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 \((\Delta \text{TFP})\) is then computed as

\[ \Delta \text{TFP} = \Delta Y - \Delta X \]
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 MUBANK data

Perpetual inventory equation used to update capital quantity index

\[ XK_t = (1-d) \cdot XK_t + \frac{VI_t}{WKA_t} \]

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 $V_{I_t}$ 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?
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.
For this reason, PEG tentatively 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 \((\Delta TFP)\) 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?