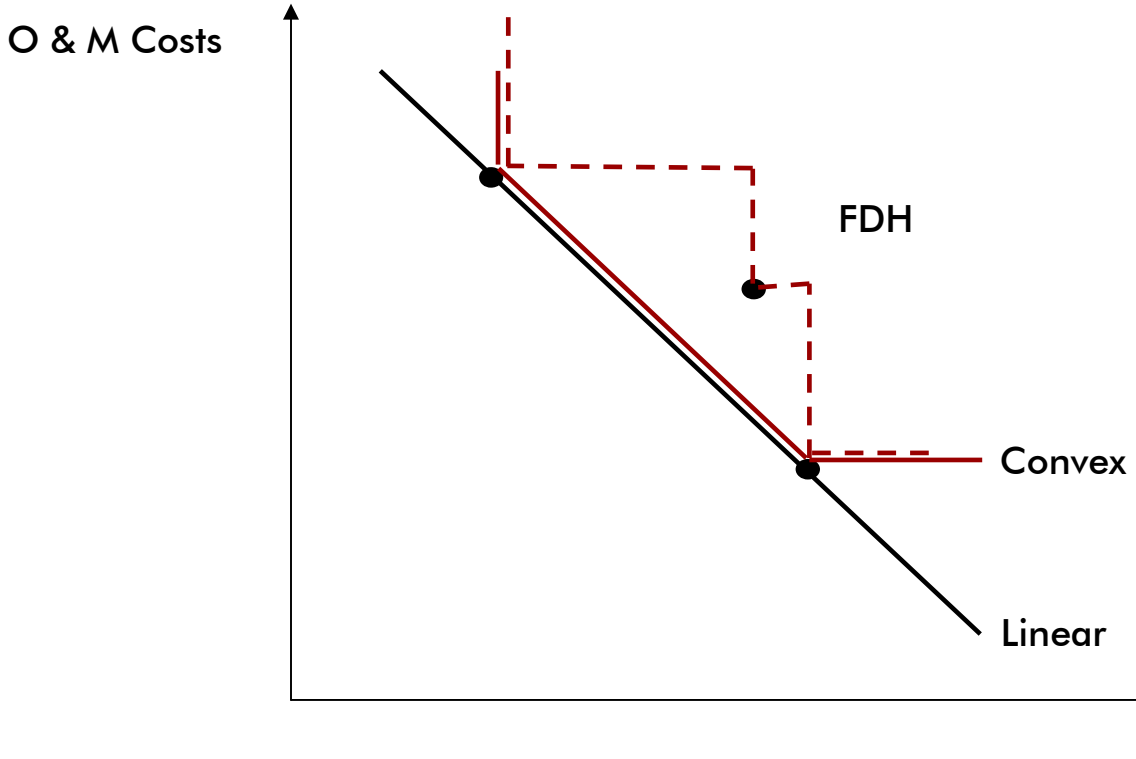
Important ?
- NO
  - If TSO is responsible for allocative decisions
- YES
  - Controllability
  - Regulatory uses
  - Present or past merits

Perfect cost substitution



O & M and capital costs added to capture substitution

Alternative scope models



	Intra	Extra
FDH	No	No
Convex	Yes	Yes
Linear	Yes	Yes

Intution

Decomposition

Three unit costs

Total UnitCost

$$UC_{ft}(w,v) = \frac{\overbrace{C_{ft}}^{\text{OPEX}} + \overbrace{\sum_{s=t_0}^{t} \varphi_s \underline{I}_{fs} \alpha(r, \underline{T}_f)}^{\text{CAPEX}}}{\underbrace{\sum_{a} N_{fa} w_{fa}}_{\text{OPEX Grid Size}} + \underbrace{\sum_{s=t_0}^{t} \sum_{a} \varphi_s n_{fas} v_{fa} \ \alpha(r, T_g)}_{\text{CAPEX Grid Size}}}$$

