Research for
Gaz Metro's Performance
Incentive Mechanism

Pacific Economics Group Research, LLC

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1. Introduction

Gaz Metro ("the Company") is approaching the expiration of its third Performance Incentive Mechanism. The current mechanism includes a revenue cap for the distribution component of the Company's services. This cap has an escalation formula that includes an "Inflation – X" term.

X factors in utility rate adjustment formulas are often calibrated using research on utility input price and productivity trends. No study of this kind has to date been undertaken in the development of Gaz Metro Performance Incentive Mechanisms. X factors have instead been negotiated.

The Regie de l'Energie has established a Task Force to review the current Performance Incentive Mechanism. In a recent decision (D-2010-116) the Regie authorized the development of a new mechanism. The Task Force has been asked to include in its report a proposal concerning Gaz Metro's expected productivity trend for the next five years, including consideration of a possible stretch factor. It has directed the Task Force to commission an independent analysis of the productivity trend of Gaz Metro, with special attention to the last ten years.

Pacific Economics Group ("PEG") Research LLC has been chosen to undertake this exercise. The invitation to bid asked for empirical research on Gaz Metro's productivity, and for a recommended range for the X factor. The Task Force has, additionally, requested the following three tasks:

1. conduct a *forward looking* empirical analysis of the productivity growth target that is consistent with expected trends in Gaz Metro's business conditions;
2. develop alternative inflation measures; and
3. propose a standard stretch factor that is applicable to Gaz Metro.

In February, the Company submitted a proposal for a new Performance Incentive Mechanism. The proposal would replace the current revenue cap with a benchmark incentive system that includes index-based cost benchmarks. There would be separate benchmarks for O&M expenses and capital expenditures ("capex").

This document is our second report to the Task Force on the project and presents updated results of our research. Section 2 of the report provides an introduction to index research and considers its potential role in the design of Performance Incentive Mechanisms. Highlights of our research on the input price and productivity trends of Gaz Metro are presented in Section 3. The final section discusses our work to develop a stretach factor and forward-looking productivity targets. Additional, more technical details of the research are provided in the Appendix.

2. Index Research and Incentive Regulation

Price and productivity research has been used for more than twenty five years to design indexing mechanisms for incentive regulation ("IR") plans. Index logic provides the rationale for this research. To understand the logic it is necessary first to have a high level understanding of input price and productivity indexes. We provide this in Section 2.1. There follows in Section 2.2 a discussion of the logic for using indexing in IR plan design. Application of the analysis to Gaz Metro is considered in Section 2.3.

2.1 Price and Productivity Indexes

2.1.1 Productivity Basics

A productivity index is the ratio of an output quantity index ("Outputs") to an input quantity index ("Inputs").

$$Productivity = \frac{Outputs}{Inputs}. \quad [1]$$

It is used to measure the efficiency with which firms convert production inputs into the goods and services they offer. The indexes we developed for this study measure productivity *trends*. The growth trend of such an index is the difference between the trends in the output and input quantity indexes.

$$trend\ Productivity = trend\ Outputs - trend\ Inputs. \quad [2]$$

Productivity grows when the output index rises more rapidly (or falls less rapidly) than the input index. Productivity growth can be volatile due to fluctuations in output and the uneven timing of certain expenditures. The volatility tends to be greater for individual companies than for an aggregation of companies such as a regional industry.

The input (quantity) index summarizes trends in the amounts of production inputs used. Growth in the usage of each input category that is itemized is measured by a "subindex". The trends in the subindexes are summarized by taking a cost-weighted average of them. Capital, labour, and miscellaneous materials and services are the major classes of base rate inputs used by gas distributors.

The scope of a productivity index depends on the array of inputs considered. Some indexes measure productivity in the use of a single input such as labor. A "multifactor" productivity ("MFP") index measures productivity in the use of several inputs. A "total factor" productivity ("TFP") index measures productivity in the use of *all* inputs.

The output (quantity) index of a firm or industry summarizes trends in the amounts of goods and services that are produced. Growth in each output dimension that is itemized is measured by a subindex. Output indexes can summarize the trends in multiple subindexes by taking a weighted average of them.

In designing an output index, choices concerning subindexes and weights depend on the manner in which the index is to be used. One possible objective is to measure the impact of output growth on company *cost.* In that event, it can be shown that the subindexes should measure the dimensions of the "workload" that drive cost and the weights should reflect the relative importance of the cost "elasticities" that correspond to these drivers. This approach to output quantity indexation was first detailed in an influential study by Denny, Fuss, and Waverman, a team that included Canadian economists.[1]

The elasticity of cost with respect to an output quantity is the percentage change in cost that will result from a 1% change in the quantity. The requisite elasticities can be estimated econometrically using a sample of historical data on the costs and quantities of utilities. In the gas distribution industry, salient cost drivers include the number of customers served and the extensiveness of the system (often measured by the miles of transmission lines and distribution mains). A multi-category output index with elasticity weights is unnecessary if econometric research reveals that there is one dominant cost driver. In this paper, we denote an output index that is cost-based as $Outputs^C$.[2] The trend in a productivity index calculated using a cost-based output index ("$Productivity^C$") has the property

$$trend\ Productivity^C = trend\ Outputs^C - trend\ Inputs. \qquad [3]$$

[1] Michael Denny, Melvin A. Fuss and Leonard Waverman (1981), "The Measurement and Interpretation of Total Factor Productivity in Regulated Industries, with an Application to Canadian Telecommunications," in Thomas Cowing and Rodney Stevenson, eds., *Productivity Measurement in Regulated Industries*, (Academic Press, New York) pages 172-218.

[2] A multidimensional cost based output index would have elasticity weights.

Output indexes may, alternatively, be designed to measure the impact of output growth on *revenue*. In that event, the subindexes should measure trends in *billing determinants* and the weight for each group of determinants that is itemized should be its share of revenue.[3] Billing determinants are the quantities companies use to calculate customer bills. A bill from Schwartz's Delicatessen in Montreal, for instance, may reflect the number of smoked meat, french fry, and pickle orders. Customer bills of gas distributors commonly feature customer (a/k/a "basic") charges and either volumetric charges or demand charges. The relevant billing determinants are therefore delivery volumes, contract demand, and the number of customers served. In this paper, we denote an output index that is revenue-based as $Outputs^R$. The trend in a TFP index calculated using a revenue-based output index ("TFP^R") has the property

$$trend\ TFP^R = trend\ Outputs^R - trend\ Inputs\ . \qquad [4]$$

2.1.2 Sources of Productivity Growth

Research by Denny, Fuss, and Waverman and others has found the sources of productivity growth to be diverse. One important source is technological change. New technologies permit an industry to produce given output quantities with fewer inputs.

Economies of scale are a second source of productivity growth. These economies are available in the longer run when cost characteristically grows less rapidly than output (as measured by $Outputs^C$). In that event, output growth can raise productivity growth. Economies of scale are one reason why prices of new consumer electronics products tend to drop as they become more popular. A company's potential for scale economy realization depends on its operating scale and the pace of its output growth. Incremental scale economies (and thus productivity growth) will typically be greater the more rapid is output growth. The potential for scale economy realization varies by industry. Our research has found that the potential is greater in the gas distribution industry than in the power distribution industry.

A third important source of productivity growth is change in X inefficiency. X inefficiency is the degree to which a company operates at the maximum efficiency that technology allows. Productivity growth will increase (decrease) to the extent that X

[3] This approach to output quantity indexation is due to the French economist Divisia.

inefficiency diminishes (increases). The potential of a company for productivity growth from this source is greater the lower is its current level of operating efficiency.

Another important source of productivity growth is changes in the miscellaneous business conditions, other than inflation and output growth, which affect cost. A good example for a gas distributor is the number of electric customers served. Economies of scope are possible from joint provision of gas and electric service. Growth in the number of electric customers served can boost productivity growth. An absence of electric customers therefore reduces a gas distributor's productivity growth potential.

An important source of productivity growth in the shorter run is the intertemporal pattern of expenditures that need not be made every year. Expenditures of this kind include those for maintenance and the replacement of aging plant. A surge in such expenditures can slow productivity growth and even produce a temporary productivity decline.

When total factor productivity is calculated using a revenue-weighted output index, growth in TFP^R also depends on the degree to which the output growth affects *revenue* differently from the way that it affects *cost.* This can be measured by the difference in the growth rates of revenue-based and cost-based output indexes. This difference may be called the "output differential".

$$Output\ Differential = growth\ Outputs^R - growth\ Outputs^C \qquad [5]$$

The output differential is important to the extent that prices do not reflect well the drivers of cost. It is an important component of TFP^R growth for many energy utilities because their rate designs frequently are not very cost causative.[4] For example, the costs of energy distributors are commonly driven in the short and medium term chiefly by growth in the number of customers served, whereas distributor revenue is commonly driven chiefly by growth in delivery volumes to residential and small business customers. Under these circumstances, the output differential and growth in TFP^R will be sensitive to trends in delivery volumes per customer (a/k/a "average use"). The output differential will be negative, slowing growth in TFP^R, when average use is declining and will be positive, accelerating TFP^R growth, when average use is rising.

[4] This phenomenon is somewhat less pronounced in Canada than in the United States.

Research by PEG has shown that declines in average use by small-volume customers are being experienced by most North American gas distributors today. Contributing factors include demand-side management ("DSM") programs and general improvements in the efficiency of furnaces and other gas-fired equipment. In contrast, electric utilities often experience increasing average use by small volume customers when large DSM programs are not underway in their service territories. It follows that results of productivity studies in the energy utility industry are very sensitive to the output specification. A study of gas distributor productivity, for instance, is apt to produce a much lower productivity growth estimate with a revenue-based output index than it will with a cost-based output index.

2.1.3 Productivity Index Volatility

The delivery volumes which typically receive the heaviest weights in a *revenue*-based output index for an energy distributor are much more volatile than the customer numbers and line miles that typically receive the heaviest weights in a *cost*-based output index. As a consequence, TFP indexes with revenue-based output indexes tend to be much more volatile than TFP indexes with cost based output indexes. Moreover, the calculation of a long term productivity trend is more sensitive to the choice of a sample period with a revenue-based output index. Delivery volumes are for this reason sometimes weather normalized in TFP^R calculations for energy utilities.

2.1.4 Price Indexes

Price indexes are used to make price comparisons. The price indexes used in the design of IR plans measure price *trends*. Indexes can summarize the trends in the prices of numerous products by taking weighted averages of the price trends of itemized product groups. An index of trends in a utility's input prices conventionally uses *cost* shares as weights so that the index can measure the impact of input price growth on its cost.[5]

[5] An index of trends in the rates that are charged by utilities that uses its revenue shares as weights measures the impact of rate growth on its revenue.

2.2 Role of Index Research in Regulation

The rate adjustment mechanism is one of the most important components of an IR plan.[6] Such mechanisms can substitute for rate cases as a means to adjust utility rates for trends in input prices, demand, and other external business conditions that affect utility earnings. Those mechanisms make it possible to extend the period between rate cases, reducing regulatory cost and strengthening utility performance incentives. The mechanism can be designed so that the expected benefits of improved performance are shared equitably between utilities and their customers. This constitutes a remarkable advance in the technology for utility regulation.

2.2.1 Price Cap Indexes

An approach to the design of rate adjustment mechanisms has been developed in North America using index logic that is grounded in theoretical and empirical research. The analysis was originally used for the development of *price* cap indexes but can be extended to consider *revenue* caps and indexed-based cost benchmarks. We begin with consideration of the growth in the prices charged by an industry that earns, in the long run, a competitive rate of return.[7] In such an industry, the long-run trend in revenue equals the long-run trend in cost.

$$trend\ Revenue = trend\ Cost. \qquad [6]$$

The trend in the revenue of any firm or industry can be shown to be the sum of the trends in (revenue-weighted) output price and quantity indexes.

$$trend\ Revenue = trend\ Outputs^R + trend\ Output\ Prices\,. \qquad [7]$$

Relations [6] and [7] together imply that the trend in an index of the prices charged by an industry that earns a competitive rate of return equals the trend in its *unit cost* index.[8]

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[6] We intend the term "rate adjustment mechanism" here to be broad enough to include the new approach to the design of the Performance Incentive Mechanism that Gaz Metro has proposed.

[7] The assumption of a competitive rate of return applies to unregulated, competitively structured markets. It is also applicable to utility industries and even to individual utilities.

[8] The long run character of this important result merits emphasis. Fluctuations in input prices, demand and other external business conditions will cause earnings to fluctuate in the short run. Fluctuations in certain expenditures that are made periodically can also have this effect. An example would be a major program of replacement investment for a distribution system with extensive asset depreciation. Since capacity adjustments are costly, they will typically not be made rapidly enough to prevent short-term fluctuations in

$$trend\ Output\ Prices = trend\ Cost - trend\ Outputs^{R} = trend\ Unit\ Cost\ . \qquad [8]$$

The result in [8] provides a conceptual framework for the design of *price* cap indexes ("PCIs"). PCIs can be calibrated to track the unit cost trend of utilities. A stretch factor, established in advance of plan operation, can be added to the formula which slows PCI growth in a manner that shares with customers expected benefits of performance improvements that are due to the stronger performance incentives of the IR plan.[9] A PCI then conforms to the unit cost paradigm to the extent that

$$trend\ PCI = trend\ Unit\ Cost + Stretch. \qquad [9]$$

The design of PCIs that track utility unit cost trends is aided by an additional result of index logic. It can be shown that the trend in any cost is the sum of the trends in appropriately specified input price and quantity indexes.

$$trend\ Cost = trend\ Input\ Prices + trend\ Inputs. \qquad [10]$$

It follows that the trend in *unit* cost is the difference between the trends in input price and TFP^R indexes.[10]

$$trend\ Unit\ Cost = trend\ Input\ Prices - trend\ TFP.^{R} \qquad [11]$$

A PCI can therefore be calibrated to track the industry unit cost trend if it is designed in accordance with the following formula:

$$trend\ PCI = trend\ Input\ Prices - \left(trend\ TFP^{R} + Stretch\ Factor\right). \qquad [12]$$

The X factor term of the PCI would, in this case, be the sum of a TFP^R trend and a stretch factor.

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returns around the competitive norm. The long run is a period long enough for the industry to adjust capacity to more secular trends in market conditions.

[9] Mention here of the stretch factor option is not meant to imply that a positive stretch factor is warranted in all cases.

[10] Here is the full logic behind this result:

$$\begin{aligned} trend\ Unit\ Cost &= trend\ Cost - trend\ Outputs^{R} \\ &= \left(trend\ Input\ Prices + \text{trend}\ Inputs\right) - trend\ Outputs^{R} \\ &= trend\ Input\ Prices - \left(trend\ Outputs^{R} - trend\ Inputs\right) \\ &= trend\ Input\ Prices - trend\ TFP^{R} \end{aligned}.$$

Output Differential

We noted in Section 2.1.2 that when the output measure in a TFP index is revenue-based, as is appropriate in the design of a *price* cap index, growth in TFP^R depends in part on the difference between the growth rates in revenue- and cost-based output quantity indexes. The difference can be material for energy distributors when their rate designs are not cost causative. Relations [3] and [4] imply that we can decompose the trend in TFP^R into the trend in the corresponding cost efficiency metric, TFP^C, and the output differential.

$$\begin{aligned} trend\ TFP^R &= \left(trend\ Outputs^C - trend\ Inputs\right) + \left(trend\ Outputs^R - trend\ Outputs^C\right) \\ &= trend\ TFP^C + Output\ Differential \end{aligned} \qquad [13]$$

We can then decompose the X factor term of a price cap index into three terms.

$$growth\ PCI\ = growth\ Input\ Prices - \left(trend\ TFP^C + Output\ Differential + Stretch\right) \qquad [14]$$

2.2.2 Revenue Cap and Cost Benchmark Indexes

A revenue cap is a rate adjustment mechanism designed to limit growth in a utility's *revenue requirement* rather than its *prices*. Such an escalator is often, though not always, paired with a revenue "decoupling" mechanism that ensures that the indicated revenue requirement is ultimately recovered. Enbridge Gas Distribution ("Enbridge") and Union Gas are examples of utilities that currently have revenue caps *with* decoupling. Green Mountain Power and FortisBC are examples of utilities that have revenue caps *without* decoupling.

Index logic provides the framework for two approaches to revenue cap design. Relations [7], [8], and [11] imply that

$$growth\ Revenue = (growth\ Input\ Prices - growth\ TFP^R) + growth\ Outputs^R. \qquad [15]$$

The revenue cap can then be escalated by first calculating the growth in a *price* cap index and then adding a supplemental adjustment for the growth in billing determinants. This is the logic supporting the revenue cap currently used by Gaz Metro.

Another result of index logic provides the basis for an alternative approach to revenue cap design. Relations [3] and [10] imply that

$$\begin{aligned} &growth\ Cost \\ &= growth\ Input\ Prices - (growth\ Outputs^C - growth\ Inputs) + growth\ Outputs^C \end{aligned}$$

$$= \textit{growth Input Prices} - \textit{growth Productivity}^C + \textit{growth Outputs}^C \qquad [16]$$

Cost growth is the difference between input price and productivity growth plus output growth. The productivity index uses the the same cost-based output measure that is used as the output escalator. This formula can establish the revenue requirement for cost *components* as well as total cost. For example, the applicable formula for non-fuel O&M expenses is

$$\textit{growth Cost}_{O\&M}$$
$$= \textit{growth Input Prices}_{O\&M} - (\textit{growth Outputs}^C{}_{O\&M} - \textit{growth Inputs}_{O\&M}) + \textit{growth Outputs}^C{}_{O\&M}$$
$$= \textit{growth Input Prices}_{O\&M} - \textit{growth Productivity}^C{}_{O\&M} + \textit{growth Outputs}^C{}_{O\&M} \qquad [17]$$

where

Input Prices$^{O\&M}$ = Price Index for O&M inputs

Outputs$^C{}_{O\&M}$ = Elasticity-weighted output index applicable to O&M

Productivity$^C{}_{O\&M}$ = Productivity index for O&M that is calculated using *Outputs*^{C}.

Formulas with *elasticity-weighted* output measures are used by the Essential Services Commission ("ESC") in the populous state of Victoria, Australia to establish multiyear O&M budgets for gas and electric distributors.[11] In the energy distribution business, however, we have noted that the number of customers served is the dominant output variable driving cost in the short and medium term. *Outputs*^{C} can then be reasonably approximated sometimes by growth in the number of customers served and there is no need to have a multidimensional output index with elasticity weights. Relation [16] can then be restated as

$$\textit{growth Cost}$$
$$= \textit{growth Input Prices} - \textit{growth Productivity}^C + \textit{growth Customers}$$

where the productivity index uses the number of customers to measure output. This formula was used in now expired O&M revenue requirement caps for Enbridge and Gazifere.

Rearranging the terms of the formula we obtain

[11] The ESC uses a more British style of incentive regulation which involves multiyear cost forecasts.

$$\begin{aligned} &\textit{growth Cost} - \textit{growth Customers} \\ &\qquad = \textit{growth } (\textit{Cost/Customer}) \\ &\qquad = \textit{growth Input Prices} - \textit{growth Productivity}^{C}. \end{aligned}$$

This provides the basis for the revenue cap formula

$$\textit{Growth Cost/Customer} = \textit{growth Inflation} - X. \qquad [18]$$

The cost per customer formula is currently used in the revenue caps of Enbridge and Gazifere and was previously used in a revenue cap for Southern California Gas, the largest U.S. gas distributor. Cost per customer formulas have been used to escalate *O&M* budgets in IR plans of FortisBC, Terasen Gas, and Vermont Gas Systems.

