# Wholesale and Retail Competition in the Canadian Petroleum Industry: An Econometric Analysis

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## Abstract

Using data on 11 Canadian cities between 1991 to 1998 we find (i) a positive correlation between market concentration and retail price levels. Specifically, prices seem to rise with market concentration but the presence of smaller independent firms does not have any significant impact on retail prices, as opposed to vertically integrated firms (majors and regionals). (ii) Variations in wholesale prices are closely related to crude oil price fluctuations.

## I. Introduction

Some recent studies have asserted that the Canadian retail gas industry is characterised by a lack of competition[2]. Further, these studies consider independent retailers to be a key component of competition and advocate amendments to the *Competition Act* which may enhance their ability to compete with other larger gas retailers[3]. Implicit in this is the belief that the presence of independents is associated with lower retail gas prices. I test this hypothesis by estimating the statistical impact of independent retailers as a group, on average gasoline prices in 11 Canadian cities over a 7-year period (1991-1998). A significant and negative relationship between retail gasoline prices and market concentration component of independents would support the idea that the presence of independent retailers, in comparison with the presence of vertically integrated retailers, is associated with lower prices.

This paper also attempts to explore the relationship between wholesale or rack prices of gasoline and crude oil price shocks. The underlying motivation here is to assess whether vertically integrated firms have the power to set wholesale prices independently of crude oil price fluctuations. A one cent/litre increase in wholesale prices arising from a one cent/litre increase in crude oil prices may be evidence that at least some changes in wholesale prices naturally stem from crude oil price fluctuations. On the other hand, an increase of more than one cent/litre in response to a one cent/litre increase in crude oil prices may be some indication that vertically integrated firms take advantage of changes in crude oil prices by setting wholesale prices asymmetrically higher. Although this is by no means a sufficient and complete test of market power, it sheds some light on whether some movement of wholesale (rack) prices are independent of crude oil price fluctuations.

A key contribution of this research is the use of data on retail and wholesale prices and market shares over a reasonably long time period time (1991-1997) and across different cities (11)[4]. Previous studies have chiefly restricted their analysis to much shorter time periods or to single cities. The problem with this approach is the occurrence of random events specific to a particular year or city which, may bias any inference drawn from these studies. Pooling data over a reasonably long time period and across several cities enables us to average out any random event that may be specific to a particular year or city and consequently arrive at robust conclusions.

Another contribution is through the employment of a wide variety of local factors apart from market shares, that may impact the relationship between retail, wholesale and crude oil prices. Ignoring such factors may bias any expected relationship between (1)

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[2] For example, the Report of the Liberal Committee on Gasoline Pricing in Canada.
[3] Gas retailers in Canada may be categorized as follows (1) Major (2) Regional and (3) Independents. This classification will be elaborated on later in the paper.
[4] For an excellent review of previous research please refer to Godby et al, "Testing for Asymmetric Pricing in the Canadian Retail Market", Working Paper, November 1998.

retail gasoline prices and market shares and (2) wholesale gasoline prices and crude oil price fluctuations. For example, average sales per gas station may also affect retail gasoline prices across cities. It is possible to imagine a situation where gas stations in a particular city are able to charge lower retail prices relative to another city, because of efficiencies gained from higher average sales volumes or throughput. Therefore, excluding an empirical measure for average sales per gas station or throughput may bias the resulting correlation obtained between retail gasoline prices and market shares.

We find that average retail gasoline prices in different Canadian cities are positively related to market concentration. In other words, this study shows that retail prices increase with market concentration. On the other hand, the presence of independents per se, does not seem to have any significant impact on average retail gas prices. These results suggest that the exit of any firm, irrespective of whether it is an integrated retailer or an independent, may lead to higher retail prices if and only if it also leads to higher concentration among firms. Further, the empirical results suggest that the changes in wholesale prices are significantly and symmetrically related to movements in crude oil prices.

## II. Trends in Retail Prices, Wholesale Prices and Market Shares

Canadian gas retailers may be categorised as (1) major vertically integrated firms, which have integrated upstream and downstream operations. In other words, crude exploration, production and development operations are conducted as well as downstream refining and retailing. These firms operate at a national level. They are Petro-Canada, Shell and Esso[5]. (2) Regional firms that also conduct integrated upstream and downstream activities but are limited in their geographic scope as compared to major firms. For example, Irving Oil and Ultramar are basically restricted to Eastern Canada, while Husky is located in the Prairies and the West[6]. (3) And finally, independents that exclusively conduct downstream retailing[7]. These firms do not own or operate refineries. Examples include Cango in Ottawa and Domo in Vancouver.

Figures 1 to 12 graph annual retail gasoline prices and market shares (1988-1997) of different retailers according to the above classification. The graphs are for the following cities: St.John's, Halifax, Saint John, Charlottetown, Montreal, Quebec,

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[5] There are a variety of contractual arrangements between vertically integrated firms and retail outlets that determine prices set at particular gas stations. Polar extremes are (1) company owned stations where the firm sets the retail price directly and (2) lessee dealerships which carry the name brand of the particular firm, but have complete discretion over prices. It would be interesting to test the impact of these contractual arrangements on prices. However, such detailed information over a reasonably long time period for all firms in the market is unavailable.

[6] This definition conforms to previous research which have analyzed market share trends in the Canadian petroleum industry. IRGMA has released reports on market share trends using the above classification.

[7] Independents purchase gasoline from majors and regionals. The benchmark price is the rack price published by a vertically integrated firm in a city. The actual price will depend on any discounts the purchaser receives off the rack price.

Ottawa, Toronto, Winnipeg, Regina, Calgary and Vancouver. Figures 13 to 17 show movements in wholesale prices for the same cities along with fluctuations in crude oil prices[8]. These graphs offer a rough idea on whether (1) increasing retail prices are significantly correlated with declining market shares for independents and (2) movements in wholesale prices are closely related to volatility in crude oil prices.

The figures offer the following observations regarding the market shares of independents: (1) With the exception of Charlottetown (which has no independent retailers), all Atlantic cities (Saint John, St.John's and Halifax) witnessed an upward trend in the market shares of independents over the sample. (2) The market share of independents declined slightly in Montreal but remained the same in Quebec. (3) Ottawa witnessed a slight decline in market share of independents while Toronto saw practically no change. (4) With respect to Western cities, the market share of independents rose in Winnipeg and Vancouver and remained more or less constant in Calgary and Regina.

