Cartel Instability and Price Wars: Retail gasoline in Canada

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Introduction

We provide a case study of a price war episode that took place in Québec City's retail gasoline market in 2000 between two periods of coordination. Our investigation sheds light on its causes, development, and aftereffects, using detailed data on prices, sales volume, and station characteristics, along with testimony from a government investigation into the origins of the war.[1,2]

Despite fragmented ownership, in the years leading up to the price war, Québec City's retail gasoline market was characterized by high margins, and limited price dispersion across stations within a neighborhood. These patterns resulted from a particular form of hub-and-spoke collusive arrangement in which upstream branded suppliers coordinated zone pricing

[1]Legal disclaimer: This case study analyses pricing in Quebec City's retail gasoline market strictly from an economic point of view. Any allegations of collusion in this market and others in the province have not been proven in a court of justice. However, for the purpose of this case study, we take collusion in investigated markets as established.

[2]The data used in this chapter come from three main sources: Kent Marketing, the leading survey company for the Canadian gasoline market, that every two months collects information on sales, amenities, brand affiliation, and a snapshot of prices for (close to) the universe of stations located in large cities sales from January 1995 until June 2001; Québec's energy board's weekly survey of retail prices at a random sample of 13 stations from December 1997 until February 2004; Market research company MJ Ervin's weekly survey of retail prices for a sample of 15 stations from January 2001 to November 2012. We also refer to documents from the Competition Bureau and from the Régie de l'énergie, that are described in more detail in Appendix A.

between their own downstream retailers and independent branded stations operating in the same neighborhood. Upstream suppliers influenced prices charged by independent station owners and softened retail competition by using non-linear wholesale pricing schemes (i.e., quantity discounts) and by offering price-support clauses that guaranteed retailers a minimum profit flow. Integrated, company-owned stations were motivated to maintain high prices and avoid stealing business from other stations, but branded independents had incentive to undercut the arrangement and take advantage of the price-support clause, especially towards the end of their contracts with the upstream firm. Nonetheless, coordination was maintained throughout the late 1990s as branded independents chose the stream of profits provided by contract renewal over those from undercutting.

Conditions changed drastically in January 2000. A branded independent retailer, in the last year of its lease contract, chose to defect from the collusive arrangement by lowering its price to increase sales volume and benefit from a price-support clause it had with an upstream supplier. This event triggered a price war that caused margins to collapse from over five cents per liter (cpl) to nearly zero, with almost no dispersion in prices across the city and surrounding area. The station that instigated the price war and other stations along commuting paths were winners, experiencing large market share increases at the expense of stations in the downtown core. Suppliers also suffered significant losses, as retail margins close to zero implied large transfers to independent retailers with price-support clauses.

The price war lasted almost a full year. Specific market characteristics made it difficult for the cartel members to regroup. Using daily station-level data, we show that it was extremely costly to restart coordination because demand was very elastic: raising the price two cpl above neighboring prices could result in a 36% loss of volume. A low-price guarantee policy offered by one of the larger players in the market also made it difficult to transition out of the price war. In December 2000, a group of stations filed a lawsuit with the regulatory agency alleging predatory pricing from some competitors. We provide evidence that following the investigation and subsequent intervention by the government, coordination restarted, and firms transitioned to a new equilibrium in which margins were even higher and prices more unified across the entire city than they had been before the price war. The post-war pricing pattern is similar to what was observed in the retail gasoline markets of four nearby cities, where a Competition Bureau investigation uncovered evidence of an alleged hard-core cartel.[3]

This case study highlights how the vertical contracts employed in many gasoline markets to share risk and soften competition can also generate a conflict of interest between suppliers

[3]See Clark and Houde (2013), Clark and Houde (2014) and Erutku and Hildebrand (2010).

and retailers. Vertical contracts featuring price-support clauses and non-linear pricing allow suppliers to influence buyers' pricing decisions and could potentially facilitate collusion.[4] However, these contractual features might also trigger price wars since retailers do not bear all the losses from deviating. Our analysis also illustrates how challenging it can be to restart coordination after the buyer deviates. We highlight in particular the significance of elastic demand and low-price guarantee policies, common features in many retail markets.

The rest of the case study is divided into five sections. In the first, we describe the main features of the industry that are important for understanding the incentives faced by firms in Québec's fuel industry. Section 2 describes the coordinated zone-pricing equilibrium that retailers and suppliers achieved before the start of the price war. In Section 3 we explain the causes of the price war and its dissemination. In Sections 4 and 5, we explain the challenges faced by firms attempting to restart coordination and the new collusive equilibrium they achieved afterward. Finally, in Section 6, we conclude.

1 Setting

In the late 1990s, there were just over 300 stations in Québec City and surrounding areas. Figure 1 shows the geographical distribution of the stations and highlights the main traffic patterns of consumers. The figure provides a heat map of the net traffic in each neighborhood (i.e., destination - origin), with positive net traffic in red and negative net traffic in blue.[5] As can be seen, traffic flows from the outer regions towards the downtown core on the North side of the St Lawrence River.[6] Before the price war, stations located in non-commuting areas and the downtown core had posted the highest prices, with lower prices posted in the peripheral neighborhoods and along commuting paths.[7]

Three different types of stations operate in the market, namely stations owned by (i) national fuel chains (brands), (ii) independent companies with brand affiliations (contracts), and (iii) unbranded independent companies. In the 1990s, station ownership was fragmented,

[4]There is a large literature studying the effect of vertical restraints on both intra and interbrand competition and how it can facilitate collusion. For an extensive discussion on that, see Rey and Vergé (2008).

[5]Information is from the Ministère des Transports et de la Mobilité durable's 2001 origin-destination survey. Net traffic for a given geographical zone 'x' corresponds to the number of respondents claiming displacement to 'x' minus the number of displacements from 'x'. There are 950 zones.

[6]For more details on commuting patterns in Québec City and their impact on demand for retail gasoline, see Houde (2012).

[7]Based on Kent database, for the period between 1997 and 1999, the average gasoline price was 59.42 cpl at areas south of the St. Lawrence River (Levis), 58.92 at the downtown core north of the river (Quebec, Sainte-Foy, Sillery, and Cap-Rouge), and 58.48 at other neighborhoods.