2.2.3 External vs. Company-Specific Productivity Targets

A question that arises in using indexes in X factor design is which utilities should be the subject of productivity research. Using the productivity trends of the entire industry to calibrate X is tantamount to simulating the outcome of competitive markets. However, individual utilities in competitive markets routinely experience windfall gains and losses. Our discussion in Section 2.1.2 of the sources of productivity growth implies that differences in the business conditions that drive productivity growth can cause utilities to have different productivity trends. For example, gas distributors that are experiencing brisk growth in the number of electric customers have a productivity growth advantage that other distributors that do not. This consideration has encouraged regulators in some jurisdictions to calibrate the X factor for a utility using the productivity trends of *similarly situated* utilities. In the northeast United States, for example, X factors have usually been calibrated using research on the productivity trends of northeast utilities.

Unfortunately, the number of utilities, for which good data are available, which face similar productivity growth drivers is sometimes quite limited. Complications like these have occasionally prompted regulators to base X factors on a utility's *own* recent historical productivity trend. This approach will weaken a utility's incentives to increase productivity growth if used repeatedly. Furthermore, a utility's productivity growth potential in one ten year period may be very different from its productivity growth potential in the following ten years. For example, rapid (slow) growth in productivity can reduce (increase) X inefficiency, making it more (less) difficult to achieve rapid productivity growth in the future. An econometric approach to setting productivity targets has been developed that can be customized to the business conditions of a distributor without using its own data or the data of a peer group. We implement this approach for Gaz Metro in work that is discussed in Section 4.1.

2.2.4 Choice of Inflation Measure

The designs of rate and revenue caps and cost benchmark indexes require the specification of inflation measures. The index logic we have detailed thus far has featured custom utility inflation measures, and there are several precedents for these. Such measures were used in the world's first large scale rate indexing plan, which applied to US railroads, and have also been used in a revenue cap for railroads in western Canada. Staff of the California Public Utilities Commission ("CPUC") developed an approach to measuring industry input price inflation which was used in several IR plans. The OEB chose an industry-specific inflation measure for the first price cap plan for Ontario power distributors. Industry-specific inflation measures have also been used in price cap plans of Enmax and EPCOR in Alberta.

Notwithstanding such precedents, the great majority of rate indexing plans approved worldwide have not featured custom utility input price indexes. They have instead featured measures of economy-wide inflation in the prices of final goods and services. Salient in this regard are consumer price indexes ("CPIs") and gross domestic product implicit price indexes ("GDPIPIs"). Indexes of both kinds are available in Canada.

Final goods and services consist chiefly of the consumer products that are covered by CPIs. GDPIPIs cover a broader array of final goods and services that include capital equipment and exports. In the United States, GDPIPI's have been favored for use in index-based regulation because they are less sensitive to the inflation in price-volatile consumer products, such as gasoline and food, that have little bearing on the cost of utility base rate inputs. In Canada, the comprehensive GDPIPI is not that stable because heavy weights are assigned to the prices of natural gas, metals, and other price volatile exports. Practical Canadian alternatives to the comprehensive macro inflation measures include the core CPI, which is monitored closely by the Bank of Canada, and the GDPIPI for final domestic demand ("GDPIPI^{FDD}"). The latter is available for Quebec and other provinces as well as for Canada and is currently used by the OEB in its indexing plans for gas and electric power distributors.

Macroeconomic inflation measures have noteworthy advantages over industry-specific measures in rate adjustment indexes. One is that they are available from Statistics ("Stats") Canada, a respected and impartial source. There is no need to go through the chores of designing custom input price indexes and updating them annually. Customers are familiar with the CPI, and this facilitates acceptance of rate indexing generally.

However, the use of a macroeconomic measure involves its own design challenges. Consider the case of a revenue cap. When a macroeconomic inflation measure is used, a revenue cap must be calibrated in a different way if it is to conform to index logic. Suppose, for example, that the inflation measure is a GDPIPI. In that event we can restate relation [16] as

$$growth\ Cost = growth\ GDPIPI - \begin{bmatrix} trend\ Productivity^{C} + (trend\ GDPIPI - trend\ Input\ Prices) \\ + Stretch\ Factor \end{bmatrix} \\ + trend\ Output^{C} \qquad [19]$$

It can be seen that the revenue cap index can still conform to the principles of index logic provided that the X factor corrects for any tendency of GDPIPI growth to differ from utility input price inflation. The difference between the trends of GDPIPI and a custom input price index may be called an "inflation differential".

Consider now that the GDPIPI is a measure of *output* price inflation. Given the broadly competitive structure of Canada's economy, the long run trend in the GDPIPI is the difference between the trends in input price and TFP indexes for the economy.

$$trend\ GDPIPI = trend\ Input\ Prices^{Economy} - trend\ TFP^{Economy}. \qquad [20]$$

GDPIPI inflation is therefore slowed by the TFP growth of the economy.

Relations [19] and [20] are often combined in discussions of X factor calibration to produce the following more complex formula for X factor calibration:

$$
\begin{aligned}
&growth\,Cost = growth\,GDPIPI \\
&-\begin{bmatrix} (trend\ Productivity^{Utility} + trend\ Productivity^{Economy}) + \\ (trend\ Input\ Prices^{Economy} - trend\ Input\ Prices^{Industry}) \\ + Stretch\ Factor \end{bmatrix} \\
&+ trend\ Output
\end{aligned} \qquad [21]
$$

In this formula, the X factor has two calibration terms: a "productivity differential" and an "input price differential". The productivity differential is the difference between the productivity trends of the industry and the economy. X will therefore be reduced by the productivity trend of the economy. In the United States, the productivity of the economy has grown quite briskly in recent years. This has tended to lower X factors when macro inflation measures are employed in rate and revenue cap indexes. In Canada, however, the productivity of the economy has tended to be much lower than in the States, and has actually been a little negative in recent years.

The input price differential is the difference between the input price trends of the economy and the industry. X will be larger (smaller) to the extent that the input price trend of the economy is more (less) rapid than that of the industry. The input price trends of a utility industry and the economy can differ for several reasons.

- Gas distribution technology is more capital intensive than the typical production process in the economy. It is therefore more sensitive to trends in construction costs and the rate of return on capital.
- Prices of particular inputs in the utility industry sometimes grow at different rates than prices for the same inputs in the economy as a whole. For example, prices of utility salaries and wages may grow more rapidly during a recession.
- Another possibility is that the prices of certain inputs grow at a different rate in some regions than they do on average throughout the economy.

Difficulties in establishing a long-term input price trend complicate identification of an appropriate input price differential. For example, the difference between the average annual growth rates of input prices of the industry and the economy is sometimes sensitive to the choice of the sample period. Even if we could establish a differential between the long-term trends it could differ considerably from the trend expected over the prospective plan period. Controversy is possible, additionally, over the method used to calculate the price of capital. The basic methodology for calculating the capital price can make a difference, as can the rate of return specification.[12] All of these complications invite gaming over the technical details of input price differential calculations. The appropriate input price differential was an area of controversy in a proceeding to establish a price cap index for Union Gas in Ontario.[13]

2.3 Application to Gaz Metro

The current performance incentive mechanism of Gaz Metro has a revenue cap for distribution services that is escalated by the term (Inflation – X) * Projected Total Throughput. This is a variant of formula [15]. To a first approximation,

$$\frac{Revenue\ Requirement_t}{Throughput_t} = \frac{Revenue\ Requirement_{t\text{-}1}}{Throughput_{t\text{-}1}} \bullet \left(1 + Inflation - X\right). \qquad [22]$$

In this formula, the term $\frac{Revenue\ Requirement_t}{Throughput_t}$ is a crude "price" that is escalated by what is effectively a price cap index. The formula for X then use the following variant of the PCI growth formula in [14], in which total throughput is used to measure productivity growth:

$$X = \left(trend\ Throughput - trend\ Inputs\right) + Stretch\ .$$

This can be restated in a way that decomposes TFP^R into a cost based productivity metric and an output differential.

$$X = trend\ TFP^C - \left(trend\ Throughput - trend\ Outputs^C\right) + Stretch\ . \qquad [23]$$

The total throughput of Gaz Metro has grown at a substantially slower pace than the number of customers that it serves. Total throughput is also sensitive to volatility in weather and the demand for gas by large business establishments such as the TCE power plant. A productivity index that uses total throughput as the output measure therefore shines little light on the trend in Gaz Metro's cost efficiency.

[12] Results can differ greatly when a bond yield is used rather than a weighted average of the bond yield and the ROE.

[13] This controversy was part of the inspiration for the development of the COS approach to capital cost measurement, which we discuss further below.

By computing the cost efficiency metric TFP^C, the Task Force can better gauge the Company's success in containing its cost growth. The important role that the output differential plays in choosing X is highlighted by the formula in [23]. TFP^C research is also useful in the design of a comprehensive revenue cap using formulas like [16] or [18] rather than the revenue cap formula that Gaz Metro currently uses. The formula in [18] also provides the logic for the index based cost targets that Gaz Metro has recently proposed. Recalling additionally the greater stability of TFP^C, there are many reasons to focus on this approach to productivity measurement in this study.

3. Input Price and Productivity Trends of Gaz Metro

This section presents an overview of our research on the input price and productivity trends of Gaz Metro. We begin by discussing data sources and the definition of cost. We then discuss in detail our calculations output, input, and productivity trends.

3.1 Data Sources

The primary source of data used in our research on the input price and productivity trends of Gaz Metro was the Company. Most of the data were filed by the Company in regulatory proceedings. We relied primarily on Stats Canada for data on the input price trends that the Company faced.

3.2 Defining Cost

The trends in input price and quantity indexes used in productivity research were noted in Section 2.1 to be cost-weighted averages of the trends in subindexes for different kinds of inputs. The weight for each itemized input group is based on its share of the applicable cost. The definition of cost and its breakdown into input groups are important issues in index design. The input indexes that we calculated for Gaz Metro involved four kinds of inputs: labour, materials and services, capital, and capital expenditures ("capex").

In our work for Gaz Metro we distinguished three categories of plant: long-lived assets, information technology software (developpments informatiques), and other short-lived plant. Long-lived assets include those for the Company's Quebec transmission, distribution, storage, and buildings. The "other short-lived" asset category consists chiefly of Programmes Commerciaux and Installations Generales other than buildings.

The applicable total cost was calculated as applicable O&M expenses plus capital cost. Applicable O&M expenses were defined as the total net (uncapitalized) O&M expenses less expenses for natural gas procurement, upstream transmission, load balancing, DSM, and pensions and benefits. The operations corresponding to this definition of cost include Quebec transmission and distribution, customer account and information services, and general administration.

The cost of labour was defined, for purposes of weighting the input indexes, as salaries and wages. The cost of material & service ("M&S") inputs was defined to be the applicable net O&M expenses less expenses for salaries and wages and pensions and other benefits. This residual input category includes the services of contract workers, insurance, real estate rents, equipment leases, materials, and miscellaneous other goods and services.

Our productivity calculations require the decomposition of costs into prices and quantities. The cost of capital is the product of a capital quantity index and an index of the price of capital services. The capital price is sometimes called a “rental” or “service” price since it reflects the annual cost of owning a unit of capital, much like prices do in competitive rental and leasing markets.[14] The capital quantity index is, effectively, an index of the trend in the real (inflation-adjusted) value of plant net of depreciation. Indexes of construction costs are commonly used as capex prices in utility productivity research. The rate base tends to grow more rapidly than the capital quantity index due to the escalation in capex prices.

Implementation of the service price approach to measuring capital cost requires specific and consistent formulas for the price and quantity indexes. We considered two alternative methods for measuring capital cost in this study: the cost of service (“COS”) and the geometric decay (“GD”) methods. The COS method was developed by PEG to simulate the way that capital cost is conventionally calculated in North American regulation. It features *historical* (“a/k/a “book”) valuation of plant and straight line depreciation. We have used the COS method in published studies for Central Maine Power, Central Vermont Public Service, the Ontario Energy Board, and Public Service of Colorado.

The GD approach has been more widely used to date in productivity research, including many studies used in X factor design. This approach features *replacement* (current dollar) valuation of utility plant and a constant depreciation rate. The value of a unit of plant in a given year depends on the cost of installing plant *in that year* and not on the costs in prior years. The cost of plant ownership is calculated net of any resulting capital gains.

[14] The daily charge for an automobile rental, for instance, should reflect the daily cost to the company of owning the automobile.

A capital service price formula should include terms for opportunity cost (return to debt and equity holders) and depreciation. The trend in the first term depends in part on the trend in the rate of return on plant [a/k/a the weighted average cost of capital ("WACC")]. The trends in both terms depend on the trend in the capex price. With the COS approach, this is a matter of the trend in a *moving average* of the capex price extending backwards many years. This greatly reduces the volatility of the COS capital service price. With the GD approach, the relevant trend is in the *current* capex price. A GD service price also includes a term for capital gains.

The formula for the GD capital service price can be restated in such a manner as to show that it depends on the *real* rate of return on plant ownership, which is the difference between the *nominal* rate of return and the growth rate of the capex price. The real rate of return can be volatile because the cost of funds is itself variable and doesn't rise and fall in lock step with capex price inflation. The real rate of return was in fact quite volatile in the last years of the sample period used in this study due, in part, to runups in prices of the steel and plastic, which are commonly used to manufacture distribution lines and mains.

We have chosen in this study to feature results using the COS approach for two reasons. One is that it is more consistent with the way the cost of capital is calculated in Quebec regulation. The other is that it yields a much more stable capital service price index that reduces potential controversy over inflation differentials.

3.3 Productivity Research

3.3.1 Sample Period

In choosing a sample period for a productivity study, it is desirable that the period include the latest available data. It is also desirable for the period to reflect the *long run* productivity trend. We generally use a sample period of at least 10 years to fulfill this second goal. Gaz Metro has provided us with data that permits us to calculate productivity trends --- for *all* input groups of interest --- over the ten-year period 2000-2009. In other words, we can calculate how O&M, capex, and total factor productivity grew between 1999 and 2009. The factor limiting an earlier start date for the analysis has been the availability of line length data.

3.3.2 Output Quantity Indexes

The index logic traced in Section 2.2 revealed that output quantity indexes featuring *cost*-based weights are useful in the design of rate and revenue cap indexes. The trend in TFP^R can be decomposed into the trend in TFP^C, a measure of cost efficiency, and an output differential. TFP^C is also useful in the design of revenue cap and index-based cost benchmarks.

To aid in the design of cost-based output indexes, we developed econometric cost models using data for a large sample of U.S. gas distributors.[15] [16] We performed separate regressions for O&M expenses, capex, and total cost. The sample period for the U.S. research was 1998-2008 for the O&M and total cost models and 1998-2007 for the capex model.[17] Where our research suggested the need for a multicategory output index we used regression results to develop indexes with elasticity weights that are reflective of Gaz Metro's situation.

Our econometric research suggested the need for only one variable --- the total number of customers served --- in a cost-based output index used to measure O&M productivity. In contrast, our research indicated the need for elasticity-weighted output indexes to measure capex productivity and TFP. For capex, we identified four statistically significant output-related cost drivers: the number of customers, expected *growth* in the number of customers (*e.g.* $\text{Customers}_{t+1} - \text{Customers}_t$), kilometers of transmission line and distribution main, and expected *growth* in same. For total cost, the statistically significant cost drivers were the number of customers and line kilometers.

Results of our research to calculate elasticity-weighted output indexes for Gaz Metro can be found in Table 1. It can be seen that, from 2000 to 2009, the number of customers grew at a 1.91% average annual rate; the expected *growth* in the number of customers grew at a 9.34% rate, line kilometers grew at a 2.01% rate, and the expected *growth* in line kilometers declined at a 8.53% annual rate. The summary output

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[15] The addition of Gaz Metro data to the sample would have involved major complications and prolonged the study but had little impact on results.
[16] A large sample increases the precision of parameter estimates.
[17] The sample period for the capex model was shorter because of our use of forward looking customer and line growth variables, the estimation of which required 2008 data.

Table 1

Calculation of Cost-Based Output Indexes

	Customers					Line Miles (km)					Summary Output Indexes					
											For O&M Productivity		For TFP[E]		For Capex	
Elasticity Weights[2]																
O&M Productivity	100%															
TFP	73.85%					26.15%										
Capital Expenditures	11.60%			24.20%		48.33%			15.87%							
				Expected Change[3]					Expected Change[3]							
Year	Level	Growth Rate	Change in Customers	Level	Growth Rate	Level[1]	Growth Rate	Change in Miles	Level	Growth Rate	Total Customers	Growth Rate	Econometrically Weighted	Growth Rate	Econometrically Weighted	Growth Rate
1998	146,955	NA	NA	NA	NA	8,030	NA	NA	NA	NA	100.0	NA	NA	NA	NA	NA
1999	148,198	0.8%	1,243	1,321	NA	8,289	3.2%	259.4	267.8	NA	100.8	0.8%	100.0	NA	100.0	NA
2000	150,741	1.7%	2,543	1,456	9.7%	8,557	3.2%	267.8	331.9	21.4%	102.6	1.7%	102.1	2.1%	107.8	7.5%
2001	150,918	0.1%	177	981	-39.5%	8,833	3.2%	276.4	242.6	-31.3%	102.7	0.1%	103.1	0.9%	94.7	-13.0%
2002	152,565	1.1%	1,647	2,202	80.9%	9,285	5.0%	451.5	212.8	-13.1%	103.8	1.1%	105.2	2.1%	115.7	20.0%
2003	153,684	0.7%	1,119	3,409	43.7%	9,285	0.0%	-	132.6	-47.3%	104.6	0.7%	105.8	0.5%	119.4	3.1%
2004	157,525	2.5%	3,841	4,589	29.7%	9,472	2.0%	187.0	193.6	37.8%	107.2	2.5%	108.3	2.3%	137.9	14.5%
2005	162,791	3.3%	5,266	4,569	-0.4%	9,682	2.2%	210.8	155.7	-21.8%	110.8	3.3%	111.6	3.0%	135.0	-2.1%
2006	167,451	2.8%	4,660	4,342	-5.1%	9,865	1.9%	183.0	125.5	-21.6%	113.9	2.8%	114.5	2.6%	130.5	-3.4%
2007	171,232	2.2%	3,781	3,973	-8.9%	9,939	0.7%	73.2	89.0	-34.3%	116.5	2.2%	116.7	1.8%	121.7	-7.0%
2008	175,816	2.6%	4,584	3,675	-7.8%	10,059	1.2%	120.2	92.8	4.2%	119.6	2.6%	119.3	2.3%	121.3	-0.3%
2009	179,370	2.0%	3,554	3,362	-8.9%	10,132	0.7%	73.6	114.1	20.6%	122.1	2.0%	121.3	1.7%	123.4	1.7%
Average Annual Growth Rates 2000-2009		**1.91%**			**9.34%**		**2.01%**			**-8.53%**		**1.91%**		**1.93%**		**2.10%**

NA = not available

[1] The 1998 and 1999 values for line miles were not available and were imputed using the 1999-2000 growth rate.

[2] Elasticity weights are based on Gaz Metro costs and quantities and econometric estimates of marginal costs prepared by PEG Research using data on the operations of U.S. gas distributors.

[3] Expected change is a three year moving average of the change in the corresponding variable. Values for 2008 and 2009 use Gaz Metro forecasts.

index for measuring capex productivity grew at a 2.10% annual rate and displayed substantial volatility. The summary output index for measuring TFP grew at a 1.93% annual rate. Gaz Metro's output generally grew at a somewhat faster rate than has been typical of U.S gas distributors in recent years.

3.3.3 Input Quantity Indexes

The trends in input (quantity) indexes were noted in Section 2.1 to be cost-share weighted averages of subindexes that measure trends in the use of various inputs. The index that we used to summarize trends in the quantities of O&M inputs had two categories: (1) labor and (2) materials and services. The index we used to summarize trends in the quantities of all inputs had three categories: labor, materials and services, and capital. The capital quantity index in turn summarizes growth in the quantities of the three asset groups that we itemized.

