# OEB REVIEW OF FURTHER EFFICIENCIES IN THE ELECTRICITY DISTRIBUTION SECTOR

SUBMISSIONS OF

A COALTION OF ONTARIO DISTRIBUTORS

**ONTARIO ENERGY BOARD**

RP-2004-0020

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This report is being filed on behalf of a coalition of Ontario distributors serving over 300,000 customers. The members are as follows:

- Aurora Hydro Connections Limited
- Brant County Power Inc.
- Brantford Power Inc.
- Center Wellington Hydro Ltd.
- Chapleau Public Utilities Corporation
- Collus Power Corp.
- Cooperative Hydro Embrun Inc.
- E.L.K. Energy Inc.
- Festival Hydro Inc.
- Fort Frances Power Corporation
- Grand Valley Energy Inc.
- Gravenhurst Hydro Electric Inc.
- Haldimand County Hydro Inc.
- Hydro 2000 Inc.
- Innisfil Hydro Distribution Systems Limited
- Lakefront Utilities Inc.
- Midland Power Utility Corporation
- Niagara-on-the-Lake Hydro Inc.
- Norfolk Power Distribution Inc.
- Northern Ontario Wires Inc.
- Orangeville Hydro Limited
- Orillia Power Distribution Corporation
- Ottawa River Power Corporation
- Parry Sound Power Corporation
- Peterborough Distribution Inc.
- St. Thomas Energy Services Inc.
- Tay Hydro Electric Distribution Company Inc.
- Tillsonburg Hydro Inc.
- Waterloo North Hydro Inc.
- Welland Hydro-Electric System Corp.
- Wellington North Power Inc.
- Westario Power Inc.
- Whitby Hydro Electric Corp.
- Woodstock Hydro Services Inc.

The report was prepared with the assistance of Dr. Adonis Yatchew of the University of Toronto (see Appendix C for curriculum vitae) and J. Mark Rodger, Partner, Borden Ladner Gervais LLP.

## Introduction

The Coalition appreciates this opportunity to supplement its oral presentation with written comments. Given the compressed time frame of this process, adequate treatment cannot be given to the broad range of issues raised in the Board Staff Discussion Paper. Indeed, we appreciate the challenges for Board Staff and its advisors in preparing their Paper in such a short time frame.

One of the central issues underlying the Discussion Paper is how should distribution be structured in order to promote economic efficiency. The Discussion Paper outlines the structures and restructuring processes that have been undertaken in certain other jurisdictions. However, of particular interest would be an analysis which would indicate which of the configurations have proven to be effective from an efficiency point of view.

Section 6 of the Discussion Paper invites comments on five areas:

1. Further Consolidation
2. Incentives
3. Load Serving Entities
4. Distribution System Planning
5. Technological Innovation.

For consistency, the discussion below is divided into these same areas.

# 1. Further Consolidation

*Optimal Structure Depends on Geographic Distribution of Customers*

The Discussion Paper points out that there are 42 Ontario distributors with less than 10,000 customers (page 4). Collectively, these comprise less than 4% of the total Ontario customer base. Utilities with less than 20,000 customers comprise less than 10% of the total.

While substantial attention has been devoted to scale economies and “minimum efficient scale”, costs depend on a variety of factors including the geographic or spatial distribution of customers and in particular their density, the types of customers being served and the load per customer.

A number of small utilities are surrounded by very sparsely populated territory, so that amalgamation with other municipal utilities is not an option. In this case, the utility may very well have achieved minimum efficient scale.

Absorption into Hydro One is also problematic for at least two reasons:

- An analysis of the relative efficiency of Hydro One – to our knowledge -- does not exist, so that it is not clear whether this form of consolidation would tend to increase or decrease system costs; [1]

- Since rates are typically based on cost averaging over customers with different characteristics, absorption may inequitably increase rates to customers of the existing municipal utility.

Indeed one might ask why one would want to promote consolidation of *any* small utilities whose distribution costs are lower than those of potential partners.

*Rationalization of Costs Should be the Objective*

It is important to note that there are both “high” and “low-cost utilities” in the various size categories. <u>The focus should therefore be on rationalization of costs rather than on “rationalization” or consolidation of small distributors.</u>

By rationalization of costs we mean at least two things:

> First, there is rationalization in the sense of justification of costs. In some cases, utilities have high costs for good reason. They may have old infrastructure, a sparse customer base or they may operate in congested urban areas.
>
> The second sense in which costs should be rationalized is where costs are unreasonably high. Where there is inefficiency, costs should be brought to reasonable levels through appropriate incentive mechanisms. This may or may not involve consolidation.

[1] Indeed, given its unique characteristics, a benchmarking analysis of Hydro One costs would appear to be difficult given available data.

*Empirical Estimates of Minimum Efficient Scale*

The Discussion Paper states that "Empirical estimates of LDC minimum efficient scale range from 20,000 customers on up.", (page 20). We are aware of four studies published in refereed publications which analyze minimum efficient scale based on data for individual distribution companies.[2] The studies try to account for differing characteristics of distributors and focus on scale economies in the wire business. Collectively, these studies suggest minimum efficient scale to be in the range of 20,000 to 30,000 customers.