There also exists variation in the magnitude of market share of independents across different cities. Nearly half of the cities in the sample (Montreal, Quebec City, Ottawa, Toronto, Winnipeg, and Calgary) exhibited average market shares for independents close to or exceeding 20%. On the other hand, we have the case of Charlottetown which has no independent retailers.

In summary, if market shares of firms are an accepted indicator of strength and health in the marketplace, these figures suggest that the Canadian retail gas industry is not facing an exodus of independents. While there has been a decline of independents in some cities, this has been balanced by a pronounced growth in their market shares in other cities.

Market shares of majors and regionals have also experienced corresponding trends, such as constant market shares between 1988 to 1991 in some cities, and growth or decline in others[9].

Average retail prices for gasoline have declined across most cities in Canada over the sample period. Some cities (Calgary, Toronto, Ottawa, Montreal and Quebec City) have witnessed declining market shares for independents along with rising prices, but this occurrence is limited to only a few years (1995-1997) of the sample. Retail prices in 1998 are down from 1997 levels in almost all cities in Canada.

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[8] Crude oil prices are represented by the Edmonton Par.

[9] Regionals experienced constant market shares, growth and decline in the following cities respectively:(1) Ottawa, Toronto, Winnipeg and Vancouver (2) Halifax, Montreal, and Quebec (3) St. John's, Saint John, Charlottetown, Regina, and Calgary. The corresponding cities for majors are (1) St.John's and Toronto (2) Charlottetown, Ottawa, Regina and Calgary (3) Halifax, Saint John, Montreal, Quebec City, Winnipeg, and Vancouver. In fact, it is interesting to note that the category with the highest number of cities for both majors and regionals is declining market shares. Considering that market shares sum to one, it is not surprising that the category with the highest number of independents is (3), or those with growing market shares.

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With respect to wholesale prices, Figures 13 to 17 show that variation in wholesale prices across cities and over time are almost identical to crude oil price fluctuations over the same time period. This suggests that vertically integrated firms (majors and regionals) do not take advantage of crude oil price fluctuations in order to increase wholesale gasoline margins[10].

## III. Empirical Model and Data

We employ the following model in order to test whether the presence of independent retailers has a significant impact on retail gasoline prices:

*Retail Price = Herfindahl Index Component of Majors + Herfindahl Index Component of Regionals + Herfindahl Index Component of Independents + Average Gas Sales Per Outlet + Average Income Per Employed Person + Population Density + Wholesale Price + City Factors + Seasonal Factors* (1)

Expression (1) assumes that retail prices are a function of market concentration as well as other factors. I propose the following model to evaluate the relationship between wholesale and crude oil prices.

*Wholesale Price = Crude Oil Price + Crude Oil Price (-1) + Crude Oil Price (-2) + Number of Wholesalers + Number of Refiners + City Factors + Seasonal Factors*

(2)

Both models were run using monthly data (or proxies there of) between January 1991 to January 1998 for St.John's, Halifax, Saint John, Montreal, Quebec, Ottawa, Toronto, Winnipeg, Regina, Calgary and Vancouver.

*Retail Price* in this case is the average monthly retail price (in litres) of regular unleaded gasoline at self service stations, excluding taxes. Saint John has the highest average price at 32.45 cents/litre, while Toronto has the lowest at 26.24 cents/litre[11].

We test the overall impact of market concentration on retail gasoline prices by constructing a Herfindahl Index (HERF_ALL) of all firms[12]. Because, this specification

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[10] Wholesale gasoline margin refers to the difference between crude oil feedstock prices and wholesale prices. In fact the graphs also indicate that the margins between wholesale and crude oil prices have been shrinking over time. However, it must also be stressed that empirical tests have not yet been conducted on the differential impacts between upward and downward movements in crude oil prices.

[11] Data on weekly average retail prices were obtained from MJ Ervin and Associates. Those were then converted into monthly averages.

[12] The Herfindahl is simply the sum of squared market shares of each individual firm. For example, assume two firms with market shares of 60% and 40% respectively. The Herfindahl in this case is $(60)^2+(40)^2$ which is equal to 5200. Market shares in this case refer to a firm's share of regular gas sales in each city.

does not permit us to assess the individual effects which majors, regionals and independents have on retail gasoline prices, we decompose the Herfindahl into the sum of the squared market shares for majors, regionals and independents separately. Hence, HERF_M, HERF_R and HERF_I are the Herfindahl components for majors, regionals and independents respectively. However, there are some cities like St.John's and Saint John where regionals have higher market shares than majors. Therefore, it may be sensible to construct one variable (HERF_C) which distinguishes firms that have both upstream as well as downstream presence (majors and regionals) from those which don't (independents). Intuitively, all these indices should share a positive relationship with retail prices. As firms become concentrated they may attain some degree of market power and be able to set prices at higher levels. However, if the presence of independents does lead to lower retail prices, the coefficient sign of HERF_I should be negative[13].

Another approach might be to estimate the impact of market share of independents (as opposed to Herfindahls) on retail prices in order to test whether independents as a group have a significant effect on retail prices. However, we prefer Herfindahls for the following reasons. First, using raw market shares may bias the relationship between retail prices and market power as it ignores the distribution of market shares among firms within a particular category. On the other hand, Herfindahls capture the effects of firm presence within a market (which market shares do) as well as the concentration or distribution of market shares among firms (which market shares don't)[14]. In other words, the Herfindahl index incorporates more information about the size distribution of firms than measures such as simple aggregate market shares.

The second reason why we prefer Herfindahls is because of their grounding in economic theory. Higher Herfindahls have shown to be equivalent to increasing price cost margins in Cournot models of competition.

There exists considerable variation in market concentration across cities and over time. Regina has the highest average concentration (1282) of majors (HERF_M) while Saint John has the lowest (305). On the other hand, Saint John has the highest average concentration of regionals (HERF_R=2305) while Ottawa has the lowest (42). Winnipeg

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This is the standard measure of market concentration used by antitrust authorities in the United States. The data is quarterly for St.John's, Saint John, Charlottetown and Halifax, and bimonthly for other cities. This data was obtained from Kent Marketing.