The quantity subindex for labour was calculated as the ratio of salary and wage expenses to a labour price index. We used as our labor price index Stats Canada's fixed weight index of average hourly earnings in the utility sector of the Quebec economy. The M&S quantity subindex was calculated as the ratio of M&S expenses to a proxy for an M&S input price index. We used as our proxy the Statistics Canada gross domestic product implicit price index for final domestic demand in Quebec ("$GDPIPI^{FDD}_{Quebec}$"). The quantity index for capital is discussed at length in Section A.3 of the Appendix.

The results of our calculation of O&M input quantity indexes are reported in Table 2. It can be seen that, over the 2000-2009 period that is the focus of our productivity research, the quantity of labor used by Gaz Metro rose at a 1.70% average annual rate, far above the 0.26% average annual growth rate of M&S inputs. This pattern is very different than the US norm, where use of materials and services by gas and electric utilities has tended in recent years to grow more rapidly than the use of labour. The U.S. pattern reflects in part the outsourcing of O&M services to both affiliated and independent companies. Table 2 also reports that the summary quantity index for O&M expenses averaged 1.18% annual growth.

Table 3 reports that the quantity of capital was fairly stable over the sample period, with a slight 0.27% average annual *decline* observed. This result is also at

Table 2

Gaz Metro O&M Input Quantity Indexes

	Costs							Input Prices						Input Quantities							
	Salaries & Wages[1]		Materials & Services[1]			Total O&M		Salaries & Wages[2]		Materials & Services[3]		Summary O&M Input Price Index		Labor (SW/W)		Materials & Services		Cost Shares		Summary O&M Input Quantity Index[4]	
Year	Million $	Growth Rate	Million $	Cost Share	Growth Rate	Million $	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Labor	materials	Level	Growth Rate
	[A]	[B]	[C]		[D]				[E]		[F]				[B] - [E]		[D] - [F]				
1998	61.5	NA	32.9	34.9%	NA	94.4	NA	84.6	NA	92.7	NA	100.0	NA	0.73	NA	0.35	NA	65.1%	34.9%	100.0	NA
1999	61.2	-0.5%	37.1	37.7%	12.0%	98.3	4.0%	90.9	7.2%	94.0	1.4%	105.2	5.1%	0.67	-7.7%	0.39	10.6%	62.3%	37.7%	98.9	-1.1%
2000	64.3	*4.9%*	37.3	36.7%	0.5%	101.6	*3.3%*	98.1	7.6%	96.4	2.5%	111.4	5.7%	0.66	-2.7%	0.39	-2.0%	63.3%	36.7%	96.6	-2.4%
2001	67.5	*4.9%*	37.5	35.7%	0.5%	105.0	*3.3%*	94.4	-3.8%	97.8	1.4%	109.3	-1.9%	0.71	8.7%	0.38	-0.9%	64.3%	35.7%	101.8	5.2%
2002	70.9	4.9%	37.7	34.7%	0.5%	108.6	3.3%	99.9	5.6%	100.0	2.2%	114.3	4.4%	0.71	-0.7%	0.38	-1.7%	65.3%	34.7%	100.7	-1.1%
2003	75.5	6.3%	39.4	34.3%	4.4%	114.9	5.6%	102.6	2.7%	101.8	1.8%	117.0	2.4%	0.74	3.6%	0.39	2.6%	65.7%	34.3%	104.1	3.3%
2004	80.9	6.9%	42.3	34.3%	7.1%	123.2	7.0%	103.2	0.7%	103.1	1.3%	118.0	0.9%	0.78	6.2%	0.41	5.8%	65.7%	34.3%	110.6	6.1%
2005	85.1	5.1%	43.8	34.0%	3.5%	128.9	4.5%	100.5	-2.7%	105.1	1.9%	116.7	-1.1%	0.85	7.8%	0.42	1.6%	66.0%	34.0%	117.1	5.7%
2006	88.4	3.8%	44.8	33.6%	2.3%	133.2	3.3%	100.3	-0.1%	106.5	1.3%	117.1	0.4%	0.88	3.9%	0.42	0.9%	66.4%	33.6%	120.5	2.9%
2007	89.7	1.5%	41.5	31.6%	-7.7%	131.2	-1.5%	105.5	5.1%	108.6	2.0%	121.9	4.0%	0.85	-3.6%	0.38	-9.6%	68.4%	31.6%	114.0	-5.6%
2008	90.8	1.2%	43.1	32.2%	3.8%	133.9	2.0%	111.4	5.4%	110.8	2.0%	127.3	4.3%	0.82	-4.2%	0.39	1.8%	67.8%	32.2%	111.4	-2.3%
2009	93.9	3.4%	45.5	32.6%	5.4%	139.4	4.0%	117.7	5.5%	112.3	1.3%	132.7	4.1%	0.80	-2.1%	0.41	4.1%	67.4%	32.6%	111.3	-0.1%
Average Annual Growth Rates																					
2000-2009		**4.28%**			**2.04%**		**3.49%**		**2.58%**		**1.78%**		**2.32%**		**1.70%**		**0.26%**				**1.18%**

NA = not available

[1] Source: Gaz Metro. Cost data were not provided for the years 2000-2001. Data for these years were imputed using actual data from 2002 and 1999. The method used was to assume that the total growth from 1999-2002 took place uniformly over the period. The imputations do not affect the average annual growth rates. Capitalized O&M expenditures were removed and included in capital cost for the years 2008-2009.

[2] Source: Statistics Canada. Table 281-0039 - Fixed weighted index of average hourly earnings for all employees (SEPH), excluding overtime, unadjusted for seasonal variation, for Quebec utilities industry as classified using the North American Industry Classification System (NAICS), monthly (index, 2002=100)

[3] Source: Statistics Canada, Gross Domestic Product of Quebec at Market Prices, Table 384-0036 - Implicit price indexes, gross domestic product (GDP) final domestic demand, provincial economic accounts, annual (index, 2002=100)

[4] The O&M input quantity index is a cost-weighted average of growth in labor and M&S input quantities. The index is of Tornqvist form.

Table 3

Productivity Indexes for Cost Efficiency Measurement

	Costs								Input Quantity Index						Cost-Based Output Indexes				Productivity			
	O&M			Capital			Total Cost		O&M		Capital[1]		Summary Input Quantity Index		O&M Productivity		TFP^E		O&M Productivity		TFP^E	
Year	Million $	Growth Rate	Cost Share	Million $	Growth Rate	Cost Share	Million $	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate
1998	94.4	NA	34.3%	180.8	NA	65.7%	275.2	NA	100.0	NA	NA	NA	NA	NA	100.0	NA	NA	NA	100.0	NA	NA	NA
1999	98.3	4.0%	35.3%	180.0	-0.5%	64.7%	278.3	1.1%	98.9	-1.1%	100.0	NA	100.0	NA	100.8	0.8%	100.0	NA	101.9	1.9%	100.0	NA
2000	101.6	3.3%	36.1%	179.6	-0.2%	63.9%	281.2	1.0%	96.6	-2.4%	99.7	-0.3%	99.0	-1.0%	102.6	1.7%	102.1	2.1%	106.2	4.1%	103.2	3.1%
2001	105.0	3.3%	36.2%	185.3	3.1%	63.8%	290.3	3.2%	101.8	5.2%	101.4	1.6%	101.9	2.9%	102.7	0.1%	103.1	0.9%	100.9	-5.1%	101.1	-2.0%
2002	108.6	3.4%	36.4%	189.6	2.3%	63.6%	298.2	2.7%	100.7	-1.1%	102.6	1.3%	102.3	0.4%	103.8	1.1%	105.2	2.1%	103.1	2.1%	102.9	1.7%
2003	114.9	5.6%	37.1%	194.6	2.6%	62.9%	309.5	3.7%	104.1	3.3%	104.4	1.7%	104.7	2.3%	104.6	0.7%	105.8	0.5%	100.5	-2.6%	101.1	-1.7%
2004	123.2	7.0%	37.9%	201.8	3.7%	62.1%	325.0	4.9%	110.6	6.1%	104.7	0.3%	107.3	2.5%	107.2	2.5%	108.3	2.3%	96.9	-3.6%	100.9	-0.1%
2005	128.9	4.5%	38.0%	210.2	4.1%	62.0%	339.1	4.3%	117.1	5.7%	106.1	1.3%	110.6	3.0%	110.8	3.3%	111.6	3.0%	94.6	-2.4%	101.0	0.0%
2006	133.2	3.3%	39.2%	206.8	-1.6%	60.8%	340.0	0.3%	120.5	2.9%	103.9	-2.1%	110.4	-0.2%	113.9	2.8%	114.5	2.6%	94.5	-0.1%	103.8	2.7%
2007	131.2	-1.5%	38.5%	209.3	1.2%	61.5%	340.5	0.1%	114.0	-5.6%	102.4	-1.5%	107.1	-3.1%	116.5	2.2%	116.7	1.8%	102.2	7.8%	109.0	4.9%
2008	133.9	2.0%	38.9%	210.3	0.5%	61.1%	344.2	1.1%	111.4	-2.3%	99.8	-2.6%	104.4	-2.5%	119.6	2.6%	119.3	2.3%	107.4	4.9%	114.3	4.7%
2009	139.4	4.0%	39.9%	209.6	-0.3%	60.1%	349.0	1.4%	111.3	-0.1%	97.3	-2.5%	102.8	-1.5%	122.1	2.0%	121.3	1.7%	109.7	2.1%	118.0	3.2%
Average Annual Growth Rates																						
2000-2009		**3.49%**			**1.52%**			**2.27%**		**1.18%**		**-0.27%**		**0.28%**		**1.91%**		**1.93%**		**0.73%**		**1.66%**

NA = Not Available

[1]The summary input quantity index for capital is calculated as a cost share weighted average of the input quantities for three asset categories. The results were produced using the COS methoc

variance with recent experience in the U.S., where the quantity of capital used by energy distributors has tended to rise more rapidly than the quantity of O&M inputs.

3.3.4 Productivity Results

Table 3 also presents the trends in some of the cost efficiency metrics for Gaz Metro. The O&M productivity index grew at a 0.73% average annual pace during the 2000-2009 period. The TFP^C index averaged 1.66% annual growth during the same period. The trend in the TFP^C index using the alternative geometric decay approach to calculating capital cost was 1.50% average annual growth.[18] This is similar to the 1.51% growth trend in TFP^C that Gazifere is estimated to have achieved over the 1991-2005 period.[19]

The TFP results for Gaz Metro are compared in Table 4 to those for some other productivity indexes. The other indexes include MFP indexes for the U.S. and Canadian private business sectors. These are analogous to our TFP index for Gaz Metro and are prepared by the U.S. Bureau of Labor Statistics and Statistics Canada, respectively.[20] Table 4 also reports results for a productivity index for a sample of U.S. gas distributors which was presented in December 2010 testimony by PEG Research for the Sempra Energy utilities in California.[21] The latter index used the number of customers as the output measure and is therefore an example of a cost efficiency metric. The geometric decay approach to the calculation of capital cost was employed.

Inspecting the results of Table 4, it can be seen that the recent productivity trend of Gaz Metro was well above the 1.18% productivity trend of U.S. gas distributors over the most recent ten years for which data are available. Recollecting our discussion above on the drivers of TFP growth, it is possible that the difference between the trends reflects differences in underlying business conditions such as the pace of output growth. The productivity trend of Gaz Metro is also above the 1.30% MFP trend of the U.S. private

[18]The lower GD productivity trend estimate in our preliminary report reflected depreciation assumptions that were inconsistent with the 33 year service life for long-lived assets.

[19] See p. 15 of the Regie's decision D-2006-158 concerning a "mechanisme incitatif" for Gazifere.

[20] They are called MFP indexes because they address the productivity of capital as well as labor.

[21] See, for example, Mark Newton Lowry and David Hovde (2010), Productivity Research for Southern California Gas, page 9, filed as Exhibit SCG-37 in Application 10-12-006 before the California Public Utilities Commission.

Table 4

Comparison of Productivity Trends

	Total Cost Efficiency Metric (TFP^c)				MFP, Private Business Sector			
	Gaz Metro		US Gas Distributors[1]		US[2]		Canada[3]	
Year	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate
1998	NA	NA	1.000	NA	87.898	NA	95.7	NA
1999	100.0	NA	1.027	2.7%	89.509	1.8%	97.6	2.0%
2000	103.2	3.1%	1.030	0.3%	91.042	1.7%	99.8	2.2%
2001	101.1	-2.0%	1.069	3.7%	91.749	0.8%	99.5	-0.3%
2002	102.9	1.7%	1.078	0.8%	93.942	2.4%	100.0	0.5%
2003	101.1	-1.7%	1.071	-0.7%	96.429	2.6%	99.5	-0.5%
2004	100.9	-0.1%	1.066	-0.5%	98.966	2.6%	98.8	-0.7%
2005	101.0	0.0%	1.041	-2.3%	100.000	1.0%	99.0	0.2%
2006	103.8	2.7%	1.111	6.5%	100.517	0.5%	98.3	-0.7%
2007	109.0	4.9%	1.112	0.1%	101.025	0.5%	97.7	-0.6%
2008	114.3	4.7%	1.125	1.1%	101.119	0.1%	95.5	-2.3%
2009	118.0	3.2%	NA	NA	101.906	0.8%	93.4	-2.2%
Average Annual Growth Rates								
1999-2008	**NA**		**1.18%**		**1.40%**		**-0.02%**	
2000-2009	**1.66%**		**NA**		**1.30%**		**-0.44%**	
2000-2008	**1.48%**		**1.01%**		**1.36%**		**-0.24%**	

NA = Not available

[1] Source: Mark Newton Lowry and David Hovde (2010), *Productivity Research for Southern California Gas*, page 9, filed as Exhibit SCG-37 in Application 10-12-006 before the California Public Utilities Commission

[2] Source: US Bureau of Labor Statistics.

[3] Source: Statistics Canada, Table 383-0021.

business sector over the same period and far above the -0.44% MFP trend of the Canadian private business sector.

Table 5 presents results of our productivity calculations for capex. It can be seen that capex productivity grew at a brisk 2.08% average annual pace over the 2000-2009 sample period. 2.10% average annual growth in capex output was achieved despite a slight 0.02% average annual increase in capex inputs. Capex productivity growth was quite volatile from year to year due to volatility in both plant additions and our capex output index. High capex productivity growth is consistent with our finding of slow capital quantity growth. If the number of customers is used as the output measure, the productivity trend of capex is instead 1.89% [1.91%-0.02%].

3.3.5 Output Differential and Implications for X in Gaz Metro's Current Plan

Pursuant to the analysis discussed in Section 2.3 above, we calculated the output differential for Gaz Metro as the difference between the growth rates in its total throughput and the elasticity-weighted output index for total cost. The throughput data were weather normalized by Gaz Metro. Results are presented in Table 6. It can be seen that total throughput was much more volatile than the elasticity-weighted output index during the sample period. Causes of volume volatility included the recent recession and the startup and shutdown of the TCE generating station.

The volatility makes the output differential unusually sensitive to the choice of sample period. Our preliminary judgment is that the 0.27% annual growth rate in total throughput for the 2000-2007 period is more representative of the long run trend in the service territory. The difference between 0.27% and the 1.93% growth trend of the elasticity-weighted output quantity index for the same period is -1.65%. The difficulty of choosing an appropriate sample period for the calculation of an output differential is a disadvantage of Gaz Metro's current approach to revenue cap design.

In Table 7 we show that the sum of the 1.656% trend in TFP^C and the -1.655% output differential is 0.001%. This number is similar to the X factor in Gaz Metro's current Performance Incentive Mechanism. The low value reflects a tendency for total throughput to grow much more slowly than the output variables that drive cost. Our

Table 5

Productivity Index for Capital Expenditures

	Outputs		Inputs						Productivity of Capital Expenditures		
	Summary Output Index		**Value of Plant Additions[2]**		**Capex Price Index[3]**		**Plant Addition Quantities**				
	Level	Growth Rate	$ Million	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Level (1999=100)	Growth Rate
Year		[A]		[B]		[C]		[D] = [B-C]			[A] - [D]
1999	100.0	NA	84.93	NA	100.3	NA	100.0	NA	1.000	100.0	NA
2000	107.8	7.5%	85.76	1.0%	102.1	1.8%	99.2	-0.9%	1.087	108.7	8.3%
2001	94.7	-13.0%	92.17	7.2%	102.5	0.4%	106.2	6.9%	0.891	89.1	-19.8%
2002	115.7	20.0%	98.87	7.0%	102.9	0.4%	113.4	6.6%	1.020	102.0	13.4%
2003	119.4	3.1%	104.76	5.8%	102.0	-0.9%	121.3	6.7%	0.984	98.4	-3.5%
2004	137.9	14.5%	132.29	23.3%	105.6	3.5%	147.9	19.8%	0.933	93.3	-5.4%
2005	135.0	-2.1%	133.52	0.9%	110.5	4.5%	142.8	-3.5%	0.946	94.6	1.4%
2006	130.5	-3.4%	126.40	-5.5%	116.1	4.9%	128.6	-10.4%	1.014	101.4	7.0%
2007	121.7	-7.0%	146.75	14.9%	121.4	4.5%	142.8	10.4%	0.852	85.2	-17.4%
2008	121.3	-0.3%	102.74	-35.7%	122.8	1.2%	98.8	-36.8%	1.228	122.8	36.5%
2009	123.4	1.7%	104.98	2.2%	123.8	0.8%	100.2	1.4%	1.232	123.2	0.3%
Average Annual Growth Rates											
2000-2009		**2.10%**		**2.12%**		**2.10%**		**0.02%**			**2.08%**

NA = Not Available

[1] The 1998 value for line miles was not available and was imputed using the 1999-2000 growth rate.

[2] Source: Gaz Metro

[3] Source: Statistics Canada. Table 383-0025 - Canadian Natural Gas Distribution, Water, and Other Systems Capital Stock Price (index, 2002=100). 1998-2007.

Where this index was not available (in 2008-2009), values were imputed using the growth rates in the comprehensive electric utility construction price index.

Source: Statistics Canada. Table 327-0011

Table 6

Calculation of Output Differential

Year	Total Volume (Normalized)		Elasticity-Weighted Output Quantity Index for TFP[c]		Output Differential
	Level	Growth Rate	Level	Growth Rate	Growth Rate
1998	227.6	NA	NA	NA	NA
1999	217.1	-4.7%	100.0	NA	NA
2000	231.0	6.2%	102.1	2.1%	4.1%
2001	195.4	-16.7%	103.1	0.9%	-17.7%
2002	200.1	2.4%	105.2	2.1%	0.3%
2003	194.6	-2.8%	105.8	0.5%	-3.3%
2004	196.2	0.8%	108.3	2.3%	-1.5%
2005	188.7	-3.9%	111.6	3.0%	-6.9%
2006	193.8	2.7%	114.5	2.6%	0.1%
2007	221.9	13.5%	116.7	1.8%	11.7%
2008	205.8	-7.6%	119.3	2.3%	-9.8%
2009	181.8	-12.4%	121.3	1.7%	-14.1%
Average Annual Growth Rates					
2000-2009		**-1.78%**		**1.93%**	**-3.71%**
2000-2008		**-0.60%**		**1.96%**	**-2.56%**
2000-2007		**0.27%**		**1.93%**	**-1.65%**

NA = Not available

Table 7

X Factor Reflective of Past Gaz Metro Experience

TFP^{C}	Output Differential	X
[A]	[B]	[A + B]
1.656%	-1.655%	0.001%

research suggests that the current X factor was too high for the demand downturn encountered in the last two years of the sample period.

3.4 Custom Input Price Indexes

We developed custom input price indexes for the O&M expenses, capex, and applicable total cost of Gaz Metro. These can be used as escalators in revenue cap and cost benchmark indexes as well in the calculation of the Company's historical productivity trends.

