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THE EFFECTS OF LOCATION AND NON-LOCATION FACTORS ON GASOLINE STATION PERFORMANCE

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ABSTRACT

An econometric model is proposed to assess the impact of both location and non-location variables on sales performance of gas stations. The general consensus in retail business is that choosing the right location and the right price is what it takes to succeed. Using a data set from the Montreal metropolitan area, we show that these variables indeed affect sales performance, but they are not the only ones. Factors such as brand name, opening hours and service play also an important role.

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INTRODUCTION

The aim of this paper is to explain variations in performance, measured by sales, of gas stations. The latter sell a set of homogeneous goods (regular and premium gasoline, diesel, etc.) and the temptation hence runs high to explain any possible difference between stations' performance by a pure location argument. Indeed, one would not assume, *ceteris paribus*, a gas station in a rural area to perform as well as one located at a highway's exit. This argument can be further developed by accounting for other fixed location factors such as the number of competitors within a certain radius. Admittedly, one expects these location factors to play an important role in explaining sales variations for the reason that consumers are probably indifferent between one gas station (or brand) and another and hence they will simply minimize the cost of fuelling their cars by stopping at the nearest facility. Still, a legitimate question remains open: are there non-location factors that could also contribute to the explanation of this variance in performance?

To answer this question, we specify an econometric sales-response model where the set of independent variables includes both location and non-location and test it using data on Montreal's gasoline market for a five-year period (1993-1997). More specifically, our performance model postulates that inherent characteristics of spatial factors, e.g., traffic flow passing the gasoline station during a period of time, market space where it is located, and competitive surrounding affect stations sales. It also assumes that marketing decisions such as, station service capacity, posted price, and operating hours affect also sales' performance. This specification permits us to account for spatial competition and market interactions between gasoline stations.

The academic empirical literature in this area is rather sparse. Robinson and Hebden (1973) studied the influence of price and promotion on sales. Our work is similar to theirs with however some differences in the choice of variables and their measurement. More recently, Png and Reitman (1994) investigated the impact of service time on sales and showed that marketing factors (price, service capacity, operating hours) have a significant impact on station's performance. The main differences between our approach and Png and Reitman (1994) are as follows. In terms of variables, we use station traffic volume as independent variable, possibly for the first time in (comparable) retailing research, to explain variations in sales performance between gasoline outlets with Origin-Destination Matrix. The intensity of competition faced by a gas station is also assessed differently. In Png and Reitman, the number of visible stations measures this intensity whereas here the number of stations within a certain radius measures intensity. Also, our econometric approach considers a random effect model, where all unobservable effects specific to a gas station but constant across time are captured by random station specific effects. Finally, note that we could not find any published study using Canadian data.

The rest of the paper is organized as follows. In Section 2, we briefly describe the Montreal gasoline market. In Section 3, we propose an econometric sales-response model, describe the variables and the data set and discuss the estimation method. In Section 4, we present and discuss the results and we conclude in Section 5.

1. MONTREAL GASOLINE MARKET

The Montreal gasoline market is mature, highly competitive with too many outlets and relatively low average pump turnovers at 2.3 MM litres/year during the period under investigation. To appreciate this number in a comparative way, in the Toronto market the average is 4 MM litres/year. During that period (1993-1997), Montreal (metropolitan area) gasoline consumption represented on average a bit more than 41% of total demand in Quebec. The annual rate of growth of demand was around 1%. Companies, in three sub-markets, segment the Montreal market, for basically managerial reasons. Montreal Center (60% of sales), Montreal West (18%) and Montreal East (22%). Outlets repartition is very much in line with sales: Montreal Center (59% of total number of outlets), Montreal West (17.5%) and Montreal East (23.5%). In 1997, averages of debits by gas station were similar in the three markets: 2.3 MM litres/year in Montreal Center and respectively 2.4 and 2.2 in Montreal West and Montreal East. The declared aim of retailers is to increase significantly the average debit.

