A Canadian Cartel Story: Damage, Punishment, and Market Power

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Plan of the Presentation

• Introduction:
  1. Which cartel?
  2. The 2 questions we are studying
  3. The methodology
  4. Why it is interesting!

• Part 1:
  1. The legal timeline
  2. Description of Sherbrooke and its gasoline market
• Part 2: Estimating the Demand:
  – The model
  – The data
  – The first results
  – Dealing with endogeneity
• Part 3: Calculating the Damage
  – Total Damages
  – Fines
• Part 4: Estimating Market Power (briefly)
• Conclusion
Introduction

• We are studying a recently uncovered retail gasoline cartel from outlets in four Quebec cities: Victoriaville, Thetford Mines, Magog and Sherbrooke.

• To be precise we concentrate on Sherbrooke (because there is no publicly available data for Victoriaville, Thetford Mines, and Magog.)

• Official definition: A cartel is an agreement between businesses not to compete with one another.
• We are trying to answer 2 questions:

1. We want to estimate the economic damage caused by the retail gasoline cartel in the city of Sherbrooke, and we want to compare that damage to the meted punishment for all the investigated markets.

We find that the fines imposed so far seem quite low in comparison to the estimated total damages.

Note that this is a standard result in empirical cartel studies:
“With sanctions well below 100% of profits, it is simply rational to join an international cartel.” (Global price fixing: our customers are the enemy, Connor 2007, p. 454.)

2- We want to estimate the cartel market power during its operation and after its demise. Did the cartel operate as a monopoly?, as a Cournot oligopoly, or was it even weaker?

We find that the market power was quite low while the cartel was operating, and even lower after that.
Introduction: Methodology

• We are using time-series analysis and basic price theory to calculate the damage and the market power.

• So, it is an empirical paper

• Our data come from: federal, provincial sources and from proprietary sources (= we bought them from specialized marketing companies.)
Introduction: Why it is interesting

• *This is the largest investigation ever for the Canadian Competition Bureau!*

• Estimating damages is important in cartel investigations.

• We show it can be done using econometrics and price theory.

• Studying the market power and its evolution is another way to look at the cartel’s operations.
  
  (It is more complicated, because it involves the marginal cost, but it is really worth it!)
Part 1.1: The Legal Timeline

- January 2000 to May 2006: The cartel is active
- June 2006 to December 2007: Cartel is broken
- June 2008 and July 2010: Price fixing charges are laid by the Competition Bureau

Our data set spans from January 2000 to June 2006.
Comments on the timeline:

1. Officially, for the Competition Bureau, conspirers were fixing prices as early as 2004. However, we believe (see later), they were doing so as early as 2000.


3. On June 2, 2006, the Commissioner of Competition confirmed the investigation into price-fixing.

4. We are pretty certain the cartel ended before the end of May 2006.
Comments on the investigation:

1. Thousand of phone calls were wiretapped
2. 100000+ documents were seized.
3. It really got started, in early 2005, when a whistleblower obtained “Immunity” and blew the whistle.
About Sherbrooke:

• The city of Sherbrooke is located about 150 kilometers to the southeast of Montreal and has a population of around 150 000 with approximately 96 000 registered drivers for a total of about 82 000 cars and light trucks.

• A minimum of 53 gasoline outlets out of a maximum of 63 (or 84%) in Sherbrooke participated in the price-fixing cartel during the period spanning from April 2005 to April 2006.
Table 1 presents the number of gasoline outlets in Sherbrooke at the beginning of each year from 2000 to 2008. Over that period of time, more than 40% of the outlets in Sherbrooke operated under the brand name of a Major Refiner (Esso, Shell, and Petro-Canada), while about 35% of them had a Regional Refiner’s brand name (Irving and Ultramar). Independent Brands managed the remaining outlets.
<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>74</td>
</tr>
<tr>
<td>2001</td>
<td>70</td>
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<tr>
<td>2002</td>
<td>70</td>
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<td>2003</td>
<td>66</td>
</tr>
<tr>
<td>2004</td>
<td>63</td>
</tr>
<tr>
<td>2005</td>
<td>60</td>
</tr>
<tr>
<td>2006</td>
<td>60</td>
</tr>
<tr>
<td>2007</td>
<td>60</td>
</tr>
<tr>
<td>2008</td>
<td>60</td>
</tr>
</tbody>
</table>
Part 2: Estimating the demand