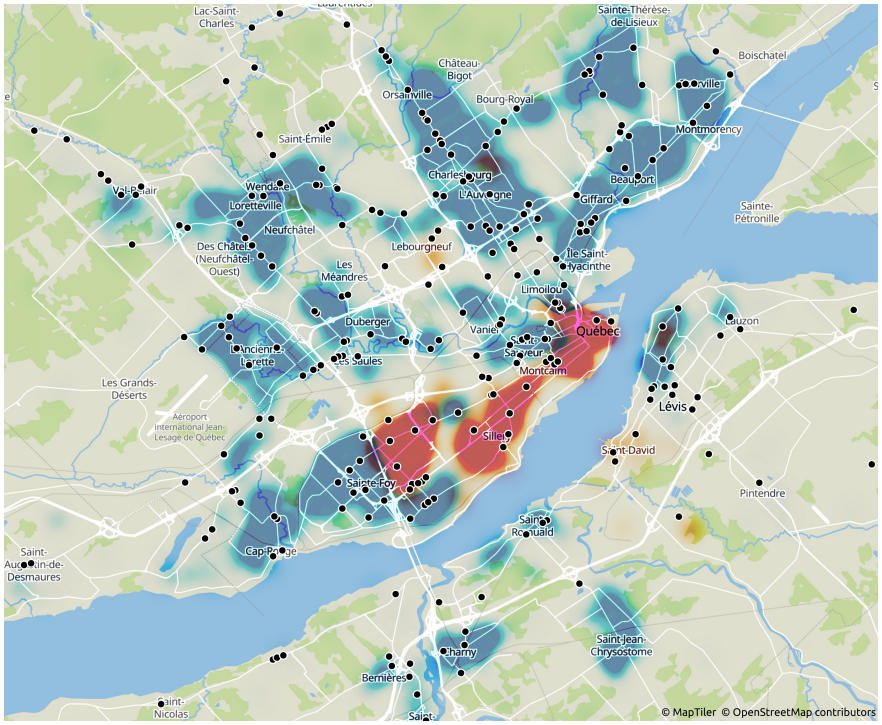


Figure 1: Québec City - Fuel stations location and net traffic flow

with around ten different fuel brands and with independent branded stations making up a significant share of the ownership of stations associated with the four major fuel suppliers: 49%, 24%, 41%, and 40% of Esso, Petro Canada, Shell, and Ultramar, respectively.

1.1 Vertical contracts:

Branded independent stations operate under two different types of contracts – commission-based and cross-lease. Both types of vertical contracts are negotiated every three to five years, reflecting local market conditions. Commission-based contracts are used primarily by one of the larger chains operating in the market, Ultramar, which owns the nearest refinery. Under these contracts it controls the inventory and sets retail prices, with the station owner receiving a commission. Rather than using this arrangement, most independent retailers operating branded stations sign long-term cross-lease contracts with an upstream supplier. The structure of these contracts differs across stations and brands, but the idea is that the independent retailer leases the facility to a supplier, who leases it back to the retailer under various terms and conditions. The main reason for the existence of these contracts is that they allow the upstream supplier to maintain access to the site in the event the station owner

sells the property. Stations operating under cross-lease contracts are responsible for setting the retail price but face a non-linear compensation scheme (namely quantity discounts).[8] The cross-lease contract specifies a "lease" paid to the station operator, which is expressed on a per-volume basis (e.g. 1.6 cpl), but not the wholesale price, since it is not contractible due to fluctuations in oil prices. Cross-lease contracts also specify a minimum quantity that the retailer needs to purchase from the supplier every period. Failure to meet this volume target leads to financial penalties. As a result, profit margins are random and subject to important downside market risk. When the market price falls, because of a price war for instance, stations must earn small or negative gross margins to avoid penalties.

Because of borrowing constraints and the presence of large fixed costs, retailers are particularly sensitive to the risk of earning negative profits during periods of low margins. To transfer part of this risk to the supplier, cross-lease contracts between station operators and oil companies are characterized by price-support clauses that establish a lower bound on the gross margin earned by retailers. These clauses, also known as minimum margins, are negotiated at the beginning of the contract and then held fixed. They ensure owners of a positive profit margin on gasoline sales even if gasoline is sold at cost (such as in the event of a price war). Although the exact nature of vertical contracts is unknown, several witnesses confirmed the existence of price-support clauses among independent stations operating under three of the four vertically integrated brands.[9] These sorts of arrangements have been used in many other retail gasoline markets throughout the world, including those in Australia, Norway, and the Netherlands.[10]

1.2 Retail price floor:

Prices in the province are regulated by the Law on petroleum products (Loi sur les produits pétroliers), which was enacted at the start of 1997 and administrated by the Régie de l'énergie du Québec (hereafter the Régie). The law stipulates a weekly floor price equal to:

$$MEP_{mt} = w_t + \tau_{mt} + T_{mt}, \tag{1}$$

where, for market m during week t, w_t is the minimum wholesale price at the terminal, τ_{mt} is an estimate of the transportation cost to deliver gasoline from the refinery to market m

[8] These agreements specify what equipment must be installed at the facility (e.g. pumps and convenience store), and determine the structure of the retailer's compensation.

[9] See Régie (2000).

[10] See Wang (2009), Foros and Steen (2013) and Faber and Janssen (2019).

(about 1/3 cents per liter in Québec City), and T_{mt} is the sum of federal and provincial taxes. Since most stations pay a wholesale price below w_t through negotiated discounts, the MEP is an upper bound on the marginal cost of selling gasoline. The price floor is determined and posted on the Régie's website every Monday.

If a firm observes rivals charging below the floor, it can sue for financial compensation based on *excessive and unreasonable commercial practices*. The floor was adopted following an earlier price war in 1996. According to the Régie, the war was caused by predatory pricing by the major retailing chains, and the floor was implemented by the Québec government in an effort to protect small independent retailers.[11]

Since the MEP only account for taxes and transportation costs, retail prices at the MEP would most likely not cover the stations' fixed operating costs. This is especially problematic for independent retailers paying higher wholesale prices. In situations where an investigation has proven that firms repeatedly price below or at the floor in a specific region, the regulation stipulates that the Régie can impose an additional minimum margin on top of the floor of around $0.03 per liter. This minimum margin has the objective of helping smaller retailers survive. It also allows the Régie to indirectly compensate stations following a price war.