3.4.1 Input Price Subindexes and Costs

The trend in a summary input price index was noted in Section 2.1.3 to be a cost-share weighted average of the growth in subindexes measuring inflation in the prices of certain groups of inputs. Our summary O&M and total cost input price indexes used the same Gaz Metro cost shares, definitions of applicable cost, and cost breakdowns which we used to calculate the input *quantity* indexes.

O&M	Salaries and wages	
	Materials and services	
Capex	Three asset category	
Total Cost	Salaries and wages	
	Materials and Services	
	Capital Cost	Long-Lived Assets
		Developpements Informatiques
		Other Short-Lived Assets

The input price subindexes were also the same as those associated with the input quantity subindexes.

O&M	Salaries & Wages	Quebec salary & wage price index for utilities
	Materials & Services	$GDPIPI^{FDD}_{Quebec}$
Capex	Long-Lived Assets	Capital stock price index for engineering structures of gas and water utilities
	Information Tech.	Commercial software price index
	Other Short-Lived	$GDPIPI^{FDD}_{Quebec}$

Total Cost	Salaries & Wages	Quebec salary & wage price index for utilities
	Materials & Services	$GDPIPI^{FDD}_{Quebec}$
	Capital	Custom, three category capital service price index based on COS formulas

Other inflation measures that we considered for use in the study are discussed further in Appendix Section 6.

Results of our research on the recent input price trends of Gaz Metro are reported in Table 8. It can be seen that over the 2000-2009 sample period salaries and wages for Quebec utility workers averaged 2.58% inflation, well above the 1.78% growth trend of the $GDPIPI^{FDD}_{Quebec}$. Inflation in the summary COS capital *service* price index was fairly stable and averaged 1.80%. Table 5 reports that inflation in the *capex* price index was more volatile and averaged 2.10%.

The difference in the trends in the capex and capital cost price indexes reflects two conditions. One is the effectiveness of our COS capital service price in smoothing the year to year volatility of the capex price index. Construction cost did rise rapidly in the 2005-2007 period, but this affects *overall* capital cost much less than it does capital *expenditures*. The other reason why the capital service price grew more slowly than the capex price is that it reflects, in addition to the trend in the capex price, the trend in the rate of return on plant, which fell substantially during the sample period.

The summary O&M input price index for Gaz Metro averaged 2.32% inflation. This is much closer to the inflation of the labor price than it is to the inflation of $GDPIPI^{FDD}_{Quebec}$ because Gaz Metro has an unusually large reliance on labor services for O&M tasks. The summary input price index for *all* inputs averaged 1.99% inflation.

Our Gaz Metro input price indexes are compared to two candidate macro-economic inflation measures --- the Quebec CPI and $GDPIPI^{FDD}_{Quebec}$ --- in Table 9 and Figure 1. It can be seen that the growth trend in the $GDPIPI^{FDD}_{Quebec}$ was well below that of the summary *O&M* input price indexes and also materially below that of the summary capex price index.

Inflation in the $GDPIPI^{FDD}_{Quebec}$ is much more similar to the inflation in the summary input price index for *total* cost. As noted in Section 2.2.3 above, a result of this kind is more likely in Canada than in the United States because of the slower growth in

Table 8

Calculating Industry-Specific Input Price Indexes

	Costs			Input Price Indexes									
	Labor[1]	Materials & Services[1]	Capital[1]	Labor[2]		Materials & Services[4]		All O&M		Capital		All Inputs	
year	Million $	Million $	Million $	Level	Growth Rate[3]	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate
1998	61.5	32.9	180.8	84.6	NA	92.7	NA	100.0	NA	100.0	NA	100.0	NA
1999	61.2	37.1	180.0	90.9	7.2%	94.0	1.4%	105.2	5.1%	99.3	-0.7%	101.3	1.3%
2000	64.3	37.3	179.6	98.1	7.6%	96.4	2.5%	111.4	5.7%	99.4	0.0%	103.5	2.1%
2001	67.5	37.5	185.3	94.4	-3.8%	97.8	1.4%	109.3	-1.9%	100.9	1.5%	103.8	0.3%
2002	70.9	37.7	189.6	99.9	5.6%	100.0	2.2%	114.3	4.4%	102.0	1.1%	106.1	2.3%
2003	75.5	39.4	194.6	102.6	2.7%	101.8	1.8%	117.0	2.4%	102.9	0.9%	107.7	1.4%
2004	80.9	42.3	201.8	103.2	0.7%	103.1	1.3%	118.0	0.9%	106.4	3.3%	110.3	2.4%
2005	85.1	43.8	210.2	100.5	-2.7%	105.1	1.9%	116.7	-1.1%	109.3	2.7%	111.7	1.3%
2006	88.4	44.8	206.8	100.3	-0.1%	106.5	1.3%	117.1	0.4%	109.9	0.5%	112.2	0.4%
2007	89.7	41.5	209.3	105.5	5.1%	108.6	2.0%	121.9	4.0%	112.8	2.6%	115.8	3.2%
2008	90.8	43.1	210.3	111.4	5.4%	110.8	2.0%	127.3	4.3%	116.3	3.1%	120.0	3.6%
2009	93.9	45.5	209.6	117.7	5.5%	112.3	1.3%	132.7	4.1%	118.9	2.2%	123.6	2.9%
Average Annual Growth Rates 2000-2009					**2.58%**		**1.78%**		**2.32%**		**1.80%**		**1.99%**

NA = Not Available

[1] Source: Gaz Metro

[2] Source: Statistics Canada. Table 281-0039 - Fixed weighted index of average hourly earnings for all employees (SEPH), excluding overtime, unadjusted for seasonal variation, for Quebec utilities industry as classified using the North American Industry Classification System (NAICS). Where this index was not available (in 2008-2009), values were imputed using the growth rates in the comprehensive electric utility construction price index. Source: Statistics Canada. Table 327-0011

[3] All growth rates calculated logarithmically.

[4] Source: Statistics Canada, Gross Domestic Product (GDP) of Quebec at Market Prices, Table 384-0036 - Implicit price indexes, GDP final domestic demand, provincial economic accounts, annual

Table 9

How Selected Macroeconomic Price Indexes Compared to Gaz Metro Input Price Indexes

	Quebec Price Indexes				Summary Gaz Metro Input Price Indexes					
	Consumer Price Index[1]		GDP Implicit Price Index - Final Domestic Demand[2]		Operation & Maintenance		Capital Expenditures[3]		Total	
	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate
1998	92.1	NA	92.7	NA	100.0	NA	100.0		100.0	NA
1999	93.5	1.5%	94.0	1.4%	105.2	5.1%	100.3	0.3%	101.3	1.3%
2000	95.8	2.4%	96.4	2.5%	111.4	5.7%	102.1	1.8%	103.5	2.1%
2001	98.0	2.3%	97.8	1.4%	109.3	-1.9%	102.5	0.4%	103.8	0.3%
2002	100.0	2.0%	100.0	2.2%	114.3	4.4%	102.9	0.4%	106.1	2.3%
2003	102.5	2.5%	101.8	1.8%	117.0	2.4%	102.0	-0.9%	107.7	1.4%
2004	104.5	1.9%	103.1	1.3%	118.0	0.9%	105.6	3.5%	110.3	2.4%
2005	106.9	2.3%	105.1	1.9%	116.7	-1.1%	110.5	4.5%	111.7	1.3%
2006	108.7	1.7%	106.5	1.3%	117.1	0.4%	116.1	4.9%	112.2	0.4%
2007	110.4	1.6%	108.6	2.0%	121.9	4.0%	121.4	4.5%	115.8	3.2%
2008	112.7	2.1%	110.8	2.0%	127.3	4.3%	122.8	1.2%	120.0	3.6%
2009	113.4	0.6%	112.3	1.3%	132.7	4.1%	123.8	0.8%	123.6	2.9%
Average Annual Growth Rate 2000-2009		**1.93%**		**1.78%**		**2.32%**		**2.10%**		**1.99%**

NA = Not Available

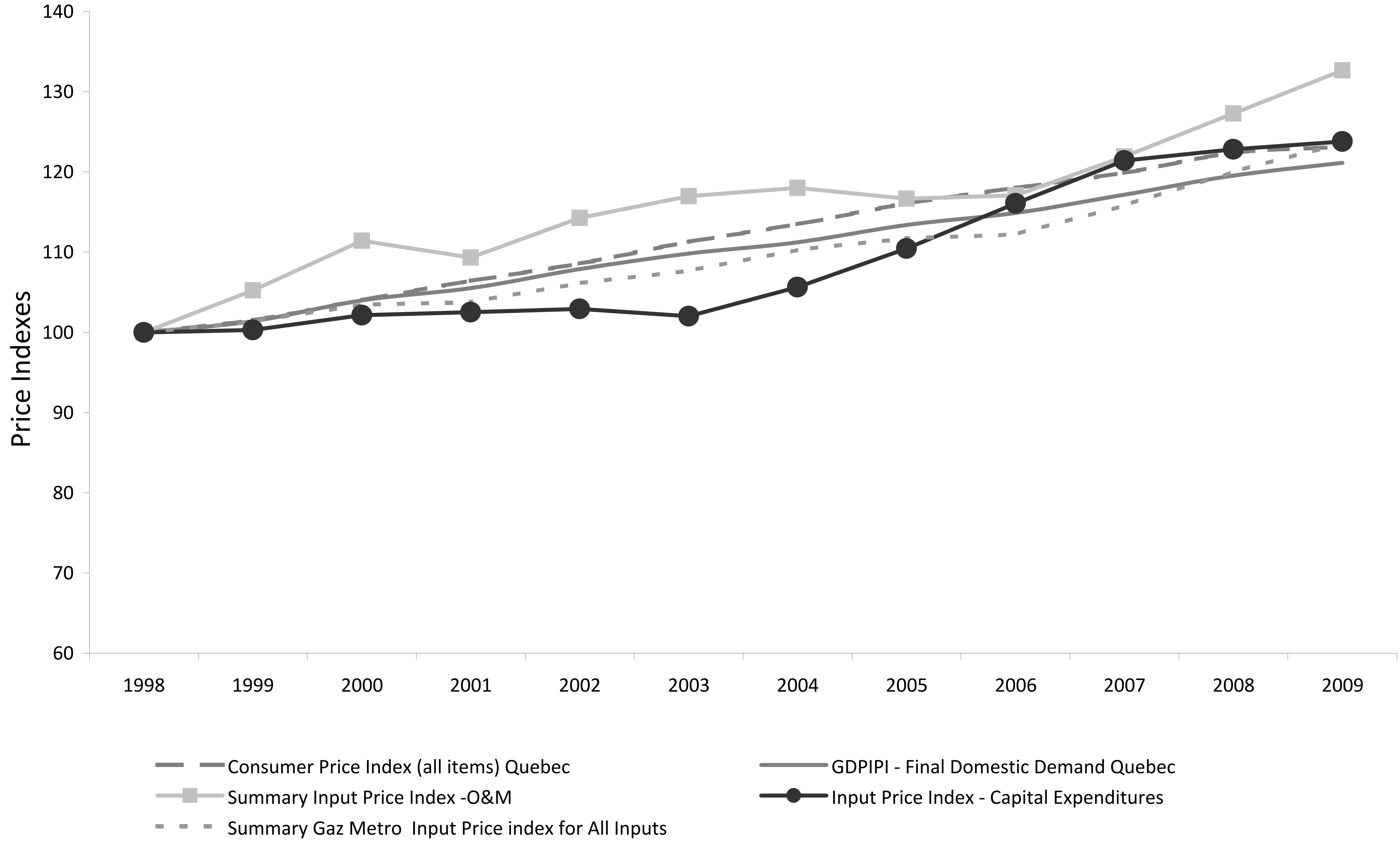
[1] Source: Statistics Canada. Table 326-0021 - Consumer Price Index (CPI) of Quebec, 2005 baskets, annual (index, 2000=100)

[2] Source: Statistics Canada. Table 384-0036 - Implicit price index, gross domestic product, final domestic demand (GDP FDD) of Quebec, provincial economic accounts, annual (index, 2000=100)

[3] Source: Statistics Canada. Table 383-0025 - Canadian Natural Gas Distribution, Water, and Other Systems Capital Stock Price (index, 2000=100). 1998-2007.
Where this index was not available (in 2008-2009), values were imputed using the growth rates in the electric utility construction price index. Source: Statistics Canada. Table 327-0011

Figure 1

How Selected Macroeconomic Price Indexes Compared to Gaz Metro Input Price Indexes



the productivity of the Canadian economy. Growth in the $GDPIPI^{FDD}_{Quebec}$ does reflect the productivity growth of the Canadian economy, but this has actually been slightly negative in recent years.

Considering, additionally, the substantial complexity of a summary input price index for total cost, which involves several input categories and a capital service price, we recommend using the Quebec $GDPIPI^{FDD}$ as the inflation measure in any *comprehensive* revenue or cost benchmark index that might ultimately be adopted for Gaz Metro. Our research suggests that there is no need for an inflation differential term in the X factor of such an index. On the other hand, the comparatively simple custom input price indexes that we have developed for Gaz Metro's O&M expenses and capex are recommended for any benchmark indexes for these costs that might be adopted.

3.4.2 Implementation Issues

Recall from Section 3.3.3 that annual growth rates in the capital stock price index for the engineering structures of gas and water utilities are not released for several years. We used the growth in Stats Canada's summary construction cost index for *power* distribution for the last two years as a replacement in the historical sample. We recommend this index as at least a *provisional* escalator for Gaz Metro's proposed capex benchmark index. Use of this alternative index raises the question of whether capex awards (and any penalties) should be revised when the preferred gas and water capital stock price index numbers are released. This would improve the fairness of the cost benchmark escalator but increase the complexity of plan administration.

Another implementation issue is whether the cost shares on the O&M input price index should be periodically updated if such an index is used in an O&M benchmark index. Freezing the cost shares at their 2009 level would simplify operation of the IR plan and strengthen Gaz Metro's performance incentives. An alternative approach meriting consideration would be to assign 50/50 weights to the labor and M&S price indexes. This would be uncompensatory to Gaz Metro at the outset, and it is probably unreasonable to assume that the Company's labor cost share is too high.

4. Other Research

4.1 Forward-Looking Productivity Growth Targets

X factors were noted in Section 2.2 to be conventionally calculated using an estimate of the productivity trend of a group of utilities. The productivity trends of utilities in the same region as the subject utility are often used for this purpose.[22] This approach isn't feasible in the case of Gaz Metro, for several reasons.

- Standardized data are unavailable that would enable us to calculate the productivity trends of other Canadian gas distributors, such as Enbridge, Union, ATCO, or Terasen.
- Most gas distributors in nearby areas of the United States (*e.g.,* the Northeast) face a considerably different set of business conditions that include more extensive cast iron and/or bare steel mains, slower customer growth, and substantially higher residential customer density.

We have developed an alternative approach to establishing productivity targets that sidesteps these challenges. This approach combines our econometric research on U.S. gas distributor cost elasticities --- first discussed in Section 3.3.2 and explained further in the Appendix Section A.3 --- with Denny, Fuss, and Waverman's mathematical analysis of the sources of productivity growth. Econometric estimates of cost model parameters are used to calculate the productivity growth that would typically be achieved by U.S. gas distributors given Gaz Metro's own business conditions. We have used this general approach as an aid to setting productivity targets in work for the OEB and the ESC. A forward-looking analysis is possible which integrates Gaz Metro forecasts of its future business conditions.

Our econometric analyses of O&M expenses, capex, and total cost all identified only two sources of productivity growth that need be considered in a forward-looking projection for Gaz Metro: technical change and the realization of scale economies from output growth. Our research also revealed that the productivity growth of gas distributors

[22] The X factor in the current price cap index for Central Maine Power, for instance, is based on the productivity trend of power distributors in the northeast United States.

is affected by growth in electric customers and changes in reliance on cast iron and bare steel mains, but these are not germane to the situation of Gaz Metro.[23] The productivity growth target formula is thus

Growth Productivity = Technical change + Scale Economy Effect. [24]

We used as our proxy for Gaz Metro's technical change potential the (negative of) the trend variable parameter estimate from the appropriate econometric model. We added to this the estimated scale economy effect that would result from Gaz Metro's forecast of growth in its customers and line kilometers in the next few years.

In the Denny Fuss and Waverman theory, the effect of incremental scale economies on productivity growth is given by the formula

Scale Economy Effect = (*1 – SUM Output Elasticities*) x *growth* $\textit{Outputs}^{C}$. [25]

The scale economy effect thus depends on two conditions. One is the possibility of incremental scale economies from output growth. This depends on the sum of the output-related cost elasticities. The intuition for this is that, if these elasticities sum to less than one, cost grows less rapidly than output. If the elasticities sum to 0.80, for instance, 1% output growth is achieved with only 0.8% cost growth and productivity growth increases by 20 basis points. The second determinant of the scale effect is the pace of output growth. Provided that incremental scale economies are possible, these economies will be greater the more rapid is output growth. Output should be measured by a cost-based output metric. We measured future output growth using the same output formulas that we used to calculate Gaz Metro's historical productivity growth.

Results of this analysis are reported in Table 10. It can be seen that the forward-looking productivity growth projection for O&M expenses is 1.55% annual growth. This is well above what the Company has recently achieved but very similar to the O&M productivity growth target in the first IR plan of Gazifere. The 1.92% and 1.11% productivity growth targets for capex and total cost, respectively, are well below the productivity growth that Gaz Metro recently achieved. The 1.11% TFP growth target is very similar to the 1.18% trend in the TFP^{C} of U.S. gas distributors which we reported in

[23] It is noteworthy that the application of our general productivity growth target methodology to all of the distributors in our U.S. sample yielded an average productivity growth target that was similar to the average productivity index trend that we reported in our recent California testimony.

Table 10

Calculating External Productivity Targets for Gaz Metro: Standard Elasticities

	Estimated Trend Effect	Scale Economy Effect: Estimated Elasticity Weight	Forecasted Output Growth[1]: Total Customers	Forecasted Output Growth[1]: Change in Customers	Forecasted Output Growth[1]: Line Miles	Forecasted Output Growth[1]: Change in Line Miles	Forecasted Output Growth[1]: Summary Output Index	SUM Elasticities	Scale Economy Effect	Forward Productivity Growth Target
	[A]						[B]	[C]	[D=B*(1-C)]	[A+D]
		Gaz Metro Elasticity Share:	100.0%							
O&M Expenses	1.16%		2.00%				2.00%	0.80	0.39%	1.55%
		Gaz Metro Elasticity Share:	11.60%	24.20%	48.33%	15.87%				
Capex	1.82%		2.00%	2.00%	1.80%	1.80%	1.87%	0.95	0.10%	1.92%
		Gaz Metro Elasticity Share:	73.85%		26.15%					
Total Cost	0.81%		2.00%		1.80%		1.95%	0.85	0.30%	1.11%

[1] Forecasts prepared by Gaz Metro

our recent California testimony. Gaz Metro has more potential to realize incremental scale economies than the typical firm in our U.S. sample but has no opportunity to realize productivity gains from growth in the number of electric customers. Should the Task Force desire an external TFP target without the econometric methodology we used for the forward looking targets, the 1.18% growth trend in the TFP^C of U.S. gas distributors is a sensible alternative.

4.2 Stretch Factor

The stretch factor term of the X factor was noted in Chapter 2 to facilitate the sharing, between utilities and customers, of any benefits that are expected to result from the stronger performance incentives that are generated by an IR plan. We have relied on three sources in developing our stretch factor recommendation. One is historical precedent. Our research over the years has revealed that the average explicit stretch factor approved for rate and revenue indexing plans of North American energy utilities is around 0.50%. For example, a 0.50% "facteur de productivite additional" was approved by the Regie for the X factor in the first IR plan for Gazifere.

