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ELSEVIER

Agricultural Economics 22 (2000) 147–162

AGRICULTURAL  
ECONOMICS

www.elsevier.com/locate/agecon

## Modeling the demand for alcoholic beverages and advertising specifications

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Received 18 March 1998; received in revised form 20 August 1999; accepted 15 September 1999

### Abstract

In this paper, the demand for beer, wine, spirits and soft drinks in Ontario is modeled in two parts: an equation is specified to endogenize group expenditures and a demand system is set up to allocate budgeted group expenditures across types of beverages. Advertising is allowed to influence both the level of group expenditures and its allocation. Three popular advertising specifications are compared using the *J*-test and the likelihood dominance criterion. Even though all three specifications fitted well according to standard criteria, the calculated expenditure, price and advertising elasticities were sensitive to the manner with which advertising is specified. This clearly highlights the need to rely on a sound criterion to identify a dominant specification. From the identified dominant specification, we found that advertising has very subtle effects on expenditures on alcoholic beverages (group and individual beverages). Thus, advertising is not effective in enlarging markets and this suggests that firms (especially breweries) use advertising to compete in zero-sum market share games. From a public policy perspective, our results are comforting but future research should investigate whether the neutral effect of advertising on aggregated expenditures hide substantial offsetting changes in the drinking habits of individuals. © 2000 Elsevier Science B.V. All rights reserved.

### 1. Introduction

The consumption of alcoholic beverages has been a public concern for decades. As a result, policymakers have designed regulations to internalize the negative consumption externalities affecting public safety (i.e., drunk driving), public health (i.e., liver cirrhosis) and

labor productivity without losing sight of the substantial contribution of consumption taxes on government revenues. Advertising is a major preoccupation of regulators in most countries. In some cases, there is or has been an outright ban on advertising while in others the restrictions are designed to censor the content of the ads or limit the range of media outlets through which the ads can be shown.

The literature on the effects of advertising of the consumption of alcoholic beverages can be classified into two groups. The first one addresses the psycho-

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logical and sociological aspects of the ads about alcoholic beverages and how they end up influencing individual consumption.<sup>1</sup> Our study falls in the second group since it is concerned with the effects of advertising on aggregate consumption. Our objective is threefold. First, we assess how different specifications of advertising effects influence the size and signs of estimated elasticities and determine whether a specification dominates the others. Second, we investigate the effect of advertising on the level of expenditures on alcoholic beverages as well as the effect of advertising on the allocation of these expenditures between beer, wine, spirits and soft drinks. As such, this constitutes an extension of what is known in some circles as the Galbraithian hypothesis.<sup>2</sup> Finally, we estimate price and expenditure elasticities to characterize the demand for alcoholic beverages and soft drinks in Ontario, Canada.

In order to achieve these objectives, we constructed a model in which group expenditure and budget shares for different types of alcoholic beverages and soft drinks are endogenized. Group expenditure is modeled as a function of prices, per capita income, advertising, demography and trigonometric variables to account for seasonality. To facilitate comparisons with previous studies, we chose dynamic versions of the LA/AIDS model to explain variations in budget shares. Three model specifications differentiated by

the manner with which advertising effects are incorporated were estimated. Bayesian techniques were used to insure that the estimated elasticities were consistent with the concavity and monotonicity conditions. We applied the *J*-test and the Likelihood Dominance Criterion (LDC) developed by Pollak and Wales (1991) to identify dominant advertising specifications for the group expenditure and budget shares sub-models. We found that advertising is not effective in enlarging markets and this suggests that firms (especially breweries) use advertising to compete in zero-sum games. From a public policy perspective, our results are comforting but future research should investigate whether the neutral effect of advertising on aggregated expenditures hide potentially perverse offsetting changes in the drinking habits of individuals.

The rest of the paper is organized as follows. The next section presents an overview of the literature on the demand for alcoholic beverages with an emphasis on the role of advertising in explaining the demand for beer, wine and spirits. This is followed by a discussion about methodology and data. Empirical findings are presented in the fourth section while the last section dwells on the modeling and policy implications.

### *1.1. The consumption of alcoholic beverages and advertising: some ambiguities and some recurring results*

Several economists have studied the demand for alcoholic beverages but only a subset have attempted to estimate the effect of advertising. Table 1 provides a non-exhaustive but insightful list of studies on the demand for alcoholic beverages and some of their elasticities. A glance at these results reveals that expenditure and own-price elasticities vary considerably from one study to another. Expenditure elasticities for beer, wine and spirits range from  $-0.83$  to  $1.94$ ,  $-0.01$  to  $2.10$  and  $0.46$  to  $2.66$ , respectively. The ranges for the own-price elasticities for the same products are:  $0.26$  to  $-0.89$ ,  $-0.43$  to  $-1.89$ ,  $-0.37$  to  $-1.88$ . The lack of consensus across studies extends to qualitative results about the nature of the relationships between alcoholic beverages (i.e., complements versus substitutes).

Studies that incorporate advertising as an explanatory variable have reported low and often negative

<sup>1</sup> Typically, these studies rely on narrowly defined samples but allow for a broad range of factors which along advertising can influence consumption. For example, Strickland (1982) reviewed 700 ads (TV and magazines) and argued that the content of the ads is less important than the influence of family and friends in explaining the level of consumption. Strickland (1983) used the TV watching habits of students to determine their exposure to advertising of alcoholic beverages. A very weak correlation was established between advertising and consumption but only after age and race were accounted for. Again, the attitude of friends and parents were much more influential than publicity which was also found to be orthogonal to the proxies used to characterize abuse. In contrast, Adlaf and Kohn (1989) found a direct link between advertising and consumption and an indirect link between advertising and abusive consumption. However, they too found that the attitude of family and friends has a stronger influence than advertising.

<sup>2</sup> The Galbraithian hypothesis can be traced back to Galbraith (1967) who asserted that advertising can have a powerful influence on the distribution of expenditures between broadly defined product groups. For a more detailed discussion, the interested reader is referred to Duffy (1991).

