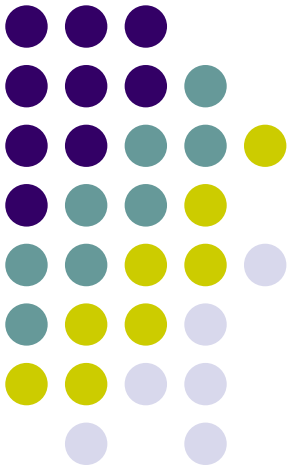
Inflation and Productivity Values

Larry Kaufmann, *Partner*
Pacific Economics Group

Toronto, Ontario
November 29, 2007



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Introduction

The presentation will present some preliminary ideas for choosing inflation and X factors in IRM3.

>>Distributor diversity critical issue for selecting X factors

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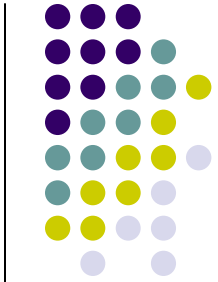
Background: Review of Inflation and X Factor Logic



Generally, in index-based IR plans, maximum allowed rates are adjusted by an price cap index (PCI) or a revenue cap index (RCI) that contains an inflation factor, X factor and Z factor

In a typical North American price cap filing, the PCI conforms to the competitive market paradigm

Logic: If an industry earns a competitive return, $\% \Delta \text{Prices} = \% \Delta \text{Unit Cost}$

>>> PCI is calibrated to track the industry's unit cost trend:

$$\% \Delta \text{Unit Cost} = \% \Delta \text{Input Prices} - \% \Delta \text{Total Factor Productivity}$$

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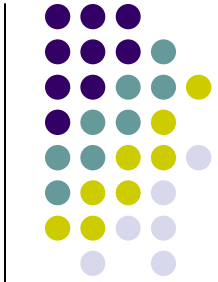
Background: Review of Inflation and X Factor Logic (Con't)



Three kinds of inflation measures are consistent with the paradigm and used in approved indexing plans:

Economy-Wide

Industry-Specific

Peer Price

>>Peer Price not feasible/desirable for IRM3

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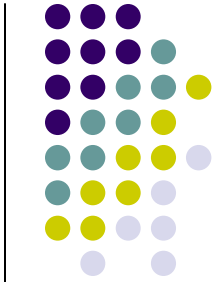

Economy-wide inflation measures use measures of aggregate inflation in the economy for inflation factor *P*

Examples:

- GDP-IPI
- GDPPI
- CPI

Precedents:

- IRM2
- Boston Gas
- Bay State Gas
- Berkshire Gas
- Union Gas
- Central Maine Power
- Southern California Edison

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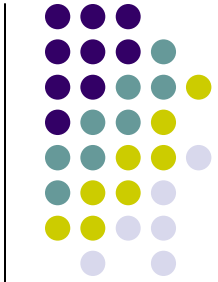

Advantages:

- Simplicity
- Familiarity of inflation measures

Disadvantages:

- Economy-wide inflation may not be a good measure of input price inflation for the utility industry
- Could lead to unreasonable "input price differentials"
- More complexity in X factor formula

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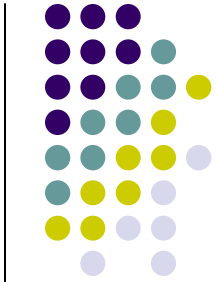

Industry-Specific Inflation Measures are tailored to reflect inflation in input prices used in utility industry

Inflation is a weighted average in input price *subindexes*

e.g. inflation = 0.20 x growth P_{Labor} +
0.20 x growth $P_{Other\ O\&M}$ +
0.60 x growth $P_{Capital}$

Information on industry input price inflation available from both public (*e.g.* BLS for labor prices) and private (*e.g.* DRI) sources

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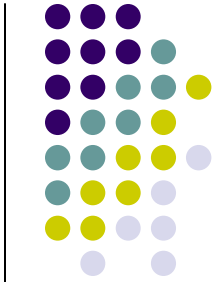