A second substantive basis for choosing stretch factors is incentive power research. We have developed an incentive power model that estimates the typical cost performance improvements that will be achieved by utilities under stylized regulatory systems. The use of numerical analysis permits us to consider regulatory systems of considerable relevance.[24] Clients who have supported the development of this model have included Sempra Energy, the Ontario Energy Board, and several Canadian utilities. We can use the model to compare the expected performance gains, under any proposed IR plan, to the gains expected under the typical regulatory systems of the companies in the U.S. gas distributor sample that we used to make forward-looking productivity growth targets. The last step in the analysis is to share via the stretch factor the expected benefits of any strengthening of performance incentives that would result from a more incentivized regulatory system.

[24] For example, we can consider the incentive power of a five year revenue cap with a 50/50 earnings sharing mechanism and an efficiency carryover mechanism between rate plans.

Based on our experience, we believe that gas distributors in our U.S. sample held rate cases about every three years on average during the sample period we used to estimate our econometric models. Earnings sharing mechanisms were uncommon. We are interested in the performance improvement in moving from this kind of regulatory system to the regulatory systems that are under consideration for Gaz Metro.

One complication that we encounter in considering the regulatory systems under consideration for Gaz Metro is that it is difficult, using the numerical analysis in our incentive power research, to model a regulatory system that involves only awards and no penalties. The results we present here assume for simplicity that there is symmetrical 50/50 sharing of all deviations between the Company's costs and index-based revenue requirements or cost benchmarks. With this modification, the incentive power impact of the kind of cost benchmarking plan that Gaz Metro is proposing are similar to those from an update of the current comprehensive revenue cap.[25]

Our incentive power research suggests that a three year rate case cycle with no earnings sharing will produce cost performance gains averaging about 0.90% in the longer run. The benefits of Gaz Metro's new regulatory system depend on the frequency of a full cost true up, such as would result if a rate case would occur between plan updates. Although the Company indicates an interest in eliminating full cost true ups, we assume here that true ups will occur every seven years. Assuming additionally symmetric 50/50 sharing, our incentive power model predicts typical long run performance gains of 1.33%. A stretch factor equal to *all* of the predicted acceleration in annual performance improvement is 1.33 – 0.90 = 0.43%. A stretch factor equal to *half*

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[25] Suppose, for example, that rates are initially set on the basis of a cost forecast ($Cost^{Forecasted}_t$) and that there is a subsequent full true up with interest for the deviation of actual cost ($Cost^{Actual}_t$) from the forecast. Suppose also that rates are, additionally, subject to symmetrical 50/50 sharing of the deviation of actual O&M expenses (COM^{Actual}_t) and capital cost (CK^{Actual}_t) from corresponding index-based cost benchmarks (COM^{Target}_t and CK^{Target}_t). It can then be shown that the net present value of revenue earned from activity in each year t is given by

$$
\begin{aligned}
Revenue_t &= Cost^{Forecasted}_t + (Cost^{Actual}_t - Cost^{Forecasted}_t) \\
&\qquad -0.50\,(COM^{Actual}_t - COM^{Target}_t) - 0.50\,(CK^{Actual}_t - CK^{Target}_t) \\
&= Cost^{Actual}_t - 0.50[(COM^{Actual}_t + CK^{Actual}_t) - (COM^{Target}_t + CK^{Target}_t)] \\
&= Cost^{Actual}_t - 0.50\,(Cost^{Actual}_t - Cost^{Target}_t) \\
&= Cost^{Actual}_t - 0.50\,(Cost^{Actual}_t - Cost^{Target}_t) + (Cost^{Target}_t - Cost^{Target}_t) \\
&= Cost^{Target}_t + 0.50\,(Cost^{Target}_t - Cost^{Actual}_t).
\end{aligned}
$$

of the performance gains is 0.5 * 0.43 = 0.22. We have traditionally advocated for half of the performance gains to be shared with customers via the stretch factor.

A final consideration in considering a stretch factor for Gaz Metro's new Performance Incentive Mechanism is the *level* of productivity that Gaz Metro has already achieved. Recall from our discussion in Section 2.1 that a high level of initial efficiency reduces prospects for reductions in X-inefficiency. This is an empirical issue, and Gaz Metro has not to our knowledge filed a rigorous study of its operating efficiency. However, it is noteworthy that the Company averaged productivity growth in the last ten years that is well above the norm for U.S. gas distributors. The Regie approved 0.20% and 0.30% "facteurs de productivite addionelles" in the second and third mechanismss incitatifs of Gazifere.

All things considered, the indicated range of potential stretch factors when the X factor is based on our forward looking external productivity growth projections is [0.20, 0.50]. If the Company's own historical productivity growth trend is used to set X, our research indicates no need for a stretch factor if there is symmetrical 50/50 sharing since the new Performance Incentive Mechanism would have the same incentive power as the old mechanism.

5. Summing Up

5.1 Revenue Cap

If the Task Force chooses a *comprehensive* revenue cap or cost benchmark index for Gaz Metro, we recommend one based on the cost efficiency metric TFP^{C} rather than a revenue-based metric such as that required for the Company's current Performance Incentive Mechanism. This would be more in line with the current revenue cap of Enbridge. Such an index would have the following general form:

$$growth\ Cost = growth\ GDPIPI^{FDD}{}_{Quebec} - X + growth\ Outputs^{C}. \qquad [20]$$

Our research did not indicate the need for a custom input price index.

Our research also suggests that the output measure in the total cost escalator should be the two-category elasticity-weighted output index that we used to measure Gaz Metro's TFP^{C}. The following alternative and simpler formula would be even more similar to that in the revenue cap of Enbridge:

$$growth\ Cost/Customer = growth\ GDPIPI^{FDD}{}_{Quebec} - X. \qquad [21]$$

We do not, however, recommend replacing the X factor with a "% of GDPIPI growth" term like that in the current Enbridge and Gazifere revenue caps. TFP growth potential does not rise and fall with inflation. The Company would experience a windfall gain in periods of unusually slow inflation and a windfall loss in periods of hyperinflation. Operating risk would be increased, raising the indicated WACC.

The X factor in [20] (or [21]) can be calculated using the following formula.

$$X = target\ TFP^{C} + (trend\ GDPIPI^{FDD}{}_{Quebec} - trend\ Input\ Prices^{Gaz\ Metro}) + Stretch$$

Our research suggests that the TFP^{C} growth target should lie in the [1.11%-1.67%] range. The limitations of our capital cost data for Gaz Metro, as well as incentive problems down the road, raise concern about the use of the Company's own productivity trend as a productivity target. The stretch factor should lie in the [0.20%-0.50%] range. There is no need for an inflation differential.

5.2 Index-Based Cost Targets

Should the Task Force instead choose index-based cost benchmarks for O&M and capital spending, as Gaz Metro proposes, it should recognize the special difficulties in developing productivity targets for components of total cost. Gaz Metro had unusually slow O&M productivity growth and unusually rapid capex productivity growth during the sample period. The Company's *future* O&M and capex productivity trends may be quite different from these trends. For example, it may need to accelerate capital spending to replace aging facilities, and this may stimulate growth in O&M productivity. The Company has in fact proposed to increase replacement capital spending. Consider also that the inherent instability of the Company's capex productivity makes its productivity trend very sensitive to the sample period.

These are arguments in favor of the external, forward looking productivity growth targets that we have developed using U.S. data. The adoption of these targets is tantamount to assuming a reversion to more normal productivity growth trends of U.S. gas distributors. However, these targets may not provide a capex benchmark that is commensurate with the new investment program that Gaz Metro has proposed.

5.2.1 O&M Expenses

An index-based O&M cost benchmark for Gaz Metro should have the following escalation formula:

$$\text{growth } Cost^{O\&M}/Customer = \text{growth Input } Prices^{OM}{}_{Gaz\ Metro} - X. \qquad [22]$$

Recall that our research did not indicate a need for an elasticity-weighted output index for O&M expenses. We once again do not recommend replacing X with a share of inflation term. O&M productivity growth does not rise and fall with inflation.

The X factor in [22] can be calculated using the following formula.

$$X = \text{target } TFP^{C}{}_{O\&M} + Stretch$$

Our research suggests that the productivity target should lie in the [0.75%, 1.55%] range. The stretch factor should once again lie in the [0.20%-0.50%] range.

5.2.2 Capex

Should the Task Force choose an index-based capex benchmark for Gaz Metro, the escalator should have the following general form.

$$\text{growth } Capex = \text{growth Input } Prices^{Capex} - X + \text{growth } Outputs^{C}. \qquad [23]$$

Our research suggests that the number of customers served is not an adequate output variable for such a model. We instead recommend the four-category elasticity-weighted output index that we used to measure the capex productivity of Gaz Metro. We once again do not recommend replacing X with a share of inflation term. Capex productivity growth does not rise and fall with inflation.

The X factor in [23] can be calculated using the following formula:

$$X = target\ Productivity^{Capex} + Stretch.$$

Our research suggests that the productivity target should lie in the [1.92%-2.38%] range. The stretch factor should once again lie in the [0.20%-0.50%] range.

5.3 Suggestions for Further Research

Modest improvements in accuracy and relevance research results can be obtained with steps such as the following.

- Productivity trend results for Gaz Metro can be extended to 2010.
- The start date of the O&M productivity index can be extended further into the past because it doesn't require line kilometer data.
- We could upgrade the line mile variable in order to assign greater weight to transmission line and larger mains.
- Small refinements in the capital cost treatment may improve the ability of our index to track the capital costs that Gaz Metro actually incurred during the sample period.

Note that these tasks would involve additional expense and delay the finalization of the research project.

Appendix

This Appendix contains additional details of our research. Sections A.1 and A.2 discuss our input and output quantity indexes respectively. Details of our econometric cost research using U.S. data are provided in Section A.3. Section A.4 discusses the calculation of capital cost. Section A.5 addresses our method for calculating productivity growth rates and trends. The Appendix concludes in Section A.6 with details of our input price research.

A.1 Input Quantity Indexes

A.1.1 Index Form

The summary input quantity indexes for O&M and total cost were of Törnqvist form.[26] This means that their annual growth rates were determined by the following general formula:

$$\ln\left(\frac{Inputs_t}{Inputs_{t-1}} \right) = \sum_j \frac{1}{2} \cdot \left(sc_{j,t} + sc_{j,t-1} \right) \cdot \ln\left(\frac{X_{j,t}}{X_{j,t-1}} \right). \qquad \text{[A1]}$$

Here in each year *t*,

$Inputs_t$ = Summary input quantity index

$X_{j,t}$ = Quantity subindex for input category *j*

$sc_{j,t}$ = Share of input category *j* in the applicable cost.

It can be seen that the growth rate of the index is a weighted average of the growth rates of the input quantity subindexes. Each growth rate is calculated as the logarithm of the ratio of the quantities in successive years. Data on the average shares of each input in the applicable cost of Gaz Metro in the current and prior years served as weights.

A.1.2 Input Quantity Subindexes

The approach used in this study to measure the trend in O&M input quantities relies on the theoretical result in relation [10] in Section 2.2.1 that the growth rate in the

[26] For seminal discussions of this index form see Törnqvist (1936) and Theil (1965).

cost of any class of input *j* is the sum of the growth rates in appropriate input price and quantity indexes for that input class. In that event,

$$growth\ Inputs_j = growth\ Cost_j - growth\ Input\ Prices_j\ . \qquad [A2]$$

A.2 Output Quantity Indexes

Our econometric research indicated the need for multi-category output indexes to measure capex productivity and TFP^C. These indexes were determined using the following general formula.

$$\ln\left(\text{Outputs}^{C}{}_{t} \Big/ \text{Outputs}^{C}{}_{t-1}\right) = \sum_i \text{se}_i \cdot \ln\left(\text{Y}_{i,t} \Big/ \text{Y}_{i,t-1}\right). \qquad [A3]$$

Here in each year *t*,

$Outputs^{C}{}_{t}$ = Output quantity index

$Y_{i,t}$ = Amount of output i

se_i = Share of output measure *i* in the sum of the estimated total cost elasticities.

It can be seen that the growth rate of the summary output index is a weighted average of the growth rates of the output subindexes. Each growth rate is calculated as the logarithm of the ratio of the quantities in successive years. The weight for each output quantity measure is its share in the sum of our estimates of the elasticities of the applicable cost with respect to the output variables.

It is challenging to calculate elasticity shares that are appropriate for Gaz Metro using data on the operations of U.S. utilities. This is chiefly due to the fact that Gaz Metro has an extraordinarily low number of residential customers relative to the extensiveness of its system. We tried to finesse this problem in the capex and total cost productivity research through the following two-step procedure. We first calculated the marginal costs that correspond to the estimates of cost elasticities in our econometric cost models. Following an adjustment for currency differences and inflation since the midpoint of the econometric sample period, cost elasticities were then calculated using

Gaz Metro's cost and output levels.[27] The resultant elasticity weights for customers and line miles in the output index for total cost were about 74% and 26% respectively. The resultant elasticity weights for customers, growth in customers, line miles, and growth in line miles in the output index for capex were 12%, 24%, 48%, and 16% respectively.

A.3 Econometric Work

Econometric research with data on the operations of U.S. gas distributors was used to develop cost-based output indexes and forward looking productivity growth projections for Gaz Metro. This section provides further details of the econometric work. We begin with a discussion of the data and then turn to consideration of cost model specification, parameter estimates, and estimation procedures.

A.3.1 Data

Diverse data sources were used in our econometric cost research. Data for years prior to the start of the econometric sample period, which we use to calculate capital cost, were drawn from Uniform Statistical Reports that U.S. gas distributors filed with the American Gas Association.[28] The number of distributors that file these reports and release them to the public has always been limited and has declined over the years. The development of a good sample has therefore required us to obtain cost and quantity data from other sources including, most notably, annual distributor reports to state regulators. These reports are fairly standardized since they often use the Form 2 that interstate gas pipeline companies file with the Federal Energy Regulatory Commission. The chief source for our data on the output of US gas distributors was Form EIA 176. Data from all of these sources are compiled by commercial vendors. We obtained our data for the sample years of this study from one of the most respected vendors, SNL Financial.[29]

US price data used in the study were drawn from Whitman, Requardt & Associates, the Regulatory Research Associates unit of SNL Financial, the Bureau of

[27] For each output variable i, the custom elasticity formula was

$$elasticity_i = \text{marginal cost}_i^{US} \cdot \frac{Output_i^{Gaz\ Metro}}{Cost^{Gaz\ Metro}}$$

[28] USR data for some variables of interest are aggregated and published annually by the Association in *Gas Facts*.

[29] Where SNL data were insufficient we used data from other sources that we have used in the past such as GasDat.

Labor Statistics ("BLS") of the U.S. Department of Labor, the Bureau of Economic Analysis ("BEA") of the U.S. Department of Commerce, the Federal Reserve Bank, and Global Insight (formerly DRI-McGraw Hill). Data on the miles of transmission lines and distribution mains owned by distributors were obtained from the American Gas Association ("AGA").

Our econometric research used a sample of data on the operations of 33 distributors. This is a sample for which quality data are available for the rigorous calculation of capital cost and prices as well as O&M expenses. The sample includes most of the larger U.S. distributors. Some of the sampled distributors also provide gas transmission and/or storage services but all were involved more extensively in gas distribution. The sampled companies are listed in Table A-1. The sample period for the econometric work was noted above to be 1998-2008. The resultant data set has 363 observations.[30] This sample is large and varied enough to permit identification of numerous drivers of gas distributor cost, as well as reasonably accurate estimation of their cost impact.

A.3.2 Definition of Variables

Cost

The costs addressed in the econometric work were non-fuel O&M expenses, capex, and capital costs. The non-fuel O&M expenses considered consisted of total gas utility O&M expenses less all reported expenses for gas production and purchase, gas transmission by others, compressor station fuel, customer service and information, employee pensions and benefits, and franchise fees. Capital costs consisted of amortization, depreciation, and return on net plant value. Taxes were excluded. Capital cost was calculated using the COS method.

Output

Only one statistically significant output measure was identified in the O&M cost research: the number of customers served. The number of customers, the expected change in customers, line miles, and the expected change in line miles were identified as

[30] Some observations for sample companies were excluded due to data problems.

Table A-1

SAMPLE OF GAS DISTRIBUTORS USED IN THE EMPIRICAL RESEARCH

Baltimore Gas and Electric	Orange and Rockland Utilities
Boston Gas	Pacific Gas and Electric
Brooklyn Union Gas	PECO Energy
Cascade Natural Gas	Peoples Gas Light and Coke
Central Hudson Gas & Electric	Peoples Natural Gas
Connecticut Natural Gas	Public Service Electric and Gas
Consolidated Edison Company of New York	Public Service Company of Colorado
East Ohio Gas	Public Service Company of North Carolina
Gaz Metro	Puget Sound Energy
Louisville Gas and Electric	Questar Gas
Madison Gas and Electric	Rochester Gas and Electric
New Jersey Natural Gas	San Diego Gas & Electric
Niagara Mohawk Power	Southern California Gas
North Shore Gas	Southern Connecticut Gas
Northern Illinois Gas	Washington Gas Light
Northwest Natural Gas	Wisconsin Gas
	Wisconsin Power and Light

Number of companies: 33

output measures in the capex research. Both of the expected change variables were calculated as three year moving averages of the annual growth in customers in the current year and the two following years. The number of customers and the total miles of transmission lines and distribution mains were identified as output variables in the total cost research. We expect cost to be higher the higher output is. The parameters of all of these variables should therefore have positive signs.

Input Prices

Cost theory also indicates that the prices paid for production inputs are relevant business condition variables. In the non-fuel O&M cost research we used a summary O&M input price index.[31] In the capex research we used a single-category capex price index. In the total cost research we used a summary index that encompassed prices of capital as well as O&M inputs.

The O&M input price index was constructed by PEG Research from U.S. price indexes for labor and materials and services. We developed the labor price index from BLS data. Occupational Employment Survey ("OES") data for 2004 were used to construct average wage rates for the service territory of each sampled distributor. These were calculated as a weighted average of the OES pay level for several job categories using weights that correspond to the gas distribution sector of the U.S. economy. Values for other years were calculated by adjusting the level in 2004 for the estimated inflation in the regional salaries and wages of utility workers. The estimated inflation was calculated from BLS employment cost indexes.

Prices for material and service ("M&S") O&M inputs were assumed to have a 25% local labor content and therefore tend to be a little higher in regions with higher labor prices. We used the 2004 labor price levelization just explained to achieve this. Values for other years were calculated by adjusting the level in 2004 for the inflation in gas utility M&S input price indexes found in the Global Insight *Power Planner*.

An O&M input price index is normally constructed by combining labor and M&S input prices using utility-specific cost share weights. However, data were unavailable for

[31] In estimating each cost model we divided cost by the appropriate summary input price index. This is commonly done in econometric cost research because it simplifies model estimation and enforces the relationship between cost and input prices that is predicted by economic theory.

many distributors on the breakdown of O&M expenses between M&S expenses and salaries and wages during the sample period. To rectify this problem we calculated separate O&M input price subindexes for distributor transmission, storage, and distribution, customer care (customer accounts and sales), and general administration. The cost share weights for each of these activities were, for sampled utilities lacking the necessary data, the typical breakdown of O&M expenses into salaries and wages and materials and services for distributors in the sample for which these data were available. We then constructed summary O&M input price indexes using utility specific cost share weights for each LDC activity.

The construction of the COS capital service price required data on capex prices and the rate of return on plant. The rate of return on plant was a 50/50 average of a bond yield and a rate of return on equity ("ROE"). For the bond yield, we used the average annual yield on Baa-rated bonds as calculated by Moody's Investor Service and reported by the Federal Reserve Bank. We used as the return on equity the annual average of the effective allowed ROEs, for a large sample of distributors, which were approved by their regulators. These ROE data were obtained from Regulatory Research Associates.

