TFP Measurement Issues

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Overview

This presentation reviews some concepts already presented in the “Primer on Productivity and Efficiency Concepts” on January 21st

Presentation then considers some of the issues related to developing measures of total factor productivity (TFP) growth for the Ontario electricity distribution industry

There is some overlap between these issues and those related to developing an inflation factor

Productivity: What is It?

Productivity is a measure of the transformation of inputs into outputs

"Total" factor productivity measures the transformation of all inputs into comprehensive output; "partial" factor productivity measures the transformation of a subset of inputs into comprehensive output

Productivity can be measured as a level or rate of change

TFP Growth

TFP growth = Growth in output quantity – Growth in input quantity

TFP growth is typically measured using indexing methods, but can also be measured/projected using econometrics

Index-Based Measures of TFP Growth

Indexing methods compute measures of comprehensive *output quantities* (Y) and *input quantities* (X)

Change in TFP (ΔTFP) is then computed as

$$\Delta TFP = \Delta Y - \Delta X$$

Output Quantity

Choices for output quantity sub-indices

- Customer numbers
- kWh deliveries
- kW
  - Billed?
  - Summer peak?
  - Winter peak?
  - Annual peak?

Subindices will be weighted by their (relative) cost elasticities

Input Quantity

Input quantity is a weighted average of:

- OM&A inputs
- Capital inputs

Weights will be the share of each input in total electricity distribution costs (and will be consistent with the inflation factor)

OM&A Input Quantity

Changes in OM&A input quantity measured as changes in OM&A expenditure minus the change in the OM&A input price subindex

OM&A input price subindex could be a weighted average of labor and non-labor input price sub-indices

OR

OM&A input price subindex could be the same as used in the inflation factor

Either way TFP and the inflation factor should be consistent

Capital Input Quantity

- Capital input quantity begins with a "benchmark" capital year
  - Should be as distant from present as possible
  - Rationale for use of MUDBANK data

Perpetual inventory equation used to update capital quantity index

$$XK_t = (1\text{-}d) \cdot XK_t + \frac{VI_t}{WKA_t}$$

Where XK_t = Capital quantity in year t

Capital Input Quantity (Con't)

Measuring capital input quantity requires:

- A benchmark capital year
- Measures of capital additions VI_t in each year
- A measure of the depreciation rate d
- An index of distributor plant asset prices WKA_t

  >>> Also used for input price index

Capital Cost

Calculating capital cost also requires decisions on:

- An appropriate rate of return (opportunity cost of capital)
- Treatment of taxes
- Treatment of “capital gains”

Issues related to developing measures of total factor productivity (TFP) growth for the Ontario electricity distribution industry

- Capital Benchmark Year
- Depreciation
- Rate of Return
- Taxes
- Capital Gains

Capital Benchmark Year

Two options:

1. 1989 Benchmark Year
    - 23-year sample period
    - Must have confidence in
        - MUDBANK data on capital 1989 – 1997
        - Ability to interpolate capital additions between 1997 MUDBANK data and 2002 RRR data

2. 2002 Benchmark Year
    - 10-year sample period
    - More confidence in underlying data
    - No need to interpolate missing capital additions

>>> contributions in aid of construction data will help to assess these options

Depreciation

Two depreciation options previously discussed

1. Economic depreciation/geometric decay

Advantages:	Academic support Used by govt. agencies Simplicity
Disadvantages:	Not necessarily compatible with regulatory accounting for depreciation

2. Regulatory depreciation

Advantages:	Consistent with regulatory accounting for depreciation
Disadvantages:	Arbitrary? Different from company to company? More complex to implement in TFP studies

Depreciation (Con’t)

Comments?

Other Options?

Rate of Return

The rate of return used in PEG's work on the inflation factor was the weighted average cost of capital, as determined by the Board

- Board-approved values for long-term debt rates, short-term debt rates, and return on equity
- Before May 2008, long-term debt and equity returns were determined for different size categories for distributors; PEG used values for medium-small companies before 2008
- Uses current deemed capital structure (40% equity, 56% long-term debt and 4% short-term debt) in all years

Rate of Return

Modify any of these elements?

Other options?

Taxes

Taxes are an important component of capital costs in most TFP studies

However, trends in tax burdens for Ontario's electricity distribution industry over the 2002-11 historical period may be very different from what is likely going forward

Taxes (Con't)

2002-11: tax rates and tax costs generally declined for electricity distributors

Lower tax costs >>> lower capital costs

>>> less input growth

>>> higher TFP growth

>>> Tax policy since 2002 probably reflected in higher, measured TFP growth for the industry

Taxes (Con't)

This trend in tax policy for electricity distributors unlikely to continue, and may even be reversed

Including taxes in estimate of 2002-2011 TFP growth could therefore create an upward bias in measured TFP trend for electricity distribution industry compared to what can be reasonably expected going forward

Taxes (Con't)

For this reason, PEG tenatively favors excluding taxes from its TFP study

Another factor supporting this view is that if tax policies change, distributors can file for relief under the Z-factor

Comments?

Capital Gains

Capital service price measures often contain "capital gains" terms, which are typically computed using changes in asset prices

However, it is well-known that capital gains terms lead to volatility in capital service prices

Capital Gains (Con't)

Given the Board's concern with mitigating volatility in the inflation factor, PEG ignored capital gains when examining alternatives for capital service prices to be used for the inflation factor

To be consistent, capital gains should also be excluded from the capital cost measures used in our TFP study

Comments?

Methods for estimating total factor productivity (TFP) growth

- Indexing
- Econometric

Index-Based Measures of TFP Growth

Indexing methods compute measures of comprehensive *output quantities* (Y) and *input quantities* (X)

Change in TFP (ΔTFP) is then computed as

$$\Delta TFP = \Delta Y - \Delta X$$

Econometric Estimates of TFP Growth

Econometric techniques can also be used to decompose TFP growth into its various components

- Time trend/technological change
- Realization of economies of scale
- Changes in business conditions
- Changes in customer density
- Changes in undergrounding

Estimated impact of various "TFP drivers" can be used to project TFP growth going forward given estimates of expected changes in business conditions

Merits of Index-Based TFP Estimates

Index-based approaches to TFP measurement

Pros

- Relatively simple
- Requires less cross sectional data
- Relies on well established techniques
- Relatively well understood and transparent

Cons

- Will not necessarily yield reliable estimates of future TFP trends if
- Business conditions in future differ from the past
- Requires relatively extensive time series data, usually at least 10 years

>>> Board used 18-year trend in 3rd Gen IR

Merits of Econometric TFP Estimates

Econometric approaches to TFP measurement

Pros

- Can reflect diversity in distributor business conditions
- Can capture differences in future business conditions compared with past
- Does not require as extensive time series data

Cons

- More complex
- More cross sectional data typically required
- Techniques and results less well understood

>>> however, we will be doing econometrics anyway for benchmarking analyses used for stretch factors

Conclusions

Some important TFP measurement issues still to be determined by PEG

- Choice of peak demand measure
- Capital benchmark year
- Depreciation measure
- Alternative to Board-approved WACC for rate of return?
- Treatment of taxes
- Treatment of capital gains
- Use econometric techniques to supplement index-based TFP estimates?