Precedents

- Ontario Power Distributors IRM1
- Pacificorp-CA (bundled power)
- Southern California Gas
- San Diego Gas and Electric – gas distribution
- San Diego Gas and Electric – electric distribution

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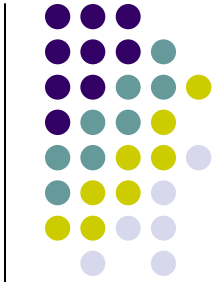

Advantages:

Designed to be a good measure of input price inflation for the utility industry

Reduces business risk (input price volatility or uncertainty of future input price trends)

Eliminates need for input price differential

Disadvantages:

Lack of familiarity

Complexity

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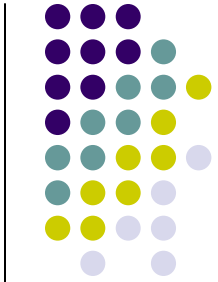

Most X-factors in approved *North American* price cap plans are *calibrated* to track industry total factor productivity trend

Total Factor Productivity (TFP)

TFP = Output/Input

TFP Growth = Changes in Output Quantity minus Changes in Input Quantity

Output quantity and input quantity often measured with indexing methods

Index-based TFP estimates also develop estimates of industry input price measures

TFP can be estimated using indexing methods or econometrically

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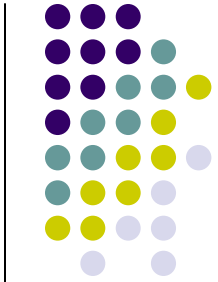

Index-based IR logic → relationship between X Factors and Inflation Factors

- Economy-wide inflation measure
  - X = sum of productivity differential and (input price) inflation differential

    i.e. $X = \left(T\dot{F}P^{I} - T\dot{F}P^{E}\right) + \left(\dot{W}^{E} - \dot{W}^{I}\right)$

- Industry-specific inflation measure
  - X = industry TFP trend
  - No inflation differential

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Inflation Factor Options

Option 1: Economy-wide Inflation Measure

Prevalent approach

Approach taken in IRM2 where inflation factor = GDP IPI

Issue: What is historic inflation differential?

>>illustrative, not definitive evidence for US from CMP proceeding

Calculating the Input Price Differential

	Input Price Indexes								Input Price Differential
	United States						Northeast Power Distributors		
	GDP-PI[1]		MFP[2]		Implied IPI				
	Level	Growth Rate [A] (%)	Level	Growth Rate [B] (%)	Level	Growth Rate [C=A+B] (%)	Level	Growth Rate [D] (%)	Growth Rate C-D (%)
1993	88.4		93.2		1.00		1.00		
1994	90.3	2.10	93.9	0.78	1.03	2.88	1.11	10.10	-7.23
1995	92.1	2.03	93.7	-0.29	1.05	1.74	1.13	2.43	-0.69
1996	93.9	1.88	95.3	1.69	1.09	3.56	1.17	3.21	0.36
1997	95.4	1.64	96.2	0.93	1.11	2.58	1.20	2.46	0.12
1998	96.5	1.10	97.4	1.30	1.14	2.41	1.20	-0.27	2.67
1999	97.9	1.43	98.7	1.30	1.17	2.73	1.26	5.31	-2.57
2000	100.0	2.16	100.0	1.31	1.21	3.47	1.30	2.74	0.73
2001	102.4	2.35	100.2	0.15	1.24	2.50	1.17	-10.46	12.96
2002	104.2	1.77	101.9	1.68	1.29	3.45	1.22	4.39	-0.95
2003	106.4	2.09	104.6	2.62	1.35	4.71	1.34	9.62	-4.91
2004	109.4	2.78	107.3	2.63	1.43	5.41	1.41	5.09	0.32
2005	112.7	2.97	109.2	1.72	1.49	4.69	1.50	5.66	-0.97
Average Annual Growth Rates 1993-2005		**2.02**		**1.32**		**3.344**		**3.357**	**-0.013**

[1] Gross Domestic Product Price Index for U.S. private business sector calculated by the BEA.

[2] Multifactor productivity for the U.S. private business sector calculated by the BLS.