Table 1  
Summary of previous studies on the demand for alcoholic beverages

Authors and country	Income elasticities			Own price elasticities		
	Beer	Wine	Spirits	Beer	Wine	Spirits
Hogarty and Elzinga, 1972 (United States)	0.43	n.a.	n.a.	−0.89	n.a.	n.a.
Johnson and Oksanen, 1974	0.04	−0.01	0.23	−0.23	−0.50	−0.91
Johnson and Oksanen, 1977 (Canada)	0.00	0.04	0.11	−0.27	−0.67	−1.14
Duffy, 1982 (UK)	0.49	1.50	1.65	−0.17	−1.14	−0.84
Clements and Johnson, 1983 (Australia)	0.80	0.75	1.91	−0.36	−0.43	−0.74
Tsolakis et al., 1983 (Australia)						
Short run	0.46	0.88	n.a.	−0.23	−0.43	n.a.
Long run	0.39	2.81	n.a.	−0.20	−1.35	n.a.
Fuss and Waverman, 1987 (Canada)						
Short run	0.39	0.54	0.83	−0.27	−0.76	−0.81
Long run	0.52	0.70	1.05	−0.32	−0.76	−0.83
Quek, 1988 (Canada)	0.44	1.26	0.95	−0.16	−0.66	−0.66
Alley et al., 1989 (British-Columbia: Canada)	−0.03	0.21	0.46	−0.11	−0.75	−1.88
Heien and Pompelli, 1989 (United States)	1.94	2.10	2.66	−0.84	−0.55	−0.50
Johnson et al., 1992 (Canada)						
Short run	0.38	0.97	0.92	−0.26	−0.88	−0.63
Long run	0.27	2.19	1.02	−0.14	−1.17	−0.37
Tegene, 1990 (United States)						
With structural change	0.50	0.66	1.72	−0.72	0.10	−1.20
Without structural change	0.83	0.69	1.80	−0.80	−1.10	−0.76
Larue et al., 1991 (Ontario: Canada)						
wine differentiated by color and origin (local vs foreign)	n.a.	0.5–1.3	n.a.	n.a.	−0.7–1.9	A
wine differentiated by country of origin	n.a.	0.6–1.5	n.a.	n.a.	−0.8–1.4	n.a.
Tremblay and Lee, 1992 (United States)						
Short run	0.08	n.a.	n.a.	−0.54	n.a.	n.a.
Long run	0.11	n.a.	n.a.	−0.72	n.a.	n.a.
Selvanathan, 1995 (UK)	0.48	2.02	1.83	−0.24	−0.55	−0.56
Gallet and List, 1998 (United States)						
1964–73	−0.26	n.a.	n.a.	−1.72	n.a.	n.a.
1983–92	−0.83	n.a.	n.a.	0.26	n.a.	n.a.
	Cross-price effects			Advertising elasticities		
	Complements	Substitutes		Beer	Wine	Spirits
Johnson and Oksanen, 1974 (Canada)	beer/wine	wine/beer		n.a.		
	beer/spirits <sup>a</sup>	wine/spirits <sup>a</sup>				
Johnson and Oksanen, 1977 (Canada)	beer/spirits	wine/beer		n.a.		
Duffy, 1982 (UK)	n.a.			0.017	−0.044	0.019
Fuss and Waverman, 1987 (Canada)	beer/wine	beer/spirits <sup>a</sup>		n.a.		
		wine/spirits <sup>a</sup>		wine/spirits <sup>a</sup>	n.a.	
				wine/beer <sup>a</sup>		
Quek, 1988 (Canada)		beer/wine <sup>a</sup>		n.a.		
		beer/spirits <sup>a</sup>				
		wine/spirits <sup>a</sup>				
Alley et al., 1989 (British-Columbia: Canada)	beer/wine <sup>a</sup>			n.a.		
	beer/spirits <sup>a</sup>					
	wine/spirits <sup>a</sup>					

Table 1 (Continued)

Authors and country	Income elasticities			Own price elasticities		
	Beer	Wine	Spirits	Beer	Wine	Spirits
Heien and Pompelli, 1989 (United States)	beer/wine <sup>a</sup> beer/spirits <sup>a</sup> wine/spirits <sup>a</sup>			n.a.		
Tegene, 1990 (United States)						
Without structural change		beer/wine <sup>a</sup>		0.282	–0.217	–0.266
With structural change		beer/spirits <sup>a</sup> wine/spirits <sup>a</sup>				
Larue et al., 1996 (Canada)	Canadian with most others	french with most other wines		n.a.		
Tremblay and Lee, 1992 (United States)		beer/spirits		0.002–0.022		
Selvanathan, 1995 (UK)	beer/spirits <sup>a</sup> wine/spirits <sup>a</sup>	beer/wine <sup>a</sup>		0.09	0.16	0.07
Gallet and List, 1998 (United States)	beer/wine 1983–92	beer/wine 1964–73		n.a.	n.a.	n.a.

<sup>a</sup> A permutation yields the same qualitative result (e.g., beer/spirits vs. spirits/beer) n.a.: not applicable.

advertising elasticities.<sup>3</sup> The lack of support for large positive advertising effects is robust to differences in methodology, time periods and geographical areas. For example, Ogborne and Smart (1975) were puzzled by the fact that beer sales actually rose through a ban on beer advertising in Manitoba during the 1980s. In order to isolate the effects of advertising (or lack of) on beer sales from other factors, they estimated a single-equation econometric model. They concluded that advertising had no effect.<sup>4</sup> Simpson et al. (1985) compared per capita consumption of alcoholic beverages of a sample of countries with complete or partial bans on the advertising of alcoholic beverages (Norway, Finland, Hungary and Denmark) to a sample of countries without restrictions (Australia and Japan). They found no significant differences and argued that other variables were likely to have a much stronger influence on consumption than advertising. Wilcox (1985) analyzed the impact of a restriction that made it illegal to convey price information in beer ads in Michigan. With data prior, during and after the

‘experiment’, he demonstrated that the restriction of price advertising did not affect beer sales. In contrast, Ornstein and Hanssens (1985) argued that price information, and hence beer ads, may have an indirect effect on beer sales through the negative effect of the ads on prices.<sup>5</sup> However, the publicity variable in their model turned out to be statistically insignificant. Duffy (1982) analyzed the effect of advertising on the consumption of beer, wine and spirits between 1963 and 1978 in England. OLS and 3SLS estimation results showed that advertising had no effect on sales. Duffy (1983) tried to capture the effect of advertising within beverage types by introducing finer product definitions (i.e., eight categories of wine and spirits). It was concluded that advertising had very small effects on budget shares and no effect on the amount spent on all alcoholic beverages. Tegene (1990) used Kalman filters to address the issue of structural change in the computations of elasticities. Indeed, he found structural changes in the demands for beer, wine and spirits but failed to identify a significant relationship between advertising and demand. Motivated by

<sup>3</sup> Negative own-advertising elasticities are common and not only in studies about alcoholic beverages. For example, Green et al. (1991) report negative elasticities for dried fruits generic advertising that are robust across advertising specifications.

<sup>4</sup> This study did not control for the publicity originating from neighboring provinces and US states.

<sup>5</sup> Price advertising need not lead to price reductions. In fact, in an oligopoly setting, it is well-known that price advertising and policies of not being ‘undercut’ facilitate collusion. The intuition is that a firm has no incentive to lower prices if it is certain that other firms will match any price cut.

the same purpose, Gallet and List (1998) used a gradual switching model to show that the demand for beer in the United States had become an inferior good insensitive to price changes. Tremblay and Lee (1992) investigated the effects of advertising on beer sales in the US for the period 1953–1983. Again, advertising failed to influence total sales but might have had an effect on the market shares of various brands.

## 2. Methodology and data

Our methodology is based on the hypothesis that advertising can alter both the size and the allocation of monthly expenditures on alcoholic beverages and soft drinks. As in Fuss and Waverman (1987) and Heien and Pick (1991), the structure of our model can be decomposed into two sub-models. The first one endogenizes expenditures on alcoholic beverages and soft drinks. It is assumed that individuals allocate their income between this group of beverages and an aggregate good. The second sub-model is a conditional AIDS demand system that allocates the expenditures derived from the first sub-model between beer, wine, spirits and soft drinks.<sup>6</sup>

<sup>6</sup>Our modeling strategy assumes that the utility function is weakly separable. This allows the utility function to be partitioned into at least two subsets, say one including alcoholic and soft drinks beverages and another one for all other goods. In this instance, the demand for a good in a particular subset can be expressed as a function of the prices of the goods in that subset and the level of expenditure spent on those goods (Pollak and Wales, 1992, p. 47). The prices of goods belonging to the other subset and the level of expenditure spent on all subsets influence the demand for a good in a given subset only through the level of expenditure allocated to the given subset. Weak separability is not a sufficient condition for treating expenditures on a given subset as exogenous (Lafrance, 1991). Hence, the estimation of conditional demand systems should endogenize subset expenditures. The estimation of subset expenditures and budget shares equations is often done in the context of a two-stage budgeting process which imposes stronger restrictions on preferences. This is so because one needs to worry about the conditions under which an aggregate price index (for the goods in a subset say the alcoholic beverages and soft drinks) can be used. Strong price aggregation is consistent with utility maximizing behavior if and only if the sub-utility functions are of either the Generalized Gorman Polar Form (GGPF) or a homothetic form. Unfortunately, homothetic weak separability translates into unitary conditional expenditures elasticities (Moschini and Green, 1994). In this study, the class of preferences for the beverage subset is the price-independent generalized log-linear or PIGLOG form which is GGPF (Deaton and Muellbauer, 1980). Two-stage budgeting using

The first sub-model is specified as a single equation with the log of per capita expenditure on alcoholic beverages and soft drinks as the dependent variable:

$$\ln x = f(\text{PSTONE}, P_{\text{NA}}, Y, \text{POP}, g(A_i), Z) \quad (1)$$

where  $x = \sum_{i=1}^n P_i Q_i$ ,  $P_i$  is the deflated price of beverage  $i$ ,  $Q_i$  is the per capita quantity consumed of beverage  $i$ , PSTONE is the Stone price index,  $P_{\text{NA}}$  is a price index for non-alcoholic beverages,  $Y$  is real per capita income, POP is the proportion of the population of age 15 and above,  $g(A_i)$  are functions of per capita advertising expenditure on beverages  $i = 1, \dots, n$ , and  $Z$  is a set of variables internalizing seasonal effects. Nominal variables were deflated by a beverage price index for Ontario.