[13] It may be argued that a positive coefficient on HERF_ALL may imply that a less concentrated market is associated with lower prices. Therefore preserving the market share of independents is desirable as it guarantees a more evenly distributed market, and consequently lower prices. However, this is an incorrect analogy. A positive coefficient of HERF_ALL simply implies that the exit of any firm be it major, regional or independent may lead to higher prices if it leads to a more concentrated market. The exit of independents should not have any special effect on retail prices.

[14] For example assume the following two situations: (a) 3 independents with 5% market share each and (b) 1 independent with 15% market share. If we were to equate the presence of independents to simple aggregate market shares, then situation (a) is the same as (b); independents have a 15% market share. However, the Herfindahl for (b) ($15^2=225$) is considerably higher than (a) ($5^2+5^2+5^2=75$) as it takes into account concentration or distribution of market shares among firms as well as presence.

has the highest (334) and Halifax the lowest (12) concentration of independents (HERF_I)[15].

The average amount of per outlet sales of gasoline in a city may also impact retail gasoline prices. An increase in per outlet gasoline sales may allow for more station efficiencies and consequently lower retail prices. In this case a negative correlation between retail prices and per outlet sales would be obtained. I construct AVGGAS in order to evaluate the this effect[16]. Toronto records the highest average monthly sales per outlet (429,335 litres) while Quebec City has the lowest (216,202 litres).

An increase in average household income (INCOME) should lead to higher prices due to an upward shift in the demand curve[17]. Ottawa has the highest median employment income ($22,317) while Saint John has the lowest ($15,233).

Population density (POPDENS) is a surrogate for station proximity and density. Intuitively, there should be more stations in areas with denser population. Therefore, prices should be lower in densely populated areas. Montreal has the highest population per square kilometre (856) while Saint John has the lowest (41).

Perhaps the most important determinant of retail prices is wholesale prices. Wholesale and retail prices should be positively correlated. An increase in wholesale prices should lead to a rise in retail prices. WHOLEP is the monthly average wholesale price of regular gasoline in a city[18]. Vancouver has the highest average wholesale price (23.84 cents/litres) and Montreal the lowest (21.69 cents/litres).

Finally, equation (1) consists of city and quarterly seasonal fixed effects, which are binary variables, intended to proxy for unobservables that may impact average retail gasoline prices.

Equation (2) evaluates possible significant determinants of wholesale prices. For example, changes in wholesale prices should be positively correlated with crude oil price fluctuations. However, it is also important to acknowledge that a change in crude oil prices may not immediately affect wholesale or retail prices. Some research suggests that it usually takes two months or so for crude oil price changes to be felt in wholesale or

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[15] Figures in parentheses refer to the sum of squared market shares of firms within a category.

[16] AVGGAS is total sales of regular unleaded gas by firms divided by the total number of outlets. As with the Herfindahl indices, the frequency of this information is quarterly or bimonthly, depending on the city. Information on the total number of outlets was obtained from Kent Marketing.

[17] Household income is proxied by annual median employment income for males and females, obtained from Statistics Canada.

[18] The data was obtained from MJ Ervin and Associates. Each vertically integrated or regional firm publishes a weekly rack or wholesale price (cents/litres) in each city. In essence, this acts as a spot price for wholesale gasoline in each market. Weekly data on rack prices published by each wholesaler in a city were obtained and then converted to a single monthly price.

retail markets[19]. Accordingly, I construct three variables to measure the impact of crude oil price changes on wholesale prices. CRUDE is the present period price of oil in cents/litres, CRUDE(-1) is last month's price, and CRUDE(-2) is the price of crude oil two months ago . A strong correlation between wholesale prices and these variables would suggest that wholesale prices follow crude oil prices closely[20].

Some other factors may also influence movements in wholesale prices. The number of wholesalers in a particular city may be an important determinant. Intuitively, wholesale prices should decline with a rise in competition[21]. NCOMP is constructed to take this into account . Wholesale prices may also be influenced by the presence of a refinery within close proximity to the city. Cities with easy access to refineries may experience lower transportation costs of moving wholesale gas to retailers, relative to cities with no easy access to a refinery. Therefore, published rack prices may be higher in cities with no refineries to account for transportation costs. I construct NREF in order to capture this effect[22]. Ottawa has the highest number of wholesalers publishing rack prices (6) while St.John's has the lowest (1). Toronto has the highest number of refineries (5) while Calgary, Ottawa and Winnipeg have the least (0).

Finally, as in equation (2), city and quarterly fixed effects are included in the analysis to proxy for unobservable factors.

## IV. Ordinary Least Squares Estimation Results

Table 1 contains empirical estimates of the impact of market concentration on average retail gasoline prices in 11 Canadian cities between 1991 to 1998. The measure of concentration is HERF_ALL (all firms) in Columns 1 and 2, HERF_C (majors and regionals) and HERF_I (independents) in Columns 3 and 4, HERF_M (majors), HERF_R (regionals), and HERF_I (independents) in Columns 5 and 6. Empirical estimates in different columns may further be identified by the inclusion of wholesale prices or city fixed effects. As specified in equation (1), retail prices should be related to movements in wholesale prices. It would also be desirable to include city effects in order to account for unobservable factors, which may impact retail gasoline prices. Examples of such unobservable variables include the average transport cost of wholesale gasoline within a city and delivery costs to terminals. However, it is also possible that such inter city differences are already picked up by the wholesale price. Therefore the effects of each of the above discussed measures of concentration are evaluated alternatively using (1) fixed

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[19] "Canadian Retail Petroleum Markets Study", an Industry Canada report prepared by MJ Ervin and Associates; Borenstein and Shephard, "Sticky Prices, Inventories and Market Power in Wholesale Gasoline Markets", NBER Working Paper Number 5468.
[20] There is no cross city variation in crude oil prices as a uniform benchmark price (Edmonton Par) is used to capture movement in crude oil prices.
[21] This information is obtained from MJ Ervin's weekly data on city specific wholesale prices.
[22] Information on city location of refineries was obtained from MJ Ervin.

effects and (2) wholesale prices[23]. Columns 1, 3 and 5 consist of estimates obtained using city fixed effects, while columns 2, 4 and 6 consist of estimates derived with the addition of wholesale prices.