Elsewhere, there has been reference to a report entitled "T&D Economies of Scale and the Mysteriously Fitted Curve: A First Cut at the Question of Whether There are Any" by Leonard S. Hyman. The statistical analysis provided in that report does not incorporate differences in distributor characteristics (such as customer density) and appears to focus on distributors that are large relative to all but the largest in Ontario. To our knowledge, the paper has not gone through an independent review or refereeing process. Although the study suggests that minimum efficient scale in distribution is at 500,000 customers, the author concludes at page 4 that "None of the indicators of efficiency showed a statistically significant relationship to scale."[3]

*The Desire for Local Control May Be Driven By Valid Economic Objectives*

The Discussion Paper suggests that "non-economic objectives such as local control" may impede the adoption of efficiency enhancing initiatives, (page 13). It could be argued that local control and local accountability provide an effective lever for promoting distributor efficiency. Moreover, the decision not to amalgamate at the present time may very well be a consequence of the lack of a suitable buyer offering the right price. Put another way, municipal owners of distribution systems may believe that their system could attract a higher price in the future, particularly once the regulatory and policy environment has stabilized.

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[2] Norway: K. Salvanes and S. Tjotta (1994), "Productivity Differences in Multiple Output Industries", Journal of Productivity Analysis, 5, 23-43.
New Zealand: D. Giles, D. and N.S. Wyatt, (1993): "Economies of Scale in the New Zealand Electricity Distribution Industry", in Models, Methods and Applications of Econometrics, ed. P.C.B. Phillips, Blackwell, 370-382.
Switzerland: M. Filippini, (1998): "Are Municipal Utilities Natural Monopolies?", Annals of Corporate and Public Economics, 69, 157-174.
Ontario: A. Yatchew, 2000, "Scale Economies in Electricity Distribution: A Semiparametric Analysis", Journal of Applied Econometrics, 15, 187-210.

[3] Other recent U.S. reports by John Kelly, of the American Public Power Association, "Evidence on Scale Economies in Electric Utility Distribution and What it Implies: Is Bigger Better", March 2001, "Electric Power Distribution Costs: Analysis and Implications for Restructuring", John Kwoka, George Washington University, February 2001, discuss scale economies. To our knowledge, neither has been independently reviewed or published in a refereed journal.

A second economic motive which supports local control relates to a municipality's economic development strategy. For example, Niagara-on-the-Lake whose economy benefits greatly from tourism, is considering under-grounding its distribution wires for aesthetic reasons.

In other instances, the desire for local control is driven by equity considerations, particularly if merger with a higher cost distributor would drive distribution costs upward.

## 2. Incentives

*Determinants of Market Structure*

In competitive settings, market forces and technology are critical determinants of market structure. It is not uncommon for markets to have many companies of varying size. Thus, there is no *a priori* reason to argue that fewer utilities would yield a more efficient structure or that they should be of uniform size.

*PBR as a Potential Driver of Consolidation*

In the absence of direct competition, regulators have increasingly turned to Performance Based Regulation to create incentives. Indeed, it could be argued that incentives can and should be created to promote operational efficiency, efficient capital planning and investment, technological innovation and efficient mergers.

Indeed, in our view, primary consideration should be given to allowing PBR mechanisms to drive consolidations where they may be beneficial, rather than basing consolidation on a pre-conceived notion that small utilities are necessarily inefficient. Under a PBR regime, where there are real rewards and penalties for performance, under-performing utilities will be more prone to sale or consolidation by their municipal owners.

*The Value of Diversity in a PBR Setting*

Section 3.1 of the Discussion Paper discusses PBR in conjunction with benchmarking. To the extent that the existence of multiple utilities provides for a broader basis for comparison and establishment of benchmarks, consolidation may not improve but in fact reduce regulatory efficiency.[4]

*Regulatory Burden*

The Coalition is sensitive to the regulator's concern about having to regulate many distribution utilities. However, the benefits of having multiple comparators would likely far outweigh regulatory costs.

First, the presence of multiple distributors creates competitive pressures in the regulatory arena. Second, it permits the regulator to assemble useful corporate performance measures across a range of utility sizes thus providing a more objective basis for setting benchmarks. Indeed, distributors routinely engage in comparisons of performance measures amongst themselves.

Moreover, relatively simple and effective regulatory rules can be devised which take advantage of diversity rather than being burdened by it. Coalition members would be pleased to participate or assist in the development of streamlined regulatory rules for distributors.

## 3. Load Serving Entities

*Scale Economies of Load Serving Entities*

The Discussion Paper "..raises the question of whether further consolidation or joint venturing would be required .. for .. utilities to get started in the load serving entity role.", (page 22).

Minimum efficient scale for load serving entities is likely much higher than for the operation of a pure distribution business. However, there is no necessity for each distributor to act as a load serving entity. One would expect that distribution companies which act as load serving entities will coexist with pure distribution companies. Indeed, in appropriate circumstances, load serving entities which are *not* associated with distribution companies will emerge in the marketplace.

In any event, a key consideration for municipal or other public owners of load serving entities will be to determine who will be the ultimate bearer of financial risk and how any losses would be covered. In order to protect "wires" customers, the regulator

[4] See for example, A. Yatchew, "Incentive Regulation of Distributing Utilities Using Yardstick Competition," (2001), Electricity Journal, 56-60, attached as Appendix B to this report.

may decide to require separation of regulated monopoly wires business from those related to serving load.