We calculated an index of market construction costs which was allowed to vary between the service territories of sampled distributors in 2009 in proportion to the relative cost of construction as measured by the total (material and installation) City Cost Indexes published in *RS Means Heavy Construction Cost Data 2010.* The market construction cost index values for earlier years were determined for each company using the rates of inflation in the appropriate regional Handy Whitman construction and equipment cost index for total gas utility plant.[32]

Other Business Conditions

Four other business condition variables are included in the O&M cost model. One is the number of customers that receive electric service from the distributor. This variable is intended to capture the extent to which the company has diversified into power distribution. Such diversification will typically lower reported gas utility cost due to the

[32] Whitman, Requardt and Associates, *Handy-Whitman Index of Public Utility Construction Costs* (Baltimore Whitman, Requardt and Associates, various issues).

realization of scope economies. These economies occur when inputs are shared in the provision of multiple services. The extent of diversification is greater the greater is the number of electric customers. We would therefore expect the value of this variable's parameter to be negative.

A second business condition variable in the O&M cost model is the share of the total miles of transmission line and distribution main that are made of cast iron. These are calculated from the AGA line mile data. Cast iron and bare steel pipe were common in gas system construction in the early days of the industry. They are still extensively used in the older distribution systems found in the Midwest and the East. Greater use of cast iron and bare steel tends to raise O&M expenses. The sign for each variable's parameter should therefore be positive.

A third additional business condition variable is a binary variable that indicates whether a company serves a densely settled urban core in addition to or instead of suburbs and small towns. Gas service is generally more costly in urban cores. Accordingly, we expect the parameter of this variable to have a positive sign.

The O&M cost model also contains a trend variable. This permits predicted cost to shift over time for reasons other than changes in the specified business conditions. The trend variable captures the net effect on cost of diverse conditions, such as technological change, that are otherwise excluded from the model. Parameters for such variables typically have a negative sign in statistical cost research.

The capex model contains the following five additional business condition variables.

- Number of electric customers
- Share of line miles cast iron
- Share of line miles bare steel
- Urban core dummy
- Trend variable

As in the O&M cost model, the number of electric customers, the urban core dummy, and the trend variable are expected to have negative, positive, and negative signs respectively. The shares of distribution miles that are cast iron and bare steel should both have positive parameters.

The total cost model has the following four additional business condition variables.

- Number of electric customers
- Average (non time-varying) share of line miles cast iron
- Urban core dummy
- Trend variable

The number of electric customers, the urban core dummy, and the trend variable have the same expected signs as in the O&M and capex models. Cast iron mains raise O&M expenses but lower capital costs due to their advanced depreciation. The parameter for the cast iron variable therefore cannot be predicted in the total cost model.

A.3.3 Parameter Estimates

Estimation results for the O&M, capex, and total cost models are reported in Tables A-2, A-3, and A-4, respectively. In all of the tables, the parameter values for the output variables are elasticities of the cost with respect to these variables at sample mean values of the business conditions. The table also reports the values of the t statistic and p value that correspond to each parameter estimate. A parameter estimate is deemed statistically significant if the hypothesis that the true parameter value equals zero is rejected. This statistical test requires the selection of a critical value for the test statistic.

In this benchmarking study we employed critical values appropriate for a 90% confidence level in a large sample. The critical value of the t statistic corresponding to this confidence level is about 1.645. The corresponding critical value for the p value is 0.10. An estimate with a t statistic of 1.645 or greater and a p value of 0.10 or less is statistically significant at a confidence level of at least 90%. The test statistics were used in model specification. All business condition variables were required to have statistically significant and plausible parameter estimates.

Table A-2

Econometric Model of O&M Expenses

VARIABLE KEY

N = Number of Gas Customers
E = Number of Electric Customers
UC = Urban Core Binary Variable
CI = % Cast Iron Distribution Miles
Trend = Time Trend

EXPLANATORY VARIABLE	ESTIMATED COEFFICIENT	T-STATISTIC	P-VALUE
N	0.800	66.19	0.000
E	-0.014	-8.69	0.000
UC	0.147	6.75	0.000
CI	0.090	13.29	0.000
Trend	-0.012	-4.70	0.000
Constant	6.883	175.56	0.000

System Rbar-Squared	0.939
Sample Period	1998-2008
Number of Observations	363

Table A-3

Econometric Model of Capital Expenditure

VARIABLE KEY

N = Number of Gas Customers
CN = Change in Number of Customers
M = Miles of Main
CM = Change in Miles of Main
UC = Urban Core Binary Variable
CI = % Cast Iron Miles
BS = % Bare Steel Miles
E = Number of Electric Customers
Trend = Time Trend

EXPLANATORY VARIABLE	ESTIMATED COEFFICIENT	T-STATISTIC	P-VALUE
N	0.339	4.64	0.000
CN	0.044	2.05	0.042
M	0.530	6.49	0.000
CM	0.035	2.96	0.003
UC	0.094	2.10	0.037
CI	0.123	5.21	0.000
BS	0.041	2.66	0.008
E	-0.008	-2.49	0.013
Trend	-0.018	-3.17	0.002
Constant	6.846	80.91	0.000

System Rbar-Squared	0.807
Sample Period	1998-2007
Number of Observations	264

Table A-4

Econometric Model of Total Cost

VARIABLE KEY

N = Number of Gas Customers
M = Miles of Main
UC = Urban Core Binary Variable
E = Number of Electric Customers
CI = % Cast Iron Distribution Miles
Trend = Time Trend

EXPLANATORY VARIABLE	ESTIMATED COEFFICIENT	T-STATISTIC	P-VALUE
N	0.757	42.623	0.000
M	0.089	3.445	0.001
UC	0.100	5.740	0.000
E	-0.004	-2.429	0.016
CI	0.069	6.323	0.000
Trend	-0.008	-6.123	0.000
Constant	12.504	435.444	0.000

System Rbar-Squared	0.957
Sample Period	1998-2008
Number of Observations	363

O&M Cost Model

Examining the results in Table A-2 it can be seen that a 1% increase in the number of customers raised cost by about 0.80%. This indicates the availability of substantial incremental scale economies from customer growth. 1% growth in the number of customers raised productivity growth by about 20 basis points. Here are the results for the other business conditions.

- Reported gas distributor O&M expenses were lower the greater were the number of electric customers served.
- Expenses were higher the greater was the share of mains made of cast iron
- Expenses were higher for distributors serving urban cores.
- Cost shifted downward over time by 1.16% annually due to technological change and other conditions that are not itemized in the model.

The table also reports the adjusted R^2 statistic for the model. This measures the ability of the model to explain variation in the sampled costs of distributors. Its value was 0.94, suggesting that the explanatory power of the model was high.

Capex Model

The results reported in Table A-3 for capex are also sensible. At the sample mean, a 1% increase in the number of customers raised capex by about 0.34%. A 1% increase in expected customer *growth* raised capex by 0.04%. A 1% increase in line miles raised capex by 0.53%. A 1% increase in expected line mile growth raised capex by 0.04%. The sum of these elasticities was 0.95, indicating the availability of modest incremental scale economies from output growth. 1% growth in all four output variables would increase capex productivity by about 5 basis points.

The estimates of the parameters of the other business conditions were also sensible.

- Capex was higher the greater was the percentage of mains made of cast iron or bare steel.
- Capex was higher for distributors that served a core urban area.
- Capex shifted downward over time by about 1.8% annually for reasons not otherwise explained in the model.

The 0.807 adjusted R^2 suggests that the explanatory value of the model was fairly high.

Total Cost Model

As for the total cost model, at the sample mean a 1% increase in the number of customers raised cost by 0.76%. A 1% increase in miles of transmission line and distribution main raised cost by about 0.09%. The sum of the two output elasticities was 0.85%, indicating the availability of modest incremental scale economies from output growth. A 1% increase in both output variables would raise productivity growth by about 15 basis points.

The estimates of the parameters of the other business conditions in the total cost model were also sensible.

- Total cost was higher the greater was the average percentage of distribution mains made of cast iron. [33]
- Cost was higher for distributors that served a core urban area.
- Cost shifted downward over time by about 0.81% annually for reasons not otherwise explained in the model.

The 0.957 adjusted R^2 was the highest for the three models that we developed. This makes sense because it is generally easier to model cost at a more aggregated level.

A.3.4 Form of the Econometric Cost Models

Specific forms must be chosen for cost models used in econometric research. Forms commonly employed by scholars include the linear, the double log, and the translog. In the following cost model of linear form,

[33] Evidently, higher O&M expenses offset lower capital cost at sample mean values of the business condition variables.

$$C_{h,t} = a_0 + a_1 \cdot N_{h,t} + a_2 \cdot W_{h,t} , \qquad \text{[A1]}$$

the variable $C_{h,t}$ is the cost of firm h in year t, $N_{h,t}$ *is* the number of customers it served, and $W_{h,t}$ is the price of labor. Here is an analogous cost model of double log form.

$$\ln C_{h,t} = a_0 + a_1 \cdot \ln N_{h,t} + a_2 \cdot \ln W_{h,t} . \qquad \text{[A2]}$$

The double log form is so-called because the left-hand side and right-hand side variable are logged. With this specification, the parameter corresponding to each business condition variable is the elasticity of cost with respect to the variable. For example, the a_1 parameter indicates the percentage change in cost resulting from 1% growth in the number of customers. Elasticity estimates are informative and make it easier to assess the reasonableness of model results. We mean-scale the data so that the parameter estimates are elasticities at sample mean values of the business conditions.

It is also noteworthy that, in a double log model, the elasticities are *constant* in the sense that they are the same for every value that the cost and business condition variables might assume.[34] The sum of elasticities, which as we have seen determines the opportunity for incremental scale economies from output growth, is the same for all firms. This treatment is restrictive, and may be inconsistent with the true form of the cost relationship that we are trying to model.

The alternative translog functional form adds quadratic terms (*e.g.* $\ln N_{h,t} \cdot \ln N_{h,t}$) and interaction terms (*e.g.* $\ln N_{h,t} \cdot \ln W_{h,t}$) to the basic double log specification. These terms make the form more flexible but would increase the complexity of the cost model and any output quantity indexes derived from it. For the gas distribution dataset that we have gathered, the addition of such terms would also strain our ability to estimate model parameters accurately. We have elected in this study to eschew the translog form in the hopes of simplifying the presentation and identifying a larger number of cost drivers. In each model, we logged cost and all variables that did not contain zero or negative values. The resultant parameters for all of the output variables are the elasticities of cost with respect to these variables.

[34] Cost elasticities are not constant in the linear model that is exemplified by equation [A1].

A.3.5 Econometric Model Estimation

A variety of estimation procedures are used in econometric research. The appropriateness of each procedure depends on the assumptions made about the distribution of the error terms. The estimation procedure that is most widely known, ordinary least squares ("OLS"), is readily available in over the counter econometric software. Another class of procedures, called generalized least squares ("GLS"), is appropriate under assumptions of more complicated error specifications. For example, GLS estimation procedures can permit the variance of the error terms of cost models to be heteroskedastic in the sense that they vary across companies. Variances can, for example, be larger for companies with large operating scale. Estimation procedures that address *several* of the error term issues that are routinely encountered in cost research are not readily available in commercial econometric software packages such as GAUSS. They require, instead, the development of customized estimation programs. While the cost of developing sophisticated estimation procedures that are tailored for benchmarking applications is sizable, the incremental cost of applying them in different studies is typically small once they have been developed.

To obtain more efficient estimates of our model parameters we corrected for autocorrelation and heteroskedasticity in the error terms. These are common phenomena in statistical cost research. The estimation procedure was developed by PEG Research using the GAUSS statistical software program. Since we estimated the unknown model disturbance matrices consistently, the estimators we eventually computed are equivalent to Maximum Likelihood Estimators ("MLEs").[35] Our estimates thus possess desirable statistical properties of MLEs.

A.4 Capital Cost

The service price approach to the measurement of capital cost has a solid basis in economic theory and is widely used in scholarly empirical work.[36] In the application of the general method used in this study, the non tax cost of a given class of utility plant j in

[35] See Dhrymes (1971), Oberhofer and Kmenta (1974), Magnus (1978).

[36] See Hall and Jorgensen (1967) for a seminal discussion of the service price method of capital cost measurement.

a given year *t* ($CK_{j,t}$) is the product of a capital service price index ($WKS_{j,t}$) and an index of the capital quantity at the end of the prior year ($XK_{j,t-1}$).

$$CK_{j,t} = WKS_{j,t} \cdot XK_{j,t-1}. \qquad [A4]$$

The value of the capital quantity index at the end of a given year depends on the quantities of plant added in that year and in a series of prior years that depends on the service life of the asset. The quantity of capital added in a given year t-s (a_{t-s}) can be calculated as

$$a_{t-s} = VK_{t-s}^{add} / WKA_{t-s}$$

where VK_{t-s}^{add} is the gross value of plant additions and WKA_{t-s} is the capex (a/k/a asset) price index. The capital quantity index also depends on the particular way that the quantities added decline in later years due to depreciation.

For long-lived assets, the quantity of capital held at the start of our sample period, in 1998, depends on the quantity of plant additions in many prior years. In Gaz Metro's regulation a 33 year service life is typical for long-lived assets. The first year during which plant addition data are need is therefore 1998-32 = 1966. Unfortunately, data on the gross plant additions of Gaz Metro were not available before *1995*. This greatly complicates the calculation of accurate capital quantity (and TFP) indexes.

In TFP research, when estimates are needed of plant additions before a certain year it is customary to assume that the net plant value at the end of the prior year (if available) resulted from a specific pattern of plant additions in the "benchmark" year and a series of prior years. A constant level of plant additions is often assumed for this purpose. Given, additionally, values for the capex price index in prior years, estimates can be obtained of the quantities of plant additions.

We attempted such a calculation for 1994 using the September 1994 values in Gaz Metro's rate base (Base de Tarification). For each asset class, the relevant sequence of years equaled the typical service life of the asset class. We assumed a thirty three year service life for long-lived assets. We were therefore required to specify a pattern of plant additions for each year of the 1961-1994 period. We assumed a five year service life for developpements informatiques and an eight year service life for other short-lived assets.

Because the benchmark year is not far in the past, the accuracy of the capital quantity and TFP indexes is fairly sensitive to the reasonableness of the assumption concerning the pattern of prior plant additions for long-lived assets. We assumed that, for each year of the 1962-94 period, the quantity of capex differed from the mean quantity during the period in proportion to the ratio of an index of gross customer additions in the same year to the mean for the same period. Gross customer additions in a given year were estimated as any *positive* growth in the number of customers since the prior year. For developpement informatique and other short-lived asset we assumed instead a *constant* level of real plant additions over the previous five years and 8 years, respectively.

We obtained from Gaz Metro data on the number of customers it served in the 1965-94 period. We imputed values for the 1961-64 period. Our imputations assumed rapid customer growth, in the five years immediately following the extension of the TransCanada PipeLines system to Quebec in 1958, from our estimate of the base of customers that had previously received deliveries of manufactured gas. In constructing the customer additions index we assigned a double weight to commercial and industrial customers to account for the higher cost of connecting these customers to the system.

We explained in Section 3.2 above that a capital service price is constructed from data on the rate of return on plant and the trend in capex prices. In this study, we used as the rate of return the weighted average cost of capital assigned to Gaz Metro by the Regie. The authorized ROE that we used for this calculation did not include the adjustment from the Performance Incentive Mechanism.

The capex price index for long-lived assets was constructed using the price index for the Canadian capital stock of engineering structures of natural gas distribution, water, and other systems. This is unfortunately released by Stats Canada with a delay of at least two years and is therefore unavailable for the last two years of the sample period. For each of these years, we assumed that the growth rate of this price index was the same as the growth of a summary power distribution construction cost index. The capex price index for developpements informatiques was a price index for commercial software. The capex price index for other plant was the $GDPIPI^{FDD}_{Quebec}$. All of these indexes are calculated by Statistics Canada.

The calculation of capital price and quantity indexes requires specific formulas. We noted in Section 3.2 that we considered two methods, the cost of service and geometric decay methods. We discuss each in turn.

A.4.1 Cost of Service Approach

The COS formulas for calculating capital price and quantity are complex but reflect the broad outlines of how capital cost is calculated in North American utility regulation. For each year t of the sample period we define the following terms for each asset category.

ck_t	Total non-tax cost of capital
ck_t^{Return}	Return on net plant value
$ck_t^{Depreciation}$	Depreciation expense
xk_t	Total quantity of plant
xk_t^{t-s}	Subset of plant in year t that remains from plant additions in year t-s
VK_t	Total (book) value of plant at the end of last year
N	Average service life of plant
r_t	Rate of return on net plant value
WKS_t	Capital (a/k/a service or rental) price

The non-tax cost of capital is the sum of depreciation and the return on net plant value.

$$ck_t = ck_t^{Return} + ck_t^{Depreciation}$$

There is a return and depreciation associated with the investment in the current year or any prior year t-s that has not been fully depreciated.[37] Assuming straight line depreciation and book valuation of utility plant, the non-tax cost of capital can then be expressed as

[37] The analysis assumes that depreciation and the return on net plant value is incurred in year t on the amount of plant remaining at the end of year t-1, as well as on any plant added in year t. This is tantamount to assuming that plant additions are made at the beginning of the year. This depends in turn on the amount of plant added (a_{t-s}) and the unit cost of construction (WKA_{t-s}) in that year.

$$ck_t = \sum_{s=0}^{N-1} \left(WKA_{t-s} \cdot xk_t^{t-s}\right) \cdot r_t + \sum_{s=0}^{N-1} WKA_{t-s} (1/N) \cdot a_{t-s} \quad . \qquad [A5]$$

$$= xk_t \cdot \sum_{s=0}^{N-1} \left(\frac{xk_t^{t-s}}{xk_t} \cdot WKA_{t-s} \right) \cdot r_t + xk_t \cdot \sum_{s=0}^{N-1} WKA_{t-s} \cdot \frac{(1/N) \cdot a_{t-s}}{xk_t}$$

The second term in the formula is a standardized approach to the calculation of depreciation that frees us from reliance on the depreciation expenses reported by utilities provided that we have many years of data on their gross plant additions.

The total quantity of capital used in each year t is the sum of the quantities of different ages in the rate base.

$$xk_t = \sum_{s=0}^{N-1} xk_{t-s} \, .$$

Under straight line depreciation it is true that in the interval $[N-1, 0]$,

$$xk_t^{t-s} = \frac{N-s}{N} \cdot a_{t-s} . \qquad [A6]$$

The capital quantity in year t is thus linked to current and past plant additions by the formula

$$xk_t = \sum_{s=0}^{N-1} \frac{N-s}{N} a_{t-s} \; . \qquad [A7]$$

The size of the addition in year t-s can then be expressed as

$$a_{t-s} = \frac{N}{N-s} \cdot xk_t^{t-s} . \qquad [A8]$$

Equations [A5] and [A8] together imply that

$$ck_t = xk_t \cdot \sum_{s=0}^{N-1} \frac{xk_t^{t-s}}{xk_t} \cdot WKA_{t-s} \cdot r_t + xk_t \cdot \sum_{s=0}^{N-1} \frac{xk_t^{t-s}}{xk_t} \cdot WKA_{t-s} \cdot \frac{1}{N-s} \qquad [A9]$$

$$= xk_t \cdot WKS_t$$

Capital is the product of a price and quantity index where the capital (service) price index has a formula

$$WKS_t = \sum_{s=0}^{N-1} \frac{xk_t^{t-s}}{xk_t} \cdot WKA_{t-s} \cdot r_t + \sum_{s=0}^{N-1} \frac{xk_t^{t-s}}{xk_t} \cdot WKA_{t-s} \cdot \frac{1}{N-s} \quad . \qquad [A10]$$

$$= \sum_{S=0}^{N-1} \frac{xk_t^{t-s}}{xk_t} \cdot WKA_{t-s} \cdot \left(r_t + \frac{1}{N-s} \right)$$

It can be seen that market construction prices and the rate of return on net plant value play key roles in the COS capital service price formula. The first term in the formula pertains to the return on net plant value. The second term pertains to depreciation. Both terms depend on WKA, the capex price index, in the *N* most recent years and not just the costs in the current year. The importance of each value of the market construction cost index depends on the share, in the total quantity of plant, of the plant remaining from additions made in that year.