\[ QPOP_t = \alpha_0 + \alpha_1 RPPRICE_t + \alpha_2 RYPOP_t + \alpha_3 TRENDS_t + \alpha_4 QPOP_{t-1} + \alpha_5 S_t + \epsilon_t \]  

where:

\( QPOP_t \) represents the monthly gasoline consumption per capita in Sherbrooke. We had to transform the series from quarterly to monthly, using a non-linear technique. Data from Kent Marketing Services Limited.
where:

\( RPPRICE_t \) is the real pump price, for gasoline in Sherbrooke measured in 2002 prices (in cents per liter), from MJ Ervin & Associates,

\( RYPOP_t \) is the monthly real disposable income per capita for the city of Sherbrooke (in 2002 $),

The vector \( S_t \) consists of monthly dummy variables to capture the seasonality present in gasoline consumption.
• Standard model similar to Dahl (1979) or Houthakker et al. (1974).
• From January 2000 to December 2007.
• We use OLS where the standard errors are heteroskedasticity-robust and are corrected for serial correlation for three lags by the Newey-West (1987) method.
• The next Table reports 3 regressions, (here we don’t report the seasonal dummies variables info, for brevity.)
### Table 3

OLS Regression Results for Equation (1)

Dependent Variable: $QPOP_t$

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Estimated Coefficients (Newey-West Standard Errors in Parentheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>63.679 $^b$</td>
</tr>
<tr>
<td></td>
<td>(29.980)</td>
</tr>
<tr>
<td><strong>RPPRICE_t</strong></td>
<td>-0.137 $^b$</td>
</tr>
<tr>
<td></td>
<td>(0.070)</td>
</tr>
<tr>
<td><strong>RYPOP_t</strong></td>
<td>-0.016</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
</tr>
<tr>
<td><strong>TREND_t</strong></td>
<td>0.073</td>
</tr>
<tr>
<td></td>
<td>(0.064)</td>
</tr>
<tr>
<td><strong>QPOP_{t-1}</strong></td>
<td>0.628 $^a$</td>
</tr>
<tr>
<td></td>
<td>(0.064)</td>
</tr>
</tbody>
</table>

Adjusted R$^2$ 0.59 0.59 0.59

No. of Usable Obs. 95 95 95

$^a$ Significance at the 1% level, $^b$ significance at the 5% level, $^c$ significance at the 10% level.
• Comments:

• In Eq (1), the coefficient on $RPPRICE_t$ is significant at the 5% level. Its negative sign implies that a decrease of 10 cpl in pump prices would result in a monthly increase of gasoline consumption of around 1.4 liter per capita. This means that the deadweight loss associated with the cartel’s supra-competitive prices is greater than zero.
• We perform a few tests (Ramsey RESET, test on residuals stationarity (Augmented Dickey Fuller test.))

• We also ran this model as a log-log specification as in Hughes et al. (2008). Our final results are virtually indistinguishable.
• Dealing with endogeneity:
The endogeneity problem might come from having real pump prices on the RHS of Equation (1), since price and output are jointly determined.

We follow Hausman (1978)’s procedure to investigate the issue of endogeneity.