## 4. Distribution System Planning

The Discussion Paper states that “Consolidation would be one means of broadening the scope of the system planning performed by distributors; however, increased collaboration among neighboring distributors could be an alternative.” (page 23).

Two central features of efficient distribution system planning is contiguity of service territory and stability and predictability of service territory boundaries. Contiguity is critical because of the physical connectivity of electricity networks. Stability of boundaries allows distributors to plan for future customer growth.

While there are “boundary” effects, it should be recognized that the proportion of the total Provincial customer base that lies at or near boundaries is small. Thus, while boundary effects may be a consideration for seeking service territory amendments or for engaging in “load transfers”, it is much to see that such effects would be a key driver of consolidation of utilities serving contiguous territories.

Indeed, one might ask whether the historical structure of Ontario distribution, which in the past accommodated many more utilities than exist at present, has led to gross inefficiencies in distribution planning. We are not aware of any analyses that come to this conclusion.

## 5. Technical Innovation

The Discussion Paper states that “In part, the appropriate adoption of new technologies can be guided by careful analysis of best practice across the industry.” (page 24).

In our view, a diversity of approaches in the industry is an important factor contributing to the evolution of best practices and technological innovation.[5] Put another way, when one cannot create direct competition for customers, then one wants to create competition in other arenas such as in the marketplace for ideas and innovations, and in regulatory arenas.

[5] Recently PUC Telecom of Sault Ste. Marie announced a project to deliver broadband service over power distribution lines.

Moreover, the presence of multiple distributors facilitates the creation of a market for outsourcing certain functions.

Again, it would seem that an incentive approach, such as PBR, is the most effective way of promoting the adoption of new and more efficient technologies.

## Conclusions

In view of the extremely compressed time-frame, this report cannot be comprehensive. Nevertheless, the Coalition would emphasize the following key points:

- **There are "high" and "low-cost" utilities in the various size categories. Thus, rationalization of distribution costs should be the primary focus rather than "rationalization" or consolidation of distributors.**
- **Political and regulatory stability is a prerequisite for rational consolidation of Ontario LDCs.**
- **Incentive based voluntary consolidation should be the goal.**
- **More generally, incentive creation should be a central objective of the regulatory model. Wherever possible, incentives should be used to promote efficient operation, efficient capital planning and investment, technological innovation and consolidation.**
- **The existence of multiple LDCs need not unduly increase regulatory burden and can substantially improve the effectiveness of regulation.**

# APPENDIX A: SLIDE PRESENTATION

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# OEB REVIEW OF FURTHER EFFICIENCIES IN ELECTRICITY DISTRIBUTION

Coalition of Ontario Distributors

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Ontario Energy Board

February 2004

# LDC Coalition

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- Gravenhurst Hydro Electric Inc.
- Haldimand County Hydro Inc.
- Hydro 2000 Inc.
- Innisfil Hydro Distribution Systems Limited
- Lakefront Utilities Inc.
- Midland Power Utility Corporation
- Niagara-on-the-Lake Hydro Inc.
- Norfolk Power Distribution Inc.
- Northern Ontario Wires Inc. (Cochrane, Kapuskasing, Iroquois Falls)
- Orangeville Hydro Limited
- Orillia Power Distribution Corporation
- Ottawa River Power Corporation
- Parry Sound Power Corporation
- Peterborough Distribution Inc.
- St. Thomas Energy Services Inc.
- Tay Hydro Electric Distribution Company Inc.
- Tillsonburg Hydro Inc.
- Waterloo North Hydro Inc.
- Welland Hydro-Electric System Corp.
- Wellington North Power Inc.
- Westario Power Inc.
- Whitby Hydro Electric Corp.
- Woodstock Hydro Services Inc.

# LDC Coalition

- Collectively the LDC Coalition serves over 300,000 customers.
- LDC Coalition members are located throughout Ontario.

# Context

- Distribution is a natural monopoly.
- Electricity distribution systems vary world-wide.
- Optimal structure depends on geographic distribution of customers.
- Contiguity of service areas is an essential feature of efficient distribution system design.

# Scope of the Discussion

- Economic efficiency
- Regulatory efficiency
- Shareholder considerations

# Economic Efficiency: Rationalization of Costs

- There are “high” and “low-cost” utilities in various size categories.
- Focus should be primarily on rationalization of costs rather than on “rationalization” or consolidation of small distributors.
- Diversity can promote technological innovation.

# Economic Efficiency: Distribution System Planning

- Contiguity and stability or at least predictability of service territory are important prerequisites of efficient distribution system planning.

- No evidence that distribution system has been planned inefficiently, despite the presence of many more utilities in the past.

# Regulatory Efficiency: Incentive Creation and Regulatory Burden

- A central regulatory objective should be incentive creation.

- The presence of multiple existing utilities need not unduly increase regulatory burden.

- Diversity may improve effectiveness of regulation.

# Regulatory Efficiency: Rationalization of Distribution

- “Rationalization” or consolidation of small distributors is better achieved through incentive creation than by mandate.

