Consumer Demand, Government Revenues, and Welfare Effects from Sectoral Free Trade: The Case of Alcoholic Beverages in British Columbia

Stephen E. Pal
Bachelor of Arts, University of Calgary, 1987

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the Department of Economics

We accept this thesis as conforming
to the required standard

[redacted]

Dr. Donald G. Ferguson, Supervisor
(Department of Economics)

[redacted]

Dr. Kenneth G. Stewart, Departmental Member
(Department of Economics)

[redacted]

Dr. Bruce R. Johnson, Outside Member
(Department of Mathematics and Statistics)

[redacted]

Dr. Michael C. Webb, External Examiner
(Department of Political Science)

Supervisor: Dr. Donald G. Ferguson

ABSTRACT

A "Linear Expenditure System" of consumer demand equations is estimated using monthly data on the sales of various kinds of alcoholic beverages in British Columbia over the period of April, 1981 to August, 1986. The estimation results are examined in view of the properties of consumer theory and the interpretation of consumer preferences, both aspects of which are compared to the evidence reported in earlier literature.

To the knowledge of the author, this thesis is the first time consumer preference estimates for alcoholic beverages are made for differing periods of the year.

The demand results are then combined within a simple general equilibrium model to simulate various scenarios of freer trade consistent with the Canada-United States Free Trade Agreement and the General Agreement on Tariffs and Trade rulings on the marketing of alcoholic beverages. Estimates are obtained under the various simulations run for the effects on alcoholic beverage demand, government revenues and consumer welfare. The results suggest free trade in all alcoholic beverages is a net benefit to B.C. consumers, the B.C. government, and the federal government's revenues on alcoholic beverages received from British Columbia.

Examiners:

Donald G Ferguson

Dr. Donald G. Ferguson, Supervisor
(Department of Economics)

Ken Stewart

Dr. Kenneth G. Stewart, Departmental Member
(Department of Economics)

Bruce R Johnson

Dr. Bruce R. Johnson, Outside Member
(Department of Mathematics and Statistics)

Michael Webb

Dr. Michael C. Webb, External Examiner
(Department of Political Science)

CONTENTS

LIST OF TABLES

ACKNOWLEDGEMENTS

Many thanks to Carol for all the support and encouragement. Also, thanks to my parents Amelia and Arthur Pal, to whom I shall always be grateful.

I appreciated the efforts of my thesis committee, and thank them for their guidance. Dr. Ferguson and Dr. Stewart were most encouraging in their approach. Andrew Alley was kind to offer the use of the rich data set he collected from the B.C. Liquor Distribution Branch. Errors and omissions remain my responsibility.

Chapter 1

INTRODUCTION

Free trade patterns have continued to emerge in many sectors of goods, and more recently particular services. This trend toward less restrictive trade is presently occurring with regard to the alcoholic beverage sector both between Canada and other countries and within Canada between provinces.

Two recent trade liberalization developments have serious implications upon the consumption, tax revenues and production sector of alcoholic beverages in British Columbia. The Canada/U.S. Free Trade Agreement (FTA), and the General Agreement on Tariffs and Trade (GATT) ruling on the marketing of alcoholic beverages, both require abandonment by the province of differential markup practices between domestic and imported alcoholic beverages. Historically such markup differences tended to favour consumption of domestically produced liquor products. Further to this the FTA and the GATT ruling call for the elimination or alteration of tariffs on imported alcoholic beverages, the quota on the importation of grapes into the province, and the alleged discriminatory listing practices by the government owned liquor retail outlets.

The choice of studying the alcoholic beverage sector in B.C. was made for several reasons. Firstly, there exists disaggregated data on which to undertake an empirical study of alcoholic beverage demand in B.C. which differentiates liquor products in general, and wines by producer origin (i.e. B.C. produced wine, U.S. produced wine, and other imported wine). Secondly, the alcoholic beverage sector has been heavily taxed in relation to other sectors, but to differing degrees between and within particular beverage groups. Information is

available on the particular taxation levels for differing alcoholic beverage categories which can be utilized in examining the sector overall. Thirdly, the provincial government while having a virtual monopoly on the retailing of alcoholic beverages is also the main protector of domestically produced liquor products and the chief recipient of tax revenues from all liquor sales in the province. This raises the interest in the fact that the government, by its monopoly retail position of alcoholic beverages, has various (possibly competing) objectives which include controlling alcohol consumption, maximizing government revenues, and protecting domestic producers. The way in which the government abides by the FTA and GATT ruling will alter the outcome of its own various objectives. Finally, although the FTA and GATT ruling only directly apply to selected parts of the alcoholic beverage sector, the demand interdependence between and within groups of alcoholic beverages and the uneven tax distortions involved would suggest more complicated and indirect effects on consumption, government revenues and domestic producers.

The primary objectives of this thesis are to:

(1) Describe the protection and taxation structure of the alcoholic beverage sector in B.C.;

(2) Describe the nature of demand for alcoholic beverages in B.C. through the estimation of a linear expenditure system (LES) model which upholds the four major properties of consumer theory; and,

(3) Apply (1) and (2) to a computational model which can measure welfare effects resulting from the FTA and GATT ruling, and the associated effects upon the demand for alcoholic beverages and government revenues.

The thesis is organized as follows. Chapter 2 outlines the approach taken to model consumer demand for alcoholic beverages with regard to consumer theory, and then presents a discussion of the data and estimation considerations for the chosen linear expenditure system (LES) demand model. The estimated demand results are examined in Chapter 3 along with their consumer preference implications and a comparison of these preferences with those found in other demand studies of alcoholic beverages. Chapter 4 presents a general equilibrium computational model and combines this with the demand results to simulate the various welfare effects, changes in government revenue, and demand changes from the imposition of the FTA and GATT ruling upon the alcoholic beverage sector. Conclusions are presented in the final chapter. The remainder of this introductory chapter discusses the various forms of protection and taxation upon the alcoholic beverage sector in British Columbia.

To set the stage for studying the effects of freer trade on the alcoholic beverage sector it is instructive to understand the history and mechanisms of how the domestic liquor industry has been and still presently is, protected through favourable taxation regimes, tariffs, listing practices, and discriminatory markup practices by governments and provincial liquor retail outlets. **Table 1** provides a view of the tariffs, excise taxes, and provincial proportionate markups on wine, beer and spirits in 1983. Tariffs on imported alcoholic beverages make up a very small part of overall consumer price, while excise taxes and provincial markups on all alcoholic beverages are substantial. A federal sales tax of 13 per cent was applied to all alcoholic beverages in 1983, while the corresponding provincial sales tax was applied at 7 per cent.

Given the producer price, taxes and markup, the price

paid by consumers can be represented by

$$\begin{aligned}\text{consumer price} = &(\text{producer price} + \text{tariff} + \text{excise taxes}) \\ &\times (1 + \text{federal sales tax}) \times (1 + \text{markup}) \\ &\times (1 + \text{provincial sales tax}).\end{aligned} \qquad (1)$$

Equation (1) was applied using the knowledge of consumer prices for alcoholic beverages, federal taxes and tariffs, and provincial markups and taxes to determine the proportion of each, and the proportion of producer prices that combine to make up consumer prices for various alcoholic beverage categories. This is displayed in **Table 2** along with what would be the case for other goods to illustrate the composition of consumer prices for differing alcoholic beverages and other goods.

The preferential markups for B.C. produced wine and beer especially, have acted as an impediment to both interprovincial and international trade of these products. One result has been to favour the set up of small breweries (as compared to other medium sized economies) which target almost all sales within the province of operation, and which are estimated to have costs of between 15 and 100 per cent higher than minimum efficient scale U.S. plants.[1]

In concert with the preferential markup given to B.C. produced wines was a policy to foster and protect B.C. grape producers. This was achieved by requiring that B.C. wineries purchase 80 per cent of their grapes from B.C. producers, who through the use of a provincial grape marketing board charged on average 1.99 times that of the landed price of grapes imported from the U.S. between 1981 and 1984.[2] As testimony to the success of this policy, B.C. grape producers supplied 94 percent of their crop to B.C. wine producers in 1983.[3]

TABLE 1

Taxes and Markups on Alcoholic Beverages in B.C., 1983

	Tariff	Excise Tax	Percentage Markups	
	(dollars per litre)			
			Domestic	Imported
Wine	0.044	0.4216	50%	110%
Beer	0.033	0.1821	45%	83%
Spirits	0.07175*	4.0479	115%	120%

* Includes bottle tax.

Sources: Anastasopoulis et.al. (1986)
Ferguson et.al. (1989).

TABLE 2**

Percentage Composition of Consumer Prices in B.C., 1983

	Wine			Beer	Spirits	Other
	B.C.	U.S.	Other	(aver.)	(aver.)	goods
Provincial Taxes and Markups	37.69	55.50	55.49	35.55	56.79	6.54
Federal Taxes	17.32	10.99	11.68	17.24	29.55	9.75
Producer Prices	44.99	33.51	32.83	47.21	13.66	83.71

** Taken from Ferguson et.al. (1989), who used the same data as this study.

Alley (1987) found that 18 per cent of B.C. winery costs are for grapes, and that removal of the grape import quota would approximately lower their total costs by 8 per cent.

It can be surmised that the preferential markup on B.C. wines was carried out to offset costs of B.C. wine producers who were subject to above normal grape costs required under the grape import quota.

A final barrier to trade which has been alleged of the B.C. government liquor retail monopoly is the charge that there existed discrimination against the listing of imported wine varieties that are close substitutes to B.C. varieties. Some wine critics are convinced that this was indeed intentionally carried out to ensure demand for B.C. wines on taste preference. This allegation is quite difficult to substantiate owing to qualitative measures of judgement on the similarities and differences of wine varieties, but to some degree is thought to have had a negative effect on the potential consumption of imported wine in B.C.

The implications of the Canada/U.S. Free Trade Agreement (FTA) and recent GATT ruling are presently, and will continue to have profound implications for the entire alcoholic beverage sector in B.C.

The FTA requires that B.C. must, over a 7 year period which began on January 1, 1989, phase out the previous 60 percentage point markup differential between B.C. and U.S. wines. The FTA allows for a cost-of-service differential to be imposed, so some markup differential is allowed. The 5 point differential for spirits that existed prior the FTA was eliminated on January 1, 1989, but again, a cost-of-service differential is allowed. Tariffs on U.S. wine and spirits were removed on January 1, 1989. The wine markup phase out is

structured so that the differential was collapsed by 25 per cent on January 1, 1989, and by a further 25 per cent on January 1, 1990. The remaining differential is to be eliminated over the next 5 years (1991-1995). The FTA also required that as of January 1, 1989, there be immediate equal national treatment in the distribution and listing of wine and spirits produced in the United States. Although beer was exempted from the FTA, it was grandfathered under the GATT and is subject to future GATT rulings.