Advertising can be modeled in different ways. Common functional forms for  $g(A_i)$  encountered in the literature include the lag transformation specification  $L^k A_i$  (e.g., Duffy, 1982, 1983; Clements and Johnson, 1983; Goddard, 1988; Tremblay and Lee, 1992)<sup>7</sup> and Kinnucan's structural heterogeneity specification  $A_i t$  (e.g., Kinnucan and Venkateswaran, 1994), where  $L$  is the lag operator and  $t$  is a time trend. Polynomial Distributed Lag (PDL) schemes are also commonly used (e.g., Thompson, 1978; Ward and Dixon, 1989). In our empirical analysis, a PDL scheme of degree 2 with end-points restrictions was compared to the other two advertising specifications. We relied on non-nested tests,<sup>8</sup> diagnostics checks and the plausibility of the derived elasticities to rank the

GGPF is also generally restrictive because it requires the utility function to be additive in the sub-utility functions. However, when there are only two sub-utility functions, strong price aggregation and two-stage budgeting does not imply unreasonable restrictions on the form of the utility function (Gorman, 1959; Fuss and Waverman, 1987). Edgerton (1997) argues that multistage budgeting can nevertheless generate 'reasonably' accurate results under rather usual conditions.

<sup>7</sup>The setting of  $k$  is arbitrary even though indicators like AIC or FPE and studies like Clarke's (Clarke, 1976) can help narrow down the range of plausible values. In our tests,  $k = 2$  worked best. A generalization to choosing a specific  $k$  is to construct a weighted average of lagged advertising levels as in Rickertsen et al. (1995). In this case, appropriate lag length and weights must be chosen.

<sup>8</sup>In the context of single equation models, several non-nested tests have been developed in the early 1980s. In this instance, we relied on the well known  $J$ -test. For a thorough review of this test and alternative ones, see Davidson and MacKinnon (1993) (pp. 381–388).

specifications. Kinnucan's structural heterogeneity outperformed the other specifications and it was retained. Regarding the modeling of seasonal effects, two competing alternatives were compared (dummy variables versus trigonometric functions). Using the same criteria as for the selection of the advertising specification, it was found that the trigonometric functions outperformed the seasonal dummies.

The functional form for the conditional demand system is the linear version of the Almost Ideal Demand System commonly known as LA/AIDS. Several arguments can be presented to justify this choice. First, several studies on alcoholic beverages have used the AIDS model (e.g., Fuss and Waverman, 1987; Alley et al., 1989; Heien and Pompelli, 1989; Larue et al., 1991) and relying on the same functional form makes for 'cleaner' comparisons. Secondly, the AIDS functional form is (locally) flexible, it is easy to estimate, especially in its linear version and it fared very well in a recent comparative study (Green et al., 1995). Finally, Alston et al. (1994) have demonstrated that LA/AIDS provides accurate estimates of elasticities when the true data generating process is AIDS.

We augmented the specification of the standard LA/AIDS model with habit formation variables (lagged quantities  $Q_{jt-12}$ ), a time trend ( $t$ ), trigonometric variables to capture seasonal effects and advertising variables. The estimated budget shares can be represented as follows:

$$w_i = \alpha_i + \sum_{j=1}^n \gamma_{ij} \ln P_j + \beta_i \ln \frac{x}{p^c} + \sum_{j=1}^n \Phi_{ij} g(A_{jt}) \\ + \sum_{j=1}^n \Omega_{ij} Q_{jt-12} + \sum_{k=1}^6 (\kappa_{cik} \cos \phi_k + \kappa_{sik} \sin \phi_k) \\ + \varphi_i t + \mu_i \quad (2)$$

where  $\phi_k = 2\pi k$ ,  $k = 1, \dots, 6$ ,  $P_j$  is the price of beverage  $j$ ,  $x$  is the level of expenditure estimated in Eq. (1),  $p^c$  is a normalized Stone price index<sup>9</sup> and  $gA_{jt}$  captures advertising effects as in Eq. (1). For theoretical con-

sistency and to reduce the number of parameters to be estimated, it is common to impose additivity, symmetry and homogeneity restrictions. A sufficient condition for the expenditure shares to be homogenous of degree zero in prices is:  $\sum_{j=1}^n \gamma_{ij} = 0$ ,  $\forall i$ . Symmetric changes in compensated demand functions can be imposed by setting  $\gamma_{ij} = \gamma_{ji}$ ,  $\forall i \neq j$ . Additivity requires  $\sum_{i=1}^n \alpha_i = 1$  and  $\sum_{i=1}^n \beta_i = 0$ . These conditions are trivially satisfied for a model with  $n$  goods when the estimation is carried out on a subset of  $n - 1$  independent equations. The parameters of the dropped equation are then computed from the restrictions and the estimated parameters of the  $n - 1$  expenditure shares.

In studies using the AIDS or LA/AIDS functional forms, it is common to test whether concavity and monotonicity conditions are respected. The concavity property of the expenditure function insures that substitution possibilities lessen the impact of price increases on expenditures while monotonicity maintains budget shares in the  $\{0, 1\}$  domain. The concavity and monotonicity conditions cannot be easily imposed because they involve inequality restrictions. For instance, concavity imposes negative semi-definiteness on the Slutsky matrix for all observations. As in Chalfant et al. (1991) and Tiffin and Aguiar (1995), we used a Bayesian framework and, more specifically Monte Carlo integration and Importance Sampling, to insure that the parameters used to compute elasticities are consistent with the concavity and monotonicity conditions.<sup>10</sup>

Conditional short term elasticities were computed according to the LA/AIDS formulae found in Alston et al. (1994). Assuming as in Chalfant (1987) that  $\partial P^* / \partial \ln P_j = w_j$ , it can be shown that the expenditure and Marshallian own and cross price elasticities are

$$\eta_i = 1 + \frac{\beta_i}{w_i}, \quad \eta_{ii} = -1 + \frac{\gamma_{ii}}{w_i} - \beta_i, \\ \eta_{ij} = \frac{\gamma_{ij}}{w_i} - \beta_i \frac{w_j}{w_i} \quad (3)$$

<sup>9</sup> As argued by Moschini (1995), the Stone price index is not invariant to the choice of measurement units in prices and quantities and this influences the approximation properties of the model. To remedy this problem, prices are divided by their mean before being used to construct the Stone price index. This normalization does not affect the computations of elasticities.