The coefficient estimates of HERF_ALL, HERF_C and HERF_M are consistently significant and possess the expected positive sign across all columns, suggesting that increased concentration among all firms and vertically integrated firms in particular lead to higher average retail gasoline prices. These estimates indicate that an increase in market share by 20% (or an increase of 400 point in either HERF_ALL, HERF_C or HERF_M) could lead to a price increase of between 1 to 5 cents a litre[24]. Of equal interest, is the consistently insignificant effect of independents (HERF_I) across all columns.

Average Gas Sales per outlet (AVGGAS) is insignificant in columns without wholesale prices but becomes significant with the inclusion of wholesale prices. Its negative coefficient indicates that an increase in gas sales per outlet permits retailers to exploit efficiencies of higher profits through increased volume of sales, resulting in lower retail prices.

Median employment income (INCOME) is positive and significant across all columns, suggesting that an increase in income leads to increased consumption and an upward shift of the demand curve, and therefore higher prices. On the other hand, population density (POPDENS) is consistently negative and significant across all columns. As stated earlier, this variable could be acting as a surrogate for gas station density. Therefore, densely populated areas could have more gas stations, which leads to lower retail prices.

Finally, wholesale prices are significantly correlated with retail prices. A $1 per litre increase in wholesale prices, on the average, results in a 80 cent/litre increase in retail prices. This result suggests that complete wholesale price increases or decreases are not passed onto retailers.

To summarise, using data between 1991 to 1998 and across 11 cities, we find that overall market concentration and increased concentration among majors and regionals are associated with higher average retail prices. On the other hand, the presence of independents does not seem to be significantly correlated with lower retail prices.

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[23] Regressions were also run with city fixed effects and wholesale prices in the same equation. However, city fixed effects generally became insignificant with the addition of wholesale prices.

[24] For example, the coefficient estimate of HERF_M in Column 5 is 0.01197. This translates to a 4.8 cent per litre increase in retail gas prices with a 20% increase in market share, or a 400 point increase in the Herfindahl (HERF_M).

## V. AR(1) Estimation Results

Since the above results are based on a monthly time series, they may suffer from autocorrelation. This is important as OLS estimates with autocorrelated errors may result in spurious correlations even though they may be consistent. Table 2 explores this possibility by repeating the estimation process of Table 1 correcting for first order autocorrelation by conducting autoregressive (AR(1)) estimation. Although the magnitude and significance of most coefficient estimates change, three key results of the previous section hold: (1) Retail prices are still significantly and positively correlated with overall market concentration and concentration among vertically integrated retailers in equations incorporating wholesale prices. (2) Generally, independents as a group still do not have a significant impact on retail prices. The exception is in Column 4. However, even in this case the coefficient estimate of HERF_I is positive, suggesting that higher market concentration by independents may lead to higher, rather than lower prices. (3) Retail prices are significantly and positively correlated with wholesale prices[25].

## VI. Wholesale Prices Estimation Results

Estimation results of equation (2) are detailed in Table 3[26]. OLS Results in Column 1 indicate that wholesale prices are very closely related to present and lagged fluctuations in crude oil prices. When added together, the coefficients of CRUDE, CRUDE(-1) and CRUDE (-2) approach unity. That means a one cent/litre increase in crude oil prices ultimately results in a one cent/litre increase in wholesale prices. Therefore, movements in wholesale prices closely reflect crude oil price volatility. Further, the significant and negative coefficient of NCOMP (number of wholesalers) indicates the important effect exerted by competition on wholesale price levels. NREF (number of refineries) is positively correlated with wholesale prices. This could be explained if areas with more refineries in fact have lower capacity utilisation, or are of lower scale (capacity), which results in higher unit costs of operation and hence higher prices[27].

Coefficient estimates in Columns 1 and 2 are AR(1) corrected for serial correlation. Although the magnitude of coefficient estimates differ somewhat, the picture

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[25] The regression runs of Table 1 (OLS) and Table 2 (AR(1)) were repeated using market shares of majors, regionals and independents instead of Herfindahls. These results do not differ significantly from the Herfindahl regressions. Majors have a significant impact on retail prices while independents do not. However, as stated earlier, the Herfindahl is preferable because it takes into account market share distribution among firms.

[26] Column 1 consists of OLS estimates, Column 2 contains AR(1) estimates without fixed effects, and finally Column 3 evaluates AR(1) estimates obtained using city fixed effects.

[27] Wholesale prices may also be influenced by the availability of imported crude oil. We attempted to test this hypothesis by estimating the impact of a dummy variable which distinguished between cities which have the option of imports (Toronto and cities east of it and Vancouver) from those who don't (cities west of Toronto) on wholesale prices. The coefficient of the dummy variable was not significantly different from zero.

essentially remains the same. Wholesale prices are significantly correlated with crude oil prices. However, most of the effects of a one cent/litre increase in crude oil prices in this case are reflected within the same month (CRUDE) or the next month (CRUDE(-1)). NCOMP (number of wholesalers) and NREF (number of wholesalers) are once again significant and possess the same coefficient signs as in Column 1.

## Conclusions

The objective of this research is to offer some preliminary observations on whether: (1) the market shares of independents as a group are significantly correlated with average retail prices (2) the movement of wholesale prices closely reflect crude oil price fluctuations.

This was done using data for the period 1991-98 for 11 cities across Canada; at least one city in each province. In carrying out this statistical analysis, we used standard econometric techniques to correct for the impact of other factors which are expected to affect prices.

The value of this kind of study is that for the first time there is a rigorous test of the correlation of retail prices and market presence of the independent gas retailers for a significant period of time, and, for several cities across Canada. This has never been done before. Data from a continuous 7 year period should correct for short term cyclical effects. Similarly, by broadening the examination of prices and market shares to 11 cities, unique effects that may occur in individual cities and would distort the results, are neutralized.

Although coefficient estimates obtained using OLS differ somewhat from corresponding AR(1) estimates, the broad conclusions remain the same, whether adjustments for autocorrelation are made or not.