The recent GATT ruling on Canada's marketing practices of alcoholic beverages calls for the removal of discriminatory pricing and listing practices by all GATT parties. As of April, 1989, the markup differential between B.C. and imported (other than U.S.) wine must be collapsed completely in equal increments over a 10 year period, while the markup difference between spirits was removed immediately. The GATT ruling allows Canada to maintain the tariffs on import (other than U.S.) wine and spirits.

As with the FTA, the GATT ruling exempted beer, at least in the immediate term. The ruling does require that after a (unspecified) time for Canadian breweries to rationalize, discriminatory pricing and listing practices in beer must be removed in Canada.

Given this understanding of the protection and taxation structure of alcoholic beverages in British Columbia, along with the earlier introduction as to the purpose and general contents of the thesis, attention is now turned to modelling consumer demand.

Chapter 2

A MODEL OF CONSUMER DEMAND

This chapter explores and discusses the approach taken to model alcoholic beverage demand in B.C. from April, 1981 to August, 1986. Firstly, consumer theory and its main properties are outlined. Secondly, the well known linear expenditure system of Stone (1954b) is introduced and discussed, hereafter referred to as the LES. Thirdly, the data used, the specification of the LES which is estimated, and various estimation considerations and procedures are presented. Finally, a modified LES model is presented which takes into consideration the seasonality patterns of alcoholic beverage sales which occur over the year.

2.1 Consumer Theory

This section reviews the major tenants in the modelling of consumer behaviour, lists the properties of the Marshallian and Hicksian demand functions, and discusses the Slutzky equation which relates Marshallian to Hicksian demands.[4]

Consumer theory rests on the hypothesis that a rational consumer will choose a most preferred consumption bundle from the set of feasible alternatives. Consumer choice theory views the behaviour of individual consumers as that of choosing consumption bundles so as to maximize a utility function subject to a given budget constraint. The consumer's problem can be stated,

$$v(\mathbf{p},y) = \max u(\mathbf{x}) \quad \text{s.t. } \mathbf{p}\bullet\mathbf{x} = y \tag{2}$$

where $\mathbf{p} = (p_1,\ldots,p_k)$ is the vector of prices of goods $1,\ldots,k$; $\mathbf{x}$ is a bundle of goods; $u(\mathbf{x})$ is a utility function; y is consumer income; and $v(\mathbf{p},y)$ is the indirect utility function. The Marshallian demand function, $x(\mathbf{p},y)$, is the function that relates $\mathbf{p}$ and y to $\mathbf{x}^*$ (where $\mathbf{x}^*$ is the consumer's demanded bundle of goods, that is, the bundle of goods which maximizes the consumer's utility).

Alternatively, it can be shown that utility maximization for a given level of income can be equivalently restated by expenditure minimization for a given level of utility. Formally represented,

$$e(\mathbf{p},u^*) = \min \mathbf{p}\bullet\mathbf{x} \quad \text{s.t. } u(\mathbf{x}) = u^* \tag{3}$$

where $e(\mathbf{p},u^*)$ is the expenditure function. Holding consumer utility constant, while varying prices and income yields the solution to the expenditure minimization problem, namely the Hicksian or income compensated demand function, denoted $h(\mathbf{p},u)$. While Marshallian demand functions are observable, Hicksian demand functions are not. Likewise Hicksian substitution effects are not directly observable, but they can be derived from the Marshallian effects in a model of sufficient theoretical content. In particular, it can be shown that the derivatives of $\mathbf{h}$ with respect to $\mathbf{p}$ can be expressed as derivatives of $\mathbf{x}$ with respect to $\mathbf{p}$ and y via the

Slutzky equation:

$$\frac{\partial h_i(\mathbf{p},u)}{\partial p_j} = \frac{\partial x_i(\mathbf{p},y)}{\partial p_j} + \left(\frac{\partial x_i(\mathbf{p},y)}{\partial y}\right) \bullet x_j \qquad (4)$$

where: $\partial h_i/\partial p_j$ is the Hicksian substitution effect;
$\partial x_i/\partial p_j$ is the Marshallian substitution effect;
$(\partial x_i/\partial y)\bullet x_j$ is the income effect; and
i,j are goods indices.

Given the above, the main properties of consumer theory can be stated with only brief comment. It is important to point out that consumer theory is the theory of the single consumer acting without error; but also may be thought of as a single representative or average of a cohort of consumers identical in all economically relevant respects. Below are stated the four properties of consumer theory.

Property 1: Adding Up. The sum of both Hicksian and Marshallian demands is equal to total expenditure.

Property 2: Homogeneity. Marshallian demands are homogeneous of degree zero in prices and income; Hicksian demands are homogeneous of degree zero in prices.

Property 3: Symmetry. The Slutzky matrix (the matrix of Hicksian substitution terms), $\partial h_i(p,u)/\partial p_j$, is symmetric.

Property 4: Negativity. The matrix of Hicksian substitution terms should be negative semi-definite; that is, the expenditure function must be concave.

If properties 1 to 4 are shown to hold for any system of demand equations, it can be shown that there can be derived a utility function representing consumer preferences.[5] An important implication for this paper stems from the fact that unless the above four properties hold for an estimated demand system, it is invalid to make welfare measures such as equivalent and compensating variation.

2.2 Choice of the LES Model

A major reason for choosing the LES to model demand of alcoholic beverages rests with the fact that by construction, the LES satisfies the adding up, homogeneity and symmetry properties of consumer theory. The fourth property, negativity, can easily be checked by examining the estimated coefficients discussed below. With the properties of consumer theory shown to hold for an estimated demand system, only then is it legitimate to make welfare calculations, which coincidentally is a major objective of this thesis.

The second major rationale for using the LES is interest in measuring the different consumption preferences of alcoholic beverages over different seasons of the year. Due to its restrictiveness and inherent properties, the LES is well suited to investigating seasonal patterns of consumption preferences, as will be demonstrated below. As shown later in Chapter 3, previous demand studies of alcoholic beverages offer only annual measures of consumer preferences. The use of the LES enables the computation of seasonal measures of consumer preferences for various alcoholic beverages. To the knowledge of the author, this paper is the first time price and income elasticity measures are computed for different seasons of the year rather than simply annual estimates.

2.3 A "Linear Expenditure System"

The LES was first developed and extensively used by Stone (1954b), and has an explicitly specified underlying utility function of the form

$$u = \sum_i \beta_i \log(q_i - \gamma_i) \tag{5}$$

where: the β's and γ's are parameters; the q_i's are the quantity demanded of goods; and, in order for the logarithms to be defined, we require $q_i > \gamma_i$ for all i.

Maximizing the utility function (5) subject to the usual budget constraint $\Sigma_i\ p_i q_i = y$, where the p's are prices and y total expenditure, leads to Marshallian demand equations of the form

$$q_i = \gamma_i + \frac{\beta_i}{p_i}(y - \sum_j p_j \gamma_j), \quad i,j = 1,\ldots,n$$
$$\text{with } \sum_j \beta_j = 1 \tag{6}$$

OR

$$p_i q_i = p_i \gamma_i + \beta_i (y - \sum_j p_j \gamma_j), \quad i,j = 1,\ldots,n$$
$$\text{with } \sum_j \beta_j = 1. \tag{7}$$

Equations (7) make up the so-called linear expenditure system (LES). Equations (6) are the associated Marshallian

demands which express q_i as a linear function of y/p_i (a measure of real total expenditure) and of relative prices p_j/p_i. It can be shown that (6) is the only form of linear demand equation which satisfies adding up, homogeneity, and symmetry.[6] The fourth property of consumer theory, negativity, holds when the expenditure function for the LES is shown to be concave. Concavity will be assured for an estimated LES model provided all β_i's are nonnegative, and provided that y is no less than $\Sigma_j\ p_j\gamma_j$.[7]

It must be noted that inspection of the underlying utility function (5) shows the LES model assumes additive preference ordering. One consequence of this is that if concavity is to hold, no inferior goods are allowed and all goods in the LES model must be Hicksian substitutes. A further consequence of additivity is that price derivatives are approximately proportional to expenditure derivatives.[8]

The use of time series data to estimate equations (6), will invariably possess strong correlated trends in q_i and y/p_i (a measure of real total expenditure). The β_i coefficients, and hence the expenditure derivatives, tend to be very well determined. Relative prices (p_j/p_i) however, lack strong variation, so that the γ_i coefficients, and hence the price derivatives, will be generally much less precisely determined. The result is that the only role for the variation in relative prices in the data, is to influence, only slightly, the absolute size of the price derivatives.

2.4 Estimation and Data Considerations

The application of the LES model was based on six product categories: B.C. wine; U.S. wine; other imported wine (which included all wine not from B.C. or the U.S., a negligible

portion of which was non-B.C. Canadian wine); beer (which includes wine coolers and cider); spirits (which includes all other alcoholic beverages); and all other goods as the sixth and final category. Monthly data on prices and quantities of each of the five alcoholic beverage categories sold through the B.C. Liquor Distribution Branch over the period April, 1981, through August, 1986, were utilized. Also used over the same time period were monthly total consumer expenditure in B.C. and the monthly CPI for British Columbia as a proxy for the price of the "other goods" category. Prior to estimation all quantities and total expenditure were expressed in per capita terms, using the 15 and over age group population. This was done to facilitate the estimation for a single representative consumer.

Since six product categories make up a complete demand system, whose covariance matrix is singular, the usual method of dropping one equation for estimation was carried out. Since it has been shown that coefficient estimates are invariant to the equation dropped, the other goods equation was dropped as it was of the least interest to the study.

Before estimation of the LES model (7), it was noted that although the data was in monthly form, differing months had a differing number of days for which alcohol could be purchased in B.C. Obviously, some monthly variation in liquor sales is due to the variation in the number of business days during which provincial liquor retail stores are open. This was addressed by dividing through each quantity and expenditure measure(s) by the corresponding monthly number of business days that alcohol was sold in a particular month of a particular year. This yielded quantity and expenditure data on a per capita per day basis, which was utilized in all estimations. The basic LES model (7) was hence estimated using the above data by iterative maximum likelihood methods

to a stable convergence. The estimation results are presented and discussed in the following chapter, but before this an alternative specification of the linear expenditure system is explored.