[3] PEG Calculation. See Table 2 for details.

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Input Price Trend of Northeast Power Distributors

Year	Distribution Plant			General Plant			Labor			Non-Labor O&M			Input Price Index	
	Index[1]	Growth Rate (%)	Weight (%)	Index[1]	Growth Rate (%)	Weight (%)	Index[2]	Growth Rate (%)	Weight (%)	Index[3]	Growth Rate (%)	Weight (%)	Index	Growth Rate (%)
1993	1.000		39.0	1.000		4.8	1.00		26.9	1.00		29.3	1.000	
1994	1.214	19.4	43.5	1.156	14.5	5.0	1.03	3.0	25.2	1.02	2.1	26.3	1.106	10.1
1995	1.242	2.2	41.9	1.188	2.8	4.9	1.06	3.1	26.3	1.04	2.0	26.9	1.134	2.4
1996	1.296	4.2	43.2	1.235	3.9	4.8	1.09	2.8	25.3	1.06	1.9	26.7	1.170	3.2
1997	1.332	2.8	42.4	1.279	3.5	4.6	1.12	2.6	24.9	1.08	1.6	28.0	1.200	2.5
1998	1.288	-3.4	42.4	1.284	0.4	4.7	1.16	3.4	24.7	1.09	1.1	28.3	1.196	-0.3
1999	1.410	9.1	40.6	1.400	8.6	5.0	1.19	2.9	24.7	1.11	1.4	29.7	1.262	5.3
2000	1.444	2.4	41.9	1.434	2.4	5.0	1.25	4.2	21.5	1.13	2.2	31.6	1.297	2.7
2001	1.102	-27.0	42.3	1.263	-12.7	5.0	1.29	3.8	21.6	1.16	2.3	31.1	1.168	-10.5
2002	1.173	6.2	40.1	1.320	4.4	5.1	1.35	4.6	25.6	1.18	1.8	29.2	1.220	4.4
2003	1.403	17.9	41.3	1.510	13.4	4.9	1.41	4.1	25.1	1.20	2.1	28.7	1.344	9.6
2004	1.502	6.8	41.5	1.570	3.9	4.5	1.49	5.2	24.4	1.24	2.8	29.7	1.414	5.1
2005	1.630	8.2	40.8	1.685	7.1	4.4	1.56	4.5	24.7	1.28	3.0	30.0	1.496	5.7
Average Annual Growth Rates (%) 1993-2005		**4.07**			**4.35**			**3.68**			**2.02**			**3.36**

[1] Capital prices were calculated by PEG from data on power distribution construction costs and the rates of return in financial markets.

[2] Labor index is the employment cost index total compensation of electric, gas, and sanitary workers, adjusted for regional trends from the Bureau of Labor Statistics.

[3] Gross Domestic Product Price Index for US produced by BEA.

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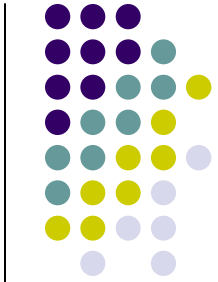
Inflation Factor Options (Con't)



Option 2: Industry Specific Inflation Measure

Construct an inflation factor that reflects input price pressures in power distribution industry

Several precedents from California

>>Illustrative example from SDG&E PBR plans for gas and power distribution

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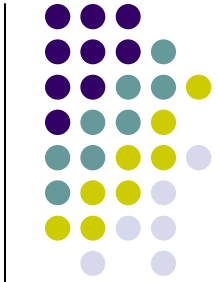


SDG&E Inflation Measure: Gas Distribution

Weighted average of indices for labor, materials, and capital.