As economic theory would predict, we find that higher average retail gas prices are associated with markets where total sales are accounted for by fewer and/or larger firms. In other words, average retail gasoline prices rise as overall market concentration increases - sales are concentrated in the hands of fewer firms and/or firms which account for a higher proportion of total sales.

When retailers are grouped according to whether they are vertically integrated or independent, we find a strong relationship between higher prices and greater concentration among vertically integrated firms. However, the presence of independents as a group does not exert any significant impact on retail prices. These results suggest that, other things remaining equal, independents do not have any direct or distinctive effect on retail gasoline prices. At best, the presence of independent gas retailers in any particular retail gasoline market affects retail prices indirectly insofar as it impacts overall concentration levels. Therefore, focusing exclusively on market shares of independents

may lead to inaccurate policy prescriptions.

Finally, wholesale prices closely reflect crude oil price fluctuations. A one cent/litre increase in crude oil price ultimately results in a one cent/litre increase in wholesale prices, suggesting that vertically integrated firms do not take advantage of crude oil price fluctuations in order to set higher wholesale prices.

**Table 1: Ordinary Least Squares Estimation (Dependent Variable: Average Retail Price)[28]**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| R-squared | 0.440665 | 0.632676 | 0.444735 | 0.634371 | 0.477574 | 0.640546 |
| Variable | With Fixed Effects | W/O Fixed Effects, with Wholesale Price | With Fixed Effects | W/O Fixed Effects, with Wholesale Price | With Fixed Effects | W/O Fixed Effects, with Wholesale Price |
| HERF_ALL (All Firms) | 0.00642 (5.64229)*** | 0.00270 (14.0378)*** | | | | |
| HERF_C (Majors & Regionals) | | | 0.00489 (3.6534)*** | 0.00267 (13.7970)*** | | |
| HERF_M (Majors) | | | | | 0.01197 (7.4086)*** | 0.00478 (6.9517)*** |
| HERF_R (Regionals) | | | | | 0.002029 (1.4587) | 0.00312 (12.1037)*** |
| HERF_I (Independents) | | | -0.00611 (-1.0725) | 0.00086 (0.8353) | -0.00013 (-0.0238) | 0.0016 (1.50807) |
| AVGGAS (Gas Consumption) | 0.0000018 (0.6691) | -0.000015 (-13.5319)*** | 0.000002 (0.76149) | -0.000015 (-13.4675)*** | 0.0000002 (0.09275) | -0.00002 (-11.7002)*** |
| INCOME (Income) | 0.000345 (5.38122)*** | 0.000066 (2.26428)** | 0.000355 (5.5185)*** | .000061 (2.1082)** | 0.00058 (8.13678)*** | 0.000027 (0.90099) |
| POPDENS (Pop. Density) | -0.02368 (-8.81436)*** | -0.002197 (-7.26205)*** | -0.02279 (-8.304)*** | -0.00237 (-7.35782)*** | -0.01772 (-6.5597)*** | -0.00271 (-8.40017)*** |
| WHOLEP (Wholesale Price) | | 0.80210 (18.5995)*** | | 0.80512 (18.6473)*** | | 0.79546 (18.70196)*** |

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[28] The sample is from 11 Canadian cities (St.John's, Halifax, Saint John, Montreal, Quebec City, Ottawa, Toronto, Winnipeg, Regina, Calgary and Vancouver) between January 1991 to January 1998. t-statistics are in parentheses. * refers to 10% level of significance, ** to 5% level of significance while *** denotes 1% level of significance.

Table 2: AR(1) Estimation (Dependent Variable: Average Retail Price)[29]

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| R-squared | 0.756455 | 0.799193 | 0.756470 | 0.799931 | 0.756746 | 0.801121 |
| Variable | With Fixed Effects | W/O Fixed Effects, with Wholesale Price | With Fixed Effects | W/O Fixed Effects, with Wholesale Price | With Fixed Effects | W/O Fixed Effects, with Wholesale Price |
| HERF_ALL (All Firms) | -0.000911 (-0.44039) | 0.00188 (3.9565)*** | | | | |
| HERF_C (Majors & Regionals) | | | -0.00071 (-0.31708) | 0.00196 (4.07632)*** | | |
| HERF_M (Majors) | | | | | 0.00085 (0.27837) | -0.00056 (-0.35491) |
| HERF_R (Regionals) | | | | | -0.00129 (-0.55872) | 0.00152 (2.51032)** |
| HERF_I (Independents) | | | 0.00086 (0.1087) | 0.00619 (2.3331)** | 0.00165 (0.20948) | 0.004401 (1.55502) |
| AVGGAS (Gas Consumption) | 0.0000019 (0.78849) | -0.0000021 (-0.98211) | 0.0000019 (0.78333) | -0.0000016 (-0.75008) | 0.0000017 (0.69933) | -0.0000006 (-0.26122) |
| INCOME (Income) | 0.000176 (2.0048)** | 0.0000289 (0.392572) | 0.000175 (1.99526)** | 0.000031 (0.42810) | 0.000222 (2.371623)** | 0.0000549 (0.74444) |
| POPDENS (Pop. Density) | -0.00174 (-0.363117) | -0.00125 (-1.30832) | -0.001798 (-0.3728) | -0.00088 (-0.86438) | -0.00162 (-0.340418) | -0.00072 (-0.71715) |
| WHOLEP (Wholesale Price) | | 0.712298 (13.3121)*** | | 0.70862 (13.1751)*** | | 0.71321 (13.26036)*** |
| | | | | | | |

[29] The sample is from 11 Canadian cities (St.John's, Halifax, Saint John, Montreal, Quebec City, Ottawa, Toronto, Winnipeg, Regina, Calgary and Vancouver) between January 1991 to January 1998. t-statistics are in parentheses. * refers to 10% level of significance, ** to 5% level of significance while *** denotes 1% level of significance.