2.5 A Modified Linear Expenditure System

It is observed that the demand for alcoholic beverages is seasonal in nature, with demand fluctuating over the course of a year. Holidays and climatic changes affect the propensity to consume of various types of alcoholic beverages to various degrees. The basic LES model (7) is designed for application to annual data, which is unsatisfactory since it cannot capture the seasonal pattern of demand evidenced in the monthly data set available. A potential way to handle this issue of seasonality is to introduce dummy variables for each of the twelve months. This would require the estimation of 12 distinct parameters for each individual LES parameter coefficient. Unfortunately, this is empirically impossible in this case since each equation would have more estimated parameter coefficients than there are available data observations.

The solution to this problem of seasonality was to group like-consumption months together to reduce the number of dummy variables necessary. By plotting the observed quantity data for each beverage category against the particular months it became apparent the same months over different years held similar patterns in demand to other months. By averaging the quantities demanded over each of the 12 months for each category of beverage, four distinct patterns were evident. The first of these was that December demand for all wines and spirits was significantly higher on average to all other months. The second distinct pattern was that for the months

of June through August beer demand was consistently above all other months as were wine and spirits demand, although for these latter two beverages demand was distinctly lower than in December. The third evident pattern of demand was that for all five categories of alcoholic beverages, the demand was significantly the lowest for the months of January and February. The fourth pattern was that for each beverage category there was very little discernable variation in demand for the months of March through May and September through November.

The four distinct patterns in the purchase of alcoholic beverages in B.C. are empirically evident from the data and are rationalized by the following reasons. Clearly the Christmas holiday season is well known for the good number of social occasions at which alcohol is purchased, so December's high demand for alcoholic beverages is understandable. The summer months of June through August are characterized by the summer holiday and tourist season throughout B.C. which is associated with a greater than normal demand for alcoholic beverages, especially beer which is consumed in greater quantities owing to the higher climatic temperatures of this period. The months of January and February follow the Christmas season which had a high demand for alcoholic beverages, and it is likely that consumers would have some left over inventory of beverages as well as a propensity to drink less after a festive holiday season. This leaves the remaining six months of March through May and September through November, which are uniformly quite even in holiday periods and climatic temperature, as being similar in demand for alcoholic beverages.

The fact that four distinct groupings of months are evident allows for the modification of the LES to incorporate this information by the use of four multiplicative dummy

variables. Equation (7), representing the basic LES model, was modified to include four dummy variables to account for the four groups of like-demand month(s),

$$p_i q_i = \left(\sum_{h=1}^{4} \gamma_{ih} Z_h\right) p_i + \left(\sum_{h=1}^{4} \beta_{ih} Z_h\right)\left[y - \sum_{j=1}^{6}\left(\sum_{h=1}^{4} \gamma_{jh} Z_h\right) p_j\right], \qquad (8)$$

where $i,j = 1,\ldots,6$; $h = 1,\ldots,4$.

For each monthly grouping h, the β_j's sum up to 1. The Z_h variables are dummies which take the value of 1 for the month(s) h and 0 otherwise. The h subscript for December is, 1; for January and February, 2; for June, July and August, 3; and for March through May and September through November, 4. Essentially a separate set of LES parameters are estimable for each of the four seasons. Equation (8) represents what will be referred to as the "modified LES model" throughout the remainder of the paper.

As mentioned earlier, estimation of a complete system of demand equations will result in a covariance matrix which is singular, therefore the procedure of dropping one equation was adopted. Again, the "other goods" equation was dropped leaving five equations. The modified LES model (8) was hence estimated by iterative maximum likelihood methods to a stable convergence. The results are discussed in the following chapter.

Chapter 3

ESTIMATION RESULTS AND CONSUMER PREFERENCES

This chapter reports the estimated parameter coefficients and descriptive statistics of both the basic LES (7) and the modified LES (8) outlined in Chapter 2. While both specifications estimated are found to uphold the four main properties of consumer theory, the modified LES is the preferred specification as it takes into consideration the seasonal nature of demand for alcoholic beverages. This is most important, given that the data set used is in monthly format. Performance of a log likelihood ratio test using the results of the two estimated specifications, suggests further that the modified LES model is to be preferred on a statistical, as well as an intuitive basis. As such, the remainder of the paper then exclusively utilizes the results of the modified LES.

The estimated results of the modified LES are interpreted with regard to the consumer preferences they imply in the form of price and income elasticity measures. This paper provides a new contribution to the literature, in that computed price and income elasticities are presented for four distinct seasons. All other studies found, offer only annual measures of price and income elasticities for alcoholic beverages.

Past studies on the demand for alcoholic beverages are then discussed with regard to consumer theory, and the implications they suggest about consumer preferences are presented in the form of price and income elasticities. Finally, the chapter concludes with a look at the consumer preferences suggested from the modified LES, and compares them to the measures computed by other studies.

3.1 Estimation Results

The estimation results of the basic LES model (7) and the modified LES model (8) are presented in **Tables 3 and 4.** The estimated parameters in the basic model, and most of the estimated parameters in the modified model, are individually statistically significant at a 5 percent level, on the basis of the computed asymptotic t-ratios. Given the non-linear estimation of both models, the standard errors computed are only approximate in nature; no joint test of the significance of the coefficients is offered.

As stated in the first chapter, the major objective of utilizing the LES was because of its strong use of consumer theory. By construction, the basic LES and the modified LES both satisfy the first three properties of consumer theory - adding up, homogeneity, and symmetry. The fourth property, negativity, is shown to hold for the estimated basic LES, as all the estimated β_i coefficients are positive and y is greater than $\Sigma_j\ p_j\gamma_j$. The fourth property is also shown to hold for the modified LES since all the estimated β_{ih} coefficients were positive and y is greater than $\Sigma_j\ p_j\gamma_{jh}$ for all h. Hence all four main properties of consumer theory introduced in Chapter 2 are shown to hold for both the estimated LES demand systems.

While the modified LES specification is the preferred model on an intuitive basis because it directly addresses the seasonality issue of alcoholic beverage sales, it is also preferred statistically on the basis of performing a likelihood ratio test which was carried out and is described as follows. The basic LES model (7) assumes no difference in parameter coefficient values over various seasons, that is, the basic model is restricted in the sense that the estimated β_i and γ_i are assumed to be constant throughout the year. The

modified LES (8) model, allows for the estimation of beta and gamma coefficients of a given alcoholic beverage for four separate seasons in a year, and as such can be thought of as being unrestricted.

The use of a likelihood ratio test allows for the testing of the null hypothesis that there exists no statistically significant seasonal variation for any given estimated coefficient of a given alcoholic beverage (as represented by the basic LES model), versus the alternative hypothesis that there does exist significant variation of at least four distinct seasons for any given estimated coefficient for some alcoholic beverage(s) (as represented by the modified LES model). Formally, if the null hypothesis cannot be rejected, the maximized value of the log likelihood function of the restricted model ($\ln L_R$), should not be significantly less than the value of the unrestricted model's maximized log likelihood function ($\ln L_U$).

The null hypothesis is rejected if

$$\Lambda = 2[\ln L_U - \ln L_R] \qquad (9)$$

exceeds $\chi^2_{(j,\alpha)}$ for a prescribed significance level (α) and the number of restrictions between the two models (j). It is found at $\alpha = 0.01$, that $\Lambda = 216.23$, which exceeds $\chi^2_{(j,\alpha)} = 76.15$, so the null hypothesis must be rejected.

Given both an intuitive and a statistical justification, the modified LES (8) model was determined to be the preferred model of choice, and is used throughout the remainder of the paper. Discussion now turns to the characterization of consumer preferences implied by the preferred estimated LES model.

Table 3

Basic Linear Expenditure System Estimation Results*

(t-ratios are in parenthesis)

	γ		β	
Spirits	0.01380	(2.41)	0.01949	(5.73)
B.C. Wine	0.01942	(7.18)	0.00218	(5.74)
Other Wine	0.00723	(2.92)	0.00349	(7.80)
U.S. Wine	0.00053	(3.76)	0.00016	(3.46)
Beer	0.26987	(6.43)	0.00691	(2.50)
Other Goods	0.17283	(3.70)	0.96777	

Loglikelihood = 833.5710

* Other Goods β coefficient computed using the identity $\Sigma\ \beta_j = 1$.

Table 4

Modified Linear Expenditure System Estimation Results

(t-ratios are in parentheses)

DECEMBER

	γ		β	
Spirits	-0.05574	(-2.01)	0.03704	(2.03)
B.C. Wine	-0.00182	(-0.06)	0.00321	(1.60)
Other Wine	0.00537	(0.38)	0.00312	(1.48)
U.S. Wine	-0.00516	(-2.03)	0.00085	(1.48)
Beer	-0.03265	(-0.11)	0.01164	(1.30)
Other Goods	-0.03202	(-0.13)	0.94414	

JANUARY and FEBRUARY

	γ		β	
Spirits	0.02300	(1.83)	0.00856	(0.75)
B.C. Wine	0.02315	(2.46)	0.00072	(0.44)
Other Wine	0.00539	(1.21)	0.00344	(2.14)
U.S. Wine	0.00017	(0.22)	0.00022	(0.78)
Beer	0.20445	(1.18)	0.00545	(0.40)
Other Goods	0.15810	(1.63)	0.98161	

JUNE through AUGUST

	γ		β	
Spirits	0.03350	(3.74)	0.00554	(1.08)
B.C. Wine	0.02281	(3.09)	0.00154	(1.97)
Other Wine	0.00907	(2.51)	0.00246	(3.25)
U.S. Wine	-0.00029	(-0.59)	0.00037	(2.91)
Beer	0.27040	(2.10)	0.01061	(1.73)
Other Goods	0.13279	(1.54)	0.97948	

MARCH through MAY and SEPTEMBER through NOVEMBER

	γ		β	
Spirits	0.03057	(4.07)	0.00235	(1.35)
B.C. Wine	0.02326	(4.31)	0.00048	(1.73)
Other Wine	0.00940	(2.72)	0.00092	(4.30)
U.S. Wine	0.00064	(1.88)	0.00004	(0.94)
Beer	0.07950	(0.93)	0.00682	(2.82)
Other Goods	-0.23631	(-1.05)	0.98939	

Loglikelihood = 941.6882

3.2 Interpretation of Consumer Preferences

To facilitate descriptive measures of consumer preference from the estimated results, formulae are displayed below which were used in calculating Marshallian and Hicksian price and income elasticities. The Slutzky equation (4) introduced in Chapter 2, was utilized in arriving at Hicksian price elasticity measures which incorporate information from the observed Marshallian demands and the related income effects.

Recall that the modified LES model (8) is in fact the basic LES model (7) nested for four distinct like-month periods. Interpretation of the coefficients from the modified LES from one of the four distinct like-demand monthly groupings eliminates the need for the h subscript notation, and collapses to the basic LES form. For this reason and the sake of clarity, the following elasticity formulae are presented from the basic LES Marshallian demand equations (6), with no loss of generality for application to the estimates of the preferred modified LES model for each of the four distinct like-demand monthly groupings.