- Coalition members strongly believe that LDC mergers should be voluntary.

# Shareholder Considerations: Political and Regulatory Uncertainty

- Unpredictable provincial policy changes are a barrier to consolidation.
- Political and regulatory parameters remain uncertain.
- Maximizing shareholder value has different meanings in different communities but often manifests itself through the desire for local control.

# Shareholder Considerations: Local Accountability and Control

Desire for local control driven by:

- Economic factors.
- Equity considerations.
- Accountability concerns.

# Concluding Comments/Summary

- Rationalization of distribution costs should be the primary focus.
- Political and regulatory stability is a prerequisite for rational consolidation of Ontario LDCs.
- Incentive based voluntary consolidation should be the goal.
- The existence of multiple LDCs need not unduly increase regulatory burden.

# APPENDIX B:

Yatchew, A. 2001: "Incentive Regulation of Distributing Utilities Using Yardstick Competition", Electricity Journal, Jan/Feb, 56-60.

# Incentive Regulation of Distributing Utilities Using Yardstick Competition

*Comparability of costs is enhanced by the use of flexible models such as nonparametric and semiparametric specifications, and robust econometric techniques such as median and quantile regression. The process of incentive regulation can be used not only to create incentives for firms to behave in a more cost-effective manner, but to create better incentives for information revelation.*

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There are at least four major objectives for incentive or performance-based regulation (PBR):

- to create strong incentives for cost minimization;
- to promote efficient capital investment expenditures;
- to ensure fair cost recovery for firms and a fair return on investment; and
- to enhance information revelation in order to mitigate the traditional asymmetry of information between the regulator and the firm.

All these objectives can be achieved much more readily if the regulator is fortunate to have multiple firms among which comparisons can be made. A device for doing so is yardstick competition/regulation. Utilities can vary widely in size and characteristics, however, and setting meaningful benchmarks to ensure fair cost recovery is a nontrivial regulatory exercise. For example, how much higher does one set allowable costs for low-density distribution utilities relative to those with high density? Both econometric and engineering estimates are relevant here. In this article, we focus on econometric

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approaches and show how they are specifically relevant to Ontario, Canada, where there are currently over 150 distribution utilities serving a population of about 12 million.

## I. Yardstick Competition / Regulation

### A. The Basic Idea

Suppose you have 100 firms of similar size and characteristics but with unit costs which vary significantly. How would you implement incentive-based regulation? A number of alternatives suggest themselves.

One way would be to calculate average unit costs and require all firms to charge prices which do not exceed these average costs. Firms below the average could increase prices to the average and pocket the gain. Any further cost savings achieved over (a pre-specified period of) time could also be retained by the firm.[1]

But averages tend to be susceptible to outliers. Thus, a second alternative would be to find the firm with median costs and use this as the benchmark.

A third alternative would be to use a percentile other than the median (which is of course the 50th percentile). For example, one could find the 25th percentile—i.e., the point where 75 percent of firms have higher costs and 25 percent have lower costs—and set this to be the maximum allowed cost. The percentile approach seems to be the most plausible—percentiles (or quantiles) which are not too far out in the tails are generally accurately estimated and robust.[2]

A fourth and much more ambitious alternative would be to find the firm with the lowest costs and set the benchmark some percentage above this level (e.g., 25 percent). This last approach, which is related to the idea of "best practices," is by far the most susceptible to outliers because you are potentially using a firm that is not comparable to the others to set the standard for the others. Furthermore, "best practices" are much more difficult to estimate accurately than, say, average or median performance.[3] Indeed, the rationale for incentive-based regulation is grounded in the idea that the regulator *cannot* estimate minimum costs especially accurately.

*For the purist, the quantile approach is probably most satisfying because the standard is set by the top performers.*

### B. Comparing Utilities with Different Characteristics

Of course, a regulator rarely has the luxury of regulating a large number of similar firms. The firms often vary widely in size and characteristics. Indeed, individual firms have the incentive to point out their differences and to argue that these justify approval of higher costs in their case. A natural tool for adjusting for differing characteristics is regression, and each of the above schemes has a regression analogue. If one is interested in average costs given a set of characteristics, then one would use ordinary least-squares regression, by far the most common and widely understood regression tool. If one is interested in median costs, then one would use median (or least absolute deviation) regression. If one is interested in estimating the 25th percentile for firms with a given set of characteristics, then quantile regression is the tool. Finally, if one is interested in finding the most efficient firms, then production frontier techniques and data envelopment analyses can be applied.[4]

For the purist, the quantile approach is probably the most satisfying because, in theory, for a given firm, the standard is being set by the top quarter performers with similar characteristics. In practice, the uncertainty in estimation of effects could very well dominate the issue of selection of the most appropriate regression technique. If, on the other hand, similar results are obtained when applying different techniques, one's confidence in the conclusions is likely strengthened. Thus, a sensible approach would be to estimate mean, median, and quantile regressions, and to evaluate the differences in results.

