

# The use of statistical methods in benchmarking

Andrew Foley  
Project Director  
WSAA

Water Services Association of Australia

The logo for the Water Services Association of Australia, featuring a stylized blue and orange wave or ripple effect.

## Efficiency Measures

- Enables direct inter-business comparison
- Tools such as TFP, DEA and SFA
- Has been used by regulators to assess relative efficiency
  - No guidance on where to improve

Water Services Association of Australia

The logo for the Water Services Association of Australia, featuring a stylized blue and orange wave or ripple effect.

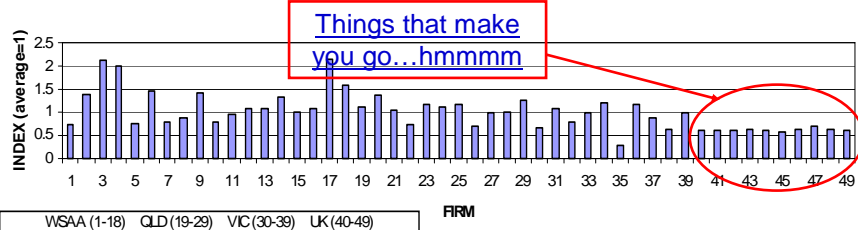
# Productivity

- Productivity = output/input
- What if more than one input and/or output?
- Use *partial productivity measures*  
eg. volume/employees
  - they do not include all inputs and outputs
  - problems with input substitution, etc. e.g. Labour vs Capital

Water Services Association of Australia

# Caution: Data vs Noise

FIGURE 6.4: WASTEWATER VOLUME COLLECTED PER PROPERTY



Water Services Association of Australia

## Total Factor Productivity

- Use a *total factor productivity* (TFP) index

$$TFP = \frac{\text{output index}}{\text{input index}}$$

- Indices require weights?

Water Services Association of Australia



## Technical Efficiency

- Build a best-practice frontier over the data points
- Can construct frontiers when multi-inputs and multi-outputs
- TE = by how much can a firm expand output or reduce inputs?

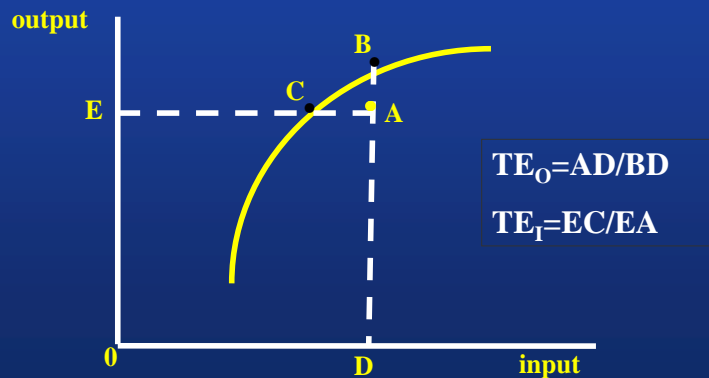
$$TE = \frac{\text{observed output}}{\text{frontier output}}$$

Water Services Association of Australia



## Technical Efficiency

How much can I reduce inputs for the same output? =  $TE_1$



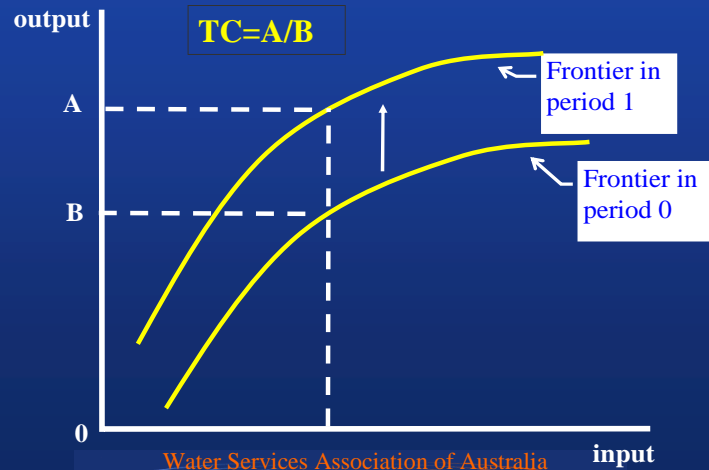
Water Services Association of Australia

## TFP Growth Components

- technical change (frontier-shift)
- technical efficiency change (catch-up)
- scale efficiency change
- input-mix allocative efficiency change
- output-mix allocative efficiency change

Water Services Association of Australia

## Technical Change (Frontier Shift)



## Frontier Estimation Methods

- Data envelopment analysis (DEA)
  - linear programming technique
  - advantages - does not impose functional form & easy to calculate
- Stochastic frontier analysis (SFA)
  - statistical technique (similar to regression)
  - advantages - accounts for data noise & can use traditional statistical tests

Both methods are multi-input, multi-output

## Use of TFP in Regulation

- Setting the X-factor
- Assume:
  - 5 year regulatory period
  - E.g May ask firms to achieve industry average TFPC pa plus also catch-up 50% towards frontier

Water Services Association of Australia

The logo for the Water Services Association of Australia, featuring the text "Water Services Association of Australia" in orange above a stylized graphic of three concentric blue and orange rings.

## Example X-factor calculation

- Firm A – TE = 0.930
- Catch-up
  - $(1-0.93)/2 = 0.035$ , 3.5% over 5 years
  - $(1.035)^{1/5} = 1.007$
  - 0.7% catch-up p.a.
- Plus Industry Avg TFP = 1.3%
- X-Factor = 2.0% p.a.

Water Services Association of Australia

The logo for the Water Services Association of Australia, featuring the text "Water Services Association of Australia" in orange above a stylized graphic of three concentric blue and orange rings.

# Comments

- Sensitive to:
  - Variable definitions (eg Capital proxy versus value)
  - Sample size
- Models only handle small numbers of variables - **DIMENSIONALITY**
- Outliers (i.e. no peer) can be "Efficient by default".
- CANNOT explain everything, at best provides a starting point for negotiation

Water Services Association of Australia

That's All Folks!

Questions?



Water Services Association of Australia