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**Table 3: Impact of Crude Oil on Wholesale Prices[30]**

| | (1) | (2) | (3) |
|---|---|---|---|
| **R-squared** | 0.652452 | 0.873190 | 0.876782 |
| **Variable** | OLS-With Fixed Effects | AR(1) –Without Fixed Effects | AR(1) –With Fixed Effects |
| **CRUDE** (Current Price) | 0.2293 (3.0907)*** | 0.53995 (15.34257)*** | 0.527678 (15.06466)*** |
| **CRUDE (-1)** (Price of Crude Last Month) | 0.21416 (1.99658)*** | 0.43768 (12.37971)*** | 0.432668 (12.0267)*** |
| **CRUDE (-2)** (Price of Crude Two Months Ago) | 0.5579 (6.353146)*** | -0.06342 (-1.74775)* | -0.07181 (-2.03313)** |
| **NCOMP** (No. of Wholesalers) | -1.34257 (-6.0253)*** | -0.52994 (-5.88246)*** | -0.454024 (-1.92728)* |
| **NREF** (Number of Refineries) | 1.1583 (7.5887)*** | 0.19637 (2.32266)** | 0.439323 (1.95946)** |
| | | | |

[30] The sample is from 11 Canadian cities (St.John's, Halifax, Saint John, Montreal, Quebec City, Ottawa, Toronto, Winnipeg, Regina, Calgary and Vancouver) between January 1991 to January 1998. t-statistics are in parentheses. * refers to 10% level of significance, ** to 5% level of significance while *** denotes 1% level of significance.
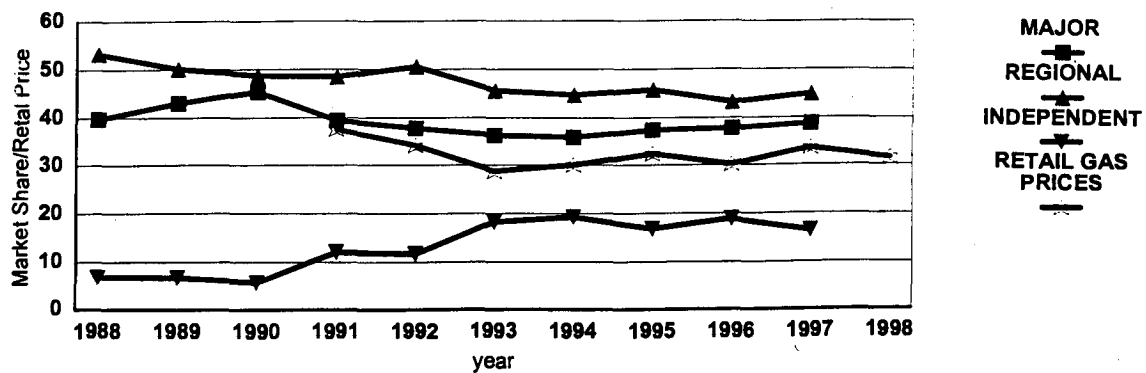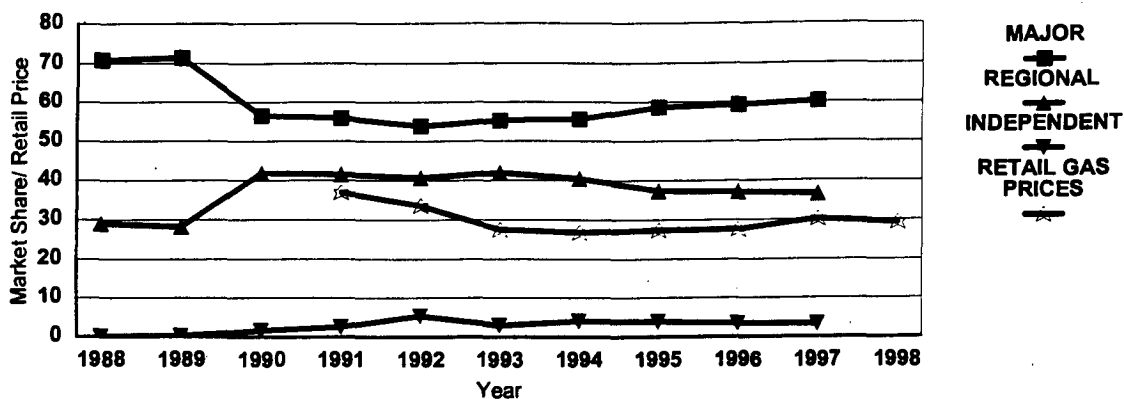
# Figure 1:St John's Nfld



Y-axis: Market Share/Retail Price (0–60)
X-axis: year (1988–1998)

Legend:
MAJOR
REGIONAL
INDEPENDENT
RETAIL GAS PRICES

# Figure 2:Halifax - Dartmouth NS



Y-axis: Market Share/ Retail Price (0–80)
X-axis: Year (1988–1998)

Legend:
MAJOR
REGIONAL
INDEPENDENT
RETAIL GAS PRICES

# Figure 3:St John NB



Y-axis: Market Share/ Retail Price (10–60)
X-axis: Year (1988–1998)

Legend:
MAJOR
REGIONAL
INDEPENDENT
RETAIL GAS PRICES
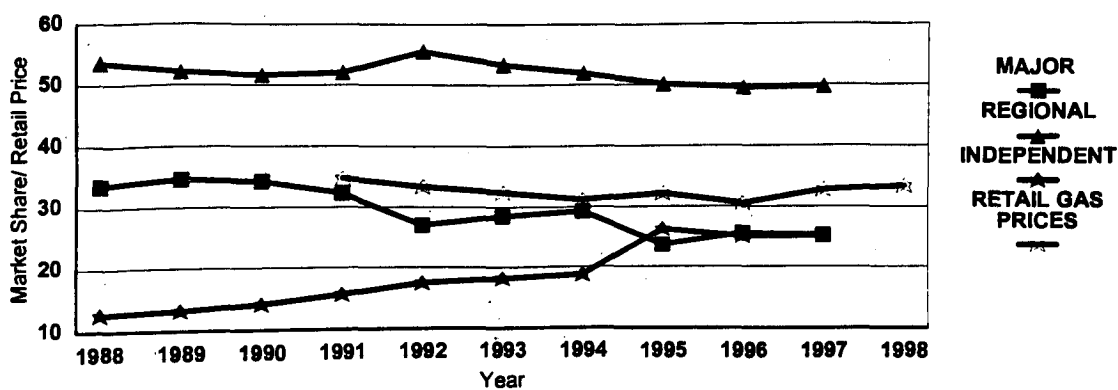
# Figure 4:Charlottetown PEI