### C. Use of Model Estimates

Suppose that one has estimated a mean, median, or quantile regression model of the form $y = x\beta + \epsilon$, where $x$ is a vector of observed variables and β the corresponding vector of parameters. The predicted values from these regressions constitute the *explainable* differences in costs in terms of observed characteristics. The regulator may choose to distinguish between these and *justifiable* differences in costs. For example, suppose one of the explanatory variables in $x$ is the "wage rate" paid by the utility. Then firms that pay higher wages for similar labor can be expected to have higher costs. The regulator may decide instead, however, to use an index of regional wages in defining allowable costs for the firm.

Inevitably, such modeling exercises fall prey to the criticism that they omit potentially important and relevant variables.[5] In the interest of perceived fairness, the regulator may be tempted to impose a common rule for all firms, such as allowing current costs plus the rate of price inflation minus a common productivity improvement requirement (i.e., the simplest of RPI-X rules).[6] Common rules have the disadvantage of unifying the interests of the regulated firms: They will all want to argue that the required productivity gain $X$ is being set too high. In contrast, a regulatory rule which incorporates differences among firms creates incentives for firms to reveal information to the regulator about themselves and each other which might otherwise not be available.

In short, yardstick competition creates competing interests in the *regulatory* arena. Utilities harmed by the omission of a particular variable will insist that it be measured, reported, and included in the regulatory rule. Thus, one of the critical benefits of yardstick competition is that *it promotes information revelation.* Furthermore, the elicited information is provided by entities most suited to the task: the utilities themselves.

## II. Distribution of Electricity in Ontario

### A. Statistical Results

To illustrate our arguments, we draw upon a statistical analysis of 81 municipal distributing utilities in Ontario, ranging in size from about 600 to 220,000 customers.[7] The estimated model is given by:

$$tc = f(cust) + \beta_1 wage + \beta_2 pcap + \beta_3 PUC + \beta_4 kwh + \beta_5 life + \beta_6 lf + \beta_7 wire + \epsilon,$$

where $tc$ is the log of total cost of distributing electricity per customer, $cust$ is the log of the number of customers, $wage$ is the log wage rate of linemen, $pcap$ is the log of historical cost of physical capital per kilometer of wire, $PUC$ is a dummy variable which is equal to 1 if the utility is a Public Utility Commission and delivers other services (such as water and sewage removal), $kwh$ is the log of kWh per customer, $life$ is the log of average remaining lifetime of assets, $lf$ is the log of the load factor, and $wire$ is the log of length of wire per customer. Except for the $PUC$ dummy, all variables are in logarithmic form so that coefficients can be interpreted as elasticities. **Table 1** summarizes the estimation results.

Thus, as shown in the table, a 10 percent increase in the wage rate is predicted to increase costs by 5.7 percent. An increase of 10 percent in length of wire per customer increases costs by an estimated 3.8 percent. Higher unit capital costs and higher load factors are also predicted to increase costs. On the other hand, *PUC*s benefit from economies of scope and exhibit approximately 7 percent lower costs. Utilities whose assets have a longer remaining life also have lower costs.

But what about economies of scale? We measure the scale of operation by the number of customers served and the effect is deliberately specified using a flexible function $f(cust)$.[8] The results of the analysis are illustrated in **Figure 1**. There is strong evidence of increasing returns to scale, but perhaps surprisingly, efficient scale of operation is achieved by fairly small distributors (some 20,000 to 30,000 customers). It should be emphasized that these utilities are not in the business of power procurement.

**Table 1:** Estimation Results, 81 Ontario Utilities

| Variable | Estimated Effect | *t* Statistic |
|---|---|---|
| *cust* | See Figure 1 | — |
| *wage* | .57 | 2.1 |
| *pcap* | .50 | 8.6 |
| *PUC* | −.07 | −2.1 |
| *kwh* | .08 | 1.2 |
| *life* | −.36 | −4.2 |
| *lf* | .39 | 2.2 |
| *wire* | .38 | 5.0 |

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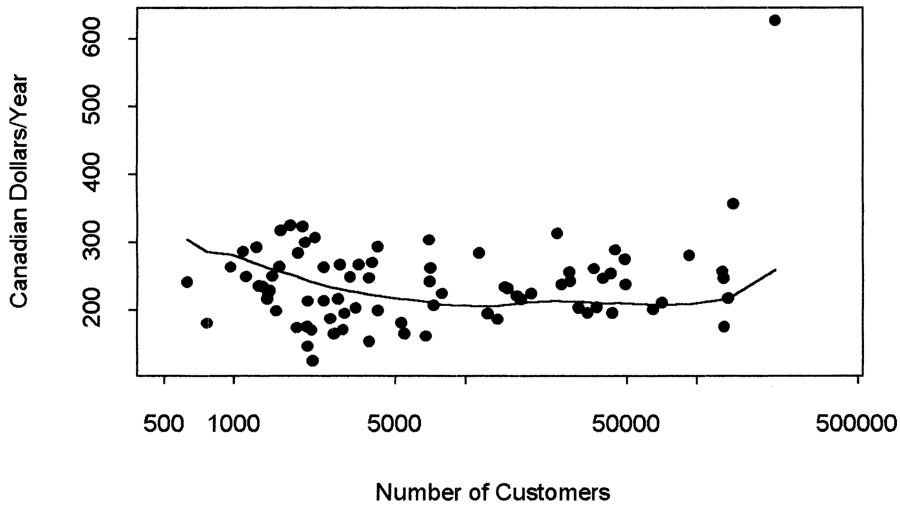


**Figure 1:** Annual Distribution Costs per Customer. The plotted points are total distribution costs per customer adjusted for all variables except the scale variable. The solid line is a "nonparametric kernel" estimate of the scale effect.