2 Pre-War Collusive Equilibrium

The heavy presence of branded independents in Québec City's retail gasoline market in the late 1990s led to the development of a hub-and-spoke arrangement in which upstream branded suppliers coordinated "zone pricing" between their own downstream retailers and independent branded stations operating in a given neighborhood.[12] Integrated, company-owned stations had the incentive to keep prices high and to abstain from business stealing. On the other hand, branded independents had reason to undercut the arrangement, especially toward the end of their contracts with the upstream firm. Suppliers have the right to terminate cross-lease contracts if they can demonstrate that the retailer lowered its price for reasons other than to respond to "normal" competitive pressures. However, demonstrating that a particular retailer initiated a price war requires costly monitoring by the supplier, which leads to a standard principal-agent problem: with imperfect monitoring, independent

[11] In fact, the 1996 price war was more likely the result of excess capacity in the industry and the decision by Ultramar, Québec's largest retailer, to institute a low-price guarantee. An investigation by the Competition Bureau of Canada did not find any evidence of predatory behavior. For further discussion of Quebec's price floor, see (Carranza, Clark, and Houde 2015).

[12] An industry report prepared by the Conference Board of Canada in 2000 also discusses the fact that many Canadian cities exhibit uniform or zone-pricing strategies The Conference Board (2001)).

stations have a clear incentive to initiate price wars by undercutting their rivals, reducing overall profits for upstream suppliers. Despite this, coordination was maintained throughout the late 1990s as branded independents chose the future stream of profits provided by contract renewal over those from deviation.

Suppliers influenced prices charged by independent station owners and softened retail competition by using non-linear wholesale price schemes and by offering price-support clauses of the sort described in the previous section. By controlling retail prices for all affiliated stations and by internalizing business-stealing externalities, upstream suppliers facilitate coordination via a sort of resale-price maintenance (RPM) pricing scheme operating through repeated interactions with independent retailers. Although RPM is illegal per se in Canada, a tacit arrangement between firms with similar results can be achieved if there are repeated interactions and if the threat of punishment is large enough. Punishment can take the form of price wars and/or threat of contract termination.

The resulting equilibrium reached by retailers and suppliers in Québec City between 1997 and 1999 featured high margins for retailers, of 5.64 cpl on average (9% of the average price).[13] The market was also characterized by relatively uniform prices within neighborhoods. The median interquartile range of prices within neighborhoods was 0.30 cpl compared to 0.94 cpl across all of Québec City and surrounding area. To further test for zone pricing, we use data on stations' prices and characteristics to investigate the contribution of different factors (station size, amenities, neighborhood and brand) to the cross-sectional variance of margins in the pre-war period.[14] Our results show that geographical location (neighborhood) is the most important factor of the margin's variance, accounting for 47.7% of the total variation. Amenities, size, and brand account for just 2.5%, 1.8%, and 4.3%, respectively.

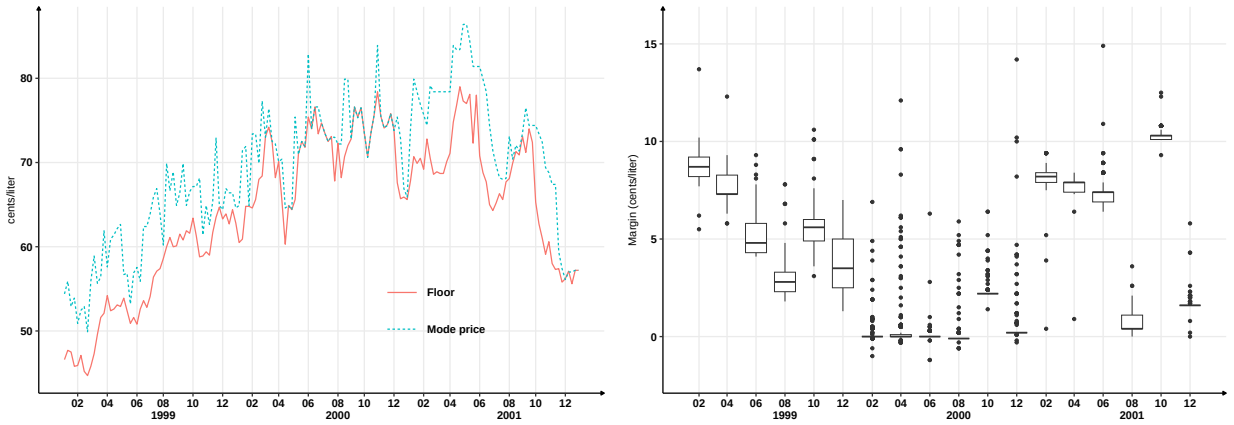
3 The Price War

In January of 2000, conditions in Québec City's retail gasoline market changed drastically when one independent station broke ranks and unilaterally lowered its price. Figure 2a plots the modal price along with the price floor around the year 2000. The late 1990s were a period of historically high oil prices during which price levels kept rising due to increases

[13] Source: Régie de l'énergie du Québec price survey.

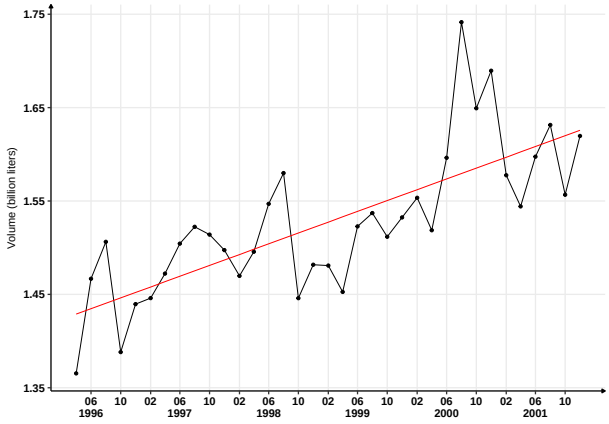
[14] Specifically, after calculating the average across time, we decompose the cross-sectional margin variance as $Var(margin_i) = Var(\hat{\gamma}_i^{neighborhood}) + Var(\hat{\gamma}_i^{amenities}) + Var(\hat{\gamma}_i^{brand}) + \hat{\beta}^2 Var(size_i) + Var(\hat{e}_i) + Cov$, where $\hat{\gamma}$ are fixed effects estimates and Cov is the sum of pairwise covariances between components. Amenities is a categorical variable indicating the presence of convenience store, repair shop and/or carwash. Neighborhood is the three-digit zip number. Size refers to the number of islands.

in the rack (wholesale) price and only reached a maximum at the beginning of 2001. It is, therefore, likely that demand for individual stations was more elastic than usual since consumers had greater incentive to search for better prices, making it difficult to sustain a collusive equilibrium. As can be seen from the figure, prices were well above the floor throughout 1999 before falling to the floor at the start of 2000.



