Incentives, Behaviour and Consequences: Data and Potential Benchmarking Alternatives

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All reported findings are preliminary.

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Overview

- Appraisal of 3rd Generation IRM dimensions - form, term, incentives
- O&M efficiency ranking vs. total cost ranking- some efficient LDCs penalized and incented to migrate to socially inferior performance
- Historical data collection in 1st Generation produced detailed capital data (e.g., stock, additions) for TFP calculation: 1988-1997 and 2000-2011
- Price-dual TFP to address quantity-based TFP data issues
- Augmented TFP to integrate performance
- Non-parametric benchmarking to address data issues and integrate performance
- Incorporate Willingness to Pay based reliability guarantee into O&M and Capital planning

Incentives

- Whole point of IR is to incent certain behaviour
- Would expect organizations to recognize and respond
- Reflect on features of current IR regimes such as
  - Used OM&A benchmarking to rank LDCs for penalties
  - Did not incorporate losses
    - ✓ improvements in losses in ‘88-’97
  - Did not incorporate reliability standards
  - Term “Three on, One off” may have created rate step function
  - (in)consistency of term may have overwhelmed intentions
    - ✓ actual terms highly diverse (COS, 2nd, COS, 3rd, 3rd, COS)

K-OM&A Ratios and Labour Capitalization for Aggregate and Selected LDCs: 2000 and - 2010

	2000			2010	
	OM&A	K	OM&A/K	OM&A	K	OM&A/K
	$920m	$710m	130%	$1351m	$1805m	75%
LDC1			178%			79%
LDC2			122%			100%
LDC3			84%			50%
Aggregate Labour Capitalization			10%			35%

3rd Gen IR Form, Term and Incentives

Term: "Three-On, One-Off"

- Produces delayed, time-shifted, rate increases
- Weakened productivity gains
- Actual sequence was highly diverse with COS, 2nd and 3rd IRM terms occurring simultaneously
- Some individual LDCs experienced multiple rate mechanisms in just 3 to 4 years

(In)Consistency of Regulation: Selected LDCs

LDC	'06	'07	'08	'09	'10	'11
A	COS	2nd	COS	3rd	3rd	COS
B	COS	2nd	2nd	COS	3rd	3rd
C	COS	2nd	2nd	2nd	2nd	COS

Ontario IR v. COS: Annual Avg. Growth in TFP

COS TFP

- 1988-93: -0.1%
- 2006-11: -0.3% (exc. TH,HO)

IR TFP

- Price Freeze
  - 1993-97: 2.1%
  - 2000-04: 1.9%
- 2nd Gen IR: 0.0% (exc. TH,HO)
- 3rd Gen IR: -0.9%

Ontario IR v. COS Rate Changes

Annual Average Rate Change per LDC under

- COS: 8.6%
- 2nd Gen IRM: 0.3%
- 3rd Gen IRM: 0.1%

Capital Additions: Diversity in 2011 % Shares for selected LDCs

	L & Over*	Equip& Materials	CC	Retire
LDC1	31	32	12	74
LDC2	60	34	25	0
LDC3	53	41	215	11
LDC4	25	75	2	19
LDC5	21	16	6	5
LDC6	37	38	26	58
LDC7	46	34	6	0
LDC8	26	67	14	40
LDC9	47	27	12	6

*Labour & overhead, equipment and materials, contributed capital.

Historical Capital Data Is Useful: TFP, DEA, MPI

1970s – 90s capital data used extensively in parametric and nonparametric research

- OEB: TFP & IPI 1988-1997
- OEB: Cost assessments/rankings among utilities
- Cronin:
  - TFP by LDC 2000 – 2011
  - Econometric Cost Functions
    - 1988 – 1997: 4 Equation Trans-log (Very Robust)
    - 2000/02 - 2006: 3 Equation Cost-Reliability (Significant)
    - 2002-2010: Cost Functions (Not Significant)
  - DEA 1988 – 1997, post 2000 (Stable)
  - MPI 1988-1997 (Frontier Effect on TFP)

Options to Address Data and Analytical Issues/Choices

- Baseline TFP post 2000: lack of 1st G capital, recent additions
  - **Price-dual TFP** using rates, IPI for desired period post 2000
- TFP not comprehensive: more optimal e.g., OFGEM includes losses (as did 1st G), WTP-based reliability guarantee, and yardstick LDC reliability benchmarks
  - **Augmented TFP** including losses, reliability
- Benchmarking post 2008: potential statistical insignificance (infers technical relationships e.g., cost, production functions)
  - **Non parametric alternative**, e.g., DEA (OFGEM, Norway)