According to Kent Marketing, a consultancy, in 1997 more than 50 different banners which sold gasoline and gas oil were listed, but this apparent market atomization should not hide the real level of concentration of this market. Indeed, Esso (Exxon), Petro-Canada, Shell and Ultramar are responsible of 85% of gasoline sales and control 64% of outlets. Since the beginning of the eighties, the gasoline market in Quebec has been subject to a deep restructuring. The number of outlets decreased year after year, and outlets with self-service increase. From 1981 to 1997, the number of gasoline outlets was cut down 31% from 7,334 to 5,059. The rationalization of gasoline outlets had a positive direct effect on site gasoline sales volume. The average annual gasoline sales volume by outlet increased from 0.6 MM litres in 1984 to 1.4 MM litres in 1996. In spite of this rationalization, the average gasoline throughput in Quebec is still below of Ontario's, where the average was above 3.5 MM litres per station in 1996.

2. SPECIFICATION OF A SALES-RESPONSE MODEL

A gas station or station is a retail institution, which sells gasoline, greases, oil and other services to drivers' satisfaction and comfort. We shall assume in this paper that sales of gasoline constitute a suitable measure of performance of a gas station. This choice can be justified on the following grounds. First, gasoline remains the main reason for a customer to visit a gas station; the other products, which could be termed as satellites become of interest once the customer is already on the premises. Second, practitioners do adopt sales of gasoline as a performance measure of a station and we wish to build a model, which can be useful to them. A third (pragmatic) argument is that gasoline sales data are accessible and homogeneous, which is not the case of sales of all other products and services available in a gas station.

Gasoline total sales respectively per year and per hour are used as alternative dependent variables. The use of total sales per hour as a dependent variable permits to capture non-linear effects, if any, of business hours on sales which will be of managerial interest if additional hours beyond the average have lower hourly sales. We use unleaded gasoline sales as the dependent variable because it represents 75% of station gasoline sales in the Montreal market.

2.1 The model

Let there be n gas stations in the market under investigation and denote by q_i the (yearly or hourly) sales in volume of station i, $i=1,...,n$. Denote by $L_i = (L_{i1},\ldots,L_{iK})$ the K-vector of location variables and by $M_i = (M_{i1},\ldots,M_{iP})$ the P-vector of marketing (non-location) variables that may affect sales of a gas station. The sales-response function thus reads

$$q_i = f(L_i, M_i).$$

Different functional forms for the above sales response function are possible and the choice depends usually on conceptual as well as on empirical elements. We shall assume here that location and marketing factors interact multiplicatively and that sales elasticities are constant. The sales model becomes

$$q_i = a_i\left(\prod_{k=1}^{K} L_{ik}^{\beta_k}\right)\left(\prod_{p=1}^{P} M_{ik}^{\gamma_p}\right),$$

where a_i is a positive parameter capturing outlet i specificities, β_k is the elasticity of location variable $k = 1,\ldots,K$, and γ_p the elasticity of marketing instrument $p = 1,\ldots,P$. In addition to provide directly the elasticities, this model is also easily linearizable and hence amenable to estimation by standard techniques. Indeed, taking the logarithm of both sides leads to the following linear model

$$\ln q_i = \ln a_i + \sum_{k=1}^{K} \beta_k \ln(L_{ik}) + \sum_{p=1}^{P} \gamma_p \ln(M_{ip}).$$

2.2 Data and Variables

2.2 1. Data

Kent Marketing[2] provided most of the data used in this study. We have data for a five-year period (1993-1997) covering 183 randomly chosen retail outlets, which corresponds to 49% of the number of outlets in the Montreal metropolitan area in 1997. This area is divided into five market zones (Montreal West, Montreal Centre-West, Montreal Centre-East, Montreal East and Montreal North).

In addition, we also use STM (Société de Transport de Montréal[3]) origin-destination estimates of automobile flows between 92 zones in the Montreal metropolitan area in 1993. This database is used to estimate the average daily number of automobiles crossing an outlet.

2.2.2. Variables

A) LOCATION VARIABLES

Location variables are characteristics of an outlet, which cannot be easily modified at least in the short-term. They affect station's potential market size and actual sales, which can be seen as the sum of a local demand component and a transient one. Unfortunately, we do not have the

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[2] Kent Marketing is Canada's leading source of retail gasoline sale volumes, prices and market share data.