(a) Weekly prices

(b) Distribution of margins



(c) Aggregate sales

Figure 2: Evolution of retail prices, margins, and sales around the 2000 price war in Québec City

The abrupt change in equilibrium prices is even more evident when looking at the distribution of margins. In Figure 2b we use a whisker plot representation of the observed margins to highlight how, during the six bi-monthly periods of 2000, the market exhibited little margin dispersion, and the vast majority of stations posted a price equal to the price

floor.[15] As can be seen from the figure, margins are much higher and dispersion much lower in the periods before and after the price war, consistent with an equilibrium featuring tacit or explicit coordination. Finally, Figure 2c illustrates that the decrease in margins during the price war had a positive impact on aggregate sales volume. Starting in the third bi-monthly period of 2000, we observe a large increase in aggregate sales when compared to the sales trend observed since 1996.

These three figures highlight the severity and impact of the price war that started during the first two months of 2000. They also clearly delineate its time span until the first month of 2001, when margins recovered to pre-war levels or higher. In what follows, we analyze the causes and consequences of the price war that took place in Québec City between January and December 2000.

3.1 Causes

On December 13th 2000, the Association of Independent Gasoline Retailers (Association québécoise des indépendants du pétrole or AQUIP) filed a complaint with the Régie based on its responsibility for enforcing the price floor regulation. Independent retailers, led by the owner of the EKO chain of gas stations Fernand Dufresne, asked the Régie to investigate violations of the regulation preventing stations from posting a price at or below the MEP. The goal of the investigation was twofold, first to determine if a violation of the Law on petroleum products had occurred, and second, to evaluate whether the price war caused sufficient damages to justify raising the floor. The investigation focused on the period between September and November 2000.

The investigation report identified the existence of price-support clauses offered to branded independent stations by major upstream suppliers as a root cause of the price war. Testimony from a manager at *Couche-Tard*, the largest convenience-store chain in Québec, established a direct link between the price-support clause and the occurrence of the price war. The magnitude of the negotiated minimum margin varied across retailers based on market conditions at the time the contract was signed. Since gross margins were relatively high between 1996 and 1998, stations that were near the end of their contacts in 2000 enjoyed minimum margins that were between 3 and 5 cpl. The manager also stated that minimum-margin clauses above 3 cpl were phased out in the late 1990s. In 2000, differences in the size of the

[15] For each time period represented by a whisker plot, the lower, middle and upper edge of the box correspond to the first, second and third quartile of the distribution. The lines extending above and below the box cover all observations that are not considered outliers. Dots above and below represent outliers.

minimum margin across retailers created an opportunity for some station owners to benefit from asymmetric contracts, as retailers with more generous price supports could sustain zero margins for longer periods and gain market share over others with less generous support from suppliers.

The manager summarized the incentives for firms with minimum-margin clauses above 3 cpl and near the end of their contracts as follows: *"a site that it knows it is going to close within two years [...] decides to treat itself at the expense of the market and limit competition for the sole purpose of increasing, tripling and quadrupling its volume to obtain the maximum remuneration."*[16] Testimony from the Couche Tard manager and other witnesses refers to one such "deviant" station operating in a suburb of Québec City. This station changed its banner at the end of 2000, and according to witnesses, benefited from a larger-than-average minimum margin clause during the price war period. Multiple witnesses confirmed that this station posted a price equal to the MEP continuously between January and December 2000. The end of this low-price strategy coincided with the beginning of the Régie investigation.

This discussion highlights the fact that price-support clauses expose suppliers to an important moral hazard risk – when the market price is such that the retail margin that an independent station would earn is close to, or lower than, the minimum margin, it has a unilateral incentive to lower its price in order to increase its volume. When this occurs, the supplier increases its payment to the station (lease price + minimum margin) and effectively offers a subsidy or "price support" to the retailer. One industry expert, interviewed during the investigation, summarized the cost to suppliers as follows: *"The price reductions may be costless to the retailer, but they are not costless to the refiner. And therefore, if the retailer is pricing in an inappropriate manner, economically inappropriate, from the perspective of the supplier, there is a clear incentive for the refiner to opt out of or change the contractual arrangement."*[17]

3.2 Dissemination

In order to provide a deeper understanding of how the price war disseminated across Québec City's neighborhoods, we document the evolution of the geographical allocation of gas sales. In Figure 3 we present a heatmap for Québec City of the difference in cumulative sales between 1999 and 2000 for different time periods. For comparison purposes, we use volume

[16] Translated from "*un site qu'elle sait qu'elle va fermer dans deux ans avec l'un de ces raffineurs-là et décide de payer une traite au marché et de nuire à la concurrence dans le seul but uniquement d'augmenter, de tripler et de quadrupler son volume pour aller chercher le maximum de rémunération.*" See Régie (2000).