OpEx UnitCost **CapEx UnitCost**

Three efficiencies

OpEx efficiency is

$$\text{OpEx } E^i = \min \{\text{OpEx UC}^k\} / \text{OpEx UC}^i$$

CapEx efficiency is

$$\text{CapEx } E^i = \min \{\text{CapEx UC}^k\} / \text{CapEx UC}^i$$

Total efficiency is

$$\text{Total } E^i = \min \{\text{Total UC}^k\} / \text{Total UC}^i$$

First problem

Partial measures may be misleading:

- A TSO may have
  - lower Opex UC
  - lower CapEx UC – and yet
  - higher Total UC !
- Known as the Fox Paradox (Fox(2003))

Example

TSO	OpEx UC	CapEx UC	Total UC
A	1/2	1/4	2/6=0.33
B	0.15/0.2	2.1/8	2.25/8.2= 0.27

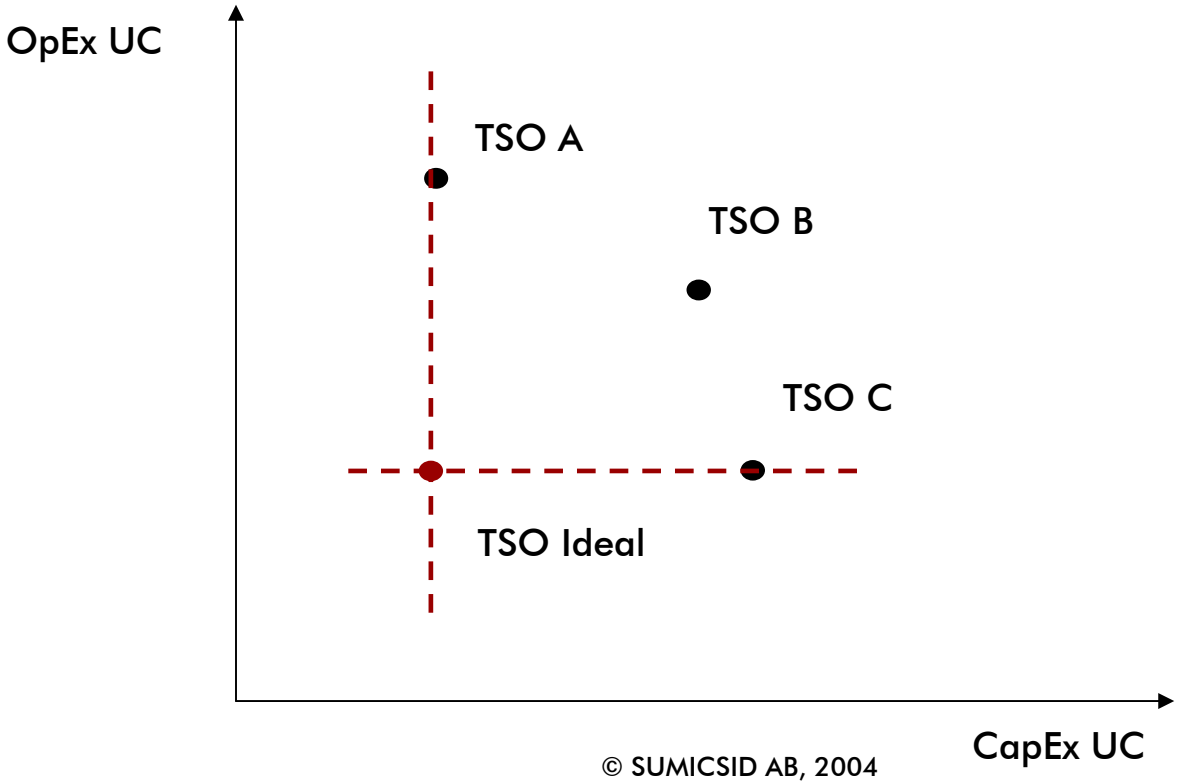
Explanation

- The relatively more efficient activities (investments)plays a larger part in B

Second problem

Partial measures may be misleading:

- Partial benchmarks make misleading comparisons
- Real units may be compared to non-feasbile ideals.