[3] http://www.stcum.qc.ca/

required data to make the distinction between these two sources of sales. We thus assume that the vehicular traffic crossing a station during a period of time embodied itself these two components. We now discuss the retained spatial variables.

Site Location (Traffic, in thousand vehicles)

It has long been argued that the site location is the most important determinant of a station performance on top of which all other factors make a marginal contribution (Nelson, 1958). In this study we are mainly concerned with the influence of site location on sales and not on location decisions. For this purpose, the density of the vehicular traffic flow passing each station is thought to be a suitable proxy for potential sales attributable to a location. Accordingly, we use a measure that records the average number of vehicles passing each station in the 24-hour period, in East-West and North-South directions. The potential customer population increases in direct proportion with the kind of road (trans-national, national, provincial, main and secondary streets). Vehicular traffic distribution is, of course, non-uniform in the market. Note that on average, 35,000 vehicles pass a gasoline station each day in the Montreal market (1993-1997).

Local competition (Competition, number of competing stations)

Local competition obviously affects a station's performance. We measure its intensity by the number of other stations within a two-kilometer radius surrounding a station in a market area sharing the same vehicular traffic flows[4]. In the Montreal market, twelve stations are on average located within this distance. We assume that the higher the degree of competition, the lower the average sales per station in that area because of demand saturation effect.

Market area (West, Centre-West, Centre-East, East, North)

Elzinga and Hogarty (1978) define a market area or market zone as the geographical space in which at least 90 percent of indigenous sellers' sales occur, and at least 90 percent of the purchases of indigenous buyers are from those sellers. In gasoline's urban market, even if product offerings of different stations are virtually identical, it is very hard to adopt the above definition. Indeed, motorists are constantly on the move and

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[4] Contrary to previous spatial models whether linear (Hotelling 1929), circular (Salop 1979), or vertical (Gabszewicz and Thisse 1979) where each firm competes with its two direct neighbors, one on either side, we consider here that each station has more than two direct competitors because of motorist's mobility and price sensitivity.

gasoline purchase may not be postponed. This implies that a milder definition of market areas, and hence their boundaries, is required. We postulate that some market areas attract more customers than others because of their intrinsic characteristics in terms of economic and commercial activities or as residential zones. Using dummy variables, we adopt a division of the Montreal metropolitan area into five zones: West, Centre-West, Centre-East, East and North (omitted category).

B) Non-location variables

Non-location (or non-spatial) factors are marketing instruments, which determine the level of outlet attraction. They are normally designed to create an agreeable environment to enhance a customer's likelihood of purchase. The assumption here is that, although the product is undifferentiated, retailers can still compete in terms of, price, quality of service, etc. to attract customers and satisfy their desires. We discuss the retained variables in the following section.

Retail posted price (Price, in ¢ per litre)

Retail gasoline posted price is what motorists glance at when they cross a station. The commodity nature of gasoline renders this information *a priori* decisive in terms of attracting customers who are first *purchasing the price* and are willing to drive up to five or six kilometres more for a two-cent reduction in price[5]. This price can be changed whenever market conditions dictate so. Note that a company may sell at different prices in different market areas. Further, simple observation leads to the conclusion that the different retailers (i.e., Majors, Nationals and Independents) do not post the same price. We shall also estimate the brand's impact on price. For our analysis, we use the annual average posted price.

Service capacity (Capacity)

Service capacity is the number of fuelling places, bays, pumps, and attendants (station size proxy) a station has to serve motorists when they purchase gasoline. An intuitive assumption, confirmed by the results in Png and Reitman (1994), is that the larger the station's service capacity, the lower is the expected service time. We have chosen fuelling places as the measure of a station service capacity in preference to pumps or attendants for the following reasons. Pumps can be of different types (single, duo or blender pumps) without necessary offering different fuelling places and thus adopting the number of pumps to measure service

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[5] Information provided by practitioners working in Montreal.

capacity could introduce an important bias. Further, the number of attendants often does not vary between stations of quite dissimilar layout.

Operating Hours (Hours)

Operating hours is measured by the number of hours per year the station is open and attendant-operated. To recover their increased investment in fixed assets, i.e., land, pumps, bays, and storage tanks, stations are pressed to operate longer hours to serve more customers.