Income elasticity:

$$\epsilon_i = \frac{\partial x_i(p,y)}{\partial y} \cdot \frac{y}{x_i} = \frac{\beta_i}{w_i} \qquad (10)$$

where, $w_i = \frac{p_i q_i}{y}$

Marshallian own price elasticity:

$$\epsilon_{ii} = \frac{\partial x_i(p,y)}{\partial p_i} \bullet \frac{p_i}{x_i(p,y)} = -1 + (1 - \beta_i)\frac{\gamma_i}{q_i} \qquad (11)$$

Marshallian cross price elasticity:

$$\epsilon_{ij} = \frac{\partial x_i(p,y)}{\partial p_j} \bullet \frac{p_j}{x_i(p,y)} = -\frac{\beta_i}{w_i}(w_j + \phi\beta_j) \qquad i \neq j \qquad (12)$$

$$\text{where, } \phi = -y^{-1}(y - \Sigma p_k \gamma_k)$$

Hicksian own price elasticity:

$$\epsilon_{ii}^* = \frac{\partial h_i(p,y)}{\partial p_i} \bullet \frac{p_i}{h_i(p,y)} = \phi\frac{\beta_i}{w_i}(1 - \beta_i) \qquad (13)$$

Hicksian cross price elasticity:

$$\epsilon_{ij}^* = \frac{\partial h_i(p,y)}{\partial p_j} \bullet \frac{p_j}{h_i(p,y)} = -\phi\frac{\beta_i}{w_i}\beta_j \qquad (14)$$

The above formulae were utilized with the estimated coefficients from the modified LES model (8) to calculate numerical elasticity measures. Given the nature of the modified LES model which captures the demand for various

alcoholic beverages at four distinct periods of the year, elasticity measures were calculated for each beverage category for the four distinct periods of the year: December; January and February; June, July and August; and, March through May and September through November. Elasticities were calculated at the point of means for the prices of the alcoholic beverages and total expenditure at each of the four distinct periods.

3.2.1 Income elasticities

Income elasticity refers to a measure which predicts the percentage change in demand for a particular good, given a one percent increase in total consumer expenditure. Although referred to as "income" elasticity, the correct variable to use in its calculation is expenditure, which is why expenditure, and not income (which captures both expenditure and savings), was used in the demand estimation and elasticity calculations in this paper. Despite this fact, some previous demand studies on alcoholic beverages have used income in place of expenditure for demand estimation and elasticity computations. These studies are identified and further discussed below in section 3.3.

Income elasticities are broadly classified into three main ranges of interest. An income elasticity measure greater than one signifies goods which are considered luxuries, while a measure of between zero and one signifies a necessity good. As a consumer's total expenditure rises (presumably because of a rise in their income), their consumption of both luxuries and necessities also rises, although the former account for an increasing budget share of their total purchases. Luxury and necessity goods are both referred to as superior goods. Alternatively, a good with a negative income elasticity is

defined as an inferior good. As a consumer's expenditure rises, their consumption of an inferior good would decline.

Table 5 displays the calculated income elasticities for the five categories of alcoholic beverages and the "other goods" category for each of the four distinct periods of the year.

Table 5: Income Elasticities - Modified LES Model

	December	June - August	January and February	Mar.- May and Sept-Nov.
Spirits	1.5755	0.3506	0.6163	0.1565
B.C. Wine	0.9553	0.5073	1.3243	0.5212
Other Wine	0.7611	0.8234	1.2459	0.3152
U.S. Wine	4.1901	1.9342	1.4328	0.2138
Beer	1.0025	0.5893	0.4619	0.4888
Other Goods	0.9863	1.0203	1.0111	1.0232

All the alcoholic beverages are characterized as superior goods throughout the year. Spirits is characterized as a luxury good in December, but as a necessity throughout the rest of the year. An increased budget share devoted to spirits for a given increase in consumer expenditure in December is consistent with the above normal prevalence of social occasions around the Christmas holiday season. Both B.C. wine and other import wine are portrayed as luxuries for

the January-February period and necessities for the other three periods, although the former is near to being a luxury for the December period. Wine from the United States is suggested to be a luxury for all periods except the March through May and September through November period. Spirits, other import wine and U.S. wine are all each characterized as having their lowest respective income elasticities for the March through May and September through November period.

All three categories of wine are characterized as being luxuries for the January-February period, while spirits are calculated to have a income elasticity of about 0.6 for this period. Perhaps this is due in part to the differing circumstances and nature of how wines are consumed as compared to spirits, and possibly in part due to the inherent differences in inventory life. While spirits have a long inventory life after being opened, wine's are more likely to be consumed in total after being opened. This may be extended to account for unopened wine and spirits as well. It is reasonable to assume that wines are often consumed as part of a special family or social meal, of which such occasions abound during the Christmas season. If wine purchases are treated as being primarily an accessory to special family and social meals, their inventory life span in the homes of consumers is less likely to last into the new year as compared to spirits.

Beer is almost uniformly shown to be a necessity in Table 5 with an income elasticity of around 0.5, the exception being the December period where beer is characterized as a very modest luxury. Again the Christmas season is offered as a likely explanation for the increased income elasticity of beer in the December period. Finally, the income elasticity of "other goods" is close to unity for all four of the consumption periods. A comparison of the above income

elasticities calculated for the various alcoholic beverages is made in relation to those from other studies later in this chapter.

3.2.2 Own price elasticities

The own price elasticity formula presented above measures the percent change in demand for a good given a one percent increase in the price of that good. While a Marshallian own price elasticity takes only into account the effect of the price change, a Hicksian own price elasticity takes into account both the Marshallian price effect and the income effect that results from the price change (recall the Slutzky equation presented earlier). The fourth property of consumer theory, negativity, and the Slutzky equation (4), require that Hicksian demands must have non-positive own price elasticities. Marshallian demand functions can have either positive or negative own price elasticities while still conforming to the properties of consumer theory. A positive Marshallian own price elasticity occurs for inferior goods (goods with a negative income elasticity), where the income effect overpowers the Hicksian own price effect. A good with a positive own price Marshallian elasticity is called a Giffen good. Goods with negative Marshallian own price elasticities are called normal goods. All superior goods (defined earlier as having a positive income elasticity) must be normal goods as well, to be consistent with the properties of consumer theory.

Tables 6 and 7 display the computed Marshallian and Hicksian own price elasticities respectively for the estimated modified LES model (8). The own price elasticities shown were computed for the five alcoholic beverages and other goods, for each of the four distinct periods. Each was calculated using the price and expenditure data, at the respective period's

point of means.

With respect to a priori expectations, in all cases, the Hicksian own price elasticities for all the alcoholic beverage categories and the other goods category are negative. All the alcoholic beverages are shown to be normal goods in all periods, as their Marshallian own price elasticities are negative. This is consistent with consumer theory since they each were earlier shown to be superior goods.

A comparison of the Marshallian and Hicksian own price elasticities for the five alcoholic beverage categories shows they are very similar in magnitude, due to negligible income effects. This is not surprising since each of the alcoholic beverage categories constitute a very small budget share of total consumer expenditure. The Marshallian own price elasticity for the other goods category is approximately unitary in each of the four distinct periods, but after the income effect is removed, the Hicksian own price elasticity is about zero in all cases. This is consistent with a priori expectations that consumption of other goods should be unaffected by an own price change after being compensated for in terms of income.

Table 6: Marshallian Own and Cross Price Demand Elasticities

Modified LES Model

(columns are quantities, rows are prices)

	Spirits	B.C. Wine	Other Wine	U.S. Wine	Beer	Other Goods
			December			
Spirits	-1.6782	0.0158	0.0126	0.0694	0.0166	0.0163
B.C. wine	0.0002	-1.0333	8.5e-5	0.0005	0.0001	0.0001
Other wine	-0.0011	-0.0007	-0.8239	-0.0030	-0.0007	-0.0007
U.S. wine	0.0011	0.0007	0.0005	-4.5298	0.0007	0.0007
Beer	0.0015	0.0009	0.0007	0.0041	-1.0835	0.0009
Other goods	0.1011	0.0613	0.0488	0.2688	0.0643	-1.0037
			January - February			
Spirits	-0.2728	-0.0135	-0.0127	-0.0146	-0.0047	-0.0103
B.C. Wine	-0.0001	-0.5731	-0.0002	-0.0003	-0.0001	-0.0002
Other Wine	-0.0008	-0.0017	-0.5404	-0.0018	-0.0006	-0.0013
U.S. Wine	-3.6e-5	-7.9e-5	-7.4e-5	-0.6204	-2.7e-5	-6.0e-5
Beer	-0.0058	-0.0125	-0.0118	-0.0135	-0.2041	-0.0095
Other Goods	-0.3366	-0.7234	-0.6806	-0.7835	-0.2523	-0.9896
			June - August			
Spirits	-0.2801	-0.0058	-0.0094	-0.0221	-0.0067	-0.0117
B.C. Wine	-0.0006	-0.4005	-0.0015	-0.0035	-0.0011	-0.0019
Other Wine	-0.0004	-0.0005	-0.6495	-0.0020	-0.0006	-0.0011
U.S. Wine	3.4e-5	5.0e-5	8.2e-5	-1.5233	5.9e-5	0.0001
Beer	-0.0034	-0.0049	-0.0079	-0.0186	-0.4699	-0.0098
Other Goods	-0.0066	-0.0956	-0.1552	-0.3645	-0.1111	-0.9960
			March-May and September-November			
Spirits	-0.2307	-0.0060	-0.0037	-0.0025	-0.0057	-0.0119
B.C. Wine	-3.4e-5	-0.7624	-6.9e-5	-4.7e-5	-0.0001	-0.0002
Other Wine	-0.0002	-0.0008	-0.4614	-0.0003	-0.0008	-0.0016
U.S. Wine	-2.0e-5	-6.5e-5	-4.0e-5	-0.3127	-6.1e-5	-0.0001
Beer	-0.0006	-0.0021	-0.0013	-0.0009	-0.7168	-0.0041
Other Goods	0.0751	0.2502	0.1513	0.1026	0.2346	-1.0053

Table 7: Hicksian Own and Cross Price Demand Elasticities

Modified LES Model

(columns are quantities, rows are prices)