Input	Source
Labor	BLS Average Hourly Earnings, Electric Gas & Sanitary Services
Non-Labor O&M	DRI Total Gas Utility Non-Labor O&M Cost Index
Capital:	
- Capital Rental Price	- DRI Rental Price of Capital - Nonresidential Structures - Public Utilities
- Price Index for Investment	- DRI Chain-Type Price Index - Investment in Nonresidential Structures – Public Utilities
- Gas Utility Construction Cost Index	- DRI Handy-Whitman Gas Utility Construction Cost Index – Total Plant, Pacific Region

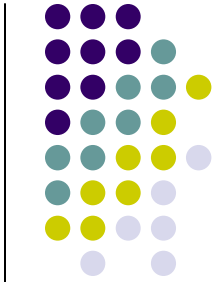
Inflation Factor Options (Con't)

SDG&E Inflation Measure: Electricity Distribution

Weighted average of indices for labor, materials, and capital.

Input	Source
Labor	BLS Average Hourly Earnings, Electric Gas & Sanitary Services
Non-Labor O&M:	
- Distribution Plant O&M	- DRI Total Distribution Plant O&M Cost Index
- Customer Accounts Operation	- DRI Customer Accounts Operation Cost Index
- Customer Service and Information	- DRI Customer Service and Information Operation Cost Index
- Sales Operation	- DRI Sales Operation Cost Index
- Total Administrative and General O&M	- DRI Total Administrative and General O&M Cost Index
Capital:	
- Capital Rental Price	- DRI Rental Price of Capital - Nonresidential Structures - Public Utilities
- Price Index for Investment	- DRI Chain-Type Price Index - Investment in Nonresidential Structures – Public Utilities
- Gas Utility Construction Cost Index	- DRI Handy-Whitman Gas Utility Construction Cost Index – Total Plant, Pacific Region

Inflation Factor Options (Con't)



Weights Assigned To Index Components

Gas

Weights Used:

Capital: 45.4%

Labor: 23.4%

Non-Labor: 31.2%

Electric

Weights Used:

Capital: 57.6%

Labor: 17.9%

Non-Labor Distribution: 6.3%

Non-Labor Cust Accts: 2.8%

Non-Labor Cust Serv: 4.3%

Non-Labor Sales: 0.1%

Non-Labor A&G: 11.0%

Weights based on average share of expenditures for California utilities.

Inflation Factor Options (Con't)

Gas Capital Cost Index: Calculation of Rental Price of Gas Utility Structures

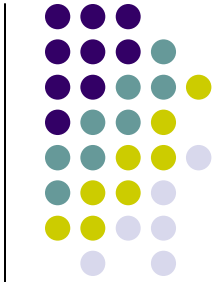
ICNRCOSTPUG = ICNRCOSTPU x (JUG@PCF / PCWICNRPU)

Where:

- ICNRCOSTPUG: Calculated rental price of gas utility structures.
- ICNRCOSTPU: Capital Rental Price, Nonresidential Structures, Public Utilities.
- JUG@PCF: Handy-Whitman Gas Utility Construction Cost Index – Total Plant, Pacific Region.
- PCWICNRPU: Chain-Type Price Index – Investment in Nonresidential Structures – Public Utilities.

Three-year moving average used for inflation measure.

Inflation Factor Options (Con't)



Electric Capital Cost Index: Calculation of Rental Price of Capital For Electric Distribution Utility Structures

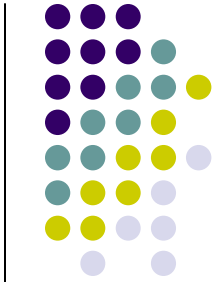
ICNRCOSTPUED = ICNRCOSTPU x (JUEPD@PCF / PCWICNRPU)

Where:

- ICNRCOSTPUED: Calculated rental price of capital for electric utility structures.
- ICNRCOSTPU: Capital Rental Price, Nonresidential Structures, Public Utilities.
- JUEPD@PCF: Handy-Whitman Electric Utility Construction Cost Index – Total Plant, Pacific Region.
- PCWICNRPU: Chain-Type Price Index – Investment in Nonresidential Structures – Public Utilities.

Three-year moving average used for inflation measure.