Brand and Special Promotions
(Esso, Petro-Canada, Shell, Ultramar and Independents)

In addition to the above variables, brand name, special promotions and loyalty cards are considered as possible factors influencing station attractiveness and gasoline sales. Unfortunately, we do not have data on special promotions and loyalty cards station by station. We shall retain the brand name as the only indicator of differentiation at this level. Again, using dummy variables, five brands are considered: Esso, Petro-Canada, Shell, Ultramar and Independents (omitted category).

Other variables

On the top of these marketing instruments, we also include a series of yearly dummy variables to capture all the effects related to other economic variables not specific to a gas station such as income variations from year to year, overall economic activity, etc.

C) Dependent Variables

Sales (Annual Sales, in mm litres and Hourly Sales, in litres)

Two different dependent variables are used: the station annual unleaded gasoline sales and the station average hourly sales, computed as total annual sales divided by the number of operating hours. Our empirical model is estimated using alternatively both variable definitions.

Table 1 recapitulates the list of variables and their unit of measurement and provides descriptive statistics.

Table 1: Descriptive Statistics

Variables	Unit of measurement	N	Min	Max	Mean or Frequency	Standard deviation
Annual Sales (1993)	Mm litres/year	183	0.0628	4.885	1.553	0.983
Annual Sales (1994)	Mm litres/year	183	0.0892	5.776	1.732	1.085
Annual Sales (1995)	Mm litres/year	183	0.0873	6.692	1.987	1.328
Annual Sales (1996)	Mm litres/year	183	0.0405	7.471	2.135	1.419
Annual Sales (1997)	Mm litres/year	183	0.0228	7.600	2.232	1.547
Hourly Sales (1993)	litres/hour	183	9.750	563.918	208.093	113.802
Hourly Sales (1994)	litres/hour	183	13.50	659.449	231.142	126.160
Hourly Sales (1995)	litres/hour	183	13.260	770.254	258.985	148.989
Hourly Sales (1996)	litres/hour	183	9.666	852.887	275.115	161.609
Hourly Sales (1997)	litres/hour	183	7.665	840.007	290.177	171.588
Price (1993)	(¢/litre)	183	48.90	63.90	51.323	1.930
Price (1994)	(¢/litre)	183	49.70	69.90	53.688	3.026
Price (1995)	(¢/litre)	183	53.90	66.90	59.890	2.198
Price (1996)	(¢/litre)	183	59.90	66.90	62.473	2.300
Price (1997)	(¢/litre)	183	56.70	67.90	60.953	1.447
Capacity	Fuelling places	915	2	16	4.47	2.68
Hours	Hours/year	915	1080	9096	7358.22	1601.20
Competition	Number of other gas stations within two-km radius	915	3	16	11.65	3.20
Traffic	Vehicles passing per day (000)	915	4	71	21.58	11.62
Esso	Dichotomous	915	0	1	0.1858	0.389
Petro-Canada	Dichotomous	915	0	1	0.1748	0.380
Shell	Dichotomous	915	0	1	0.1093	0.312
Ultramar	Dichotomous	915	0	1	0.1748	0.380
Independents	Dichotomous	915	0	1	0.3552	0.478
Centre-east	Dichotomous	915	0	1	0.2131	0.409
Centre-west	Dichotomous	915	0	1	0.1694	0.375
West	Dichotomous	915	0	1	0.2677	0.443
East	Dichotomous	915	0	1	0.2185	0.413
North	Dichotomous	915	0	1	0.1311	0.337

2.3 Econometric Estimation Method

As stated earlier, two empirical models are considered for the analysis of sales with respectively annual and hourly sales as dependent variable.