	Spirits	B.C. Wine	Other Wine	U.S. Wine	Beer	Other Goods
	---------- December ----------					
Spirits	-1.6412	0.0383	0.0305	0.1679	0.0402	1.0074
B.C. wine	0.0054	-1.0301	0.0026	0.0146	0.0035	0.0034
Other wine	0.0053	0.0032	-0.8208	0.0141	0.0034	0.0033
U.S. wine	0.0015	0.0009	0.0007	-4.5289	0.0009	0.0009
Beer	0.0198	0.0120	0.0096	0.0528	-1.0718	0.0124
Other goods	1.6091	0.9758	0.7774	4.2796	1.0239	-0.0596
	---------- January - February ----------					
Spirits	-0.2642	0.0049	0.0046	0.0053	0.0017	0.4293
B.C. Wine	0.0002	-0.5723	0.0004	0.0004	0.0001	0.0003
Other Wine	0.0009	0.0020	-0.5370	0.0021	0.0007	0.0015
U.S. Wine	5.9e-5	0.0001	0.0001	-0.6202	4.5e-5	9.8e-5
Beer	0.0015	0.0031	0.0029	0.0034	-0.1987	0.0024
Other Goods	0.2617	0.5622	0.5289	0.6089	0.1961	-0.0080
	---------- June - August ----------					
Spirits	-0.2746	0.0022	0.0036	0.0084	0.0026	0.7872
B.C. Wine	0.0004	-0.3990	0.0010	0.0023	0.0007	0.0012
Other Wine	0.0007	0.0010	-0.6470	0.0038	0.0011	0.0020
U.S. Wine	0.0001	0.0001	0.0002	-1.5230	0.0002	0.0003
Beer	0.0029	0.0042	0.0069	0.0162	-0.4593	0.0085
Other Goods	0.2705	0.3914	0.6353	1.4923	0.4547	-0.0165
	-------- March-May and September-November ------					
Spirits	-0.2284	0.0018	0.0011	0.0007	0.0017	1.4805
B.C. Wine	0.0001	-0.7620	0.0002	0.0001	0.0003	0.0007
Other Wine	0.0002	0.0006	-0.4605	0.0003	0.0007	0.0014
U.S. Wine	8.9e-6	2.9e-5	1.8e-5	-0.3126	2.8e-5	5.8e-5
Beer	0.0016	0.0052	0.0031	0.0021	-0.7099	0.0102
Other Goods	0.2265	0.7542	0.4561	0.3093	0.7073	-0.0159

In most cases, the five alcoholic beverage categories are shown to be own price inelastic. The exceptions being in the December period, where spirits, B.C. Wine, U.S. Wine and beer are found to be price elastic. Beer and B.C. Wine are just slightly price elastic, while spirits is somewhat more elastic, and U.S. Wine is the most price elastic. In addition, U.S. Wine is also found to be price elastic for the June-August period. The December period was found to be the most price sensitive to changes in the own price of each of the five alcoholic beverage categories.

3.2.3 Cross Price Elasticities

The remaining results of interest are the Marshallian and Hicksian cross price elasticities. The Hicksian cross price elasticities give the more accurate picture of cross price substitution as they capture substitution effects net of income effects. As noted in section 2.3 of the previous chapter, because the underlying utility function of the LES model assumes additive preference ordering, this affects the Marshallian demands of the LES. As seen in Equation (14), the Hicksian cross price elasticity for all pairs of goods must be positive if concavity is to hold for the associated expenditure function of the LES. Since concavity was shown to hold for the estimated modified LES, it is no surprise that all goods were computed to be Hicksian substitutes in Table 7.

Examination of Table 7 reveals that each of the five alcoholic beverages are characterized as weak Hicksian substitutes with respect to each other. This is consistent with the expectation that one would expect goods with few close substitutes to be own price inelastic. Given all alcoholic beverages were found to be own price inelastic for all periods except for December, it is not unreasonable to

accept that the five alcoholic beverage categories are portrayed as having few close substitutes. As shall be examined shortly in the next section, a good number of researchers have concluded that there appears to be little substitutability between various alcoholic beverages.

While the nature of the LES model concentrates mainly on the income and own price effects of the five alcoholic beverage categories, the cross price elasticities provide some measure of consumer preferences between the beverages. Given the implications for consumer preferences of alcoholic beverages suggested by the modified LES model, attention is now turned to the results of other studies on the demand for alcoholic beverages.

3.3 Past Studies on the Demand for Alcoholic Beverages

Applied demand analysis of alcoholic beverages has been intensively studied. The fact that alcohol sales are heavily regulated has meant that price-quantity data has been of generally high quality, and thus useful for empirical analysis. The sociological, medical and economic effects of alcohol consumption are other underlying sources of interest in studying alcohol demand. As with applied demand analysis in general, there have been two diverse modelling approaches taken in studying the demand for alcoholic beverages. The first, and by far the most common approach taken, has been the estimation of single demand equations. The second, although standard in applied econometric demand analysis for many years, is a systems approach.

The single equation approach has for the most part employed the use of structural models which specify demand equations as being either linear or log linear. A partial

(but representative) list of the structural single equation approach include studies by Acheson (1977), Duffy (1983), Hogarty and Elzinga (1972), Johnson and Oksanen (1974, 1977), Kitchin (1981), McGuinness (1980), and Owen (1979). Cook and Tauchen (1982) use a reduced form equation to represent the market for alcoholic beverages as a system of simultaneous equations.

All of these single equation demand approaches in the studies cited above have a number of deficiencies. They are ad hoc and arbitrary in specifying the functional form of demand, that is, they offer no reasoning as to why they believe their estimated demand functions are, for example, linear or nonlinear. A more serious problem of the single equation approach is its emptiness with respect to the major propositions of consumer theory. Only homogeneity can be checked for in a single equation model, net substitution (Hicksian) effects cannot be derived, and it is impossible to test for symmetry or negativity.

Alternatively, the systems approach of modelling the demand for alcoholic beverages has more recently been pursued by a handful of researchers in published and unpublished studies. To my knowledge the only published studies using a systems approach which differentiate between beer, wine and spirits are Clements and Johnson (1982) for Australia, Heien and Pompelli (1989) for the U.S., and Selvanathan (1988) for the U.K. The Heien and Pompelli study uses the Almost Ideal Demand System (AIDS), while the other two employ the Rotterdam system of demand.

TABLE 8

Previous Studies Results of the Demand for Alcoholic Beverages*

	Income Elasticities			Own Price Elasticities		
	Spirits	Beer	Wine	Spirits	Beer	Wine
Alley et.al. (1989)	0.46	-0.03		-1.88	-0.11	
B.C. wine			0.21			-0.75
U.S. wine			0.32			-0.93
other wine			0.67			-0.78
Anastasopoulis et.al. (1986)	0.90	1.02	1.32	-0.74	-0.92	-0.03
Clements and Johnson (1982)	1.91	0.80	0.75	-0.74	-0.36	-0.43
Cook and Tauchen (1982)	0.43			-1.80		
Duffy (1983)	1.67	0.84	2.21	-0.77	+0.20	-0.77
Fuss and Waverman (1988)						
Canada, short run	0.89	0.42	0.57	-0.76	-0.34	-0.85
Canada, long run	1.14	0.56	0.74	-0.78	-0.39	-0.85
B.C., short run	0.77	0.31	0.50	-0.77	-0.24	-0.88
B.C., long run	0.98	0.43	0.65	-0.78	-0.30	-0.88
Heien and Pompelli (1989)				-0.50	-0.84	-0.55
Hogarty and Elzinga (1972)		0.43			-0.89	
Johnson and Oksanen (1974)	0.40	0.06	-0.02	-1.60	-0.38	-1.30
Oksanen (1977)	0.15			-1.77	-0.33	-1.78
Owen (1979)			1.23			-0.62
Selvanathan (1988)	2.18	0.41	1.74	-0.79	-0.20	-0.49

* Much of this table was taken from Alley et.al. (1989).

Unpublished studies using a system of equations approach include work by: Alley, Ferguson, and Stewart (1989) for British Columbia using an AIDS model; Anastasopoulis, Irvine, and Sims (1981) for Canada employing a translog system; and Fuss and Waverman (1987) for Canada using an AIDS model.

Past studies on the demand for alcoholic beverages using a systems approach have most often chosen not to check whether the properties of consumer theory actually hold for the estimated models. There are however several exceptions which include the two studies cited which employ the Rotterdam model and the work by Alley et. al. (1989). Both applications of the Rotterdam model cited above failed to reject the hypothesis of homogeneity and symmetry, and verified that negativity held. These results were conditional in that the systems estimated were not "complete" since total expenditure on alcoholic beverages was taken as given and no "other goods" category was employed. The paper by Alley et. al. (1989) found that homogeneity and symmetry were rejected and that negativity did not hold for the estimated AIDS model. These results however, were also conditional in that the AIDS model estimated had less severe rejections of symmetry than usually found and the non-concavity of the expenditure function was comparatively mild.

One common thread of nearly all demand models of alcoholic beverages, both single equation and the systems approach, are the implications for consumer preferences given by calculated price and income elasticities. **Table 8** summarizes the cited studies as to their computed own price and income elasticities for wine, beer, and spirits. Cross price elasticity relationships regarding the Marshallian substitution effects between spirits, wine, and beer are presented in most of the studies cited above, though the results are about evenly divided as to whether various

alcoholic beverages are substitutes or complements compared to one another. Most of the studies reviewed provide Marshallian cross price elasticity estimates, but Alley et. al. (1989) also provide Hicksian cross price elasticity estimates. All the studies reviewed offer only annual elasticity measures.

Inspection of Table 8 indicates income elasticity measures for spirits ranging from a low of 0.15 found by Johnson and Oksanen (1977) for Canada to a high of 1.91 by Clements and Johnson (1982) for Australia. The majority of the studies tend to characterize spirits as being a superior good, being either a luxury or approaching an income elasticity of one.

Income elasticities in the studies reviewed have fairly consistently tended to characterize beer as a necessity, with most estimates ranging between about zero to one. Income elasticities for wine appear to have the least consistency in agreement between the various studies reviewed. Of the studies offering positive income elasticity measures for wine, four reported income elastic results, while three provided inelastic estimates. Only one study, Johnson and Oksanen (1974), provided a negative income elasticity for wine.

Estimates of Marshallian own price elasticities for spirits, are reported ranging from between -1.88 to -0.5, with four studies reporting elastic Marshallian own price demand, and six reporting inelastic Marshallian own price demand. Almost all studies reported negative inelastic Marshallian own price elasticities for wine and beer. The exceptions being wine in the studies by Johnson and Oksanen (1974, 1977), with measures of -1.30 and -1.78 respectively; and beer in the study by Duffy (1983) who reported a positive Marshallian own price elasticity of 0.20, although he noted it to be statistically insignificant. In most cases, the absolute

magnitude of the Marshallian own price elasticity for wine was above 0.5, while for beer it was below 0.5.