A.4.2 Geometric Decay Approach

The alternative geometric decay approach to capital cost calculation was undertaken only for long-lived plant. The quantities of long-lived plant added in each year of the 1961-94 period were calculated by the same method used in the COS research. This quantity was then depreciated at a constant (geometric) depreciation rate *d* that reflected the assumption of a thirty-three year service life. The total capital quantity at the end of 1994 is the sum of the depreciated capital quantities of each vintage. For years after 1994, the following general geometric decay formula was used to compute values of the capital quantity index.

$$XK_{j,t} = (1-d)\cdot XK_{j,t-1} + \frac{VKA_{j,t}}{WKA_{j,t}}. \qquad \text{[A11]}$$

Note that this formula is far simpler than the corresponding COS formula. Mathematical elegance is part of the appeal of the geometric decay approach to calculating capital cost.

The generic formula for the non-tax capital service price indexes based on geometric decay is

$$WKS_t = d\cdot WKA_t + WKA_{t-1}\cdot r_t + (WKA_t - WKA_{t-1})\,. \qquad \text{[A12]}$$

We restated this as

$$WKS_t = d\cdot WKA_t + WKA_{j,t-1}\left[r_t - \frac{\left(WKA_{j,t} - WKA_{j,t-1}\right)}{WKA_{j,t-1}}\right]. \qquad \text{[A13]}$$

The first term in [A13] pertains to depreciation. The term in brackets is the real rate of return on plant. The term r_t is the corresponding nominal rate of return and has the same values used in the calculation of the COS capital price. The real rate of return is inherently volatile because the growth rate of asset prices does not always rise and fall in proportion to the nominal rate of return. To reduce volatility, the bracketed term was smoothed for 2008.

A.5 Productivity Growth Rates and Trends

The annual growth rate in each productivity index is given by the formula

$$\ln\left(\frac{Productivity_t}{Productivity_{t-1}}\right)$$
$$= \ln\left(\frac{Output\ Quantities_t}{Output\ Quantities_{t-1}}\right) - \ln\left(\frac{Input\ Quantities_t}{Input\ Quantities_{t-1}}\right).$$

[A14]

The long run trend in each productivity index was calculated as its average annual growth rate over the sample period.

A.6 Price Indexes

A.6.1 Price Index Formulas

The summary Gaz Metro input price indexes used in this study are of Törnqvist form. This means that the annual growth rate of each index is determined by the following general formula:

$$\ln\left(\frac{Input\ Prices_t}{Input\ Prices_{t-1}}\right) = \sum_j \frac{1}{2} \cdot \left(sc_{j,t} + sc_{j,t-1}\right) \cdot \ln\left(\frac{W_{j,t}}{W_{j,t-1}}\right). \quad [A15]$$

Here in each year *t*,

$Input\ Prices_t$ = Input price index

$W_{j,t}$ = Price subindex for input category *j*

$sc_{j,t}$ = Share of input category *j* in applicable total cost.

The growth rate of the index is a weighted average of the growth rates of input price subindexes. Each growth rate is calculated as the logarithm of the ratio of the subindex values in successive years. The average shares of each input group in the applicable cost of Gaz Metro during the two years are the weights.

A.6.2 Alternative Inflation Measures

A variety of price indexes are available from Statistics Canada for use in the input price and productivity research. In this section we present an array of candidate indexes that we gathered. Table A-5 presents a group of *macroeconomic* inflation measures. All save one of the indexes is designed to measure trends in the prices of *final* goods and services in Canada or Quebec. It can be seen that these indexes vary considerably in their volatility, which is measured by their standard deviation. The CPIs (all items) for Canada and Quebec and the GDPIPI for Canada are much more volatile that the $GDPIPI^{FDD}$ for Canada or Quebec or the core CPI (which is available only for Canada). In 2009, for instance, the CPI (all items) for Canada grew only 0.3%, and the GDPIPI for Canada *fell* by 2.2%. In the same year, the core CPI grew by 1.7% and the $GDPIPI^{FDD}_{Quebec}$ by 1.3%.

Table A-6 presents alternative labor price indexes. The fixed weight indexes of average hourly earnings are expressly designed to measure price *trends.* Over the full sample period, the *all-industry* salary and wage price trends in Canada and Quebec were substantially the same. Salaries and wages of *utility* workers grew much more rapidly in Canada than in Quebec.

Tables A-7, A-8, and A-9 and Figure A-1 present three groups of indexes that could serve as capex price indexes for the long-lived assets of Gaz Metro:

- Natural Gas Distribution, Water, and Other Systems Capital Stock Price Indexes
- Electric Utility Construction Price Indexes
- Non-Residential Building Construction Price Indexes.

Recall that we have selected the Natural Gas Distribution, Water, and Other Systems Capital Stock Price Index for engineering structures as the asset price index for Gaz Metro's long lived assets. It can be seen that price indexes are available for several additional gas distribution and water asset categories, including land, building structures, and machinery and equipment. We believe that taking a weighted average of these indexes would complicate the calculations without adding much to the accuracy of the study.

Table A-5

Macroeconomic Inflation Measures for Quebec and Canada

	Canada								Quebec					
	CPI (all items)[1]		Core CPI[1 2]		Gross Domestic Product Implicit Price Indexes[3]				CPI (all items)[1]		Gross Domestic Product Implicit Price Indexes[3]			
					Comprehensive		Final Domestic Demand				Comprehensive		Final Domestic Demand	
Year	Level	Growth Rate[4]	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate
1977	33.6	7.7%												
1978	36.6	8.6%												
1979	40	8.9%							40.5					
1980	44	9.5%							44.7	9.9%				
1981	49.5	11.8%			55.7		53.6		50.2	11.6%	51.9		55.2	
1982	54.9	10.4%			60.4	8.1%	58.7	9.1%	56	10.9%	57	9.4%	60.6	9.3%
1983	58.1	5.7%			63.7	5.3%	61.9	5.3%	59.1	5.4%	60.3	5.6%	63.7	5.0%
1984	60.6	4.2%	62.9		65.8	3.2%	64.4	4.0%	61.5	4.0%	63.1	4.5%	66.4	4.2%
1985	63	3.9%	65.1	3.4%	67.8	3.0%	66.7	3.5%	64.2	4.3%	65.4	3.6%	69	3.8%
1986	65.6	4.0%	68	4.4%	69.9	3.1%	69.2	3.7%	67.3	4.7%	70	6.8%	71.4	3.4%
1987	68.5	4.3%	71	4.3%	73.1	4.5%	72	4.0%	70.2	4.2%	73.6	5.0%	74.3	4.0%
1988	71.2	3.9%	74	4.1%	76.4	4.4%	74.7	3.7%	72.8	3.6%	77.2	4.8%	76.9	3.4%
1989	74.8	4.9%	77.2	4.2%	79.8	4.4%	77.9	4.2%	75.9	4.2%	80.8	4.6%	79.9	3.8%
1990	78.4	4.7%	79.8	3.3%	82.4	3.2%	80.9	3.8%	79.2	4.3%	83.2	2.9%	83	3.8%
1991	82.8	5.5%	82.1	2.8%	84.8	2.9%	83.7	3.4%	85	7.1%	86.5	3.9%	85.8	3.3%
1992	84	1.4%	83.6	1.8%	85.9	1.3%	85.1	1.7%	86.6	1.9%	87.9	1.6%	87.3	1.7%
1993	85.6	1.9%	85.3	2.0%	87.2	1.5%	86.8	2.0%	87.7	1.3%	88.3	0.5%	88.6	1.5%
1994	85.7	0.1%	86.9	1.9%	88.2	1.1%	88.1	1.5%	86.6	-1.3%	88.9	0.7%	89.1	0.6%
1995	87.6	2.2%	88.8	2.2%	90.2	2.2%	89.2	1.2%	88.1	1.7%	90.9	2.2%	89.9	0.9%
1996	88.9	1.5%	90.3	1.7%	91.6	1.5%	90.2	1.1%	89.5	1.6%	91.7	0.9%	90.6	0.8%
1997	90.4	1.7%	92	1.9%	92.7	1.2%	91.5	1.4%	90.8	1.4%	92.7	1.1%	91.8	1.3%
1998	91.3	1.0%	93.2	1.3%	92.3	-0.4%	92.7	1.3%	92.1	1.4%	93.6	1.0%	92.7	1.0%
1999	92.9	1.7%	94.5	1.4%	93.9	1.7%	93.9	1.3%	93.5	1.5%	94.7	1.2%	94	1.4%
2000	95.4	2.7%	95.7	1.3%	97.8	4.1%	96.1	2.3%	95.8	2.4%	96.8	2.2%	96.4	2.5%
2001	97.8	2.5%	97.7	2.1%	98.9	1.1%	97.8	1.8%	98	2.3%	98.2	1.4%	97.8	1.4%
2002	100	2.2%	100	2.3%	100	1.1%	100	2.2%	100	2.0%	100	1.8%	100	2.2%
2003	102.8	2.8%	102.2	2.2%	103.3	3.2%	101.5	1.5%	102.5	2.5%	102.6	2.6%	101.8	1.8%
2004	104.7	1.8%	103.8	1.6%	106.6	3.1%	103.2	1.7%	104.5	1.9%	104.7	2.0%	103.1	1.3%
2005	107	2.2%	105.5	1.6%	110.1	3.2%	105.5	2.2%	106.9	2.3%	106.5	1.7%	105.1	1.9%
2006	109.1	1.9%	107.5	1.9%	113	2.6%	107.9	2.2%	108.7	1.7%	108.6	2.0%	106.5	1.3%
2007	111.5	2.2%	109.8	2.1%	116.7	3.2%	110.4	2.3%	110.4	1.6%	111.4	2.5%	108.6	2.0%
2008	114.1	2.3%	111.7	1.7%	121.4	3.9%	112.9	2.2%	112.7	2.1%	112.8	1.2%	110.8	2.0%
2009	114.4	0.3%	113.6	1.7%	118.8	-2.2%	114.4	1.3%	113.4	0.6%	113.6	0.7%	112.3	1.3%
2010	116.5	1.8%	115.6	1.7%	NA	NA	NA	NA	114.8	1.2%	NA	NA	NA	NA
Annual Growth Rates														
1988-2007		**2.44%**		**2.18%**		**2.34%**		**2.14%**		**2.26%**		**2.07%**		**1.90%**
1998-2007		**2.10%**		**1.77%**		**2.30%**		**1.88%**		**1.95%**		**1.84%**		**1.68%**
1990-2009		**2.12%**		**1.93%**		**1.99%**		**1.92%**		**2.01%**		**1.70%**		**1.70%**
2000-2009		**2.08%**		**1.84%**		**2.35%**		**1.97%**		**1.93%**		**1.82%**		**1.78%**
Standard Deviation														
1990-2010		**1.20%**		**0.48%**		**1.52%**		**0.70%**		**1.52%**		**0.86%**		**0.81%**

Footnotes
[1] Statistics Canada. Table 326-0021 - Consumer Price Index (CPI), 2005 basket, annual (2002=100 unless otherwise noted) (table).
[2] The Core CPI excludes from the all-items CPI the effect of changes in indirect taxes and eight of the most volatile components identified by the Bank of Canada:
fruit, fruit preparations and nuts; vegetables and vegetable preparations; mortgage interest cost; natural gas; fuel oil and other fuels; gasoline; inter-city transportation; and tobacco products and smokers' supplies.
[3] Statistics Canada. Table 384-0036 - Implicit price indexes, gross domestic product (GDP), provincial economic accounts, annual (index, 2002=100).
[4] All growth rates are calculated logarithmically.

Notes:
- Annual CPI data become available for the previous year near the end of January of the following year (e.g. Annual 2010 data became available on 1/25/2011).
- CPI data are not revised. Only seasonally adjusted CPI data are subject to revision and are also available at the end of January of the following year.
- Annual GDPIPI data become available for the previous year near the beginning of November of the following year (e.g. Annual 2010 data become available November 2011). Preliminary data for the previous year are released near the end of April of the following year.
- GDP data are revised periodically as improved data sources and/or methodology become available.
- "NA" is defined as "Not available."

Table A-6

Salary and Wage Price Indexes for Quebec and Canada

Year	Fixed weighted index of average hourly earnings for all employees[1 2] — Canada: Industrial Aggregate	Canada: Utilities	Quebec: Industrial Aggregate	Quebec: Utilities	Average weekly earnings (Industrial aggregate excluding unclassified businesses)[2 3] — Canada	Quebec		Composite construction union wage rate index[4] — Canada	Quebec
1981								40.0	37.1
1982								43.7	40.4
1983								49.2	44.9
1984								51.0	46.6
1985								52.2	48.0
1986								53.7	49.4
1987								55.2	52.1
1988								57.2	54.6
1989								59.9	57.5
1990								63.2	60.3
1991	82.02	67.38	85.18	71.51	553.15	545.45		67.0	64.1
1992	84.71	70.17	88.48	74.20	572.41	566.03		70.1	67.8
1993	86.44	72.41	89.84	77.67	582.87	572.63		71.7	68.5
1994	87.63	73.23	90.19	78.22	592.88	575.46		73.2	69.1
1995	89.62	74.57	91.71	79.62	598.67	579.41		74.6	69.1
1996	91.73	75.88	93.21	81.30	611.01	585.52		75.3	69.1
1997	92.28	77.70	93.98	81.31	623.43	594.29		76.8	71.9
1998	93.78	80.83	94.39	84.58	632.72	602.17		78.4	73.8
1999	94.81	86.13	94.06	90.93	640.47	605.74		79.7	74.8
2000	96.73	88.73	95.98	98.08	655.55	616.25		81.8	77.3
2001	98.03	95.01	97.14	94.43	656.74	622.83		83.8	78.8
2002	100.18	99.90	100.15	99.88	672.68	639.04		87.0	83.7
2003	103.13	105.16	102.83	102.56	690.79	656.64		89.3	86.8
2004	105.90	107.02	105.81	103.24	709.41	673.69		91.4	89.6
2005	109.23	108.92	108.73	100.46	737.29	695.58		94.1	94.3
2006	112.09	111.24	111.14	100.33	755.48	708.27		97.0	97.3
2007	117.25	117.38	117.08	105.53	788.06	738.73		100.0	100.0
2008	121.34	118.86	120.08	111.39	810.52	751.19		104.9	102.9
2009	125.02	125.52	123.62	117.66	823.53	759.42		109.2	106.0
				Annual Growth Rates					
1992-2009	**2.3%**	**3.5%**	**2.1%**	**2.8%**	**2.2%**	**1.8%**	**1982-2009**	**3.6%**	**3.7%**
2000-2009	**2.8%**	**3.8%**	**2.7%**	**2.6%**	**2.5%**	**2.3%**	**1990-2009**	**3.0%**	**3.1%**

Footnotes

[1] Statistics Canada. Table 281-0039 - Fixed weighted index of average hourly earnings for all employees (SEPH), excluding overtime, unadjusted for seasonal variation, for selected industries classified using the North American Industry Classification System (NAICS), monthly (index, 2002=100)

[2] Industrial aggregate covers all industrial sectors except those primarily involved in agriculture, fishing and trapping, private household services, religious organisations and the military personnel of the defence services.

[3] Statistics Canada. Table 281-0027 - Average weekly earnings (SEPH), unadjusted for seasonal variation, by type of employee for selected industries classified using the North American Industry Classification System (NAICS), annual (current dollars)

[4] Statistics Canada. Table 327-0045 - Construction union wage rate indexes, monthly (index, 2007=100)

Notes

- Payroll employment, earnings and hours data are released on a monthly basis. Data are released near the end of each month for the month two months prior (e.g. August 2011 data will be released near the end of October 2011).

Table A-7

Canadian Natural Gas Distribution, Water, and Other Systems Capital Stock Price Indexes

	Information and communication technologies machinery and equipment[1]		Non-information and communication technologies machinery and equipment[2]		Building structures		Engineering structures[3]		Land	
Year	Level	Growth Rate[4]	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate
1961	3091.7		17.5		17.9		12.6		35.4	
1962	3102.6	0.4%	17.9	2.3%	17.8	-0.6%	12.7	0.8%	32.8	-7.6%
1963	3165.2	2.0%	20.1	11.6%	18.2	2.2%	13.1	3.1%	30.4	-7.6%
1964	3205.4	1.3%	18.7	-7.2%	18.4	1.1%	13.6	3.7%	28.6	-6.1%
1965	3282.6	2.4%	19.3	3.2%	19.2	4.3%	14.4	5.7%	28	-2.1%
1966	3226.8	-1.7%	19.7	2.1%	20.5	6.6%	15.2	5.4%	27.9	-0.4%
1967	3312.1	2.6%	19.5	-1.0%	21.3	3.8%	16	5.1%	27	-3.3%
1968	3325.9	0.4%	19.4	-0.5%	21.2	-0.5%	16.2	1.2%	25.8	-4.5%
1969	3353.1	0.8%	19.8	2.0%	22.2	4.6%	17.1	5.4%	25.7	-0.4%
1970	3408.4	1.6%	20.9	5.4%	23.3	4.8%	18.1	5.7%	25.6	-0.4%
1971	3505.1	2.8%	21.5	2.8%	24.6	5.4%	19.3	6.4%	26.1	1.9%
1972	3522.7	0.5%	22	2.3%	26.9	8.9%	20.5	6.0%	27.6	5.6%
1973	3564.8	1.2%	23	4.4%	29	7.5%	21.8	6.1%	31	11.6%
1974	3466.6	-2.8%	26.2	13.0%	35.4	19.9%	26.1	18.0%	36.1	15.2%
1975	3606.7	4.0%	31	16.8%	40.4	13.2%	30.8	16.6%	39.7	9.5%
1976	3213.5	-11.5%	32.8	5.6%	41.3	2.2%	33.4	8.1%	40.9	3.0%
1977	2807.1	-13.5%	36.2	9.9%	42.2	2.2%	36	7.5%	43.4	5.9%
1978	2060.2	-30.9%	40.5	11.2%	43.8	3.7%	38.8	7.5%	45.2	4.1%
1979	1826.7	-12.0%	45.2	11.0%	46.9	6.8%	42.7	9.6%	49.9	9.9%
1980	1347.4	-30.4%	50.4	10.9%	52.1	10.5%	47.1	9.8%	56.7	12.8%
1981	1139	-16.8%	56.2	10.9%	60.4	14.8%	52.2	10.3%	62.8	10.2%
1982	1108.6	-2.7%	60.7	7.7%	65.3	7.8%	57.9	10.4%	65.2	3.8%
1983	793.6	-33.4%	61.8	1.8%	64	-2.0%	60.8	4.9%	63.6	-2.5%
1984	688.1	-14.3%	64.7	4.6%	62.7	-2.1%	62.8	3.2%	64	0.6%
1985	576.5	-17.7%	68.5	5.7%	63.9	1.9%	64.6	2.8%	64	0.0%
1986	486.4	-17.0%	70.6	3.0%	66.5	4.0%	66.5	2.9%	66.2	3.4%
1987	409.9	-17.1%	70.6	0.0%	70.8	6.3%	68.2	2.5%	69.3	4.6%
1988	373.8	-9.2%	70.1	-0.7%	75.2	6.0%	71.9	5.3%	74	6.6%
1989	316.2	-16.7%	72.2	3.0%	80.4	6.7%	74.6	3.7%	78.2	5.5%
1990	286.2	-10.0%	74	2.5%	83.2	3.4%	77.5	3.8%	81	3.5%
1991	230.6	-21.6%	72	-2.7%	80.4	-3.4%	79.6	2.7%	80.3	-0.9%
1992	204.5	-12.0%	74.8	3.8%	80.4	0.0%	81	1.7%	79.8	-0.6%
1993	197.5	-3.5%	77.8	3.9%	80.6	0.2%	82.5	1.8%	81.8	2.5%
1994	185.6	-6.2%	81.5	4.6%	82.2	2.0%	85.6	3.7%	84.5	3.2%
1995	169	-9.4%	84.7	3.9%	84.7	3.0%	86.1	0.6%	87.1	3.0%
1996	146.3	-14.4%	86.3	1.9%	86	1.5%	89.2	3.5%	89.8	3.1%
1997	135.1	-8.0%	87.5	1.4%	87.7	2.0%	91.7	2.8%	91.3	1.7%
1998	122.6	-9.7%	93.3	6.4%	89.3	1.8%	94.6	3.1%	92.7	1.5%
1999	109.7	-11.1%	94.8	1.6%	91	1.9%	96.4	1.9%	94.7	2.1%
2000	105.2	-4.2%	95.7	0.9%	95.6	4.9%	98.7	2.4%	97.2	2.6%
2001	103.6	-1.5%	98.3	2.7%	98.5	3.0%	98.8	0.1%	98.1	0.9%
2002	100	-3.5%	100	1.7%	100	1.5%	100	1.2%	100	1.9%
2003	92.5	-7.8%	93.3	-6.9%	102.6	2.6%	101.1	1.1%	103.9	3.8%
2004	85.8	-7.5%	89.6	-4.0%	108.7	5.8%	107.2	5.9%	112.9	8.3%
2005	79.5	-7.6%	87.6	-2.3%	114	4.8%	113.9	6.1%	123.2	8.7%
2006	76.3	-4.1%	85.6	-2.3%	122.8	7.4%	122.1	7.0%	137	10.6%
2007	74.7	-2.1%	84.5	-1.3%	136	10.2%	128.4	5.0%	151.2	9.9%
Annual Growth Rates										
1962-2007		**-8.1%**		**3.4%**		**4.4%**		**5.0%**		**3.2%**
1968-2007		**-9.5%**		**3.7%**		**4.6%**		**5.2%**		**4.3%**
1978-2007		**-12.1%**		**2.8%**		**3.9%**		**4.2%**		**4.2%**
1988-2007		**-8.5%**		**0.9%**		**3.3%**		**3.2%**		**3.9%**
1998-2007		**-5.9%**		**-0.3%**		**4.4%**		**3.4%**		**5.0%**