Model I (Annual sales)

$$\ln(AnnualSales_{it}) = a_i + b_p \ln(Price_{it}) + bc_e \ln(Price_{it}) * Esso +$$
$$bc_p \ln(Price_{it}) * Petro-Canada + bc_s \ln(Price_{it}) * Shell + bc_u \ln(Price_{it}) * Ultramar$$
$$+ b_H \ln(Hours_t) + b_{CA} \ln(Capacity_i) + b_T \ln(Traffic_i) + b_{co} \ln(Competition_i) + c_E Esso +$$
$$c_p Petro-Canada + c_s Shell + c_u Ultramar + d_{CE} Centre-East + d_{CW} Centre-West +$$
$$d_W West + e_{1994} Year94 + e_{1995} Year95 + e_{1996} Year96 + e_{1997} Year97 + u_{it}$$

Model II (Hourly sales)

$$\ln(HourlySales_{it}) = a_i + b_p \ln(Price_{it}) + bc_e \ln(Price_{it}) * Esso +$$
$$bc_p \ln(Price_{it}) * Petro-Canada + bc_s \ln(Price_{it}) * Shell + bc_u \ln(Price_{it}) * Ultramar$$
$$+ b_{CA} \ln(Capacity_i) + b_T \ln(Traffic_i) + b_{co} \ln(Competition_i) + c_E Esso +$$
$$c_p Petro-Canada + c_s Shell + c_u Ultramar + d_{CE} Centre-East + d_{CW} Centre-West +$$
$$d_W West + e_{1994} Year94 + e_{1995} Year95 + e_{1996} Year96 + e_{1997} Year97 + u_{it}$$

where a_i is a site specific random effect, *b, bc, c, d* and *e* are parameters identical across time and sites and Year94...Year97 are time specific dummy variables. Both models are first estimated by ordinary least squares (OLS) assuming no site specific effects and then with site specific random effects (a_i) using the *Panel (varcomp)* procedure as it is implemented in *TSP (Time Series Processor), version 4.5.*[6] The a_i are assumed independent of the regressors and drawn from a common normal distribution with fixed mean and variance. The site specific random effects include all unobservable effects specific to a gas station but constant across time that may influence sales in a gas station. Those effects include, among other things, station type (owned, jobber, direct service operations) and visibility (such as in Png and Reitman, 1994). The u_{it} are *i.i.d* disturbances also drawn from a common normal distribution with a fixed

[6] TSP is a software product of TSP International.
For further details: www.tspintl.com.

variance. Finally, both specifications allow for brand specific price elasticities by including price-brand interaction variables.

3. RESULTS

The main estimation results of the two sales models by OLS and station specific random effects are summarized in Table 2.

Table 2: Results of Annual and Hourly Attraction Sales Models

	Model I ln(Annual Sales)		Model II ln(Hourly Sales)	
INDEPENDENT VARIABLES	**OLS**	**Random Effects**	**OLS**	**Random Effects**
Intercept	19.397*	16.892*	17.919*	15.438*
	(9.072)	(9.109)	(9.131)	(9.177)
ln (Price)	-3.468*	-2.794*	-3.360*	-2.711*
	(-6.978)	(-6.585)	(-6.807)	(-6.416)
ln(Price)*Esso	2.404*	1.932*	2.400*	1.934*
	(4.550)	(4.509)	(4.537)	(4.507)
ln(Price)*Shell	2.428*	2.087*	2.423*	2.092*
	(3.695)	(3.955)	(3.683)	(3.959)
ln(Price)*Ultramar	1.980*	1.613*	1.950*	1.588*
	(3.533)	(3.567)	(3.478)	(3.508)
ln(Price)*Petro-	2.324*	2.125*	2.301*	2.099*
Canada	(4.113)	(4.673)	(4.069)	(4.613)
ln (Hours)	0.8771*	0.8677*	-	-
	(12.356)	(12.157)		
Ln (Capacity)	0.626*	0.615*	0.606*	0.595*
	(15.896)	(15.209)	(16.07)	(15.244)
ln (Traffic)	0.1336*	0.103**	0.134*	0.102**
	(3.613)	(2.479)	(3.633)	(2.448)
Ln (Competition)	-0.3042*	-0.320*	-0.306*	-0.321*
	(-4.9218)	(-4.711)	(-4.946)	(-4.719)