<sup>10</sup> The implementation is thoroughly described in Chalfant et al. (1991). A classical alternative to imposing curvature conditions has been proposed by Moschini (1998) and Ryan and Wales (1998). Though more cumbersome, the Bayesian framework has the advantage of providing an estimate of the probability that the restrictions hold.

where the  $w_i$ 's are the estimated budget shares. The formulae for the Hicksian/compensated and substitution elasticities are

$$\begin{aligned}\eta_{ij}^* &= w_j \sigma_{ij} = \eta_{ij} + w_j \eta_i, & \sigma_{ii} &= 1 + \frac{\gamma_{ii}}{w_i^2} - \frac{1}{w_i}, \\ \sigma_{ij} &= 1 + \frac{\gamma_{ij}}{w_i w_j}, & \forall i &\neq j,\end{aligned}\quad (4)$$

As in Goddard (1988) and Duffy (1982), the formula for the advertising elasticity is

$$AD_{ij} = \left( \frac{\Phi_{ij}}{w_i} \right) \quad (5)$$

Conditional short term elasticities are static measures that do not take into account habit formation. Adjusting for the dynamics yields the following conditional long run expenditures and Marshallian elasticities:

$$\begin{aligned}\eta_i &= \frac{\beta_i + w_i}{w_i - (\Omega_i \times Q_i)}, & \eta_{ii} &= \frac{\gamma_{ii} - w_i - (\beta_i \times w_i)}{w_i - (\Omega_i \times Q_i)}, \\ \eta_{ij} &= \frac{\gamma_{ij} - (\beta_i \times w_j)}{w_i - (\Omega_i \times Q_i)}\end{aligned}\quad (6)$$

where  $\Omega_i$  is a coefficient associated with habit formation and  $Q_i$  is the mean of per capita consumption for beverage  $i$ . Hicksian and substitution elasticities can be derived through the Slutsky equation. Conditional long run advertising elasticities are computed according to the formula below:

$$AD_{ij} \frac{\Phi_{ij}}{w_i - (\Omega_i \times Q_i)} \quad (7)$$

Finally, total elasticities that combine both estimation stages can be computed (e.g., Edgerton, 1997). These elasticities are useful because they take into account that a change in an exogenous variable will affect the budget shares of each type of alcoholic beverages as well as the overall budget spent on alcoholic beverages. Total price, income and advertising elasticities are computed according to the following formulae:

$$\begin{aligned}\eta_{ij}^T &= \eta_{ij} + w_i \eta_i \beta_y, & \eta_i^T &= \eta_i \beta_y, \\ AD_{ij}^T &= AD_{ij} + \eta_i A_{yj},\end{aligned}\quad (8)$$

where  $\eta_{ij}$  and  $\eta_i$  are the conditional Marshallian price and expenditures elasticities,  $w_i$  is the budget

share for beverage  $i$ ,  $\beta_y$  is the income coefficient from the first sub-model and  $A_{yj}$  is the advertising coefficient for beverage  $j$  in the group expenditure sub-model.

A critical step in the implementation of the Bayesian framework is the generation of the parameter estimates and the variance-covariance matrix that are used in the generation of antithetic replications. We attempted an FIML estimation of both sub-models with homogeneity and symmetry imposed. Even though convergence was achieved, less than 0.1% of the 10000 replications generated from the estimated coefficients and the variance-covariance matrix were consistent with the monotonicity and concavity conditions. As a result, we chose to estimate the sub-models separately. The first sub-model was estimated with OLS and the second sub-model was estimated with the ITSUR estimator. Prior to the estimation, we checked the stationarity property of the variables in the model with the Augmented Dickey–Fuller test. The results led us to reject the null of non-stationarity and to estimate both sub-models in levels.<sup>11</sup>

The monthly data series for this study cover a period starting in May of 1979 and ending in April of 1987. Data about quantities consumed and expenditures on wine, spirits and beer were provided by the Liquor Control Board of Ontario and Brewers Retail. The data on advertising expenditures comes from Ambler Research and Elliot Research. These two firms graciously made available to us their compilations of advertising expenditures. The advertising expenditures were aggregated over all media.

Fig. 1 illustrates the evolution of per capita consumption of beer, wine, spirits and soft drinks in Ontario between 1979 and 1987. Among alcoholic beverages, beer is the product with the highest per capita consumption with 6 l/person/year or about six times the per capita consumption of wine and spirits. Consumption trends for all beverages are flat over the entire sample period. However, there appears to be seasonal deviations around the trends. The seasonal pattern for beer consumption is characterized by peaks

<sup>11</sup> Because of obvious seasonal effects, the specification of the ADF tests included seasonal dummy variables. Because they are of the same order as the constant term, these nonstochastic regressors do not affect the asymptotic distributions of the test statistics (Davidson and MacKinnon, 1993, p. 705).



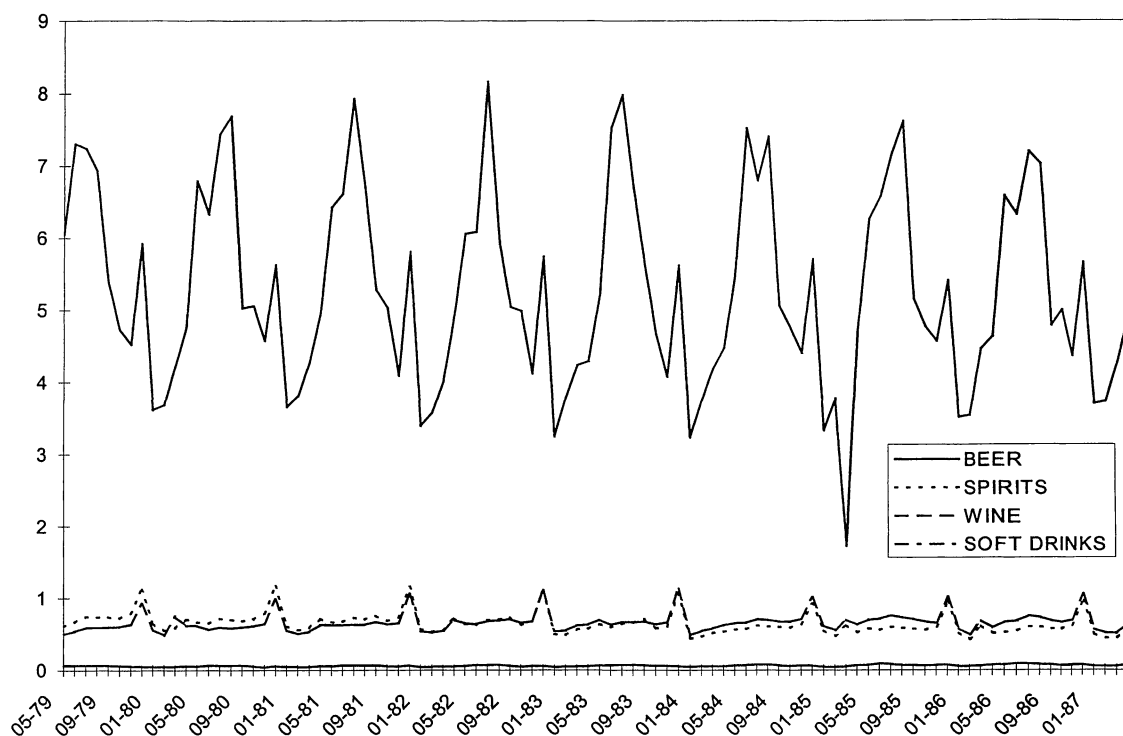


Fig. 1. Ontario per capita consumption.

in the summer and around Christmas. As an indication of the magnitudes of the seasonal variations, per capita beer consumption typically falls under 2 l in February to rise to roughly 8 l in July. The seasonal pattern for per capita soft drinks consumption is very similar to the one for beer. In contrast, per capita consumption of wine and spirits slowly rise in the spring and summer months before 'jumping' to a peak in December.