Inflation Factor Options (Con't)



Inflation factor for Ontario power distribution industry would ideally use Ontario data

Allocation of OM&A between labor and non-labor not consistent among Ontario distributors

PEG has constructed labor price and OM&A price indices in our benchmarking work for Ontario distributors

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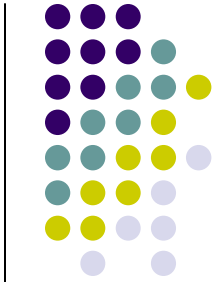
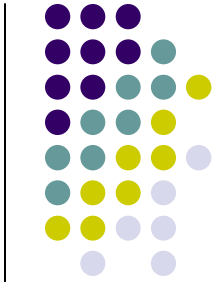
Inflation Factor Options (Con't)



Details of PEG's OM&A price index

- Weights are approximately 50-50 between labor and non-labor inputs
- Slight adjustments to adjust labor cost shares depending on initial wage rates
- Labor price subindex constructed using (employment cost) weighted average of local costs per employee, using Stats Canada data
- Non-labor price index measured using GDP-IPI

Inflation Factor Options (Con't)



For a comprehensive IRM application, PEG would need to add a capital price index to our OM&A price index

SDG&E data and approach can be used to develop a feasible capital service price index

>>Are there better options using Canadian/Ontario data?

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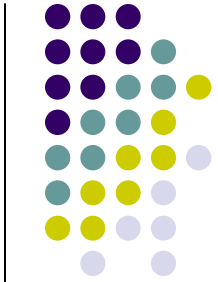
X Factor Options



Two main methods can be used to estimate Total Factor Productivity (TFP) and calibrate X factors

1. Index-based Methods

2. Econometric Methods

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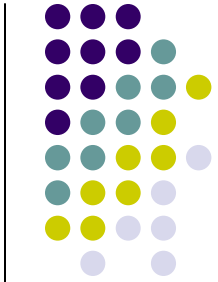

Indexing methods compute measures of comprehensive output quantities (Y) and input quantities (X)

Change in TFP (ΔTFP) is then computed as

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

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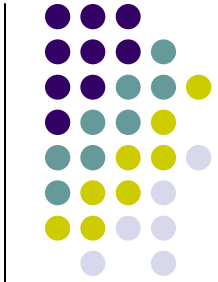
X Factor Options (Con't)



Output quantity a weighted average of:

- Customer Numbers
- kWh deliveries
- kW demand (if available and accurate)

Revenue shares should be used to weight output quantity subindexes but are often unavailable

Cost elasticity shares are a second best, feasible alternative for output weights

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X Factor Options (Con't)

Input quantity a weighted average of:

- Labor inputs (if available)
- Other OM&A inputs
- Capital inputs

Changes in input quantity measured as changes in expenditure on the input minus the change in the associated input price subindex

>> input price indices constructed at same time as TFP indexes

X Factor Options (Con't)

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

- May not reflect diversity among distributors
- 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

  >> probably not feasible in Ontario (?)

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X Factor Options (Con't)

One possible way of dealing with distributor diversity

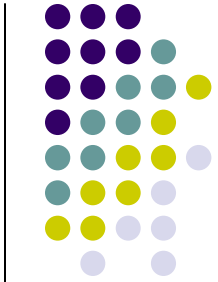
→ Compute TFP trends for "cohorts" of Ontario utilities

Issues

- How to define cohorts

  → PEG's benchmarking work a starting point
- Doesn't deal with the lack of time series data for computing trends

X Factor Options (Con't)



One way of dealing with the lack of time series data is to compute a "rolling X factor" *i.e.* X factor/factors updated each year

As new TFP information becomes available

>>Precedent: US railroad plan

This approach would also reflect recent industry conditions (*e.g.* capital spending) as they occur

On the other hand this approach is

- complex (especially if there are different "rolling" X factors for different groups
- more uncertain – value of X changes each year and is not known in advance

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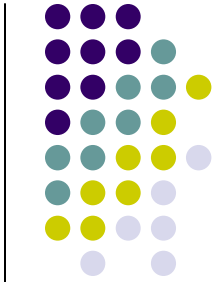
X Factor Options (Con't)



TFP trends can be computed for US power distributors

>> are US trends relevant in Ontario?