Result: we should indeed address the endogeneity issue.
• We run this Eq (2) :

\[ RPPRICE_t = \beta_0 + \beta_1 MRPPRICE_t + \beta_3 END_t + \beta_4 Y_t + \mu_t \]

where:

• \( MRPPRICE_t \) is Montreal’s real pump prices (similar approach as Hausman, Leonard, and Zona (1994))

• \( END_t \) is a dummy variable, which indicates whether retail prices are observed after the “announcement” (from June 2006 til Dec 2007):

• The coefficient \( \beta_{3,est} \) is statistically significant and negative and imply that the announcement triggered a 1.73 cpl decrease in the price of gasoline at the pump in Sherbrooke.
<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Estimated Coefficients (Newey-West Standard Errors in Parentheses)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
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<tr>
<td><strong>Constant</strong></td>
<td>-8.14</td>
<td>-7.92</td>
</tr>
<tr>
<td></td>
<td>(15.82)</td>
<td>(5.84)</td>
</tr>
<tr>
<td><strong>RYPOP(_t)</strong></td>
<td>9.31 E-3</td>
<td>9.17 E-3 (^a)</td>
</tr>
<tr>
<td></td>
<td>(9.73 E-3)</td>
<td>(3.00 E-3)</td>
</tr>
<tr>
<td><strong>TREND(_t)</strong></td>
<td>-3.66 E-4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(2.40 E-2)</td>
<td></td>
</tr>
<tr>
<td><strong>QPOP(_{t-1})</strong></td>
<td>-2.82 E-2</td>
<td>-2.82 E-2</td>
</tr>
<tr>
<td></td>
<td>(3.52 E-2)</td>
<td>(3.52 E-2)</td>
</tr>
<tr>
<td><strong>END(_t)</strong></td>
<td>-1.73 (^b)</td>
<td>-1.73 (^a)</td>
</tr>
<tr>
<td></td>
<td>(0.74)</td>
<td>(0.66)</td>
</tr>
<tr>
<td><strong>MRPPRICE(_t)</strong></td>
<td>0.95 (^a)</td>
<td>0.95 (^a)</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Adjusted R(^2)</td>
<td>0.98</td>
<td>0.97</td>
</tr>
<tr>
<td>No. of Usable Obs.</td>
<td>95</td>
<td>95</td>
</tr>
</tbody>
</table>

\(^a\) Significance at the 1% level, \(^b\) significance at the 5% level, \(^c\) significance at the 10% level.
Finally we run Eq 1, using the fitted value from Equation (2) as an explanatory variable for prices.

Results are very similar to the ones with a simple OLS.

Message: when the price goes up by ten cent per liter, the quantity demanded goes down between .7 and 1.3 liter per month per capita.
### Table 6
Instrumental Variable Regression Results for Equation (1)
Dependent Variable: $QPOP_t$

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Estimated Coefficients (Newey-West Standard Errors in Parentheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>62.71 $^b$</td>
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<td></td>
<td>(30.36)</td>
</tr>
<tr>
<td><strong>$iRPPRICE_t$</strong></td>
<td>-0.13 $^c$</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
</tr>
<tr>
<td><strong>$RYPPOP_t$</strong></td>
<td>-0.02</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
</tr>
<tr>
<td><strong>$TREND_t$</strong></td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
</tr>
<tr>
<td><strong>$QPOP_{t-1}$</strong></td>
<td>0.63 $^a$</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.58</td>
</tr>
<tr>
<td>No. of Usable Obs.</td>
<td>95</td>
</tr>
</tbody>
</table>

$^a$ Significance at the 1% level, $^b$ significance at the 5% level, $^c$ significance at the 10% level.
• Comment on the cartel we know that the cartel was in place in 2004 and collapsed on June 2006. Since our time series start in January 2000, we must justify why we think the cartel was already operating by then. To do so, we estimate with OLS the following equation during the pre-announcement period:

\[ RPPRICE_t = \delta_0 + \delta_1 S_t + \delta_2 RWHOLE_t + \delta_3 START_t + \xi_t. \]

• The real current wholesale price, \( RWHOLE_t \), (for Montreal) and is used as a proxy for the marginal cost of gasoline retailers in Sherbrooke.