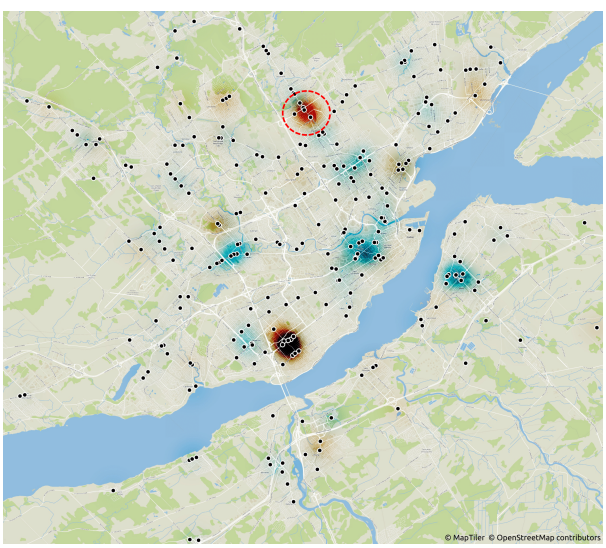
[17] Interview of John D. Todd in Régie (2000).

shares instead of levels and represent positive share differences with red and negative differences using blue. The median station had a volume share of 0.3% at the end of 1999. Figure 3a illustrates the change in shares for the first two months of the price war relative to the same period of the previous year. An area in the district of Charlesbourg at the North end of Québec City (red circle) stands out with some stations having considerably larger share gains and their aggregate sales share increasing by 0.28 percentage points in 2000 relative to the same period in 1999.[18,19] Of particular note is a Petro Canada station that achieved a 5-fold increase in sales relative to the same period in 1999. As mentioned above, from the testimony during the Régie investigation we know that the deviant station was located in one of the suburbs of the city and was not an unbranded station. Since the Charlesbourg Petro Canada station is a clear outlier in cumulative volume-share difference during the first two months of 2000 and maintains an elevated cumulative sale share difference throughout the year, we strongly suspect that it is the deviant.

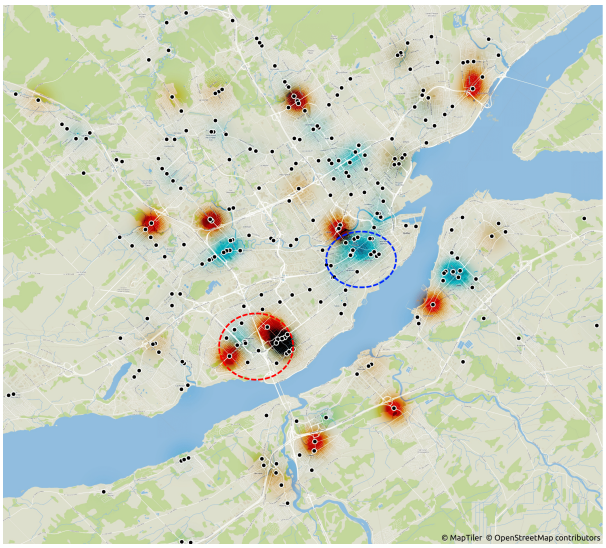
In Figure 3b we compare sales shares during the first six months of each year. At this stage of the price war, stations not only in Charlesbourg but also in other neighborhoods located along commuting paths started to experience sale shares significantly higher than those observed during the same period of the previous year. For example, stations in Sainte-Foy, which is located just on the Québec City side of the bridge (red circle) used by commuters coming from the South shore to the city, had an aggregate share increase of 0.45 percentage points in the first semester. On the other hand, stations located in the downtown core (blue circle), just to the East of Sainte-Foy, were underperforming and losing an aggregate of 0.84 percentage points in market share at the end of the semester. Finally, we can see from Figure 3c, which covers the first 10 months of the year, that the same trend continued until the end of the price war. Stations located along the entry points to Québec City (red circle) featured higher yearly sales than the previous year, while stations located inside the city (blue circle) experienced a decrease in share relative to the previous year, with the city core suffering a decrease of 1.73 percentage points in sales share.

[18] The specific area we refer to is Forward Sortation Area G1G.

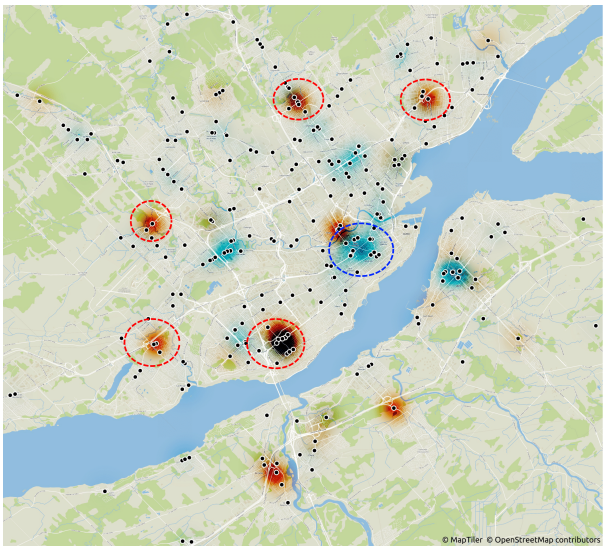
[19] For comparison, the standard deviation of share difference from 1997 to 1998 and 1998 to 1999 is 0.21 percentage points.



(a) Jan-Feb



(b) Jan-Jun



(c) Jan-Oct

Figure 3: Difference in share of cumulative sales between 1999 and 2000

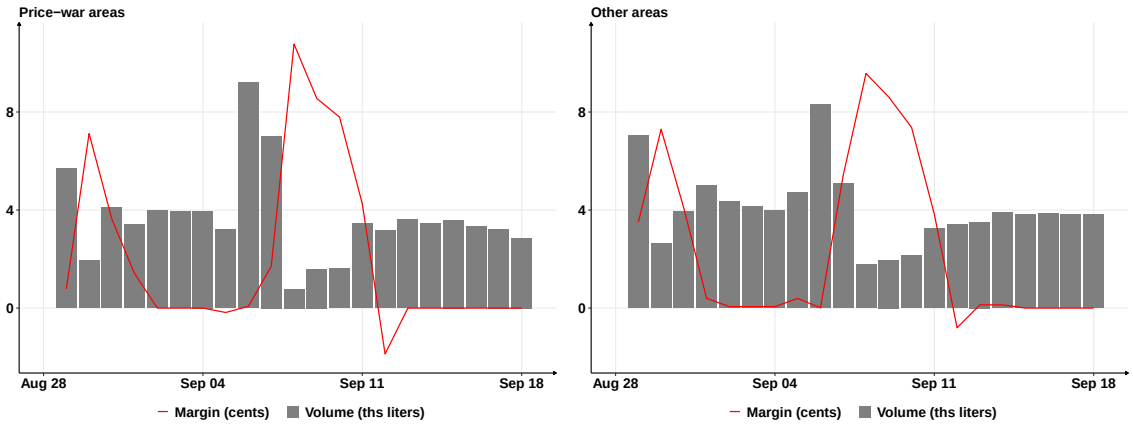
4 Length of the War

The price war lasted for almost an entire year, coming to an end only in November of that year when the government finally intervened.[20] The persistence of the war raises questions about the difficulties faced by retailers that may have been trying to restart collusion.