Fig. 2 shows the trends in per capita expenditures on advertising for beer, wine and spirits. As for per capita consumption, beer leads the other alcoholic beverages. Unlike the per capita consumption series, the long term trends in advertising are not flat and exhibit rather modest seasonal variations. Per capita advertising expenditure for beer gradually rose between 1979 and 1984 and fell thereafter (reaching a peak of \$0.058 in September of 1984). Per capita advertising expenditures on wine and spirits peaked much earlier than beer and have been declining throughout most of the sample period. The decline in per capita advertising expenditures is most pronounced for spirits (\$0.04 in April of 1981 versus \$0.015 in April of 1987).

### 3. The results

The estimation results of the dominant specification of the first sub-model are presented in Table 2. To avoid coefficients with wrong signs and implausible elasticities, we augmented the specification of Eq. (1) with: (i) a lagged dependent variable to allow for dynamic expenditure adjustments and (ii) a non-alcoholic beverages price index. This version of the first sub-model, like its competitors with different advertising specifications, fitted very well as indicated by the high adjusted  $R^2$  and the magnitude of most  $t$  statistics. As expected the trigonometric variables introduced to internalize the seasonal variations in expenditures on alcoholic and soft drinks beverages are highly significant. The Stone price index (PSTONE) has a coefficient of 0.59 which suggests that the demand for the alcoholic and soft drinks beverages aggregate is inelastic. Expenditures on alcoholic and soft drinks beverages are unaffected by changes in per capita income as indicated by the small and insignificant per capita income ( $Y$ ) coefficient.

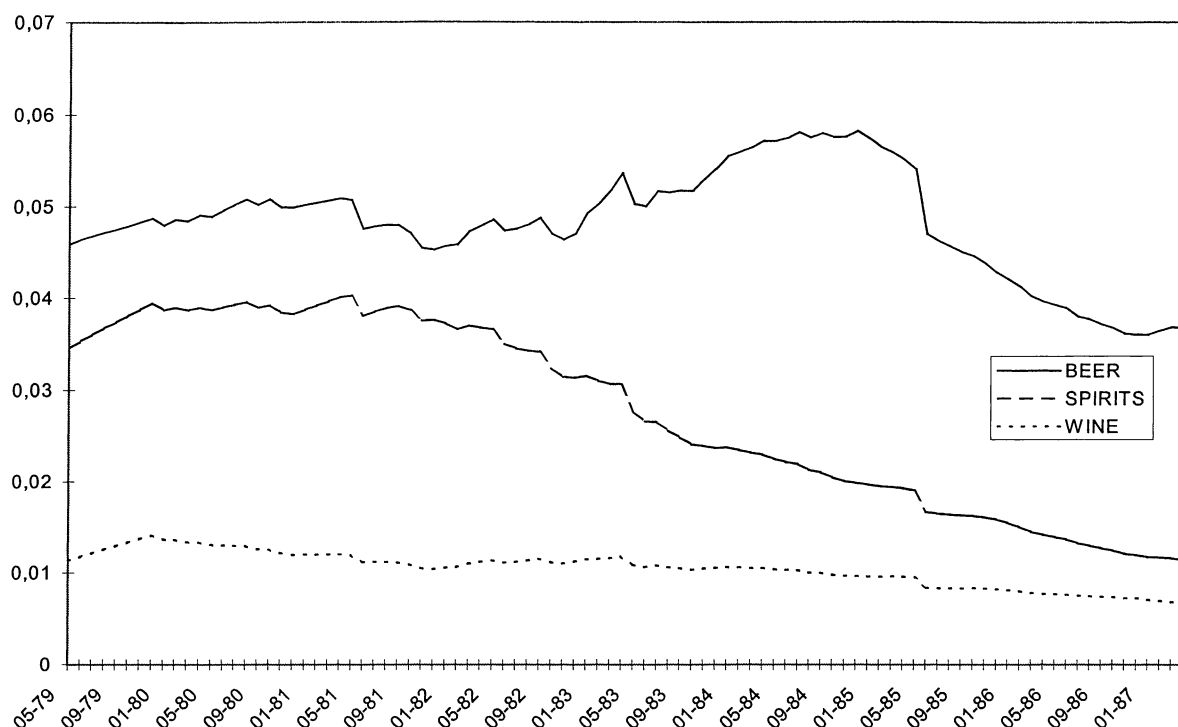


Fig. 2. Ontario per capita expenditures on advertising.

cient. It is unclear whether the lack of significance is real or an artifact stemming from the relatively short period covered by our monthly series. The coefficients for beer and spirits advertising are positive but insignificant but the ones for wine and soft drinks are statistically significant and respectively negative and positive. In short, advertising has a rather weak effect on the level of expenditures allocated to alcoholic beverages. The negative sign on the POP coefficient means that expenditures on alcoholic and soft drinks beverages falls as the population gets older. This confirms that changes of life styles over the life cycle of individual consumers contribute to the shrinkage of the market for alcoholic beverages.

The results from the application of the LDC criterion to three LA/AIDS sub-models provided a clear ranking about the three competing advertising specifications (see Footnote 10 about the mechanics). The Polynomial Distributed Lag (PDL) was identified as the dominant one. Kinnucan's structural heterogeneity and the lag transformation specifications ranked second and third. The estimation results for the dominant

specification are presented in Table 3. A large proportion of the coefficient are significant and the standard measures of fit are good (i.e., system's  $R^2$ : 0.99;  $R^2$ s for the beer, spirits, and wine equations are: 0.82, 0.91, 0.92). The habit formation coefficients for wine and spirits are significant and therefore support the hypothesis that consumers gradually develop a taste for wine and spirits. This phenomenon is not observed for a more homogenous product like (Canadian) beer. The own and cross advertising coefficients are significant, an outcome that suggests that advertising effects need not be limited to brand switching within narrowly defined product categories. The imposition of the inequality restrictions slightly altered the magnitude of the coefficients but did not provoke sign reversals. However the importance of inequality restrictions should not be underestimated as will become evident in our discussion of the elasticities below.

Table 4 compares results from the three advertising specifications in the LA/AIDS sub-model. In some respects, the three specifications appear equivalent.

Table 2  
Estimation results from the per capita expenditure sub-model<sup>a</sup>

Parameters <sup>b</sup>	Coefficients	t-statistics
Constant	12.4182	2.09
PSTONE	0.5902	1.72
$A_{\text{beer}}$	0.0018	1.07
$A_{\text{spirits}}$	0.0007	0.21
$A_{\text{wine}}$	-0.0103	-2.71
$A_{\text{soft-drinks}}$	0.0026	1.67
$\ln x_{t-1}$	-0.2314	-3.19
POP	-0.000001	-1.90
$A_{\text{apple-juice}}$	0.0001	0.61
$A_{\text{tomato-juice}}$	-0.0001	-0.41
$Y$	0.0983	0.17
$P_{\text{NA}}$	0.4435	1.47
$\cos 1$	-0.1075	-4.38
$\sin 1$	0.1478	14.99
$\cos 2$	-0.0600	-7.43
$\sin 2$	0.1043	9.11
$\cos 3$	0.1025	13.47
$\cos 4$	-0.0317	-4.34
$\sin 4$	-0.0582	-8.99
$\cos 5$	-0.0320	-4.99
$\sin 5$	0.0509	6.95
$\cos 6$	0.0262	5.72

<sup>a</sup>  $R^2 = 0.98$ ;  $R^2$  adjusted = 0.97; DW = 2.07.

<sup>b</sup> Advertising was specified according to Kinnucan's structural heterogeneity hypothesis.

For example, the concavity and monotonicity conditions hold with probabilities varying from 23 to 27% across advertising specifications. Similarly, the results regarding the substitutability between beer and spirits and beer and soft drinks, the complementarity between beer and wine and the positive sign of the advertising elasticity for spirits are robust across advertising specifications. We can also be confident about the positioning of the conditional short run expenditure elasticities relative to the unit reference. These results and historical simulations do not provide sharp contrasts between different advertising specifications. According to the reported probabilities, we can be confident that the conditional expenditure elasticity for beer is the only one in excess of one. Divergence in results is found in the advertising elasticities. The results for the PDL specification and its related but less general Lag Transformation counterpart contrast with the results from the Structural Heterogeneity specification. The probability of a negative own-advertising elasticity is 0.98 for the PDL specification and only 0.07 for the Structural Heterogeneity model.