• We have also introduced the dummy variable \( START_t \), which takes a value of 1 from January 2000 to December 2003 and 0 otherwise. If the cartel was in place at the beginning of our sample, then the coefficient associated with \( START_t \) should not be negative and statistically significant.
The estimated coefficient of the variable $START_t$ is positive and statistically significant at the 1% level, confirming our suspicion that the cartel was in place before the start of the Competition Bureau’s investigation and allowing us to proceed with our analysis with confidence.
Part 3: Calculating the Damage

\[ DPUMP_t = POP_t \times [(QPOP_t \times \Delta P) + DWL] \]

where:

- \( QPOP_t \) is the quantity per cap. sold in month \( t \)
- \( \Delta P \) is the price overcharge (measured by the difference between the collusive price and the but-for price)
- \( DWL = (\Delta Q \times \Delta P)/2 \) (because of lin-lin.)
- \( \Delta Q \) measuring how much the per capita gasoline consumption would have increased if prices had fallen from the collusive price to the but-for price.
From our demand estimation (Table 6), a decrease of 1 cpl in the real pump price in gasoline in Sherbrooke would lead to a monthly increase of per capita gasoline consumption ranging from 0.071 to 0.131 liter. This gives us: \( \Delta Q / \Delta P \)

We also need a measure of the overcharge \( \Delta P \).

Erutku and Hildebrand (2010) have used a difference-in-difference estimator and find be as \( \Delta P \) high as 1.75 cpl, which is similar to the coefficient estimates of the variable \( END_t \) in Eq. 2. Our replication of this methodology with our longer database hints that a lower bound of the overcharge is 0.97 cpl.
Accordingly, total damages could be as low as $8.4 million or as high as $15.1 million expressed in 2002 Canadian dollars for the period spanning from January 2000 to May 2006.

On a monthly basis, total damages range from 0.9% to 3% of the market size.

As for the deadweight loss, it never represents less (more) than .03% (.16%) of monthly total damages.
• Regarding fines F:
  – 2.7 millions
  – 44 months in jail (to be served in the community)
• Overall, not a big deterrent (especially if one compares the potential cartel profit versus the expected punishment: \( E(F) = p \cdot F \), where \( 0 < p < 1 \) is the probability of being caught)
• Effective March 2010, under new legislation, higher fines will be levied and stiffer prison sentences imposed.
Part 4: Market Power

• We know that $MR = MC$, so we have:

$$MR = (P.Q)' = P + \theta \cdot Q \cdot (dP/dQ) = P + \theta \cdot Q \cdot P'(Q) = c$$

where $c$ is the marginal cost and $\theta$ (small Theta) is our conduct parameter (i.e. market power):

– $\theta$ is equal to 0 in perfect competition,
– $\theta$ is equal to 1 in monopoly.
– and $\theta$ is equal to $1/n$ in a symmetric n-firm Cournot oligopoly.

• Our goal is to estimate the parameter $\theta$ and how it changed after the collapse of the cartel.
• We estimate $\theta$ using supply and demand.
• We also compare the estimated parameter $\theta$ with the elasticity-adjusted Lerner index, $L^\eta$

$$L^\eta = \left[ \frac{(P_{\text{Price}}^{\text{extax}} - MC_i)/ P_{\text{Price}}^{\text{extax}}}{\eta} \right].$$

with $\eta$ being the elasticity of demand in absolute value), which is a direct measure of market power.

• In theory (and empirically), $\theta$ and $L^\eta$ are (should be) the same.
First finding \( \theta \)

1- We restrict our analysis to lin-lin (as in Wolfram, 1999) and log-log (as in Porter, 1983) demand functions:

- **Lin-Lin** \( \text{QUANTITY}_t = \alpha_0 + \alpha_1 \text{PPRICE}_t + \alpha_2 \text{Y}_t + \varepsilon_t \) \hfill (1)

- **Log-Log** \( \text{LQUANTITY}_t = \alpha'_0 + \alpha'_1 \text{LPPRICE}_t + \alpha'_2 \text{LY}_t + \varepsilon'_t \) \hfill (1')

- Note: usual econometric issues are addressed.
2- We have the Marginal Cost:

- \( MC_t = TC_t + WPRICE_t \) (2)

where \( TC_t \) is a measure of the transportation cost to deliver one liter of wholesale gasoline to retail outlets (Source: Regie de l’energie) and \( WPRICE_t \) is the wholesale price for one liter of gasoline.