The largest distributor has by far the highest unit costs. Statistically, the results on minimum efficient scale are consistent with similar analyses conducted in Norway and New Zealand.[9]

### B. Explainable Versus Allowable Costs

How can the regulator use the model to determine allowable costs? Let us consider the variables on a case by case basis:

- scale (as measured by the number of customers *cust*): all firms could be required to meet cost levels associated with minimum efficient scale. For large utilities exhibiting decreasing returns to scale, this could result in internal reorganization or other cost cutting measures; for small utilities, this would create the incentives for mergers. In exceptional cases, scale may be exogenous, e.g., when a utility is surrounded by completely unpopulated territory; in this case, the regulator may not require full adjustment.
- *wage*: allowable costs could be based upon mean industry wage levels with possible corrections for regional differences in wages.
- *pcap:* this variable measures the cost of physical plant per kilometer of distribution, and it is perhaps the most problematic; variation in *pcap* across utilities is due to a number of factors including variation in local conditions (such as terrain and weather), the presence of additional facilities, such as distributor-owned transformers, the historical timing of capital acquisition, and over/under-spending on capital. The regulator may decide to avoid stranded capital cost issues by simply allowing all current capital costs, then regulating capital additions using yardstick competition or other mechanisms.
- *PUC:* some utilities benefit from scope economies by delivering other services; utilities achieving these savings would be permitted to keep them, thus creating the incentives for others to explore similar opportunities.
- *life:* newer assets appear to require lower servicing costs. The treatment of this variable would depend upon how capital additions were regulated.
- *lf:* higher distribution costs associated with higher load factors could be allowed.
- *wire:* customer density is one of the most important variables differentiating distributing utilities, and higher costs associated with distribution to areas of low density would in all likelihood be allowable.

Even if the regulator decided not to use the model in its entirety for purposes of setting the regulatory rule, certain estimated effects (such as those associated with density or scale) could be used to assist in the determination of allowable costs.

## III. Conclusions

Econometric models can inform the regulatory process in important ways. They can be used to estimate the effects of critical variables such as scale, density, and load factor on the costs of operating a distributing utility. Flexible specifications such as nonparametric and semiparametric models, and robust estimation techniques such as median and quantile regression, can inspire greater confidence in the statistical results. This is true regardless of how the regulator ultimately uses the results.

From the point of view of the regulator, a good intra-jurisdictional information base is highly desirable. This requires careful definition of variables and a methodology that ensures comparability across utilities. Furthermore, amalgamations of utilities which do not substantially reduce costs but which result in a deterioration of the information available to the regulator may not, on balance, be desirable.

In some jurisdictions, there are too few firms to allow reasonable statistical analysis. In such circumstances, good empirical analyses from other jurisdictions acquire much greater importance.

The process of explaining cost differences among utilities and determining which ones are allowable should result in fairer regulatory rules. However, there is another important benefit which we have emphasized. By creating a strong linkage between the regulatory rule and *differences* among utilities, utilities have a greater incentive to reveal information about themselves and about each other to the regulator.

Put another way, incentive regulation can not only be used to create incentives for firms to behave in a more cost-effective manner, it can also be used to create better incentives for information revelation. ■

*From the point of view of the regulator a good intra-jurisdictional information base is highly desirable.*

**Endnotes:**

**1.** This idea is set out nicely in a paper by Andrei Shleifer, *A Theory of Yardstick Competition*, RAND J. OF ECON., Autumn 1985, at 319–27. See also Thomas Weyman-Jones, *Problems of Yardstick Regulation in Electricity Distribution*, in THE REGULATORY CHALLENGE (Matthew Bishop, John Kay, and Colin Mayer, eds., Oxford: Oxford University Press, 1995).

**2.** For example, suppose that the sample contains a relatively small proportion of utilities which are "different" and which we call outliers. As long as the quantile you are trying to estimate exceeds the proportion of such outliers, then the bias in the estimate of the quantile is affected only by the proportion of outliers, not by their distribution. For example, suppose we have 95 low-density utilities and five medium-density utilities with lower costs. Then, the 25th percentile of the mixture of 100 utilities will be biased downward, but the bias will be unaffected if the five medium-density utilities are replaced by five high-density utilities with much lower costs.

**3.** Just as the lowest temperature in February is more volatile than the median temperature.

**4.** There are considerable volumes of literatures on production frontier estimation and data envelopment analysis. For a foothold into these see William H. Greene, *Frontier Production Functions*, in HANDBOOK OF APPLIED ECONOMETRICS, VOL. II: MICROECONOMICS (M. Hashem Pesaran and Peter Schmidt, eds., Malden, MA: Blackwell, 1997), and WILLIAM COOPER, LAWRENCE M. SEIFORD, AND KAORU TONE, DATA ENVELOPMENT ANALYSIS (Boston: Kluwer Academic Press, 2000).