US TFP trend results can still serve as a "sanity check" on Ontario results, regardless of method used to estimate TFP

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X Factor Options (Con't)

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

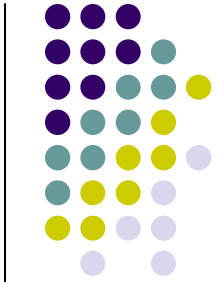
Time trend/technological change

Realization of economies of scale

Changes in business conditions
- Changes in customer density
- Changes in undergrounding
- System age and investment requirements

Changes in the efficiency of operations

X Factor Options (Con't)



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

Precedents

- Ontario Gas IR
- Victoria gas rate review (PFP)

PEG also presented TFP decomposition evidence for the power distribution industry in Victoria

X Factor Options (Con't)

Example

$$\dot{TFP} = \hat{a}_0 + \hat{a}_1\dot{N} + \hat{a}_2\dot{V} + \hat{a}_3\dot{UG} + \hat{a}_4 time$$

→ coefficients estimated from total cost function

→ reflect underlying impact of "driver" variables on TFP growth

For company *j*

$$\dot{TFP}_j = \hat{a}_0 + \hat{a}_1\dot{N}_j + +\hat{a}_2\dot{V}_j + \hat{a}_3\dot{UG}_j + \hat{a}_4 time$$

>> TFP projection tailored for values of individual driver variables of company *j*

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X Factor Options (Con't)

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

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Options for Implementing Econometric Approach

Option 1: Rely on US Data

- Feasible
- Models exist but need to be refined
- Possible refinements
  - System age (investment needs)
  - Recent changes in investment spending

Issues

- Lack of small companies?
- Are US business conditions relevant for Ontario?

  >> less of an issue for coefficients than trends (coefficients* changes in business conditions)

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ECONOMETRIC COST MODEL FOR POWER DISTRIBUTION

VARIABLE KEY

L = Labor Price
K = Capital Price
N = Number Customers
V = Total Throughput
M = Distribution Line Miles
OH = % Plant Overhead
NG = Number of Gas Customers
TF = % Territory Forested
Nadd20 = Twenty Year Customer Growth
VRC = % Deliveries Residential and Commerical
NC = Non-Contiguous Service Territory
TXGX = O&M Expenses for Transmission and Generation
CD= Competiton Dummy

EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC	EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
WL	0.167	117.55	OH	-0.711	-13.46
LL	-0.074	-4.78	OHM	-0.337	-5.54
LK	0.006	0.53			
LN	0.019	3.66	NG	-0.007	-9.04
LV	-0.039	-9.04			
LM	0.002	0.60	Nadd20	-0.039	-2.81
WK	0.549	266.27	TF	0.064	12.25
KK	0.059	3.30	TFM	0.064	12.96
KN	-0.058	-8.68			
KV	0.092	15.11	VRC	0.281	8.31
KM	-0.017	-3.37			
			NC	0.012	5.76
N	0.410	15.77			
NN	0.730	7.05	TXGX	-0.020	-2.93
NV	-0.595	-6.24			
NM	-0.142	-2.43	CD	0.005	2.50
V	0.406	19.05	Trend	-0.017	-16.56
VV	1.009	11.22			
VM	-0.368	-7.83	Constant	19.290	1217.52
M	0.199	12.11			
MM	0.461	7.54	System Rbar-Squared	0.985	
			Number of Obsevations	979	

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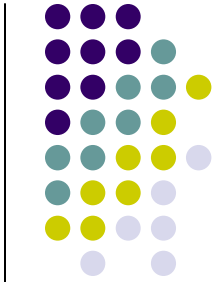

Options for Implementing Econometric Approach

Option 2: Rely on Ontario Data

- PEG OM&A benchmarking model a starting point
- Would need to add capital data

  >>Not available for many companies?
- Would also need to consider new business condition variables

Issues

- Capital data
- Data on additional business condition variables

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Econometric Model of OM&A Expenses: Double Log Form

VARIABLE KEY

WL= Labour Price
N= Number Retail Customers
V= Retail Deliveries
M= Distribution Line Circuit Kilometers
F= % Forestation of Rural Service Territory
UN= Percent of Distribution Plant that is Underground
CS= Canadian Shield (binary)
NCT= Non-Contiguous Service Territory (binary)

EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC	EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
WL	0.794	4.835	**F**	0.014	2.992
N	0.643	20.738	**UN**	-0.059	-5.833
V	0.142	4.911	**CS**	0.015	3.522
M	0.140	8.871	**NCT**	0.004	1.650
Constant	15.788	2081.988			

Other Results

System Rbar-Squared	0.977
Sample Period	2002-2005
Number of Observations	324

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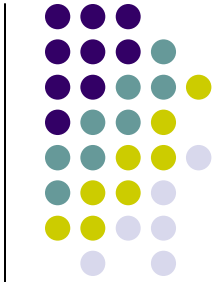
Econometric Model of OM&A Expenses: Translog Form



VARIABLE KEY

WL= Labour Price
N= Number Retail Customers
V= Retail Deliveries
M= Distribution Line Circuit Kilometers
UN= Percent of Distribution Plant that is Underground
CS= Canadian Shield (binary)

EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
WL	1.124	4.544
WLWL	4.294	0.522
WLN	-3.727	-3.288
WLV	5.356	5.707
WLM	-2.423	-5.739
N	0.576	14.465
NN	-0.246	-0.957
V	0.224	6.307
VV	-0.208	-1.314
M	0.138	5.385
MM	0.209	4.769
UN	-0.034	-3.216
CS	0.024	5.186
Constant	15.805	1754.127

Other Results

System Rbar-Squared	0.98
Sample Period	2002-2005
Number of Observations	324

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X Factor Options (Con't)

Options for Implementing Econometric Approach

Option 3: A mix of US and Ontario data could also be used

>> probably best option?

Issues

- Increased complexity
- Issues from Options 1 and 2 may still be problematic?

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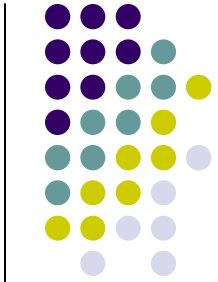
X Factor Options (Con't)



Other Issues

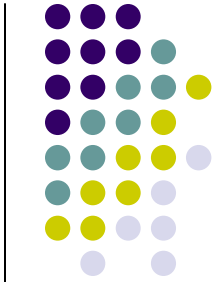
How many X factors should be estimated to accommodate diversity:

- What is an appropriate number of X factors?
- How to determine relevant "cohorts"?

X-factors may also contain "stretch factor" aka "consumer dividend"

- Basic Idea: Set X above industry TFP trend as benefit-sharing mechanism
- Adds a third term to X factor formula, in addition to productivity and inflation differentials
- In principle, value of consumer dividend can differ among companies to reflect differences in efficiency at outset of IR plan and hence potential for TFP gains under the plan
  >> Is this desirable for IRM3?

X Factor Options (Con't)



Effect of IR Form on X-factor

Forward looking test years can also be used to set X factors

- Comprehensive, or
- Comprehensove with information quality incentive (IQI), or
- Capital only, O&M indexing

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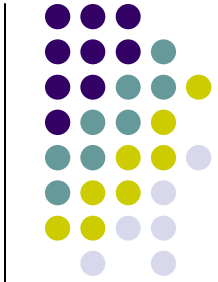
X Factor Options (Con't)



Effect of IR Form on X-factor

Forward-looking test year approach raises a host of issues

- Feasibility
- Information burdens for Staff and many distributors
- How to establish terms of IQI
- Incentives to game reported opex-capex

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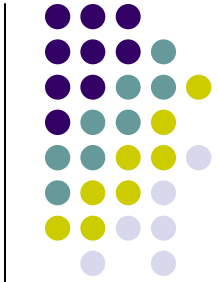
X Factor Options (Con't)



Other options for developing a "core" model for comprehensive IR that accommodates distributor diversity?

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Next Steps

Working group feedback

Which options should be pursued for

- Inflation factor
- X factor(s)

Further or more detailed analysis of options that are worth exploring?

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