Y-axis: Market Share/ Retail Price (25–65)
X-axis: Year (1988–1998)

Legend:
MAJOR
REGIONAL
RETAIL GAS PRICES

# Figure 5:Montreal All PQ



Y-axis: Market Share/Retail Prices (10–70)
X-axis: Year (1988–1998)

Legend:
MAJOR
REGIONAL
INDEPENDENT
RETAIL GAS PRICES

# Figure 6:Quebec City PQ



Y-axis: Market Share/ Retail Prices (10–60)
X-axis: Year (1988–1998)

Legend:
MAJOR
REGIONAL
INDEPENDENT
RETAIL GAS PRICES

# Figure 7:Ottawa Ont



MAJOR
REGIONAL
INDEPENDENT
RETAIL GAS PRICES
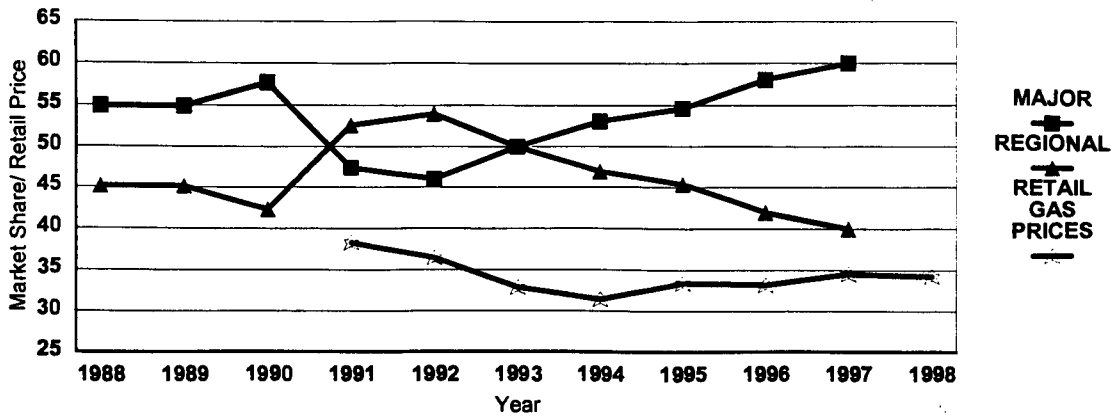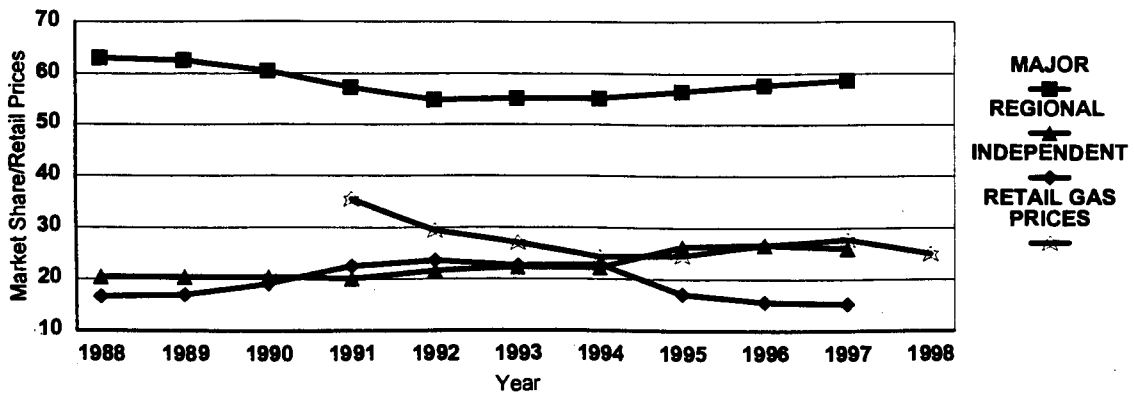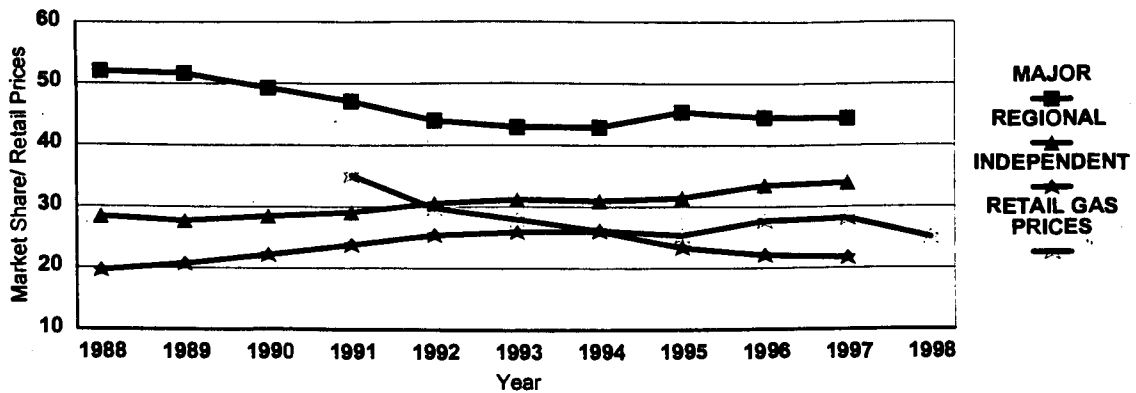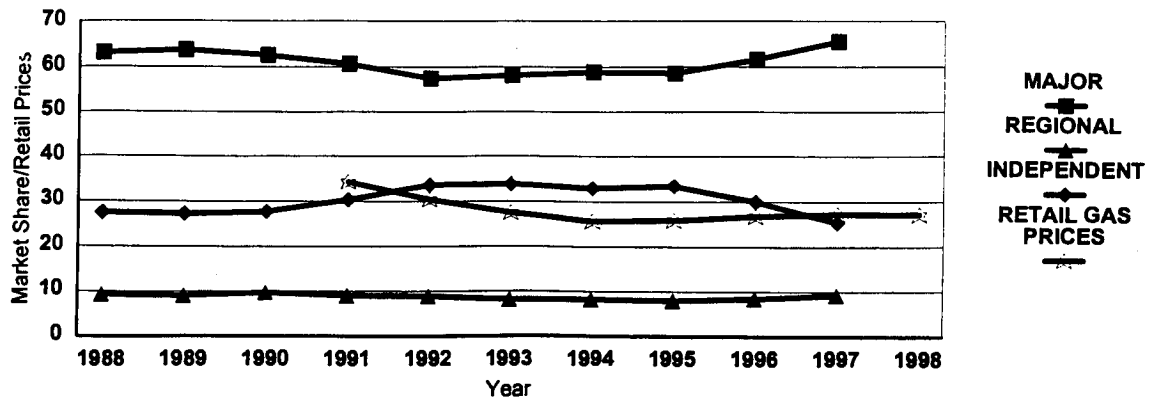
# Figure 8:Metro Toronto Ont