The Hicksian own price elasticities computed by Alley et. al. (1989) were extremely close in magnitude to their corresponding Marshallian estimates owing to the very small budget shares of the alcoholic beverage categories.

Evidence concerning the Marshallian substitution effects between spirits, wine and beer offers two differing views regarding the nature of cross price elasticities between alcoholic beverages. The first is that the cross price effects between spirits, beer and wine are weak. The studies reviewed provide conflicting and inconsistent results concerning the cross price effects on the demand for spirits, beer and wine. This inconsistency, argues Anastasopoulis et. al. (1986), supports the hypothesis of little substitutability between spirits, beer and wine, and that one would not expect complementarity between alcoholic beverages. The second view regards complementarity between alcoholic beverages as being most plausible.

For several of the studies reviewed, complementary relationships are suggested for the demand for beer given a change in the price of spirits or wine. Conversely, a substitution relationship is suggested for the demand of spirits or wine given a change in price of another alcoholic beverage. Alley et. al. (1989) find that beer is consistently complementary with other alcoholic beverages, while B.C. wine, other import wine and spirits are mutual complements. Further, they found that only U.S. wine exhibits extensive substitutability with other alcoholic beverages.

Given that the nature of demand data is such that cross price elasticities are often not well determined, there exists

limited scope to further the debate of the cross price effects suggested by other researchers, or to read too much significance into the estimates which they offer.

3.4 Discussion

Presented in section 3.2 were consumer preference measures from the modified LES for spirits, beer, B.C. Wine, U.S. Wine and other imported wine. Elasticities were computed for each of these beverages for 4 differing periods of the year. The periods chosen were December, January-February, June-August, and March-May and September-November. These periods were determined on the basis of a priori information of the consumption of alcoholic beverages. This information consisted of the holiday and climatic affects on the consumption pattern of alcoholic beverages and an examination of the quantity data for the various categories of beverages, both separately and collectively.

The computed elasticity measures of the estimated modified LES indicate that consumer preferences for a given alcoholic beverage, differs for various times of the year. Generally, the own price demand for spirits, beer and wine was found to be elastic for December and inelastic for the other periods of the year. The income elasticity of beer was found to be about 0.5 all year, except in December when it was computed to be about one. Similarly, spirits were computed to be a luxury in December but a necessity for the other periods of the year. The income elasticity for U.S. Wine suggests it to be a luxury good for the December, June-August and January-February periods, but a necessity for the March-May and September-November period. Both B.C. Wine and other imported wine were computed to be luxury goods for the January-February period and necessities for the other three periods, although both had income elasticity measures above 0.75 for the

December period. Finally, the modified LES model yielded cross price elasticities which suggest the five alcoholic beverage categories are weak substitutes for one another in all four distinct consumption periods.

The overall results paint a plausible description of consumer preferences for each particular beverage category over the four distinct consumption periods of the year. They suggest differing preferences between each beverage, and differing preferences for each particular beverage over the differing periods of the year. The income and price elasticity measures of the other demand studies examined offer no direct comparisons with those of the modified LES model, as they are all annual elasticity estimates. Still, several comparative inferences can be offered.

First, the debate whether a particular alcoholic beverage is price elastic or inelastic, or a luxury or a necessity good, on an annual basis, may in fact not really be important. The estimates from the modified LES model suggest that the own price and income elasticities of a particular alcoholic beverage category can vary considerably depending on the month or group of months one is examining. When annual estimates are used this variance is lost from sight. The quantity demanded for a particular beverage can differ greatly for different periods of the year so as to contribute differing weights to the data which is aggregated into an annual figure. The result is that once an annual price or income elasticity measure is computed, it can offer little interpretation as to the consumer preferences of an alcoholic beverage for any particular time of the year.

A second comparative observation rests with the estimated magnitudes of the income elasticities between various alcoholic beverages. Most of the studies reviewed suggest

that spirits have a higher income elasticity than wine and beer, and that wine has a higher income elasticity than beer. Spirits are generally characterized in the literature as being a luxury good, wine being a modest or near luxury, while beer is almost always estimated to be a necessity. This conclusion was generally found to hold true in the income elasticity measures from the modified LES model for the four distinct consumption periods throughout the year. However, there were some interesting exceptions. In each period except December, all three categories of wine were found to have greater income elasticities than spirits, which was characterized as only being a luxury in the December period. Wine imported from the U.S. was found to be a strong luxury throughout the year except in the March-May and September-November period. Beer was found to be a very modest luxury in the December period, but a necessity throughout the remainder of the year. Again it was evident from the income elasticity estimates that particular beverages have differing consumer preferences for different periods of the year.

The discussion raised in this chapter concerning the differing nature and circumstances of how wine, spirits and beer are consumed, and how consumption differs for a particular beverage over different seasons of the year, suggests further investigation is warranted in future demand studies of alcoholic beverages. To the knowledge of the author, this paper is the first time consumer elasticity measures have been offered for various alcoholic beverages over different seasons of the year. All previous demand studies reviewed have offered elasticity measures computed on an annual basis. Evidence has been presented that while such annual measures offer a general indication as to consumer preferences, such preferences can fluctuate widely over various periods of the year.

Attention is now turned upon applying the estimated LES demand model to estimate the consumer welfare, government revenue and demand effects of freer trade in alcoholic beverages.

CHAPTER 4

POLICY SIMULATIONS USING THE LES DEMAND MODEL

This chapter presents a computational general equilibrium model to simulate policy changes of freer trade in alcoholic beverages and then goes on to apply the model to the estimated LES demand model under a series of policy changes resulting from the FTA and GATT panel ruling described earlier. The welfare analysis is valid since the estimated LES model was shown to satisfy the four properties of consumer theory. First however, the estimated modified LES model is calibrated to allow for the subsequent welfare analysis.

4.1 Calibration of the LES Model

As mentioned earlier the major objective of utilizing the LES was because of its strong use of consumer theory. By construction the estimated LES (8) satisfied the first three properties of consumer theory - adding up, homogeneity, and symmetry. The fourth property was shown to hold since all the estimated β_{ih} coefficients were positive and hence negativity holds for the estimated LES (8) demand system.

Recall that all quantities and total expenditure were in per capita per day format for estimation of the model. This was necessary to account for the differing number of business days from month to month. To accommodate the welfare analysis which follows, the estimated LES model has to be converted back into per month terms. This is accomplished by multiplying through the estimated equations (8) by the mean number of business days for each of the four monthly groups. This has the effect of altering only the γ coefficients so

that the model is now back in per capita per month terms. The altered γ coefficients are now denoted $\hat{\gamma}$.

The final modification necessary to operationalize the LES model for the welfare analysis was to calibrate it to ensure when the mean prices and expenditure were applied the model could deliver the mean quantity measures. The model was in a per month form with the ability to yield quantity demand for each of the five alcoholic beverage categories for four separate like-demand monthly groupings. In order to calibrate the Marshallian demand equations each equation was first aggregated into an annual form from the four like-demand monthly groupings. This aggregation required that the coefficients for each of the 12 months be assigned their value from their like-demand grouping. The dependant variable for each equation that was used in calibration was the actual annual quantity demand taken at the sample means, $\bar{Q}_i$. The demand equations used for calibration were of the form

$$\bar{Q}_i = \lambda_i \left(\sum_{m=1}^{12} \hat{\gamma}_{im} \right) + \sum_{m=1}^{12} \left(\beta_{im} \frac{(\bar{y} - \sum_j \bar{p}_j \hat{\gamma}_{jm} \lambda_j)}{\bar{p}_i} \right) \qquad (15)$$

With this information in hand the 6 equation LES model was calibrated using the annual quantities ($\bar{Q}_i$), monthly prices ($\bar{p}_i$) and monthly total expenditures ($\bar{y}$) taken at the sample means, together with the previously estimated β and $\hat{\gamma}$ coefficients to estimate six λ calibration coefficients.

Again only the gamma, and not the beta coefficients were affected. The six estimated calibration coefficients were used to calculate calibrated gamma coefficients, denoted $\tilde{\gamma}_i$, where $\tilde{\gamma}_i = \hat{\gamma}_i \lambda_i$. The estimated $\tilde{\gamma}$ and β coefficients of the calibrated LES model are displayed in **Table 9**. The estimated

and calibrated LES model is now ready for the demand and welfare analysis which is undertaken below.

4.2 A Computational General Equilibrium Model

In studying the effects of the FTA and GATT ruling on alcoholic beverages, it is necessary to consider the resultant changes in federal taxes, provincial taxes (including markups), production costs associated with the removal of the grape importation quota, and the eventual rationalization of the beer industry. For reasons of comparison this paper adopts the modelling approach taken by Ferguson et.al. (1989). This section does little more than replicate their general equilibrium model for which it shall be later applied to the estimated and calibrated LES demand model described above.

The view is taken that production of alcoholic beverages is a relatively small portion of British Columbia's small open economy subject to world product markets and national factor markets. Both world prices and factor incomes are taken as given, and it is assumed that factors of production can be reallocated without altering their returns in light of policy changes toward a particular industry (in this case the alcoholic beverage industry). The grape growing industry in the Okanagan might be taken to be an exception to this view, although growers have been allowed financial compensation under the federal/provincial Grape Assistance Initiative for pulling out their vineyards.[9]

Given these assumptions, Ferguson et.al. (1989) present a simple general equilibrium model which possesses many features of partial equilibrium analysis, but also addresses how the alcoholic beverage industry, which on the whole faces exceedingly high rates of taxation, relates to the overall tax

structure of the economy. Their model directly addresses the distortions involved due to the large taxes put on alcoholic beverages.

For the demand side of the model assume a representative consumer with indirect utility function

$$u = v[\mathbf{p}, y], \tag{16}$$

with consumer prices and expenditures given by

$$\mathbf{p} = \bar{\mathbf{p}} + \mathbf{t}_p + \mathbf{t}_f \tag{17}$$

$$y = \bar{y} - T, \tag{18}$$

where $\bar{\mathbf{p}}$ is a vector of producer prices, $\mathbf{t}_f$ and $\mathbf{t}_p$ are vectors of the federal and provincial taxes (including markups), $\bar{y}$ is initial expenditure on goods and services, and T is a tax variable to be discussed below. In line with the assumptions made above, $\bar{y}$ is treated as given.

For the production side of the model it is assumed that the marginal costs for any single plant are independent of the level of output, but are dependent on factor prices which are given. Plants with different design capacity have different costs, so the construction of plants with larger capacity could be expected to have reduced unit costs. It is assumed, that for domestically produced goods, this would be translated through to domestic producer prices $\bar{p}_d$ which change in proportion with unit costs. For internationally produced goods, producer prices $\bar{p}_i$, are treated as given.