- Note that our MC is independent of the quantity.
• The supply relationship, \( P = c - \theta \cdot Q \cdot P'(Q) \), is empirically implemented as

\[
P_{\text{price\ (extax)}}(t) = \beta_1 MC_t + \beta_2 QUANTITY_t + \mu_t \quad (3)
\]

• We estimate (3) for two different time periods: pre-announcement (from January 2000 to May 2006) and post-announcement (from June 2006 to December 2008).

• So, \( \beta_2 = -\theta \cdot P'(Q) \)

• Now we have two cases:
1. If the demand is linear:

\[ QUANTITY_t = \alpha_0 + \alpha_1 PPRICE_t + \alpha_2 Y_t + \varepsilon_t \quad (1) \]

then \( \beta_2 = -\frac{\theta}{\alpha_1} \) (where \( \alpha_1 \) is \( 1/ P'(Q) \)).

So we can estimate \( \theta \) as \(-\beta_2.\alpha_1\)

We have two estimates for \( \theta \) because:

- we have a \( \beta_2 \) during the cartel
- we have a \( \beta_2 \) after the cartel
2. If the demand is log-log:

\[ \text{LQUANTITY}_t = \alpha_0' + \alpha_1' \text{LPRICE}_t + \alpha_2' \text{LY}_t + \epsilon'_t \]

(1’)

then \( \theta = -\beta_2 \cdot \alpha_1' \cdot (\text{averPPRICE}/\text{averQUANTITY}) \)

Because \( \alpha_1' \) is the demand elasticity.

Again, we have two estimates for \( \theta \) (during and after the cartel)

[Note: Using the Davidson, MacKinnon, and White Test (1983), we find that the log-log demand specification is more appropriate to the lin-lin one.]
After estimating the demand curves, supply curves, we find these results:

1. Adjusted Lerner indexes are higher than the conduct parameters

2. Both techniques show a drop in market power after the cartel’s end.

<table>
<thead>
<tr>
<th>Elasticity-Adjusted Lerner Index $L''_t$ and Estimated Conduct Parameter $\hat{\theta}$</th>
<th>Lin-Lin Model</th>
<th>Log-Log Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Announcement</td>
<td>Post-Announcement</td>
<td>Pre-Announcement</td>
</tr>
<tr>
<td>Mean $L''_t$</td>
<td>0.0182</td>
<td>0.013151</td>
</tr>
<tr>
<td>$\hat{\theta}$</td>
<td>0.0091</td>
<td>0.0087</td>
</tr>
</tbody>
</table>
• Our estimated conduct parameters and the elasticity-adjusted Lerner indices suggest that the level of market power exercised by gasoline retailers in Sherbrooke was quite low in both periods.

• If the 60 or so outlets in Sherbrooke had acted as symmetric Cournot competitors, the conduct parameter would have taken a value of $1/60 = 0.0167$.

• Inefficient collusion.
Conclusion

• Damage from this cartel was between between $8.4 million and $15.1 million.
• Punishment was a fraction of this damage.
• Our estimated conduct parameters correctly predict changes in market power levels between the pre- and post-announcement periods.
• However, we also note this cartel was weak even while it was operating.
Note on the Corts Critique (1999)

Corts [1999] finds that the NEIO can yield inconsistent estimates of the conduct parameter if firms are engaged in *efficient collusion* (=above Cournot, below monopoly) (because the traditional NEIO approach doesn’t consider the potentially binding incentive compatibility constraint (ICC) associated with the sustainability of collusion.)

Puller (2009) offers a solution to the Corts (1999)’s critique.
We do not use, however, Puller (2009)’s correction for two reasons:

1. it requires firm-level quantity data, which we do not have.
2. Puller (2009)’s correction is robust to efficient tacit collusion, but may not be robust to other forms of dynamic pricing.

• The degree of market power in Sherbrooke’s retail gasoline market is quite low implying that collusion may have been quite inefficient. So the Cort’s critique may not even apply to our situation.