MAJOR
REGIONAL
INDEPENDENT
RETAIL GAS PRICES

# Figure 9:Winnipeg MAN



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INDEPENDENT
RETAIL GAS PRICES

## Figure 10:Regina SASK

Y-axis: Market Share/Retail Price — 80, 70, 60, 50, 40, 30, 20, 10, 0
X-axis: Year — 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998

Legend:
MAJOR
REGIONAL
INDEPENDENT
RETAIL GAS PRICES

## Figure 11:Calgary ALTA

Y-axis: Market Share/Retail Price — 70, 60, 50, 40, 30, 20, 10
X-axis: Year — 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998

Legend:
MAJOR
REGIONAL
RETAIL GAS PRICES
INDEPENDENT

## Figure 12:Vancouver BC

Y-axis: Market Share/Retail Price — 70, 80, 50, 40, 30, 20, 10, 0
X-axis: Year — 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998

Legend:
MAJOR
REGIONAL
INDEPENDENT
RETAIL GAS PRICES

# Chart 13



Legend:
- CRUDE
- VANCOUVER
- CALGARY
- EDMONTON

Y-axis: Cents/Litres (0.00, 5.00, 10.00, 15.00, 20.00, 25.00, 30.00, 35.00, 40.00)

X-axis: Date (Jan-91, Jan-92, Jan-93, Jan-94, Jan-95, Jan-96, Jan-97, Jan-98)

# Chart 14



Y-axis: **Cents/Litres** — 0.00, 5.00, 10.00, 15.00, 20.00, 25.00, 30.00, 35.00

X-axis: **Date** — Jan-91, Jan-92, Jan-93, Jan-94, Jan-95, Jan-96, Jan-97, Jan-98

Legend:
- CRUDE
- MONTREAL
- QUEBEC

**Chart 15**

Cents/Litres

Date

CRUDE
OTTAWA
TORONTO

# Chart 16



**Cents/Litres** (y-axis): 40.00, 35.00, 30.00, 25.00, 20.00, 15.00, 10.00, 5.00, 0.00

**Date** (x-axis): Jan-91, Jan-92, Jan-93, Jan-94, Jan-95, Jan-96, Jan-97, Jan-98

Legend:
- CRUDE
- HALIFAX
- SAINT JOHN
- ST. JOHNS

# Chart 17

**Cents/Litres** (y-axis)

40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00

**Date** (x-axis): Jan-91, Jan-92, Jan-93, Jan-94, Jan-95, Jan-96, Jan-97, Jan-98

Legend:
- ◆ CRUDE
- ■ WINNIPEG
- △ REGINA

# Anindya Sen

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**Citizenship:**          Canadian

**Languages:**            English, French

**Research Interests:**   Empirical Industrial Organization
                          Public Economics/Public Finance
                          Law and Economics

**Teaching Interests:**   Industrial Organization
                          Public Economics
                          Law and Economics

## Current Occupation

June 1998-               Economist, Competition Bureau
   • Assigned exclusively to Bank Mergers
   • Responsible for developing empirical models intended to
   assess possible impact of Bank Mergers on competition

## Education

1998     Ph.D., Economics, University of Toronto

         Dissertation: "An Empirical Assessment of Highway Traffic Laws"
         Supervisors: Samuel A. Rea, Michael Baker, Dwayne Benjamin

1992     M.A., Economics, Concordia University (1990-1992), Montreal

1990     B.A.(Hons.), Economics, University of Delhi (1987-1990), India

## Awards

Entrepreneurship Research Alliance Grant, 1997
Olin Research Grant, Law and Economics Program, University of Toronto, 1995-97
University of Toronto Open Fellowship, 1992-1997
University of Toronto Kernaghan Fellowship, 1992

## Research Papers

"Will the Bank Mergers Result in Significant Price Increases?", Mimeo, Competition Bureau

"Estimating the Impact of Bank Mergers on Credit for Small Business", Mimeo, Competition Bureau

"Bank Concentration and Bankruptcies: Is There Any Relationship?", Mimeo, Competition Bureau

"The Canadian Experience with Impaired Driving Laws: Estimating the Econometric Model of Crime"; final preparation for submission (Presented at the American Law and Economics Association, May 1997; the Canadian Law and Economics Association, October 1996; and the Canadian Economics Association, June 1996)

"The Economics of Traffic Regulation: Another Look at the Peltzman Hypothesis" (Presented at the Canadian Law and Economics Association, September 1997)

" Did the U.S.-Canada Softwood Lumber Dispute Have Any Effect on Domestic Productivity?", research sponsored by the Entrepreneurship Research Alliance (ERA)

## Other Experience
1992-1997:        Teaching Assistant, University of Toronto
  • Microeconomics, Law and Economics, Industrial Organization, Urban and Public
      Economics, and Environmental Economics for third and fourth year undergraduates
  • Conducted tutorials and graded problems and examinations

1997:             Researcher, Entrepreneurship Research Alliance (ERA)
  • Analyzed impact of U.S.-Canada softwood lumber dispute on industry productivity
      and industry subsidies; used translog cost functions and constructed productivity
      indices

1995-1996:   Researcher, Great Lakes-St.Lawrence Basin (GLSLB) Project
  • Developed econometric model representative of a GLSLB wood products firm; model
      being extended by Environment Canada biologists to predict the future use of forest
      resources in a post global warming forest

## References

| | | |
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