Price-dual TFP Estimates

- Used by FCC and CRTC in PBR Regulation
- Requires rates and input prices on LDCs
- No historical data needed outside the period of analysis (e.g., 2002 -2011, etc.)
- Overcomes the need for decades of capital data (e.g., in 1st Gen capital stock, accumulated depreciation, additions, retirements, and depreciation started in 1972)

Price-dual TFP Estimates: Methodology

If economic profits are zero, then

$$(1) \qquad p_i q_i = w_j v_j.$$

Where:

p = price of output i

q = quantity of output i

w = price of input j

v = quantity of input j

Totally differentiating gives:

$$(2) \qquad p_i d q_i + dp_i q_i = w_j dv_j + dw_j v_j$$

Price-dual TFP Estimates: Methodology

Dividing the LHS by $\sum p_i q_i$ and the RHS by $\sum w_j v_j$ (which is permissible if (1) holds)

$$(3) \quad \sum_{i=1}^{n} r_i d\ln p_i = \sum_{j=1}^{m} s_j d\ln w_j - \left[\sum_{i=1}^{n} r_i d\ln q_i - \sum_{j=1}^{m} s_j d\ln v_j\right]$$

where r_i are respective revenue weights and s_j are respective cost weights. The far RHS expression in brackets may be understood as a total factor productivity growth rate.

For example, if output prices rise by 1 percent, input prices by 2 percent, then inferentially, the rise in TFP would be 1 percent.

$$(4) \quad 1 - 2 = - [1]$$

Adjustments can also be made to relax the profit assumption.

Non Parametric Benchmarking

- Observed changes in O&M, K, labour capitalization may make robust statistical estimation with post 2008 data problematic.
- Our results using this data to estimate cost and other functions were insignificant. Prior work using the 1988-1997 and 2000-2006 data had produced robust signficant results.
- Non parametric approaches e.g., Data Envelopment Analysis (DEA) have been used by regulators such as OFGEM and NVE.
- NVE used DEA to establish frontier and long-term TFP growth for hundreds of utilities in very dissimilar locations.
- DEA has also been misapplied by some regulators like Dte

Non Parametric Benchmarking

We have used DEA on Ontario data 1988-1997 and for various years post 2000 with very goods results. For further information on benchmarking, DEA, and Ontario data, see:

- "Flawed Competition Policies: Designing 'Markets' with Biased Cost and Efficiency Benchmarks," *Review of Industrial Organization*, 2007.
- "Agency Costs of Third-Party Financing and the Effects of Regulatory Changes on Utility Costs and Factor Choices," *Annuals of Public and Cooperative Economics,* 78, No.4, 2007.
- "The Road Not Taken: PBR with Endogenous Market Designs," *Public Utilities Fortnightly,* March 2004.

Non Parametric Benchmarking

Advantages:

- Requires minimum time series (e.g., 1 yr. in the limit but not preferable) - defines frontier and LDCs on frontier, and distance from frontier for LDC's off frontier
- Looked at DEA results for Ontario from '88 to '09
  - frontier stable over time e.g., 5 – 10 yrs. with some movement on/off
- Quantity data calculates technical efficiency (TE); price data can calculate allocative efficiency (AE) as well
- Can calculate TFP over time interval using Malmquist (MPI)
- We have calculated MPI for Ontario – results similar to MPI TFP results found by regulator for Norwegian distributors
- Environmental variables can reflect diversity
- DEA can be combined with statistical analysis of environmental variables

Additional Analytical Applications using Ontario Data

- "Going Beyond Scale Economies in Distribution: the Effects of Firm Boundary and Financing Choices on Utility Costs." *Annuals of Public and Cooperative Economics, 2011, 82:3: pp. 277–299*
- "Dealing with Asymmetric Risk: Improving Performance through Graduated ROE incentives." *Public Utilities Fortnightly,* May, 2009.
- "How Effective are M&As in Distribution? Evaluating the Government's Policy of Using Mergers and Amalgamations to Drive Efficiencies into Ontario's LDCs," *Electricity Journal*, April, 2007.
- "Inter-Utility Differences in Efficiency." Prepared for the Canadian Economics Association Meeting, Montreal, May 2001.