The reported probabilities clearly support the Galbraithian hypothesis about the importance of cross advertising effects. In the PDL model, advertising expenditures on soft drinks and spirits have a negative influence on beer consumption but advertising on beer and soft drinks tend to boost consumption of spirits. For wine, the probabilities are not high enough to warrant strong conclusions about cross advertising effects.

Table 5 also illustrates differences across specifications. The magnitude of the advertising elasticities vary considerably from one specification to another and sign reversals are observed for all beverages except spirits. The long run elasticities consistent with concavity and monotonicity for beer and wine computed from the PDL and lag transformation models are negative. This phenomenon is not surprising since the presence of negative advertising elasticities is well documented in the literature. Saffer (1997) attributes this phenomenon to a S-shaped 'industry-level alcohol advertising response function'. At high levels of advertising like the ones observed in North American markets, the response function is flat and could have a negative slope. Obviously, this does not apply to spirits with total long run elasticities ranging from 0.225 to 0.361. Spirits have the highest own-advertising elasticity across model specifications.

Table 6 shows that the total own-price elasticities for spirits and wine are essentially unitary across specifications. In contrast, the elasticities for beer and soft drinks vary widely but they remain within the boundaries implicitly defined by Table 1. The beer elasticities range from -0.59 to -1.05 while for soft drinks they span the  $\{-0.22, -0.79\}$  interval. This evidence clearly shows that advertising specifications can significantly affect advertising and other elasticities! The magnitude of the elasticities, especially for the more heavily taxed spirits and wine, suggest that the government would not increase its revenues through further tax increases.

The long run conditional expenditure elasticities reported in Table 7 are all close to unity except for soft drinks. These long run elasticities are more plausible than their short run counterparts reported in Table 4. The elasticity for beer is under unity and smaller than the elasticities for wine and spirits which exceed unity. The total income elasticities are low for all beverages and thus confirm that increases in revenue do not lead

Table 3  
Estimation results of the LA/AIDS sub-model (based on 10000 replications)

Parameters	Estimates (w/o ineq. restr.)	Estimates (w. ineq. restr.)	Parameters	Estimates (w/o ineq. restr.)	Estimates (w. ineq. restr.)
$\alpha_{\text{beer}}$	0.42167 (0.223) <sup>a</sup>	0.41256 (0.004) <sup>b</sup>	cos 1	−0.01113 (0.004)	−0.01129 (0.000)
$\tau_{\text{beer}}$	−0.00005 (0.017)	0.00048 (0.000)	sin 1	−0.04573 (0.004)	−0.04578 (0.001)
$AD_{\text{beer-beer}}$	−0.00209 (0.001)	−0.00212 (0.000)	cos 2	0.01096 (0.004)	0.01096 (0.000)
$AD_{\text{beer-spirits}}$	−0.00425 (0.002)	−0.00424 (0.000)	sin 2	0.00425 (0.003)	0.00432 (0.000)
$AD_{\text{beer-wine}}$	0.00761 (0.003)	0.00762 (0.000)	cos 3	0.01349 (0.003)	0.01348 (0.000)
$AD_{\text{beer-SD}}$	−0.00333 (0.002)	−0.00331 (0.000)	sin 3	−0.00799 (0.004)	−0.00797 (0.000)
$Q_{\text{beer}}$	−0.00392 (0.004)	−0.00399 (0.001)	cos 4	−0.00556 (0.004)	−0.00566 (0.000)
$\gamma_{\text{beer-beer}}$	0.09631 (0.103)	0.09211 (0.001)	sin 4	−0.01252 (0.003)	−0.01255 (0.000)
$\gamma_{\text{beer-spirits}}$	−0.02521 (0.082)	−0.02185 (0.001)	cos 5	−0.00342 (0.003)	−0.00347 (0.000)
$\gamma_{\text{beer-wine}}$	−0.07466 (0.025)	−0.07394 (0.000)	sin 5	0.00743 (0.004)	0.00752 (0.000)
$\gamma_{\text{beer-SD}}^c$	0.00356 (0.053)	0.00368 (0.001)	cos 6	0.00006 (0.002)	0.00006 (0.000)
$\beta_{\text{beer}}$	0.00014 (0.000)	0.00014 (0.020)	sin 6	−0.00711 (0.004)	−0.00711 (0.000)
cos 1	0.00412 (0.006)	0.00421 (0.259)	$\alpha_{\text{wine}}$	−0.08538 (0.068)	−0.08369 (0.002)
sin 1	0.05251 (0.007)	0.05273 (2.082)	$\tau_{\text{wine}}$	0.00651 (0.004)	0.00646 (0.000)
cos 2	−0.01513 (0.005)	−0.01512 (−)	$AD_{\text{wine-beer}}$	0.00019 (0.000)	0.00019 (0.000)
sin 2	0.00286 (0.004)	0.00273 (−)	$AD_{\text{wine-spirits}}$	0.00064 (0.001)	0.00064 (0.000)
cos 3	−0.00529 (0.004)	−0.00523 (0.006)	$AD_{\text{wine-wine}}$	−0.00089 (0.001)	−0.00089 (0.000)
sin 3	−0.00150 (0.004)	−0.00143 (−)	$AD_{\text{wine-SD}}$	0.00032 (0.000)	0.00032 (0.000)
cos 4	0.00208 (0.004)	0.00218 (−)	$Q_{\text{wine}}$	0.01766 (0.009)	0.01777 (0.000)
sin 4	0.00995 (0.004)	0.00999 (−)	$\gamma_{\text{wine-beer}}$	−0.07466 (0.025)	−0.07394 (0.002)
cos 5	−0.00676 (0.004)	−0.00667 (−)	$\gamma_{\text{wine-spirits}}$	0.06766 (0.240)	0.06704 (0.001)
sin 5	−0.00023 (0.004)	−0.00026 (−)	$\gamma_{\text{wine-wine}}$	0.01529 (0.009)	0.01513 (0.000)
cos 6	0.00217 (0.003)	0.00216 (−)	$\gamma_{\text{wine-SD}}$	−0.00829 (0.016)	−0.00822 (0.000)
sin 6	0.00685 (0.005)	0.00687 (−)	$\beta_{\text{wine}}$	−0.00003 (0.000)	−0.00003 (0.000)
$\alpha_{\text{spirits}}$	0.12180 (0.220)	0.12791 (−)	cos 1	−0.00214 (0.001)	−0.00215 (0.000)
$\tau_{\text{spirits}}$	−0.01643 (0.014)	−0.01678 (−)	sin 1	−0.01542 (0.001)	−0.01544 (0.000)
$AD_{\text{spirits-beer}}$	0.00213 (0.001)	0.00214 (0.006)	cos 2	0.00374 (0.001)	0.00374 (0.000)
$AD_{\text{spirits-spirits}}$	0.00330 (0.002)	0.00332 (−)	sin 2	0.00189 (0.001)	0.00191 (0.000)
$AD_{\text{spirits-wine}}$	−0.00541 (0.003)	−0.05439 (0.020)	cos 3	0.00399 (0.001)	0.00400 (0.000)
$AD_{\text{spirits-SD}}$	0.00152 (0.001)	0.00153 (0.020)	sin 3	−0.00108 (0.001)	−0.00107 (0.000)
$Q_{\text{spirits}}$	0.04771 (0.024)	0.04812 (−)	cos 4	−0.00190 (0.001)	−0.00194 (0.000)
$\gamma_{\text{spirits-beer}}$	−0.02521 (0.082)	−0.02185 (0.020)	sin 4	−0.00404 (0.001)	−0.00403 (0.000)
$\gamma_{\text{spirits-spirits}}$	0.06282 (0.078)	0.06062 (0.002)	cos 5	−0.00208 (0.001)	−0.00209 (0.000)
$\gamma_{\text{spirits-wine}}$	0.06766 (0.024)	0.06704 (0.001)	sin 5	0.00379 (0.001)	0.00381 (0.000)
$\gamma_{\text{spirits-SD}}$	−0.10527 (0.047)	−0.10581 (0.002)	cos 6	0.00104 (0.001)	0.00104 (0.000)
$\beta_{\text{spirits}}$	−0.00015 (0.000)	−0.00015 (0.000)	sin 6	−0.00267 (0.001)	−0.00266 (0.000)

<sup>a</sup> Numbers in parentheses are standard deviations.