Footnotes

[1] Information and communication technologies machinery and equipment consists of computer hardware, software and telecommunication equipment

[2] Those assets are machinery equipment other than computer hardware, software and telecommunication equipment

[3] Engineering assets provide the foundation capital for railways, utilities, oil and gas, and pipelines

[4] All growth rates are calculated logarithmically.

Sources:

Statistics Canada. Table 383-0025 - Investment, capital stock and capital services of physical assets, by North American Industry Classification System (NAICS), annual (dollars unless otherwise noted) (index, 2002=100)

Notes

• Table 383-0025 data become available near the end of December or beginning of January for the year three years or four years prior, respectively (e.g. Data for 2007 became available on December 24, 2010

Table A-8

Canadian Electric Utility Construction Price Indexes

	Distribution Systems							Transmission line systems	
	Total							Total	
Year	Level	Growth Rate[1]	Total direct costs	Materials	Labour	Construction equipment	Construction indirects	Level	Growth Rate
1956	17.7				8.3	17.3		20	
1957	18	1.7%			8.6	18.3		20.6	3.0%
1958	17.4	-3.4%			9.3	19		19.5	-5.5%
1959	18.1	3.9%			9.8	24.7		20.1	3.0%
1960	18.7	3.3%			10.4	20		19.8	-1.5%
1961	18.7	0.0%			10.9	20.3		18.6	-6.3%
1962	19	1.6%			11.4	20		19.3	3.7%
1963	19.1	0.5%			11.9	20.2		19.7	2.1%
1964	19.5	2.1%			12.3	20.4		20.4	3.5%
1965	19.9	2.0%			12.9	20.5		21.4	4.8%
1966	20.9	4.9%			13.5	20.9	14.5	22.3	4.1%
1967	21.7	3.8%			15.1	22	15.6	22.5	0.9%
1968	21.5	-0.9%			16.2	22.5	16.8	22.2	-1.3%
1969	22.4	4.1%			17.5	23.3	18.1	22.9	3.1%
1970	24.1	7.3%			18.9	24.7	19.6	25	8.8%
1971	25	3.7%	25.6	29.8	20.3	26	21.2	26.1	4.3%
1972	26.1	4.3%	26.6	30	22.1	26.9	23.2	27.3	4.5%
1973	28.5	8.8%	29.1	32.6	25	27.9	24.7	29.3	7.1%
1974	34.3	18.5%	35.6	42.3	27.4	32	27.7	35.5	19.2%
1975	38.5	11.6%	39.7	45.7	32.5	34.8	31.9	41.6	15.9%
1976	40.7	5.6%	41.7	45.5	37.2	39.1	35.2	44.6	7.0%
1977	43.4	6.4%	44.4	46.7	41.4	43.3	38.3	47	5.2%
1978	46.6	7.1%	47.7	50.3	44.2	48.3	41	50.6	7.4%
1979	52.9	12.7%	54.5	60.3	47	54.2	44.5	56.5	11.0%
1980	60.3	13.1%	62.3	70.6	51.6	61.7	49.4	63.3	11.4%
1981	65.7	8.6%	67.8	75	57.5	74	55.2	69.7	9.6%
1982	71.8	8.9%	73.7	79.9	64.5	82.1	62.3	75.1	7.5%
1983	74.8	4.1%	76.2	79.1	71	86.2	67.2	77	2.5%
1984	78.1	4.3%	79.4	83	73.6	88.9	70.9	80.6	4.6%
1985	82.1	5.0%	83.7	88.7	76	93	74.1	81.6	1.2%
1986	84	2.3%	85.5	90.7	78	90.4	76.5	84	2.9%
1987	86.6	3.0%	87.9	93.3	80.7	91.3	79.5	89.2	6.0%
1988	91.9	5.9%	93.6	101.7	83.6	89.5	83	96.5	7.9%
1989	95.5	3.8%	97.3	105	88	91.9	85.7	102.6	6.1%
1990	98.5	3.1%	99.9	106.9	91.3	97.2	90.8	104	1.4%
1991	97.7	-0.8%	97.9	98.5	96.9	99.4	96.8	100.4	-3.5%
1992	100	2.3%	100	100	100	100	100	100	-0.4%
1993	102.5	2.5%	102.5	102.1	102.7	104.8	102.3	103	3.0%
1994	108.2	5.4%	109.1	112.5	104.3	111	103.3	108.1	4.8%
1995	116.7	7.6%	118.7	128.1	106.1	120.3	105.5	112.8	4.3%
1996	116.6	-0.1%	118.2	126.1	106.6	125.7	107.9	113.5	0.6%
1997	118	1.2%	119.3	125	110.1	129.8	111.1	115.7	1.9%
1998	122.8	4.0%	123	125.4	117.6	138.1	121.4	121	4.5%
1999	126.1	2.7%	126	126	123.6	141.5	126.9	122.2	1.0%
2000	128.7	2.0%	129.1	128.6	128.8	135.3	126.7	124.7	2.0%
2001	129.6	0.7%	129.8	127.7	130.7	142	128.9	127	1.8%
2002	130.5	0.7%	130.6	127.6	132.3	145.5	129.9	129.2	1.7%
2003	130.6	0.1%	130.9	127.8	132.7	145.5	129	126.4	-2.2%
2004	131.1	0.4%	131.3	132.5	127.2	148	129.9	129	2.0%
2005	133.6	1.9%	134.2	138.2	125.3	157.7	130.4	130.9	1.5%
2006	142.4	6.4%	144.2	155	127.5	160	132.6	136.2	4.0%
2007	148.8	4.4%	150.7	165	130.3	160	138.4	142.6	4.6%
2008	150.3	1.0%	151.9	167.6	127.7	173.8	141.4	148.8	4.3%
2009	151.1	0.5%	150.7	167.4	127.2	158.7	153.4	149.7	0.6%
Annual Growth Rates									
1962-2007		**4.5%**	**NA**	**NA**	**5.4%**	**4.5%**	**NA**		**4.4%**
1968-2007		**4.8%**	**NA**	**NA**	**5.4%**	**5.0%**	**5.5%**		**4.6%**
1978-2007		**4.1%**	**4.1%**	**4.2%**	**3.8%**	**4.4%**	**4.3%**		**3.7%**
1988-2007		**2.7%**	**2.4%**	**2.4%**	**2.2%**	**2.9%**	**2.6%**		**2.3%**
1998-2007		**2.3%**	**2.3%**	**2.8%**	**1.7%**	**2.1%**	**2.2%**		**2.1%**
1980-2009		**3.5%**	**3.4%**	**3.4%**	**3.3%**	**3.6%**	**4.1%**		**3.2%**
1990-2009		**2.3%**	**2.2%**	**2.3%**	**1.8%**	**2.7%**	**2.9%**		**1.9%**
2000-2009		**1.8%**	**1.8%**	**2.8%**	**0.3%**	**1.1%**	**1.9%**		**2.0%**

Footnotes
[1] All growth rates are calculated logarithmically.

Source: Statistics Canada. Table 327-0011 - Electric utility construction price indexes (EUCPI), annual (index, 1992=100)

Notes:
• Table 327-0011 release schedule is as follows for a year *t* :
In September/October of *t*, preliminary first-half data are released for *t* ;
in April of *t* + 1, preliminary annual data are released for *t;*
in September/October of *t* + 1, revised annual data are released for *t;*
and in April of *t* + 2, final annual data are released for *t.*

Table A-9

Canadian Non-Residental Building Construction Price Indexes

	Seven census metropolitan area composite						Montréal, Quebec					
	Total, non-residential building construction		Total, commercial structures		Total, industrial structures		Total, non-residential building construction		Total, commercial structures		Total, industrial structures	
Year	Level	Growth Rate[1]	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate	Level	Growth Rate
1981	58.3		59.8		52.5		58.0		59.5		55.0	
1982	62.8	7.4%	64.4	7.4%	56.5	7.2%	63.2	8.5%	64.9	8.6%	59.4	7.8%
1983	62.0	-1.2%	63.2	-1.9%	56.4	-0.2%	64.1	1.4%	66.1	1.8%	59.6	0.3%
1984	60.9	-1.9%	61.8	-2.3%	56.3	0.0%	65.7	2.5%	67.6	2.3%	61.2	2.7%
1985	62.2	2.2%	63.1	2.1%	58.7	4.0%	68.4	4.0%	70.2	3.7%	64.3	4.8%
1986	65.0	4.3%	66.0	4.5%	62.0	5.5%	72.2	5.5%	73.9	5.2%	68.2	6.0%
1987	69.7	7.1%	71.0	7.2%	65.9	6.1%	76.4	5.7%	78.4	5.9%	71.8	5.1%
1988	74.6	6.8%	76.1	7.0%	70.6	7.0%	80.3	5.0%	82.2	4.7%	76.0	5.6%
1989	79.5	6.4%	81.1	6.4%	75.8	7.1%	83.5	3.9%	85.3	3.7%	79.5	4.5%
1990	81.8	2.9%	83.3	2.7%	78.1	2.9%	85.3	2.1%	87.0	2.0%	81.3	2.3%
1991	78.8	-3.8%	79.8	-4.3%	76.0	-2.7%	82.2	-3.7%	83.4	-4.3%	79.2	-2.6%
1992	78.7	-0.1%	79.6	-0.2%	76.1	0.1%	81.8	-0.5%	82.5	-1.0%	79.4	0.2%
1993	79.2	0.6%	80.0	0.5%	76.7	0.9%	80.6	-1.4%	81.6	-1.1%	78.4	-1.2%
1994	80.9	2.0%	81.5	1.9%	78.8	2.6%	81.7	1.3%	82.4	1.0%	79.8	1.8%
1995	83.4	3.1%	84.0	3.0%	81.2	3.1%	84.4	3.2%	85.1	3.1%	83.0	3.9%
1996	84.9	1.8%	85.3	1.5%	82.8	1.9%	85.5	1.3%	86.1	1.3%	84.2	1.4%
1997	86.7	2.2%	87.0	1.9%	85.0	2.7%	87.9	2.9%	88.5	2.7%	86.9	3.1%
1998	88.5	2.0%	88.8	2.1%	86.8	2.0%	89.8	2.1%	90.2	1.9%	89.0	2.5%
1999	90.1	1.8%	90.4	1.8%	88.6	2.1%	91.6	2.0%	92.0	2.0%	90.9	2.1%
2000	95.1	5.4%	95.3	5.3%	94.3	6.2%	95.9	4.7%	96.3	4.6%	95.5	4.9%
2001	98.2	3.2%	98.3	3.1%	97.9	3.7%	97.5	1.7%	97.7	1.5%	97.5	2.0%
2002	100.0	1.8%	100.0	1.7%	100.0	2.2%	100.0	2.5%	100.0	2.3%	100.0	2.6%
2003	103.0	3.0%	102.9	2.9%	103.1	3.1%	102.5	2.4%	102.6	2.5%	102.5	2.4%
2004	109.7	6.3%	109.4	6.1%	111.1	7.4%	108.1	5.3%	107.8	5.0%	109.2	6.3%
2005	115.9	5.5%	115.5	5.4%	118.0	6.1%	113.1	4.6%	112.8	4.5%	115.0	5.2%
2006	124.9	7.5%	124.6	7.6%	127.3	7.5%	117.4	3.8%	117.1	3.7%	119.4	3.8%
2007	136.8	9.1%	137.3	9.6%	138.4	8.4%	121.6	3.5%	121.1	3.4%	123.8	3.6%
2008	150.9	9.8%	151.3	9.8%	154.2	10.8%	130.4	6.9%	130.0	7.1%	132.9	7.1%
2009	142.0	-6.0%	141.4	-6.8%	146.7	-5.0%	134.5	3.2%	134.0	3.0%	138.4	4.0%
2010	141.5	-0.4%	140.6	-0.6%	146.2	-0.3%	136.1	1.1%	135.5	1.1%	139.5	0.8%
Annual Growth Rates												
1988-2007		**3.4%**		**3.3%**		**3.7%**		**2.3%**		**2.2%**		**2.7%**
1998-2007		**4.6%**		**4.6%**		**4.9%**		**3.2%**		**3.1%**		**3.5%**
1982-2010		**3.1%**		**2.9%**		**3.5%**		**2.9%**		**2.8%**		**3.2%**
1991-2010		**2.7%**		**2.6%**		**3.1%**		**2.3%**		**2.2%**		**2.7%**
2001-2010		**4.0%**		**3.9%**		**4.4%**		**3.5%**		**3.4%**		**3.8%**

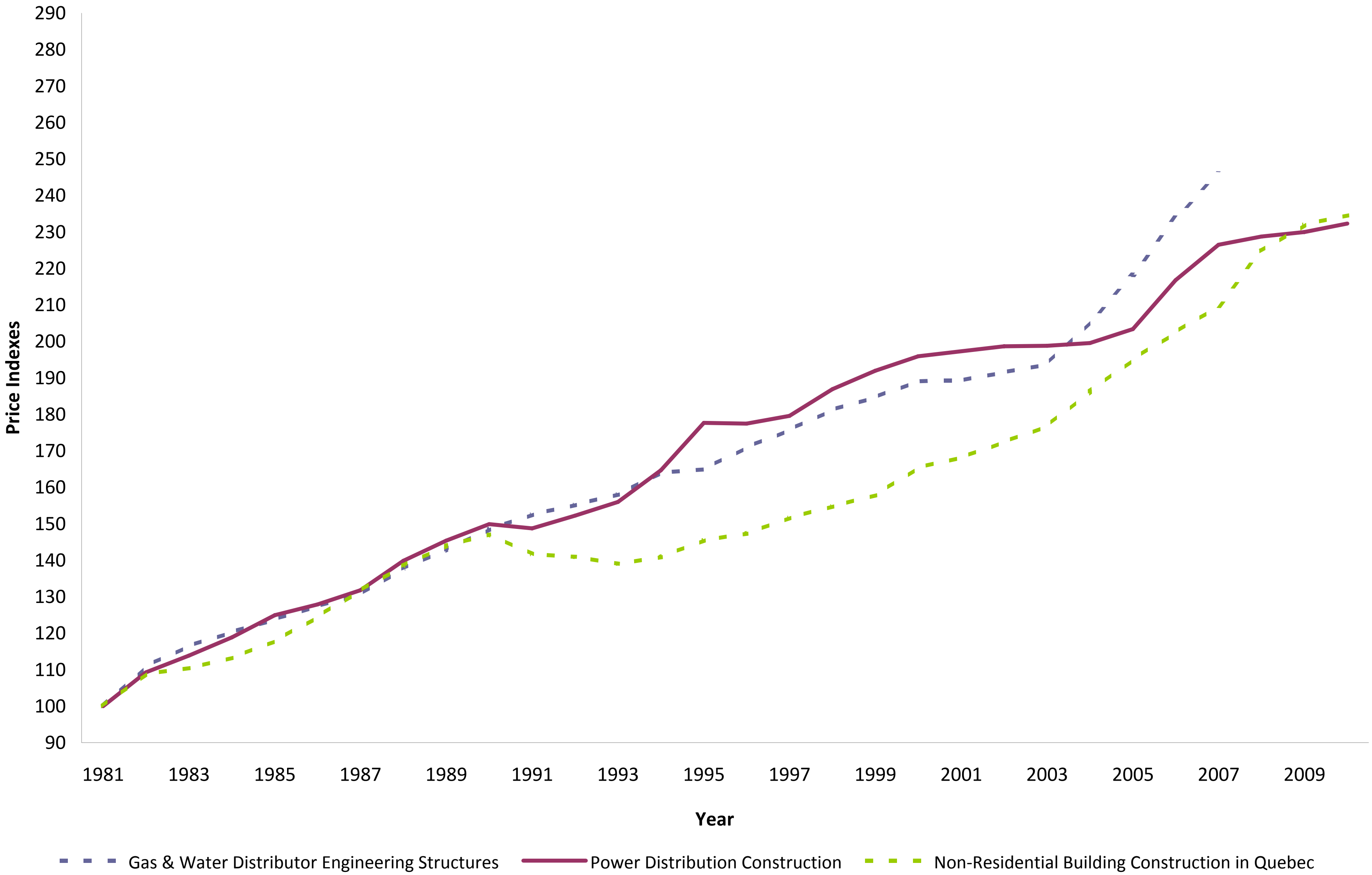
Footnotes
[1] All growth rates are calculated logarithmically.

Source:
Statistics Canada. Table 327-0043 - Price indexes of non-residential building construction, by class of structure, quarterly (index, 2002=10C

Notes
• Data are released on a quarterly basis. Data for each quarter are released during the second or third week of the month two months following the end of the quarter (e.g. Q1 2010 data were released 5/18/2010)

Figure A-1

Comparing Trends in Alternative Capex Price Indexes



We noted in Section A.4 that the growth rate in our featured capex price index for long-lived assets is only made available with a lag of several years. This is not a problem with the two construction cost indexes. It can be seen that the summary electric utility construction price index for power distribution does a better job of tracking our featured index than do either of the non-residential building construction price indexes. However, the tracking is far from perfect. A benchmark index that is not ultimately updated to reflect the inflation in the preferred capex price index will raise the Company's operating risk.

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