Solutions (1)

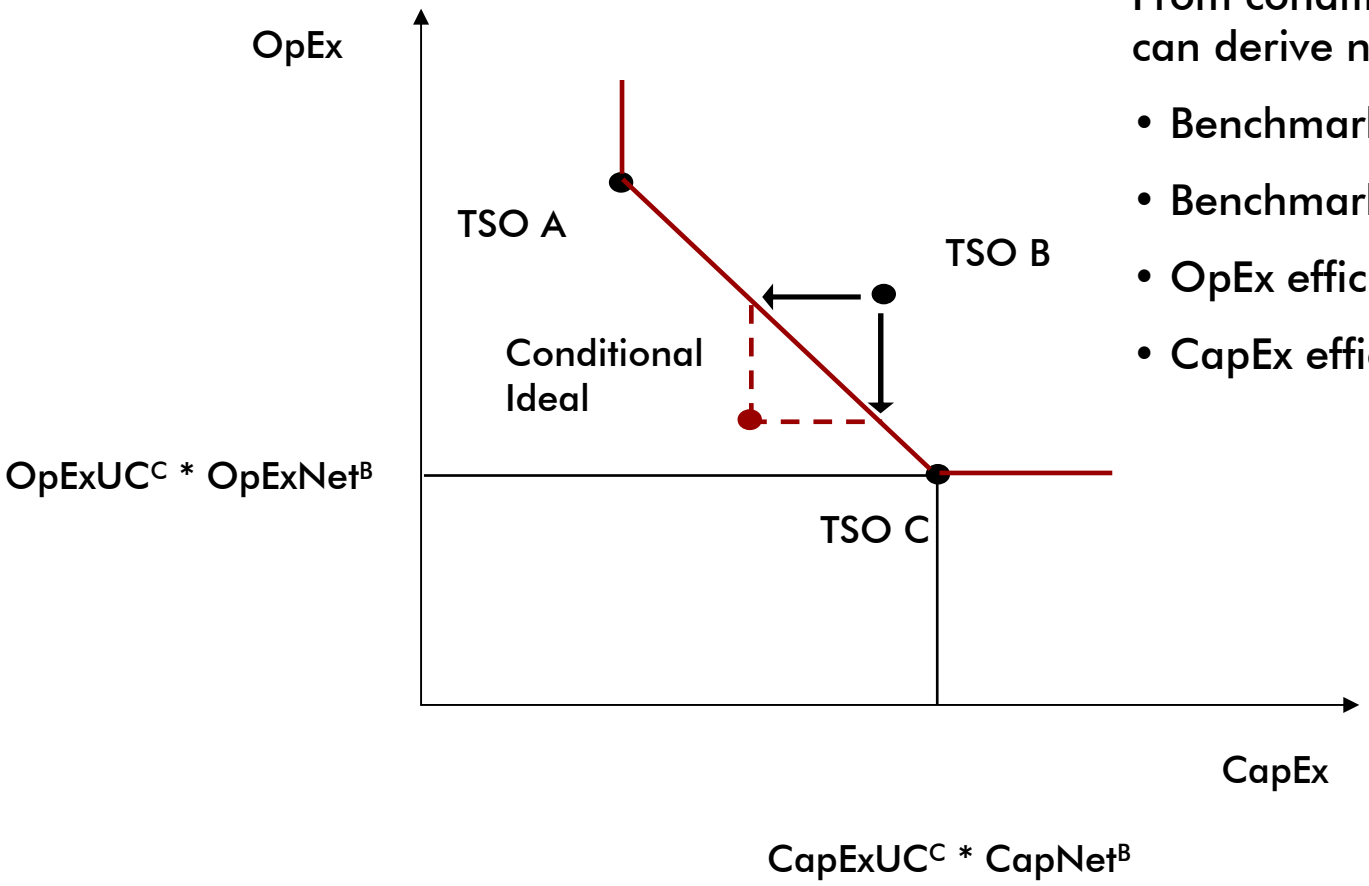
Move to absolute values

- Similar to input iso-quants
- Solves base / weight problem
- Outfoxing the fox

Move to conditional benchmarks

- Sub-vector approach
- Directional efficiency
- Different scope assumptions

Solutions (2)