Ferguson et.al. (1989) choose in their model to ignore

the possible effects of distortions due to different profit markups. Such consideration would require numerous speculative assumptions regarding the complex internal distribution of production amongst various branches of the alcoholic beverage industry and the economy. Such an exercise was not undertaken and is justified due to the fact that producer profit differentials are relatively very small compared to the distortions resulting from the tax structure for the alcoholic beverage sector.

The model supposes that government revenues lost from the alcoholic beverage industry resulting from trade liberalization will be made up through the imposition of a redistributive tax applied to all goods and services, which for modelling purposes, shows up in the form of a reduction in consumer expenditure. For simplicity this tax is represented by an equivalent lump sum tax T [recall equation (18)].

Finally, the model considers the revenue changes to provincial and federal levels. Although the FTA and GATT ruling affect all provinces, the nature of effects differ for each individual province. The magnitude of the cumulative national effect upon federal revenues is uncertain without examination of each particular province, something beyond the scope of this thesis.

The federal revenues received from B.C. are represented

$$R_f = t_f \bullet q[p,y], \qquad (19)$$

where q[p,y] is the vector of Marshallian demand functions. Any changes in federal revenue from B.C. due to trade liberalization of alcoholic beverages are seen as being small

in relation to the federal budget and would be absorbed by it. While these changes in federal revenues are later reported adjacent to the policy simulation results, they do not formally constitute a part of the model being discussed.

The provincial revenues

$$R_p = t_p \bullet q[p, y], \tag{20}$$

are central to the model and are appropriately considered as affecting a small regional economy which the model addresses. Changes in provincial revenues are thus matched by equal changes in taxes on all other goods so it is assumed that

$$T + R_p = \text{constant}. \tag{21}$$

The components discussed above which make up the simple general equilibrium model of Ferguson et.al. (1989) include (16), (17), (18), (20), and (21). This model is empirically applied in the following section to the estimated LES demand model under a series of changing prices and taxes associated with the FTA and GATT ruling.

TABLE 9

Calibrated LES $\tilde{\gamma}$ and β Estimated Coefficients

DECEMBER

	$\tilde{\gamma}$	β
Spirits	-1.53226	0.03704
B.C. Wine	-0.04771	0.00321
Other Wine	0.13763	0.00312
U.S. Wine	-0.02872	0.00085
Beer	-0.85670	0.01164
Other Goods	-0.85949	0.94414

JANUARY and FEBRUARY

	$\tilde{\gamma}$	β
Spirits	0.63231	0.00856
B.C. Wine	0.60792	0.00072
Other Wine	0.13808	0.00344
U.S. Wine	0.00095	0.00022
Beer	5.36441	0.00545
Other Goods	4.24377	0.98161

JUNE through AUGUST

	$\tilde{\gamma}$	β
Spirits	0.92097	0.00554
B.C. Wine	0.59884	0.00154
Other Wine	0.23234	0.00246
U.S. Wine	-0.00163	0.00037
Beer	7.09482	0.01061
Other Goods	3.56439	0.97948

MARCH through MAY and SEPTEMBER through NOVEMBER

	$\tilde{\gamma}$	β
Spirits	0.84034	0.00235
B.C. Wine	0.61086	0.00048
Other Wine	0.24095	0.00092
U.S. Wine	0.00359	0.00004
Beer	2.08581	0.00682
Other Goods	-6.34310	0.98939

4.3 Policy Simulations

As discussed earlier a modified LES demand model was estimated for five separate alcoholic beverage categories and one "other goods" category. This LES model represents the central component here to the simple general equilibrium computational model described in section 4.2. In applying this computational model various aspects of the FTA and GATT ruling had to be addressed.

Six separate scenarios were considered in analyzing the effects of freer trade liberalization, and are denoted I.A. through III.

Case I, FTA

Markups on U.S. wine and spirits and B.C. wine and spirits collapsed together in between previous U.S. and B.C. markup levels, with only a five point percentage differential remaining. Tariffs on U.S. wine and spirits removed, grape import quota removed.

I.A. - Markups on U.S. and B.C. wine, tariffs on U.S. wine.
I.B. - Scenario I.A., plus removal of grape quota.
I.C. - Scenario I.B., plus markups on U.S. and B.C. spirits, tariffs on U.S. spirits.

Case II, GATT Short Run

Scenario I.C. plus complete collapse of the differential markups on B.C. and other import wine and spirits in between their previous markup levels.

II.A. - wine only.
II.B. - wine and spirits.

Case III, GATT Long Run

Scenario II.B. plus a reduction in markup on all imported beer to the domestic beer markup level, and full rationalization of the domestic beer industry.

Equation (1) from Chapter 1 was used to calculate the consumer and producer prices for the scenarios for each of the three categories of wine. The mean of the observed prices for B.C., U.S. and other imported wine were taken along with Equation (1) and the initial values of the various taxes and markups outlined in Chapter 1 to calculate mean producer prices, which were then used in Equation (1) again to arrive at consumer prices and tax components under each of the six scenarios.

For beer and spirits this could not be done directly since the data did not distinguish between domestic and imported beer and spirits. Each were handled differently in calculating consumer and producer prices.

Separate producer prices for domestic and foreign beer firms were deduced by using Equation (1) and applying the respective taxes and markups from the common mean initial retail price. It was found the producer price of imported beer was, on average, only 71 per cent of the domestic producer price.[10] This information on imported beer producer prices was used as the basis for calculating retail beer prices in the last scenario, coinciding with the full rationalization of Canada's brewing industry and the reduction of the markup level on imported beer to the domestic beer markup level.

Spirits were treated as having a common producer price in all countries. Using the average retail price of spirits

along with knowledge of the respective market shares of Canadian, U.S., and other imported spirits, differing taxes and markups, and Equation (1), a figure was reached for the common spirits producer price. This was then used with the above information to arrive at a composite spirits price index under each of the scenarios, and based on the assumption of a constant respective market share. This last assumption is reasonable in that markup differential and tariffs account for relatively little of the final price of spirits.

One final addition to the computational model was the inclusion of measures of welfare change to evaluate and compare the six scenarios to the base case mean. These are the equivalent and compensating variation.

For each of the freer trade scenarios the calculated prices and tax components were included with equations (15), (17), (18), (20), (21), and the equivalent and compensating variation equations for the LES expenditure function to form the computational model. The model was run for each of the six scenarios and the results are presented in the following section.

4.4 Simulation Results

Table 10 presents the results of the simulations for the 6 freer trade scenarios described in the previous section. The equivalent variation (EV) provides a welfare measure for the effects of the six policy scenarios viewed from the base case. The EV views changes in provincial revenues as affecting consumer expenditures. Alternatively, the compensating variation (CV) is a welfare measure that assumes the policy change has occurred and indicates the compensation required to move back to the status quo.

TABLE 10

Policy Simulation Results

Scenerio	I.A.	I.B.	I.C.	II.A.	II.B.	III.
	Changes in Welfare (millions of dollars per year)					
Equivalent Variation	-1.7074	2.5549	2.5632	6.6061	7.2525	93.2225
Compensating Variation	-1.7076	2.5551	2.5634	6.6046	7.2503	93.0848
	Changes in Government Revenue (millions of dollars per year)					
Change in provincial revenue	13.9546	12.0834	12.0638	1.7700	-0.3899	21.7200
Change in federal revenue	-0.5388	-0.3962	-0.4032	0.2278	0.5312	4.0415
	Percentage Change in Quantity Demanded					
Spirits	0.0104	0.0113	0.0139	0.0057	0.2592	0.3163
B.C. wine	-5.3166	-3.5134	-3.5135	-3.5183	-3.5120	-3.4732
Other wine	0.0068	0.0113	0.0112	10.0591	10.0568	10.1816
U.S. wine	8.8392	8.8438	8.8437	8.8209	8.8117	9.0117
Beer	0.0056	0.0096	0.0096	0.0016	-0.0002	9.8164
Other goods	0.0087	0.0169	0.0169	0.0020	-0.0001	0.1572

To approximate the welfare effects if changes in all government revenue are ignored subtract the Δ provincial revenue from the EV. To approximate the welfare effects if changes in both provincial and federal revenues affect consumer expenditure, add the Δ federal revenues to the EV.

All of the figures presented in Table 10 present departures from the base case mean of the data to the various scenarios. The one exception to this are the CV calculations, which view the particular policy scenarios as the base case, and measure the compensation required to return to the status quo. Leaving aside the CV, the way in which the scenarios were constructed allows for consideration of the cumulative effects of the policy changes as one moves from left to right in Table 10. A particular policy can be approximated by subtracting the figure immediately to the left of that policy scenario.

A number of interesting observations are provided from the results. Removal of the tariff on U.S. wine and collapsing the markup between B.C. and U.S. wine in scenario I.A. resulted in a welfare loss. However, in each of the other five scenarios there was a welfare gain. Increased consumer prices for B.C. wine leads the model to predict about a 5.3 percent decrease in demand for B.C. wine in Scenario I.A., but this is tempered by removal of the grape import quota to about a 3.5 percent decrease in the demand for B.C. wine in scenario I.B. and beyond. The decreased markup and removal of the tariff on U.S. wine is predicted to increase the demand for American wines by about 9 percent in all policy scenarios. The nature of the LES demand model is evident in that changes in demand are only significant when the own price of a beverage is altered with the demand for other beverages only being slightly altered. The changes in demand predicted are all as expected from an own price perspective, although the

cross price effects are obviously very weak with the LES demand model.

While only modest gains in welfare are made under two of the three scenarios representing the FTA, the gains in welfare under the GATT ruling are in the order of twice the magnitude concerning wines and spirits. Collapsing the markup in between previous other import wine and B.C. wine markup levels in scenario II.A. suggests about a 10 percent increase in the demand for other import wine. The collapsing of markups for B.C. produced spirits and other imported spirits in between their previous markup levels suggests a modest 0.25 percent increase in overall demand for spirits.

The welfare gain under scenario III is clearly much larger owing in large part to the fact that expenditures on beer were some five times that made on imported wines on average for the period of study.

The impact on government revenues points to somewhat conflicting differences of interest for the two levels of government. Both find the largest gains in revenue under scenario III although the increase for the province is approximately five times that of the federal government in this case. Putting aside the issue of beer and the last scenario, the Province of B.C. clearly would prefer the revenue increases under the FTA, while the preferred scenarios for the federal government fall under the trade liberalization of the short-run GATT ruling.

From the policy simulations, it is evident from the results in Table 10 that welfare gains and losses must be viewed in relation to the changes in government revenues and the demand for the various alcoholic beverages. These changes in demand are certain to impact the wine and beer producing

sectors of British Columbia, but have only a very limited impact on the spirits producing sector in British Columbia.