**5.** This subject merits much more discussion. Suffice it to say here that omission of a variable may exacerbate regulatory error not only because certain appropriate costs are not allowed, but also because some firms may be required to meet standards set by other firms whose costs appear to be lower as a result of the omission of the variable.

**6.** Indeed, it could be argued that current costs represent better benchmarks against which productivity improvement should be applied than adjustments made on the basis of models. This is true if one believes that utilities operating under the same regulatory regime would have operated with similar degrees of inefficiency. On the other hand, there is evidence that utilities with inherently higher costs (say, because of lower density of customers) feel the pressure to lower costs and may be more efficient.

**7.** See Adonis Yatchew, *Scale Economies in Electricity Distribution: A Semiparametric Analysis*, J. APPLIED ECONOMETRICS, Mar./Apr. 2000, at 187–210. For purposes of illustration, we report the results of conventional regression techniques. Results using median regression were, in this case, similar.

**8.** More precisely, in order not to prejudge the scale effect, we have allowed it to enter nonparametrically. For an introduction to such techniques, see WOLFGANG HARDLE, APPLIED NONPARAMETRIC REGRESSION (New York: Cambridge University Press, 1990); or Adonis Yatchew, *Nonparametric Regression Techniques in Economics*, J. ECON. LITERATURE, June 1998, at 669–21.

**9.** Kjell Salvanes and Sigve Tjotta, *Productivity Differences in Multiple Output Industries*, J. PRODUCTIVITY ANALYSIS, Jan. 1994, at 23–43; and David Giles and Nicolas Wyatt, *Economies of Scale in the New Zealand Electricity Distribution Industry*, in MODELS, METHODS AND APPLICATIONS OF ECONOMETRICS (Peter C.B. Phillips, ed., Cambridge, MA: Blackwell, 1993), at 370–82. See also John Kelly, *The Future Role of Distribution Utilities: A Dissenting View*, ELEC. J., June 1999, at 22–29.

  

# APPENDIX C:

# CURRICULUM VITAE -- ADONIS YATCHEW

## CURRICULUM VITAE -- ADONIS JOHN YATCHEW

**ACADEMIC OFFICE ADDRESS:**
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**CURRENT EMPLOYMENT STATUS** Associate Professor of Economics
University of Toronto

**OTHER PROFESSIONAL ACTIVITIES**
Joint Editor (with Campbell Watkins), The Energy Journal (1995-present)
Editor (with Yves Smeers) 1997, Distributed Generation, special issue of the Energy Journal
Advisory Editor, Economics Letters (1985-1997)

Teaching award: 1987 SAC APUS Teaching Award, University of Toronto
Member, Advisory Board, *Eurasia Foundation*

**DEGREES:** Ph.D. Harvard University, Economics - 1980
M.A., University of Toronto, Economics - 1975
B.A., University of Toronto, Mathematics and Economics - 1974

**ACADEMIC EXPERIENCE:**

| | |
|---|---|
| 1989,1990, 1991 | Visiting Research Associate, Harvard University |
| 1986 | Visiting Fellow Commoner, Trinity College, Cambridge, U.K. |
| 1980 to 1986 | Assistant Professor, Economics, University of Toronto |
| 1984 | Visiting Research Associate, National Bureau of Economic Research, Cambridge, Massachusetts |
| 1982 to 1984 | Visiting Assistant Professor, University of Chicago |
| 1976 | Lecturer, University of Toronto, Scarborough College |

**REFEREED PAPERS / NOTES:**

Pesando, J., and Yatchew, A., 1977, "Real vs. Nominal Interest Rates and the Demand for Consumer Durables in Canada", Journal of Money, Credit, and Banking, 428-436.

Bird, R., Bucovetsky, M., and Yatchew, A., 1985, "Tax Incentives for Film Production: The Canadian Experience", Public Finance Quarterly, Vol. 13, 396-421.

Epstein, L., and Yatchew, A., 1985, "The Empirical Determination of Technology and Expectations: A Simplified Procedure:, Journal of Econometrics, Vol. 27, 235-258.

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Griliches, Z. and A. Yatchew, 1981, “Sample Selection Bias and Endogeneity in the Estimation of the Wage Equation: An Alternative Specification, Annales de l’Insee, 43, 35-46.

Yatchew, A., and Griliches, Z., 1985, "Specification Error in Probit Models", Review of Economics and Statistics, 134-139.

Yatchew, A., 1985, "A Note on Nonparametric Tests of Consumer Behaviour", Economics Letters, Vol. 18, 45-48.

Yatchew, A., 1986, "Comment" on Frontier Production Functions, Econometric Reviews, Vol. 4(2), 345-352.

Yatchew, A., 1988, "Some Tests of Nonparametric Regression Models", Dynamic Econometric Modelling, Proceedings of the Third International Symposium on Economic Theory, W. Barnett, E. Berndt, H.White (eds.), Cambridge University Press, 121-135.

Yatchew, A., 1992, "Nonparametric Regression Tests Based on Least Squares", Econometric Theory, Vol. 8, 435-451.

Waverman, L. and A. Yatchew (1994), "The Regulation of Electricity in Canada", in International Comparisons of Electricity Regulation, R. Gilbert and E. Kahn, editors, Cambridge University Press, 366-405.