From conditional ideal we can derive new conditional

- Benchmark UC in OpEx
- Benchmark UC in CapEx
- OpEx efficiency
- CapEx efficiency

Dynamics

Importance

Absolute levels may not be the most

- Relevant for incentive purposes
- Fair to incumbent management

Dynamic developments may be more important

- Total, OpEx and CapEx Unit Costs
- Total, OpEx and CapEx (Conditional) Efficiency

Performance measure

Let $E^i(s,t)$ be

Efficiency of TSO^i 's
performance in period s
againt tecnology in period t

$E^i(s,t)$ could be

- Total efficiency
- OpEx efficiency
- CapEx efficiency
- Inverse of UC
- Inverse of OpEx UC
- Inverse of CapEx UC

Malmquist index

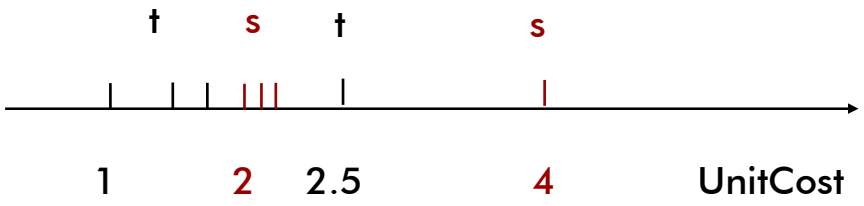
TSO^i 's improvement from period s to period t:

Malmquist index: $$M^i(s,t) = \sqrt{\frac{E^i(t,s)}{E^i(s,s)}\frac{E^i(t,t)}{E^i(s,t)}}$$

Intuition

- We compare efficiency in period t to period s.
- The base technology can be either s og t technology, so we take geometric mean
- Improvements make nominator larger than denominator.
- M > 1 corresponds to progress.

Malmquist example



Malmquist index:

$$M^i(s,t) = \sqrt{\frac{E^i(t,s)}{E^i(s,s)}\frac{E^i(t,t)}{E^i(s,t)}} = \sqrt{\frac{\frac{2}{2.5}}{\frac{2}{4}}\frac{\frac{1}{2.5}}{\frac{1}{4}}} = \frac{4}{2.5}$$

OBS: Special simple case.

Since output is the same and input is one dimensional, the base is not important.

In general, with 1 input 1 output, :

$M=[out^t/out^s] / [in^t/in^s]$ = out growth / in growth

Malmquist decomposition

Decomposition:

$$M^i(s,t) = \sqrt{\frac{TE^i(t,s)}{TE^i(s,s)}\frac{TE^i(t,t)}{TE^i(s,t)}} = \underbrace{\sqrt{\frac{TE^i(t,s)}{TE^i(t,t)}\frac{TE^i(s,s)}{TE^i(s,t)}}}_{TC} \cdot \underbrace{\frac{TE^i(t,t)}{TE^i(s,s)}}_{EC}$$

TC

Technical change

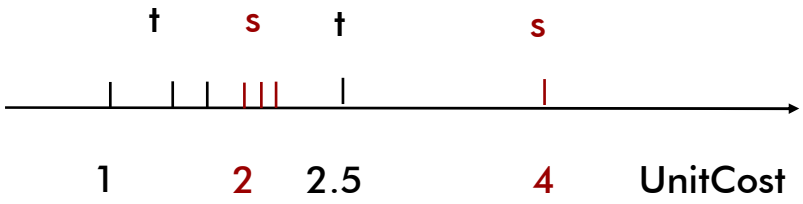
(Frontier shift)

EC

Efficiency change

(Catch-Up)