Using rich daily price and quantity information for the largest independent retail chain

[20]This is longer than the price wars described in Porter (1985) for instance.

in Québec City, Eko, we are able to illustrate one such attempt to restart coordination. In Figure 4 we plot margins and volume for Eko stations during the first three weeks of September 2000. On September 5th, we observe a stark increase in the average sales (gray bars) at Eko stations, which we conjecture likely reflects an attempt by nearby stations to restart coordination by increasing prices above the floor. In the following days, Eko stations increased margins (red line) above zero in what was likely a response to this price-increase attempt. However, this increase had a severe impact on the stations' immediate sales, with daily volume decreasing to a level that was less than half of what is observed during days when stations charged at the price floor. After only four days, Eko stations started to reduce margins back to zero, which resulted in daily gasoline volume recovering to the level observed before the event. The speed and intensity at which sales responded to the increase in margins highlight the considerable cost that stations incur when unilaterally setting margins above market. Finally, by contrasting the average demand response between Eko stations located in the entryway areas and stations located elsewhere, the graph is also suggestive that restarting costs can differ substantially depending on the local market structure faced by each station.



Notes: Price-war areas are Charlesbourg, Levis, Saint-Foy, and Beauport.

Figure 4: Eko stations' daily margins and sales during the price war period

Two factors, in particular, may explain why restarting collusion was challenging in this setting: (i) demand was very elastic, and (ii) one of the leading firms operated under a low price guarantee. These market features may have posed challenges for any firm or station trying to unilaterally increase its price above the market price, since it would lose too much volume.[21]

[21]The difficulties faced by these retailers trying to restart collusion are similar to those faced by firms

4.1 Price elasticity

To quantify the loss in sales for stations from raising their prices, in Table 1 we measure the demand response to price changes while controlling for other demand determinants. In column (1), we regress log sales on log prices using the Eko data. In column (2), we provide validation to our result by running a similar regression but in another dataset, the Kent Marketing data. The findings imply short-run elasticities of -6 using the Eko data (i.e., a 1% increase in price implies a 6% decrease in sales) and -8 using Kent, suggesting that consumers are well-informed about the distribution of gasoline prices across the market and react accordingly. The demand response is even more striking when we evaluate the impact of posting a price two cents above the market price. In Column (3), we quantify that such a price difference had an average impact on sales of around -36% for Eko stations.[22] Moreover, using a dummy variable for geographical areas located along Québec City's entryways, we found an even higher response of drivers to above-market prices of -49%. Corroborating the findings from Figure 4, the regression results suggest that retail chains face substantial losses in sales if they try to restart coordination by unilaterally raising prices away from the competitive equilibrium, and that this is especially true in highly competitive areas such as the entryways.

Table 1: Demand response to prices during price-war period

	log(Sales)		
	1	2	3
log(Price)	−6.141	−8.074	
	(0.668)	(1.082)	
2 cent or more above market price			−0.459
			(0.043)
2 cent or more above market price × price-war area			−0.206
			(0.105)
Data Source	Eko	Kent	Eko
Time FE	Week+Day of Week	Bimonth	Week+Day of Week
Individual FE	Station	FSA+Brand	Station
Adj. R^2	0.343	0.607	0.254
Num. obs.	2531	1744	2639

Notes: Sales and Price refer to unleaded gasoline sold during 2000. Market price is defined as the mode price of the last Regie price survey. Additional control variables: in model 1, log(price) of the closest station in the last Regie survey, dummies for the previous and next day price change sign; in model 2, log(price) of the closest station in Kent, number of islands and dummy for convenience store; in model 3, price 2 cents below market price, plus interaction with the number of stations in a 500 meters range. Heteroscedasticity robust standard errors. FSA corresponds to the first three digits of the station's zip code.

attempting to get collusion off the ground in the first place. For instance, Igami and Sugaya (2022) document that vitamin C margins took roughly three years after the beginning of the collusive arrangement to achieve stability. Byrne and deRoos (2019) and Alé-Chilet (2018) also find evidence of a slow and costly adjustment to coordination.

[22] Based on column (3), $\Delta Sales/Sales = \exp(-0.459) - 1$

The estimated sales response implies a large opportunity cost for stations from trying to sustain above-floor prices. Using the results from column (3) in Table 1, we compute the difference in daily profit from charging 5 cents above the floor vs charging at the floor and receiving a price support clause of 3 cents.[23] In this case, stations located at entryways would have suffered a short-term opportunity cost of around $18,636 per day from not increasing sales and receiving the price support, which corresponds to 14% of their daily profit. The stations located in Québec City's downtown core, on the other hand, would have experienced an increase in profits of around $6,302, or 5% of daily profit, in the short term.

4.2 Low-price guarantees

Ultramar is the largest chain of branded retailers in the province of Québec. It is vertically integrated, operating the only refinery in the Québec City region. Its head office maintains price-setting control through a combination of lessee retailers acting under commission and company-owned stores.

In the summer of 1996, Ultramar instituted a low-price guarantee policy known as Valeur-Plus (or ValuePlus). Each Ultramar station is required to list the lowest price among stations located within *close proximity*. To operationalize the guarantee, Ultramar employs a team of regional representatives who are responsible for establishing and adjusting prices. The company has also put in place a centralized pricing center that monitors prices across the province and has provided a free phone line through which rival stations and consumers can report discrepancies. From Table 2 we can see that the policy immediately changed the way that Ultramar set prices. The table presents the fraction of Ultramar stations that charge a price below any other station within a 1km radius.[24] In the early 1990s, this fraction was at most 40%. It increased somewhat in 1994 and 1995, before jumping sharply in 1996 to more than 90%, at which point it stabilized. For comparison purposes, we show the same information for two of the other main chains, Petro Canada and Shell. We see a similar increase in 1993 and 1994, but there was no big jump in 1996 as there was for Ultramar.

The low-price guarantee, together with highly elastic demand, made it difficult for other stations to raise their prices much above those of a nearby Ultramar station in an effort to restart coordination.[25] The announcement of the low-price guarantee policy likely provided a clear signal for price-sensitive but uninformed consumers, and for other chains about

[23] The average margin from stations that charged 2 cents above market price was 5.6 cents.