Esso	-9.3681*	-7.437*	-9.370*	-7.466*
	(-4.373)	(-4.279)	(-4.370)	(-4.290)
Petro-Canada	-9.1258*	-8.315*	-9.051*	-8.233*
	(-3.987)	(-4.513)	(-3.951)	(-4.463)
Shell	-9.553*	-8.155*	-9.552*	-8.197*
	(-3.587)	(-3.810)	(-3.582)	(-3.824)
Ultramar	-7.753*	-6.255*	-7.648*	-6.171*
	(-3.416)	(-3.413)	(-3.368)	(-3.364)
Centre-East	0.9062	0.111	0.792	0.110
	(0.1612)	(1.722)	(0.1407)	(1.696)
Centre-West	-0.0269	-0.132	-0.0300	-0.325
	(-0.464)	(-0.021)	(-0.517)	(-0.0532)
West	0.0219	0.0357	0.0200	0.0339
	(0.401)	(0.568)	(0.367)	(0.5398)
East	0.0471	0.092	0.0465	0.0907
	(0.8494)	(1.429)	(0.836)	(1.409)
Year94	0.1784*	0.1594*	0.1739*	0.1559*
	(3.241)	(3.607)	(3.160)	(3.527)
Year95	0.4804*	0.4121*	0.4637*	0.3988*
	(5.668)	(5.805)	(5.501)	(5.638)
Year96	0.6307*	0.5424*	0.6085*	0.5245*
	(6.316)	(6.4303)	(6.138)	(6.250)
Year97	0.5754*	0.4987*	0.5616*	0.4890*
	(6.704)	(6.5132)	(6.1904)	(6.3918)
Adjusted R^2	0.614	0.610	0.460	0.456
Lagrange Multiplier Test		57.607		49.891

Notes:
1) Numbers in parenthesis are t statistics.
2) * Significant at the 1% confidence level. ** Significant at 5% confidence level.

The results obtained by OLS are qualitatively similar to those obtained with the random effects approach. However, a Lagrange multiplier test for the random effects specification show that the estimated variances of the specific effects (a_i) are statistically different from zero in both sales and hourly sales models.[7] The random effects specifications are therefore statistically relevant. Furthermore, a fixed effects model is ruled out in our case because it will not permit the identification of the coefficients associated with variables which are specific to a station but constant across time such as *Traffic, Capacity,* and *Competition.* Note also that results with annual sales and hourly sales as dependent variables are almost identical which is due to the fact that the coefficient associated with ln(Hours) in the annual sales equation is not statistically different from one in both OLS and random effects specifications.[8] Therefore, we shall focus on the results obtained with the random effects specification with hourly sales as the dependent variable.

We have also estimated the same model specification using a linear functional form rather than a logarithmic one. In order to choose between the two functional forms, we performed a *J* test.[9] The results of this test, not presented here but available from the authors upon request, show that the logarithmic form unambiguously dominates the linear form.[10] Since the results obtained with the linear functional forms are irrelevant (from a statistical point of view) they are not presented and discussed here but may be obtained from the authors.

3.1. The effect of spatial factors on gasoline station sales

Recall that the spatial factor is captured by the variables Traffic, Competition and the four dummy variables relative to geographical zones. Our results are as follows:

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[7] In both sales and hourly sales models, the LM test statistics exceed the critical value of a chi-squared with one degree of freedom at the 1% confidence level (6.63). See, for instance, Greene (2003), chap. 13, pages 298-299 for more details on the LM test.

[8] In both cases, the coefficient associated with ln(Hours) is not statistically different from one using a t test at the 5% confidence level (the computed t ratios for this test are -1.73 for the OLS and -1.85 for the random effect model).

[9] For a complete description of the J test, see Greene (2003), chap. 8, pages 154-155.

[10] In the case where H_0 is the linear model, λ=119.308 with a t ratio of 3.272, which means that it is clearly rejected. When H_o is the logarithmic model, λ = -0.00054 with a t ratio of -0.836, indicating that the logarithmic model cannot be rejected.

- Traffic and Competition are statistically significant (at the 5% confidence level) and have the right expected signs with coefficients respectively equal to 0.102 for Traffic and -0.321 for Competition. These results, which say basically that sales are quite inelastic to these two variables, replicate the ones in Robinson and Hebden (1976) and Png and Reitman (1994) who also found that the location elaticity is small.

- *Ceteris paribus,* annual sales of a given gas station are not related to the geographical zone where it is located. This result can be explained by the facts that the specific characteristics of these zones may already be embedded in the variable Traffic and that they are actually of the same type (i.e., all urban areas).