<sup>b</sup> Numbers in brackets are numerical standard errors (NSE).

<sup>c</sup> SD: soft drinks; The coefficients of the soft drinks equation were derived from the additivity condition.

to drastic consumption changes. Conditional Hicksian elasticities are reported in Table 8. All own-price elasticities are smaller than one in absolute values which implies inelastic compensated demands. The pairs beer/wine and spirits/soft drinks are complements while all other pairs of beverages exhibit substitution relations. Differences between short run and long run elasticities are minor in comparison to the differences observed between elasticities computed

with and without the inequality restrictions. Dynamics are unimportant for beer but matter a little for wine and spirits.

Conditional Marshallian elasticities are reported in Table 9. All beverages are price inelastic both in the short run and in the long run. However, the long run own-price elasticities for spirits and wine are close to unity. For beer, the cross-price elasticities are small except for wine. A glance at the probabilities

Table 4

Posterior Probabilities about conditional short run elasticities from the three LA/AIDS sub-models<sup>a</sup>

Restrictions	PDL	Struc. Het.	Lag Trans.	Restrictions	PDL	Struc. Het.	Lag Trans.
Concavity and Monotonicity	0.2496	0.2398	0.2714	$\eta_{SD} < 1$	0.72	0.61	0.66
$\sigma_{\text{beer-spirits}} > 0$	1.00	1.00	1.00	$\eta_{\text{beer-spirits}}^* < 0$	1.00	1.00	1.00
$\sigma_{\text{beer-wine}} < 0$	0.95	0.90	0.74	$\eta_{\text{beer-wine}}^* < 0$	0.95	0.90	0.74
$\sigma_{\text{beer-SD}} > 0$	0.96	0.94	0.91	$\eta_{\text{beer-SD}}^* < 0$	0.96	0.94	0.92
$\sigma_{\text{spirits-wine}} > 0$	1.00	1.00	0.99	$\eta_{\text{spirits-beer}}^* < 0$	1.00	1.00	1.00
$\sigma_{\text{spirits-SD}} < 0$	0.57	0.70	0.55	$\eta_{\text{spirits-wine}}^* < 0$	1.00	1.00	0.99
$\sigma_{\text{wine-SD}} > 0$	0.99	0.95	0.95	$\eta_{\text{spirits-SD}}^* < 0$	0.57	0.70	0.54
$AD_{\text{beer-beer}} < 0$	0.98	0.07	0.77	$\eta_{\text{wine-beer}}^* < 0$	0.95	0.90	0.74
$AD_{\text{spirits-spirit}} > 0$	0.98	0.96	0.92	$\eta_{\text{wine-spirits}}^* < 0$	1.00	1.00	0.99
$AD_{\text{wine-wine}} < 0$	0.88	0.41	0.74	$\eta_{\text{wine-SD}}^* < 0$	0.99	0.95	0.95
$AD_{SD-SD} > 0$	0.92	0.40	0.88	$\eta_{SD-beer}^* < 0$	0.96	0.94	0.92
$AD_{\text{beer-spirits}} < 0$	0.99	0.93	0.92	$\eta_{SD-spirits}^* < 0$	0.57	0.70	0.54
$AD_{\text{beer-wine}} > 0$	0.99	0.81	0.95	$\eta_{SD-wine}^* < 0$	0.99	0.95	0.95
$AD_{\text{beer-SD}} < 0$	0.98	0.93	0.88	$\eta_{SD-spirits}^* < 0$	0.41	0.34	0.19
$AD_{\text{spirits-beer}} > 0$	0.99	0.02	0.93	$\eta_{\text{beer-wine}}^* < 0$	0.99	0.98	0.95
$AD_{\text{spirits-wine}} < 0$	0.98	0.83	0.94	$\eta_{\text{beer-SD}}^* < 0$	0.45	0.61	0.52
$AD_{\text{spirits-SD}} > 0$	0.86	0.97	0.65	$\eta_{\text{spirits-beer}}^* < 0$	0.41	0.34	0.19
$AD_{\text{wine-beer}} > 0$	0.83	0.32	0.32	$\eta_{\text{spirits-wine}}^* < 0$	0.99	0.97	0.95
$AD_{\text{wine-spirits}} > 0$	0.91	0.72	0.75	$\eta_{\text{spirits-SD}}^* < 0$	0.99	0.90	0.95
$AD_{\text{wine-SD}} > 0$	0.76	0.49	0.51	$\eta_{\text{wine-beer}}^* < 0$	0.99	0.98	0.95
$AD_{SD-beer} < 0$	0.62	0.29	0.79	$\eta_{\text{wine-spirits}}^* < 0$	0.99	0.97	0.95
$AD_{SD-spirits} > 0$	0.65	0.51	0.53	$\eta_{\text{wine-SD}}^* < 0$	0.68	0.61	0.77
$AD_{SD-wine} < 0$	0.79	0.60	0.62	$\eta_{SD-beer}^* < 0$	0.45	0.61	0.52
$\eta_{\text{beer}} > 1$	0.96	0.96	0.83	$\eta_{SD-spirits}^* < 0$	0.99	0.90	0.95
$\eta_{\text{spirits}} < 1$	0.98	0.97	0.90	$\eta_{SD-wine}^* < 0$	0.69	0.60	0.77
$\eta_{\text{wine}} < 1$	0.94	0.91	0.79	—	—	—	—

<sup>a</sup>  $\sigma$ : Allen–Uzawa elasticities of substitution, AD: advertising elasticities,  $\eta_i$ : expenditures elasticities,  $\eta_{ij}^*$ : Hicksian elasticities,  $\eta_{ii}$ : Marshallian elasticities, SD: soft drinks. Except for the probability about the concavity and monotonicity conditions, all other probabilities are computed from the truncated posterior distribution consistent with concavity and monotonicity.

Table 5

Conditional and total advertising elasticities from the three LA/AIDS sub-model specifications and the dominant group expenditures sub-model<sup>a</sup>

	Beer	Spirits	Wine	SD		Beer	Spirits	Wine	SD
Short run (w/o ineq. restr.)					Short run (w. ineq. restr.)				
PDL	−0.008	0.010	−0.008	0.006	PDL	−0.009	0.009	−0.007	0.007
	−0.006	0.011	−0.018	0.009		−0.007	0.010	−0.017	0.010
Struc. Het.	0.254	0.215	0.014	−0.018	Struc. Het.	0.228	0.242	0.007	−0.027
	0.256	0.252	0.004	−0.015		0.230	0.243	−0.003	−0.024
Lag Trans.	−0.079	0.281	−0.129	0.152	Lag Trans.	−0.125	0.222	−0.103	0.210
	−0.077	0.282	−0.139	0.155		−0.123	0.223	−0.113	0.213
Long run (w/o ineq. restr.)					Long run (w. ineq. restr.)				
PDL	−0.273	0.392	−0.296	0.093	PDL	−0.287	0.360	−0.260	0.099.100
	−0.271	0.393	0.307	0.094		−0.285	0.361	−0.271	0.100
Struc. Het.	0.254	0.215	0.014	−0.016	Struc.Het.	0.228	0.241	0.007	−0.027
	0.256	0.216	0.002	−0.013		0.230	0.242	−0.005	−0.026
	−0.084	0.283	−0.130	0.172	Lag Trans.	−0.129	0.224	−0.105	0.286
Lag Trans.	−0.082	0.284	−0.141	0.175		−0.127	0.225	−0.116	0.289

<sup>a</sup> Total income elasticities appear right below conditional expenditure elasticities SD: soft drinks.