[24] Price information is from the Kent Marketing survey.

[25] In the case of a busted cartel in four cities of Quebec in 2005 and 2006, Clark and Houde (2013) provides evidence on how even small delays in price matching by Ultramar implied large transfers between retailers.

Table 2: Fraction of stations pricing at the minimum

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Ultramar	0.36	0.32	0.40	0.62	0.73	0.92	0.92	0.83	0.92	0.94	0.94
Petro Canada	0.20	0.37	0.55	0.63	0.76	0.62	0.73	0.87	0.73	0.83	0.76
Shell	0.27	0.51	0.49	0.65	0.61	0.47	0.61	0.69	0.57	0.73	0.75

Notes: To compute the fraction for a given brand we: locate for each station that is part of the chain all other stations that are inside a 1km circular range; find the minimum retail price for unleaded gasoline inside the range; count the number of stations belonging to the chain that price at the minimum in its range, and divide by the total number of stations with price information.

the willingness of Ultramar to engage in fierce competition.[26] Moreover, since it was not clear what was the definition of *close proximity* used by Ultramar to establish the reference neighborhood for each of its station, the policy created uncertainty for some nearby rivals as to whether the local Ultramar station would actually follow on a price increase. Finally, it would also have been common knowledge across retailers that Ultramar would not be leading any attempt to raise prices.

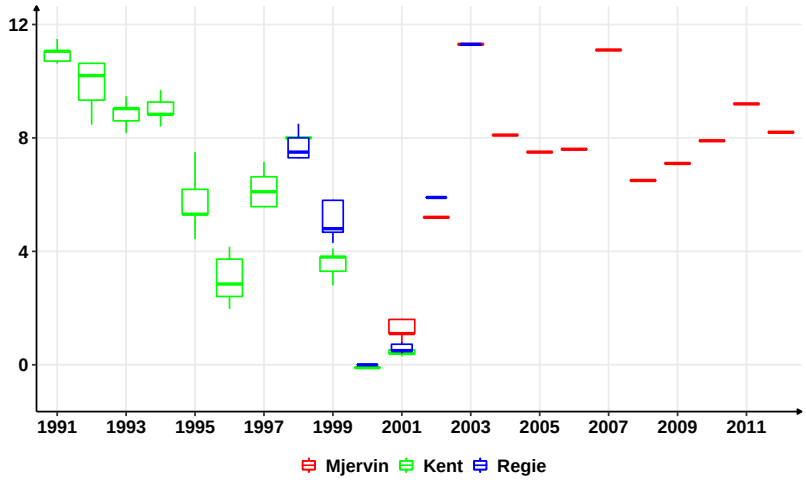
5 Aftereffects

The conclusion of the Québec City price war coincided with the request by AQUIP for a Régie-led investigation into violation of the price floor regulation. The investigation was initiated in January 2001 and lasted until July of the same year. It determined that the severity and geographical extent of the price war justified government intervention. The final report states that "*it [the Regie] intends to send a clear message to market participants that market aberrations are not tolerated and that the rationalization of the market must continue according to the rules of free competition for the benefit of consumers.*"[27] The Régie then decided to raise the price floor by 3 cpl between September and November of 2001. Later, in a 2004 report it produced, the Régie analyzed the market and concluded that the intervention had been successful at *"preventing prolonged periods of price war."* From Figure 2a we can establish that prices started to move away from the floor towards a more elevated level in December 2000, and especially into 2001. The margins observed after the price war are even higher than those achieved by the within-brand hub-and-spoke

[26] See Moorthy and Winter (2006) for a discussion of the effects of price-matching guarantees on price information in an environment with search costs.

[27] See Régie (2000).

arrangements that characterized the pre-war period.[28] Despite the increase in margins, dispersion was minimal in 2001, shrinking to almost zero by the end of the year.



Notes: For comparison, we select Kent observations only from stations that are closest to stations surveyed by Régie. Margins are surveyed around the last week of August of each year.

Figure 6: Evolution of margin dispersion

In Figure 6 we use another whisker plot to provide further details on the timing and size of the recovery. The figure shows that the high margins and limited dispersion that developed in 2001 persisted in Québec City well after the end of the price war. We combine three of our data sets to provide a comprehensive overview of pricing before, during, and after the war.[29] From the figure it is clear that margins are very elevated and that prices are nearly uniform. In fact, at least among the 13 stations surveyed by the Régie, pricing is uniform starting in 2002. Since the Régie data only go until 2003, we also use the MJ Ervin survey of 15 (possibly different) stations that covers the 2001 to 2012 period to see whether uniformity and high margins persist. Indeed we find that there is no dispersion at

[28] It should be noted that the retail gasoline price level increased by 15.5% in real terms from 1997 to 2003. This increase was, for the most part, due to increases in the rack price. The high price levels probably had a negative impact on margins. Even so, firms manage to charge markups higher than those observed before the price war.

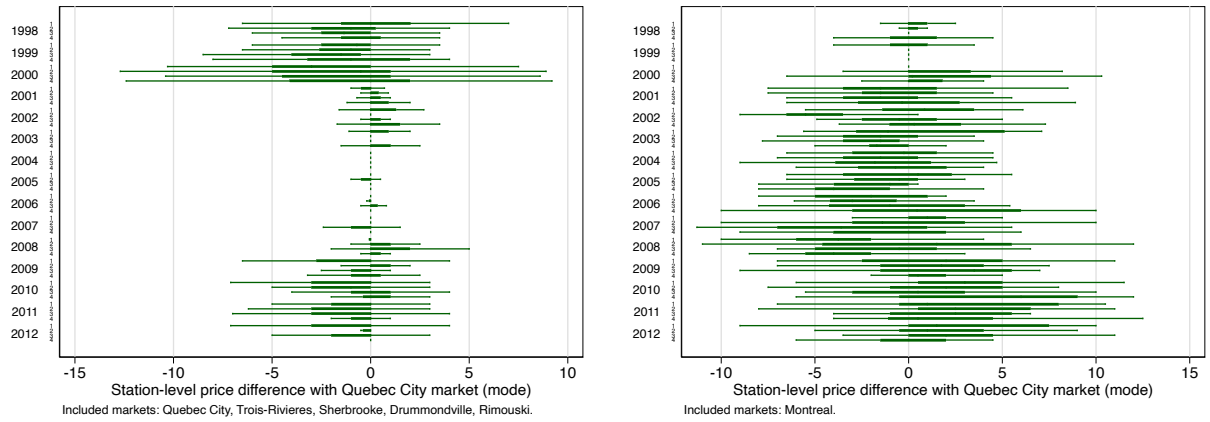
[29] Unlike in Figure 2b, which uses all of the 306 stations from the Kent Marketing data set, here we focus on a restricted set of stations. The reason for this is that we do not have access to the Kent Marketing data after 2001 and therefore, to study dispersion in the period after the price war we must incorporate data from the Régie and MJ Ervin. Since these data sets survey a smaller number of stations than does Kent Marketing, we restrict the number of Kent stations we consider for our analysis in an effort to be sure that any differences in dispersion over time that we identify are not driven by the greater number of stations in the Kent survey. More specifically, the Régie surveys only 13 stations and so, for consistency, we use information from just 13 stations in the Kent sample, taking one station for each of the Régie stations. In each case we take the closest Kent station.

