Total Factor Productivity and Energy Network Regulation

AEMC Framework and Issues Paper Public Forum

11 February 2009

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Presentation outline

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- TFP - What is it?
- How is TFP calculated?
- The use of TFP in setting price caps
- Use and calculation of TFP in Australia
- Issues

Total factor productivity

- TFP is total output produced per unit of total input
- Index number measure which forms the ratio of all output quantities (weighted by revenue or output cost shares) to all input quantities (weighted by cost shares)
- Commonly look at TFP growth but can also look at TFP levels across firms within an industry
- TFP growth is the ratio of the change in a weighted average of output quantities to the change in a weighted average of input quantities
- TFP is a relatively simple, transparent, robust and reproducible technique
- Requires values and quantities for all outputs and inputs and data on key operating environment characteristics

Calculating TFP - Outputs

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- Important issue for networks is specifying appropriate outputs – demand side versus supply side aspects
- To capture these multiple dimensions of network output typically measure distribution output using three output quantities: throughput, system capacity and customer numbers
- Issue of how revenue is allocated to these outputs for weighting
- Early studies simply measured output by system throughput
- But a major part of network output is providing the capacity to supply the product
- The network provider has the responsibility of providing the 'road' (ie system capacity) and keeping it in good condition but has little, if any, control over the amount of 'traffic' that goes down the road
- Also output dimension associated with number of customers
- Service quality important but hard to incorporate

Calculating TFP - Inputs

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- Early studies used labour, materials and services, and capital
- Extensive use of contracting out has made using separate labour data problematic
- Inputs are now usually just broken into broad categories of operating expenses and capital
- Need to include depreciation, interest cost and capital gains in capital user cost
- Measuring capital input quantity is more difficult – what physical depreciation profile is appropriate for networks?
- Are physical quantity or deflated asset value quantity measures better proxies for annual capital input quantity?

The use of TFP in price cap setting

TFP and incentive regulation

- Aim of mimicking competitive markets
- Regulation by price caps (CPI-X):
  - industry average price prevails;
  - not based on own costs;
  - response to efficiency and other changes gradual
- High power but also high risk (under or over earning)
- Innovation encouraged, less scope to 'game' system
- Delinks prices and own costs, low regulatory costs
- $X \equiv [\Delta TFP - \Delta TFP_E] - [\Delta W - \Delta W_E] - \Delta M$

Building Blocks versus TFP

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- The building block approach is based on detailed analysis of each network's own projected costs and circumstances and on judgements regarding efficiency gaps
  - Advantages: can focus on specific circumstances and be more forward looking
  - Disadvantages: often subjective, 'black box', non-reproducible ('in our professional opinion ...'), resource intensive, intrusive, can distort input mix, spurious accuracy, more scope to game
- The productivity approach uses observable information on performance of all relevant networks to set parameters
  - Advantages: objective, transparent, reproducible, economical, addresses asymmetric information, less scope to game
  - Disadvantages: may not take adequate account of network-specific circumstances, still have to forecast, higher risk

Alternative ways of using TFP

- Use industry partial factor productivity (PFP) index growth rates to set efficiency targets for components of Building Block approach
- Better suited to opex than capital targets as capital PFP gives information on capital stock, not directly on capex
- Opex partial productivity can be used to roll forward opex allowance in building blocks using 'rate of change' formula:

  ΔReal Opex = ΔOpex Price – ΔOpex Partial Productivity + ΔOutput Quantity – ΔCPI
- Use industry TFP index growth rate to set overall efficiency target – then no separate targets for input components
- Very few examples of pure application of this (US railroads, NZ electricity distribution)
- Use as one of the pieces of information that 'inform' the (subjective) decision on setting the X factor – more common

Forecasting future TFP growth

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- Future productivity growth will depend on:
  - Rate of technological change in the industry which determines how fast the efficient frontier is moving
  - Scope to achieve economies of scale
  - How efficient the business is which determines how far the business is from the efficient frontier and how fast it can close any efficiency gap
- Using index numbers we can extrapolate past industry TFP growth but caution is required in reforming industries
- Can derive efficiency levels using multilateral indexes and other benchmarking methods
- Can approximate frontier growth by TFP growth of most efficient firms (European approach) and form judgment on rate at which others can remove efficiency gaps
- Can use econometric methods but this introduces a number of problems including arbitrary assumptions and non-reproducibility

TFP Studies in Australia

‘PEG/ESC’ EDB TFP specification

4 outputs:

- customer numbers
- throughput in peak periods (generally 7AM to 11PM) in GWh
- throughput in off–peak periods in GWh
- peak demand as measured by the non–coincident peak in GW

Outputs are revenue share weighted

2 inputs:

- opex
- capital (measured by constant price asset value)

Lawrence EDB TFP specification

3 outputs:

- throughput in GWh
- customer numbers
- system capacity based on MVA–kms

Outputs are output cost share weighted

5 inputs

- opex
- overhead lines in MVA–kms
- underground lines in MVA–kms
- transformers in KVA
- other capital (quantity is real DORC)

Specification issues

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- Should outputs be revenue or output cost weighted?
- How can we broaden the system capacity output measure to include transformer capacity, etc?
- How can we include reliability and service quality as output measures?
- How can we allow for improved system security (ie increased redundancy, etc) as an output?
- What physical depreciation profile is appropriate?
- Deflated asset value approach may overstate the rate of physical depreciation, underestimate the quantity of capital used and overstate the rate of TFP growth
- How do we handle the problem of distribution 'boundary' and system structure differences between states?

Measurement issues

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- Are data sufficiently complete and robust both across networks and through time for each network?
- How should the data be collected and made available?
- Are there clear and stable definitions for all variables?
- Are all relevant data in the public domain or able to put into the public domain?
- Do relevant stakeholders have 'ownership' of the data?
- What is the appropriate industry average?
- Need to adjust for operating environment differences?
- Split sample urban/rural?
- Supplement with overseas data?

Assessing regulatory TFP studies

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- Are all major outputs and inputs included?
- Are all outputs and inputs adequately specified?
- Have the key stakeholders been consulted on model specification and data accuracy?
- Have operating environment differences been allowed for?
- Are the data accurate, consistent and comparable?
- Is the modeling transparent and the data accessible?