Table 6  
Long run Marshallian total price elasticities for all three advertising specifications

	Beer			Spirits			Wine			Soft drinks		
	PDL	Struc. Het.	Lag Trans	PDL	Struc. Het.	Lag Trans	PDL	Struc. Het.	Lag Trans	PDL	Struc. Het.	Lag Trans
Beer	−0.59	−0.89	−1.05	−0.05	0.15	0.29	−0.24	−0.19	−0.14	0.04	0.09	0.03
Spirits	−0.04	0.15	0.25	−0.88	−1.12	−1.07	0.23	0.20	0.17	−0.31	−0.15	−0.22
Wine	−0.64	0.57	0.38	0.64	0.51	0.39	−0.96	−1.01	−0.92	−0.06	−0.01	−0.07
SD	0.02	0.14	0.12	−0.15	−0.15	−0.23	−0.01	0.00	0.01	−0.22	−0.49	−0.79

Table 7  
Long run conditional expenditure and total income elasticities associated with the dominant model specification

Cond. exp. (w/o ineq. restr.)				Cond. exp. (w. ineq. restr.)			
Beer	Spirit	Wine	SD <sup>a</sup>	Beer	Spirit	Wine	SD
0.933	1.100	1.108	0.422	0.925	1.110	1.114	0.404
Total income (w/o ineq.restr.)				Total income (w. ineq.restr.)			
0.092	0.108	0.109	0.041	0.091	0.109	0.110	0.040

<sup>a</sup> SD: soft drinks.

Table 8  
Conditional Hicksian elasticities from the PDL LA/AIDS sub-model

Short run (w/o ineq. restr.)					Short run (w. ineq. restr.)				
Elasticities	Beer	Spirit	Wine	SD	Elasticities	Beer	Spirit	Wine	SD
Beer	−0.382	0.262	−0.150	0.271	beer	−0.552	0.416	−0.110	0.247
Spirits	0.204	−0.475	0.317	−0.046	spirits	0.324	−0.602	0.282	−0.003
Wine	−0.330	0.894	−0.751	0.187	wine	−0.242	0.795	−0.780	0.227
Soft drinks	0.285	−0.062	0.089	−0.313	soft drinks	0.259	−0.004	0.108	−0.364
Long run (w/o ineq. restr.)					Long run (w. ineq. restr.)				
Elasticities	Beer	Spirit	Wine	SD	Elasticities	Beer	Spirit	Wine	SD
Beer	−0.347	0.237	−0.142	0.252	beer	−0.507	0.382	−0.101	0.226
Spirits	0.229	−0.527	0.348	−0.049	spirits	0.361	−0.671	0.312	−0.003
Wine	−0.364	0.988	−0.833	0.209	wine	−0.269	0.885	−0.871	0.254
Soft drinks	0.126	−0.023	0.037	−0.140	soft drinks	0.105	−0.003	0.046	−0.154

Table 9  
Conditional Marshallian elasticities from the PDL LA/AIDS sub-model

Short run (w/o ineq. restr.)					Short run (w. ineq. restr.)				
Elasticities	Beer	Spirit	Wine	SD	Elasticities	Beer	Spirit	Wine	SD
Beer	−0.654	−0.087	−0.273	0.013	beer	−0.660	−0.081	−0.273	0.013
Spirits	−0.067	−0.823	0.193	−0.303	spirits	−0.063	−0.826	0.193	−0.304
Wine	−0.601	0.546	−0.874	−0.071	wine	−0.600	0.544	−0.877	−0.067
Soft drinks	0.014	−0.410	−0.034	−0.570	soft drinks	0.014	−0.411	−0.032	−0.572
Long run (w/o ineq. restr.)					Long run (w. ineq. restr.)				
Elasticities	Beer	Spirit	Wine	SD	Elasticities	Beer	Spirit	Wine	SD
Beer	−0.600	−0.088	−0.257	0.011	beer	−0.613	−0.075	−0.254	0.012
Spirits	−0.070	−0.910	0.212	−0.333	spirits	−0.069	−0.917	0.214	−0.337
Wine	−0.664	0.602	−0.969	−0.076	wine	−0.669	0.606	−0.977	−0.074
Soft drinks	0.012	−0.169	−0.015	−0.249	soft drinks	0.006	−0.166	−0.013	−0.231

in Table 4 confirms that beer and wine are complements. From Tables 4 and 9, we can infer that like wine and beer, spirits and soft drinks are complements for each other. As expected, spirits are substitutes for wines and vice versa.

### 3.1. Modeling and policy implications

There exists a large body of literature in demand analysis that demonstrates that the choice of a functional form has a strong incidence on calculated elasticities. In this paper we presented empirical evidence which suggests that ‘finer’ specification issues matter as well. We focused on the specification of advertising in demand analysis holding the choice of a functional form constant. Three popular specifications were compared. They all performed well (in terms of estimation and simulation) but they produced wide-ranging price and advertising elasticities. We believe that practitioners are often confronted to difficult model selection decisions and this is why a criterion like that of Pollak and Wales (1991) Likelihood Dominance Criterion is likely to become an indispensable instrument in the practitioner’s tool kit.

Taxes on alcoholic beverages and cigarettes serve two important but conflicting purposes. They are a major source of government revenues and a public health/safety instrument meant to address consumption externalities. Much has been said about negative externalities associated with alcohol consumption but recent evidence about the positive health effects derived from moderate alcohol consumption have led some economists (e.g., Heien, 1995) to call for tax reductions, stricter enforcement of drunk-driving laws and increased spending on public health education. Lower sin taxes would also lessen revenue losses and the negative externalities attributed to smuggling, a major problem in Ontario. We found total own-price elasticities for spirits and wine purchased in Ontario to be very close to unity regardless of the advertising specification chosen. Consequently, tax reductions are likely to increase both welfare and government revenue. The evidence for beer is less clear since the own-price elasticity for beer turned out to be very sensitive to the choice of advertising specification.

We found the effectiveness of advertising to vary across advertising specifications and beverage types. According to the results from the dominant specifica-

tion, the current levels of beer advertising are in the negative segment of a hypothetical S-shaped industry advertising response function. In contrast, the results for spirits indicate that advertising is still an effective mean to stimulate consumption. We found weak advertising effects on aggregate alcohol expenditures and evidence of cross-product effects. From a public policy perspective, these results are somewhat comforting but it must be noted that they may hide potentially adverse offsetting changes among individual consumers (i.e., abusers versus non-abusers).

In light of the level of expenditures devoted to and the effectiveness of advertising, we can conclude that industry spending on advertising is excessive, especially on the part of breweries. This suggests that advertising is effective at promoting brand-switching among beer drinkers. Perhaps, game theoretic models could shed some light as to why breweries (jointly) overspend on advertising.<sup>12</sup> Institutional factors, such as Ontario’s pricing restrictions, might encourage advertising competition and hence spending on advertising.

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<sup>12</sup> Given the high degree of concentration, one must wonder why collusion cannot be sustained. Gasmi et al. (1992) have developed a game theoretic framework to empirically analyze advertising expenditures in the soft drinks industry. We have not found applications pertaining to alcoholic beverages.

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