Yatchew, A. 1997, “An Elementary Estimator of the Partial Linear Model”, Economics Letters, Vol. 57, pp.135-43. Vol. 59, 1998 403-5.

Yatchew, A. and L. Bos 1997, “Nonparametric Regression and Testing in Economic Models”, Journal of Quantitative Economics, 13, 81-131, www.chass.utoronto.ca/~yatchew.

Yatchew, A. 1998, “Nonparametric Regression Techniques in Economics”, Journal of Economic Literature, 36, 669-721.

Yatchew, A., 1999, "An Elementary Nonparametric Differencing Test of Equality of Regression Functions", Economics Letters, 271-8.

Yatchew, A., 2000, "Scale Economies in Electricity Distribution: A Semiparametric Analysis", Journal of Applied Econometrics, 15, 187-210.

Yatchew, A. and Joungyeo Angela No, 2001: "Household Gasoline Demand in Canada", Econometrica, 1697-1710.

Yatchew, A.,Yiguo Sun and Catherine Deri, 2003: " Efficient Estimation of Semi-parametric Equivalence Scales With Evidence From South Africa", Journal of Business and Economic Statistics, 21, 247-257.

Hall, Peter and A. Yatchew, 2003: "Unified Approach to Testing Functional Hypotheses in Semiparametric Contexts", www.chass.utoronto.ca/~yatchew . Forthcoming, Journal of Econometrics.

**REFEREED BOOK**

Yatchew, A., 2003, Semiparametric Regression for the Applied Econometrician, 213 pages, Themes in Modern Econometrics, ed. P.C.B. Phillips, Cambridge University Press.

**OTHER PAPERS / STUDIES**

Yatchew, A. 1995, "The Distribution of Electricity on Ontario: Restructuring Issues, Costs and Regulation",Ontario Hydro at the Millenium, University of Toronto Press, 327-342,353-354.

Yatchew, A. 1995, "Comments on The Regulation of Trade in Electricity: A Canadian Perspective",Ontario Hydro at the Millenium, University of Toronto Press, 165-7.

Yatchew, A. 2001: "Incentive Regulation of Distributing Utilities Using Yardstick Competition", Electricity Journal, Jan/Feb, 56-60.

Littlechild, S. and A. Yatchew, 2002: "Hydro One Transmission and Distribution: Should They Remain Combined or be Separated", www.chass.utoronto.ca/~yatchew .

**WORK IN PROGRESS**

Yatchew, A.,and Yiguo Sun 2001: "Differencing vs. Smoothing in Nonparametric Regression: Simple Techniques and Monte Carlo Results", revise and resubmit, Journal of Economic Surveys.

Yatchew, A. and W. Haerdle 2003: "Dynamic Nonparametric State Price Density Estimation Using Constrained Least Squares and the Bootstrap", www.chass.utoronto.ca/~yatchew. Revise and resubmit, Journal of Econometrics.

Yatchew, A., 1999, "Differencing Methods in Nonparametric Regression: Simple Techniques for the Applied Econometrician, 86 manuscript pages.

**PROFESSIONAL EXPERIENCE:**

Senior Consultant, Charles River Associates

Member, Board of Directors, *EnerConnect*

E**lectrical Utilities:**

(2003) Testified before the Ontario Energy Board on Service Area Amendments.

(2003) Testified before the New Brunswick Board of Commissioners of Public Utilities on performance based regulation, benchmarking and rate of return issues

(1993-1998) Prepared major studies for the Municipal Electric Association on restructuring of the electric utility industry in Ontario

(1991-1992) Research Director for the Municipal Electric Association in their intervention before the Environmental Assessment Board in connection with Ontario Hydro's 25 year Demand/Supply Plan

(1992) Prepared testimony on forecasts of electricity demand for Ontario -- Environmental Assessment Board Hearing

(1982-1995) consultant to the Municipal Electric Association at the Ontario Hydro Rate Hearings before the Ontario Energy Board

**Banking Industry:**

(1997) Prepared analysis of securities lending for Canada Trust

**Bell Mobility:**

(1991- 1994) prepared short term market assessment and forecasts for cellular telephone sales

**Oil Pipelines:**

(1987, 1992) coauthored studies on pipeline cost allocation.

**Airlines:**

(1989) prepared technical analysis of the effects of booking system biases in a major U.S. lawsuit

**Competition / Antitrust:**

(1990) prepared statistical analysis in connection with a legal proceeding on anti-competitive behavior relating to the supply of paper forms

(1989) prepared analysis in connection with the Imperial Oil/Texaco merger deliberations before the Federal Competition Tribunal

**Toronto Transit Commission:**

(1988, 1989, 1991), various studies on subjects such as subway reliability measures, evaluation criteria for resource allocation, statistical procedures in relation to count data

**Natural Gas:**

(1985), coauthored a major background study for the Federal Government/Province of Alberta energy price negotiations

**Minerals:**

(1985), performed econometric analysis of zinc, copper, potash markets as part of a larger study for Cominco

**Statistics, Probability:**

(1985), designed data sampling scheme for Parking Authority of Toronto - to be used for monitoring flows into parking lots and as a broad audit check

**Tax Incentives to the Canadian Film Industry:**

(1981), one of three co-investigators in study of film industry for Federal Government