all through to the end of the sample, and that margins are quite high, although they do fall somewhat in 2008.

These post-war pricing patterns are consistent with those observed in the retail gasoline markets in four nearby cities where a Competition Bureau investigation uncovered evidence of an alleged hard-core cartel. The Bureau's investigation focused on the retail gasoline markets of four cities in the province of Quebec: Magog, Sherbrooke, Thetford Mines, and Victoriaville; and culminated with the issuing of search warrants in 2006, after which margins fell sharply. Evidence suggests that it was not only stations in the four target markets that reacted to the Bureau investigation, but that similar patterns can be detected in a number of other nearby markets in the Eastern part of the province, including Québec City. In contrast, cities in the Western part of the province experienced no margin adjustment at this time.[30] These findings, while suggestive of collusion being widespread in the province, are not conclusive, since, to our knowledge, the Competition Bureau investigation was not extended to markets outside of the four cities investigated. As a result, there exists no direct evidence of explicit coordination among players outside these four markets and other reasons can explain the similarities in pricing.

Using the price data for other cities in the province, we can investigate these patterns further. To see whether pricing in other markets was similar to Québec City pricing, in Figure 7a we plot the difference between the modal price in Québec City and station-level posted prices for stations located across the Central and Eastern part of the province, including Québec City stations. The figure shows that, starting just after the price war, pricing in the central-east markets began to follow Québec City pricing – the difference between prices surveyed at other stations in the region and the modal Québec City price, falls to zero. In other words, these stations feature the same high prices as in Québec City. Among these markets is Sherbrooke, one of the markets targeted in the Competition Bureau investigation. Consistent with margin collapse in response to the Bureau investigation, all of the Eastern markets we consider here appear to move in the same direction. In contrast, Figure 7b shows that the same patterns do not exist in the city of Montréal, located at the west part of the province. Following the price war, there are considerable differences between prices at Montréal stations and the modal price in Québec City and these persist or even become

[30] See Clark and Houde (2014) who use micro-level price data to study the impact on margins and adjustment asymmetry of the collapse of the cartels following the Competition Bureau investigation in 2005 and 2006. See also Erutku and Hildebrand (2010) who estimate the collusion overcharges in the Sherbrooke market. Their results show that following the announcement of the Bureau investigation, prices decreased by nearly 2 cpl relative to Montreal, but not at all relative to Quebec City.



(a) Central and eastern regions (b) Montreal

Notes: Each observation corresponds to the difference between the station-level posted price and the modal price in Québec City on the same survey date.

Figure 7: Distribution of gasoline prices in the South and East regions of Québec relative to the modal price in Québec City

larger in later years. Comparing margins between 2002 and 2006 we find that they were 6.45 cpl in Québec City and only 4.06 cpl in Montreal.

Note that from Figure 7a we can see that, starting in 2008, differences relative to Québec City begin to arise again suggesting that, in the years after the Bureau investigation, the market seems to have been disrupted.

6 Conclusion

We provide an investigation into the price war that occurred in Québec City's retail gasoline market between two episodes of price coordination. Our analysis identifies two main market features that influenced the origin and duration of the price war: (i) the existence of non-linear contracts, and (ii) low-price guarantees. The former is identified as the root cause of the price war as it created asymmetric margins between gas stations, inducing those with low margins to defect, while the latter, in conjunction with elevated demand elasticity, helps to explain its prolonged duration. Gasoline markets are far from alone amongst retail markets in being characterized by these two features and so it is worth understanding the ways in which they contribute to the sustainability of collusive arrangements. The role of low-price guarantees is particularly compelling, since not only can they lead to longer lasting price wars, but they can also allow periods of price stability to persist longer.

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A Documents

The documents from the Régie de lénergie can be found here:

http://www.regie-energie.qc.ca/audiences/3457-00/index.html.

They include information related to the motion requesting the inclusion of the fixed amount for operating costs in the minimum price provided for in subsection 59 (2) of the Act respecting the Régie de l'énergie (R-3457-2000).

For the purpose of this case study, we base our understanding of the facts with respect to the alleged retail-gasoline cartel that arose in certain markets in the province of Quebec in the years after the price war mostly on documents prepared by the Competition Bureau. We were given a copy of the 52-page affidavit of Mr. Pierre-Yves Guay of the Competition Bureau dated May 16, 2006 in file no 500-26-039962-067 of the Superior Court of Quebec, district of Montreal. From the Court, we received copies of the three annexes attached to the affidavit of Mr. Guay. Annex A is a 143-page document which contains mostly reported wiretap telephone conversations with respect to the region of Victoriaville; Annex B is a 45-page document which contains mostly reported wiretap telephone conversations with respect to the region of Thetford Mines; Annex C is a 121-page document which contains mostly reported wiretap telephone conversation with respect to the regions of Sherbrooke and Magog. We will refer to the affidavit of Mr. Guay and its three annexes as the "Competition Bureau documents." We also found information on the actions taken by the Competition Bureau on its website. These documents are analysed and reported on more extensively in Clark and Houde (2013) and Clark and Houde (2014).