3.2 The effects of non-spatial factors on gasoline station sales

Turning to non-spatial variables, we obtain the following results:

- Gasoline posted price affects, as expected, negatively and significantly hourly sales (as well as yearly sales). The results also show that price elasticites are closely related to the brand. Indeed, whereas price elasticity is -2.711 for Independent retailers, it is -1.123 for Ultramar, -0.777 for Esso, -0.619 for Shell and -0.612 for Petro-Canada. These results suggest, schematically, that the retailers are actually serving different market segments. Indeed, the Independent retailers' market segment seems to be made of highly price-sensitive and non loyal consumers. The customers of the Nationals (Esso, Shell and Petro-Canada) appear to be loyal by their willingness to pay a (relatively) high price for a "premium" gasoline brand. The customers of Ultramar can be characterized of being somewhere in the middle. Although, a number of studies have found that primary demand for gasoline is rather inelastic, e.g., Dahl and Sterner (1991), Epsey (1996, 1998) and Kayser (2000), our estimations show that this result does not apply to all brands. They provide also a background to rethink the idea that gasoline is a homogeneous hard-to-differentiate product. The estimated elasticities associated with Price are also the largest obtained among all the continuous variables included in our model. This result indicates that Price is the most important determinant of sales by a gas station.

- Station service capacity influences positively sales. As a large share of sales occurs during peak hours, service capacity allows a station to offer high service quality with short queues. Our result confirms the one in Png and Reitman (1994).

- Given that brands are used in interactions with price, the results associated with the Esso, Shell, Petro-Canada and Ultramar dummy variables cannot be interpreted directly. All four coefficients are negative and statistically significant, but it does not mean that hourly sales of Independents are larger, *ceteris paribus*. In fact, since hourly sales are significantly more price elastic for Independents, their underlying demand function is less steep than in the case of other brands. Therefore, it is not surprising that the intercept (on the hourly sales axis) is larger for Independents relatively to other brands.

- The coefficients of the dichotomous variables Year94, ..., Year97 are all positive and significant showing hence that there is an upward trend with respect to 1993, the omitted category. Note the important increase between 1994, 1995 and 1996 which may be explained by the economic recovery after the recession of the early nineties.

CONCLUSION

To the best of our knowledge, no published empirical study using Canadian data in gasoline retailing have simultaneously explored the effects of location and non-location factors on station gasoline sales. Here lies the main contribution of this paper. We discuss now the managerial implications of our study and some worth conducting extensions.

- Choosing a right location and a suitable pricing policy are not the sole ingredients for sales performance. A special attention should also be devoted to other controlable factors such as opening hours and ancillary services (see also below). The managerial utility of our results is, as for any sales response model, in providing precise estimates of the impact of the different variables of interest. This should feed the evaluation of profitability of different decisions, e.g., pricing and opening hours.

- Price has been expected to play a significant role, and it does, in this context of hard-to-differentiate product. The results show however that in terms of sales performance, the Nationals still enjoy a premium relatively to the Independents according to our results.

Brand name is probably capturing some factors which have not been measured here such as fidelity card (the period under investigation corresponds to the beginning of such programs) and ancillary services and their quality (store, repair services, etc.). Given the availability of such services and promotion program, it is clearly of interest to verify if these elements do create a brand and/or station fidelity. It is also relevant to assess the profitability of such programs. One conjecture is that their existence (and probably huge cost) is yet another example of prisonner's dilemma where no company can afford being the only one not offering such promotion.

- The fact that the variable opening hours exerts a positive impact on sales is actually not surprising. What remains to be assessed by managers is the profitability of extending opening hours. The computation should take into account all elements of the decision (sales of gasoline, sales of other products, etc.).

- Competition has been measured here by the number of stations within a two kilometres radius. An obvious question of interest to scholars in location theory is to which extent the results are affected by this particular measurement choice. Another question of both academic and managerial interest is to study cross competitive effects, i.e., is it "preferable" to have as neighbour brand X or brand Y? Further, is the effect symmetric, i.e., does the presence of X affect more sales of Y than the other way around.

- Finally, an analysis of the impact of the expected arrival of new players in the gasoline retail business such as Costo, Canadian Tire and others merit both academic and managerial special attention.

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