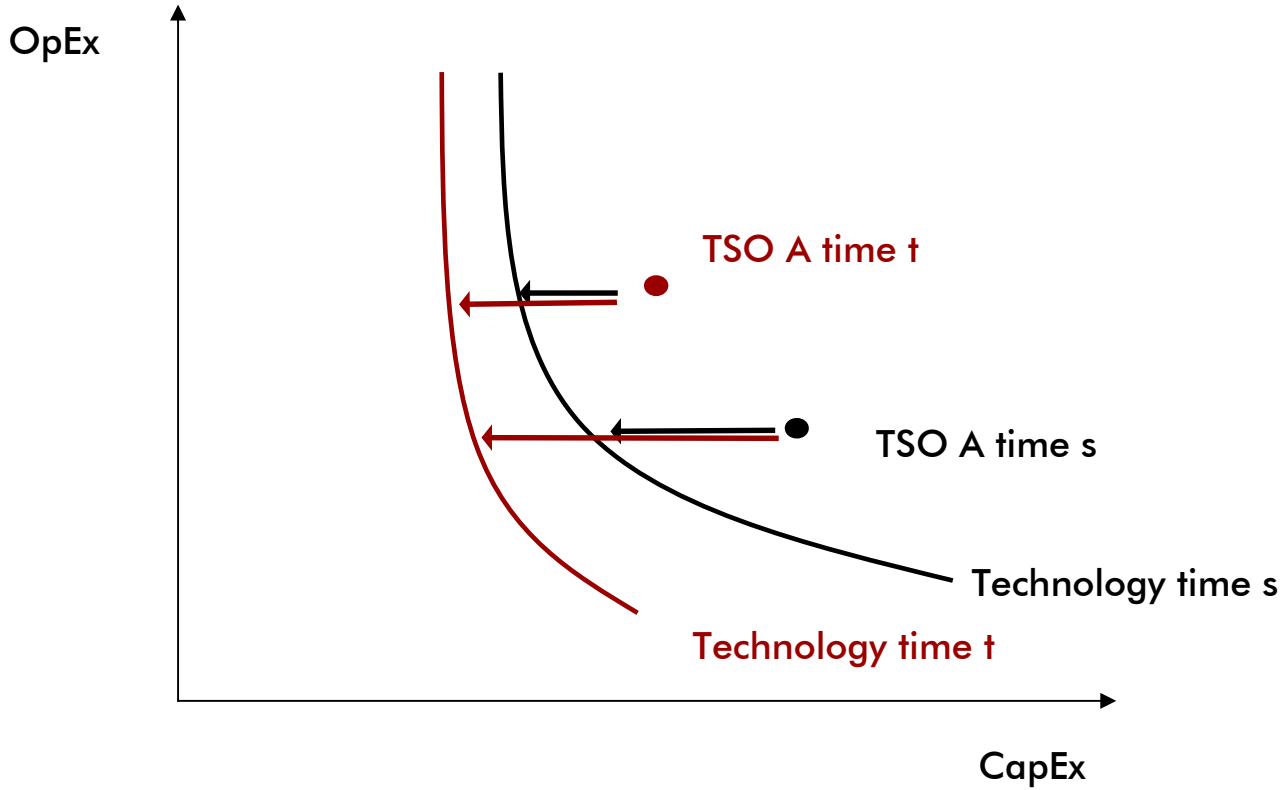
Example:



$$\sqrt{\frac{2/2.5}{1/2.5}\cdot\frac{2/4}{1/4}} \cdot \frac{1/2.5}{2/4} = 2 \cdot \frac{4}{5}$$

Extensions

We apply the same logic to the conditional measures:



Chaining over several periods

For multi-period decomposition, we would like to have

$$I(1,2) \times I(2,3) = I(1,3)$$

Malquist fails this circular test

- Unless technical change is so-called Hicks-neutral.
- So do must others indices

Remedy

- Fix the base technology
- E.g. last perdiods technology
- Or pooled technology

Drawback

- The result is base dependend

Malmquist merits

Merits

- No behavioral assumptions required
- No price information (output values) required
- Tells a story
- (May also think of it as a Fisher index with fixed input and output prices)

Potential problems

- Malmquist fails circular test. Remedy: Fixed base.
- Enough data for estimation ?

Conclusions

Summing up

Comparability

- ECOM+ assumptions
- Ways to relax scale and scope assumptions

Decomposition

- The Fox in implicit ECOM+ usage
- Six UC and Efficiencies: Total Cost, OpEx and CapEx
- More relevant (conditional) measures

Dynamics

- Malmquist productivity and its decomposition
- A series of 6+ dynamic measures

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