Overall, leaving aside the fate of B.C. beer and wine producers, the results suggest freer trade in all alcoholic beverages, as represented by scenario III, are a net benefit to B.C. consumers, the tax revenues of the B.C. government, and the federal government's tax revenues on alcoholic beverages collected from the consumers of British Columbia.

CHAPTER 5

CONCLUSIONS

This study has estimated a model of consumer demand using monthly data on the sales of various kinds of alcoholic beverages in British Columbia over the period of April, 1981 to August, 1986. The estimation results were examined in view of the properties of consumer theory, and to interpret consumer preferences, both aspects of which were compared to the evidence reported in earlier literature. The demand results were then combined within a simple general equilibrium model to simulate various scenarios of freer trade consistent with the Canada-United States Free Trade Agreement (FTA) and the General Agreement on Tariffs and Trade (GATT) ruling on the marketing of alcoholic beverages. Estimates are obtained under the various simulations run for the effects on alcoholic beverage demand, government revenues and consumer welfare. The results suggest freer trade in all alcoholic beverages is a net benefit to B.C. consumers, the B.C. government, and the federal government's revenues on alcoholic beverages received from British Columbia.

The protection and taxation of alcoholic beverages in British Columbia was described through an examination of the taxes, tariffs, listing practices, discriminatory markups and import quotas on grapes which combine to impact the alcoholic beverage sector. Also described were the implications of the Canada/United States Free Trade Agreement (FTA) and General Agreement on Tariffs and Trade (GATT) ruling on the marketing of alcoholic beverages, both which require the abandonment by the Province of differential markup practices between domestic and imported alcoholic beverages. The required changes in taxes and markups were later used in constructing freer trade

policy scenarios which were simulated to measure consumer welfare, demand and government revenue changes.

"The Linear Expenditure System (LES)" developed by Stone (1954b) was introduced and discussed. The basic LES was modified to capture the seasonal demand patterns of alcoholic beverage sales over the course of a year. Both the basic and modified LES models, by construction, satisfy the first three properties of consumer theory. The fourth property, negativity, can easily be checked for by examining the estimated demand results. Both models when estimated, upheld the property of negativity. This was a major reason for choosing the LES model, since only if consumer theory is shown to hold is it legitimate to later undertake consumer welfare calculations.

The key reason for choosing the modified LES model, was to allow the computation of seasonal measures of consumer preferences for various types of alcoholic beverages. To the knowledge of the author, this paper was the first time price and income elasticity measures were computed for different seasons or consumption periods of the year. Four distinct patterns in the sales of alcoholic beverages were evident from the data. These were chosen as the four seasonal consumption periods and were incorporated into constructing the modified LES model. These periods were: December; January-February; June-August; and, March-May and September-November.

Both the basic and modified LES models were estimated and the results presented. Performance of a log likelihood ratio test using the results of the two estimated specifications, suggested further that the modified LES model was to be preferred on a statistical, as well as an intuitive basis. The estimated modified LES model results were interpreted with regard to the consumer preferences they imply in the form of

price and income elasticity measures.

The results suggest that consumer preferences for various alcoholic beverages do vary considerably over the four distinct consumption periods of the year. A comparison of the elasticity measures with those of previous studies indicates that annual elasticity measures tend to hide the demand fluctuations occurring throughout the year. The debate whether a particular alcoholic beverage is price elastic or inelastic, or a luxury or a necessity, on an annual basis, may in fact not really be that important or meaningful.

The elasticity measures from the modified LES model provided a plausible description of consumer preferences for each particular beverage category over the four distinct consumption periods of the year. In all periods, each of the five alcoholic beverage categories are characterized as own price normal and income superior goods. For the December period, all beverages were computed to be luxury goods and own price elastic, though most were computed to be own price inelastic in the other three periods. Like most other studies, beer tended to be characterized as having the lowest income elasticity, with wine and spirits being characterized as either luxuries or necessities depending upon the particular time of the year. It is suggested that besides differing periods of the year, consumption of alcoholic beverages is likely affected by the particular beverage and the accompanying circumstances and characteristics of how, when and where it is consumed. For example, the inventory life of opened spirits is significantly greater than most types of wine, and all beer. The discussion raised concerning the differing nature and circumstances of how wine, beer and spirits are consumed, and how consumption differs for a particular beverage over different periods of the year, suggests that further investigation is warranted in future

demand studies of alcoholic beverages.

A computational general equilibrium model was introduced, and applied to the estimated calibrated modified LES model under a series of policy changes to simulate the effects of freer trade resulting from the FTA and GATT ruling described earlier. The model was run for the calculated price and tax components of the freer trade scenarios with the LES demand equations, price, tax and government revenue equations, and the equivalent and compensating variation equations from the LES expenditure and indirect utility functions. The results indicated that in five of the six scenarios there was a gain in consumer welfare.

Freer trade with the U.S. in wine and spirits under the FTA encompassed the removal of tariffs on U.S. wine and spirits, the collapsing of markups between U.S. and B.C. wine to a five percent differential, and removal of the import quota on grapes used by B.C. wine producers. On an annual basis, this resulted in a decreased demand for B.C. wine by about 3.5 percent, an increase in the demand for U.S. wine by about 8.8 percent, an increase in B.C. government revenues by some $12 million dollars, a decrease in federal government revenues of about $0.4 million dollars, and an increase in consumer welfare of about $2.5 million dollars.

Freer trade as required by the GATT included collapsing the markups completely to in between the previous markups of B.C. and other imported wine and spirits. When this was combined with the changes required by the FTA, and computed on an annual basis against the results of the FTA only, there was predicted over a 10 percent increase in the demand for other import wine, a modest 0.25 percent increase in the overall demand for spirits, a fall of just over $12 million dollars in provincial alcohol revenues, an increase in federal tax

revenues by about $0.9 million dollars, and an increase in consumer welfare of about $4.7 million dollars.

The final scenario which simulates international freer trade in beer as well as for wine and spirits as described above, suggests that on an annual basis against the status quo, the gain in consumer welfare would reach about $93 million dollars, provincial revenues would increase by almost $22 million dollars, federal revenues would increase by about $4 million dollars, and the demand for beer overall would increase by almost 10 percent. It is important to view consumer welfare gains and losses in relation to the accompanying changes in government revenues and the demand for the various types of alcoholic beverages. The changes in demand are certain to affect the wine and beer producing sectors of British Columbia who have been quite protected over the years.

The consequences of freer trade on producers of alcoholic beverages, while not considered in this paper, provides another interesting area for future study into the B.C. alcoholic beverage sector, as does examining the effect of freer trade on the quality of B.C. produced wine.

NOTES

[1] This range in production costs was estimated by Irvine, Sims and Anastasopoulis (1989).

[2] See Ferguson et.al. (1989).

[3] See Agriculture Canada (1986).

[4] For a more complete review see Varian (1984).

[5] See Deaton (1986).

[6] See, for example, Phlips (1974), pp. 122-125.

[7] For an exposition of the requirements for negativity of the LES, see Thomas (1988).

[8] For a detailed discussion of the properties of the LES, see Deaton (1975), or Thomas (1987).

[9] See British Columbia (1989).

[10] See Ferguson et.al. (1989).

BIBLIOGRAPHY

Acheson, K. (1977) "Revenue vs. Protection: The Pricing of Wine by the Liquor Control Board of Ontario," Canadian Journal of Economics 10, 246-262.

Agriculture Canada (1986) "Development in the Agri-food sector in British Columbia, Grape Commodity Profile." Agriculture Development Branch, New Westminster, British Columbia.

Alley, A., Ferguson, D., and K. Stewart (1989) "An Almost Ideal Demand System for Alcoholic Beverages in British Columbia." Discussion Paper 89-11, Department of Economics, University of Victoria.

Alley, A. (1987) "Consumer Demand for Alcoholic Beverages in British Columbia With and Without Free Trade in Wine." Unpublished Masters Thesis. University of Victoria.

Anastasopoulis, A., Irvine, I., and W.A. Sims (1986) "Free Trade between Canada and the United States in Alcoholic Beverages," Working Paper, Institute of Applied Economic Research, Concordia University, Montreal.

British Columbia (1989) "Canada-British Columbia Grape and Wine Adjustment Assistance Initiative." ARDA Branch, Victoria, British Columbia.

Clements, K., and L. Johnson (1983) "The Demand for Beer, Wine and Spirits: A System-wide Analysis," Journal of Business 56, 273-304.

Cook, P., and G. Tauchen (1982) "The Effect of Liquor Taxes on Heavy Drinking," The Bell Journal of Economics, Autumn, 379-390.

Deaton, A.S. (1986) "Demand Analysis," in The Handbook of Econometrics, Volume III, ed. by Griliches, Z., and M.D. Intrilligator. (Amsterdam: Elsevier Science Publishers).

Deaton, A.S., and J. Muellbauer (1980a) Economics and Consumer Behavior. (Cambridge: Cambridge University Press).

Deaton, A.S., and J. Muellbauer (1980b) "An Almost Ideal Demand System," American Economic Review 70, 312-326.

Deaton, A.S. (1975) Models and Projections of Demand in Post-War Britain. (London: Chapman and Hall).

Duffy, M. (1983) "The Demand for Alcoholic Drink in the U.K. 1963-1978," Applied Economics 15, 125-140.

Ferguson, D., Stewart, K., and A. Alley (1989) "Sectoral Free Trade in the Presence of Tax Distortions: The Case of Alcoholic Beverages," Discussion Paper 89-12, Department of Economics, University of Victoria.

Fuss, M., and L. Waverman (1987) "The Demand for Alcoholic Beverages in Canada: An Application of the Almost Ideal Demand System," Working paper no. 8714, Institute for Policy Analysis, University of Toronto.

Hogarty, T., and K. Elzinga (1972) "The Demand for Beer," Review of Economics and Statistics 54, 195-198.

Irvine, I., Sims, W.A., and A. Anastasopoulis (1989) "Interprovincial versus International Free Trade: The Brewing Industry," Working Paper, Institute of Applied Economic Research, Concordia University, Montreal.

Johnson, J. and E. Oksanen (1977) "Estimation of the Demand for Alcoholic Beverages in Canada from Pooled Time Series and Cross Sections," Review of Economics and Statistics 59, 113-118.

Johnson, J. and E. Oksanen (1974) "Socio-economic Determinants of the Consumption of Alcoholic Beverages, Applied Economics 6, 293-301.

Kitchin, P. (1981) "Some Socio-Economic Determinants of Alcohol Consumption: Research Note," International Journal of Social Economics 8,31-35.

McGuiness, A.J. (1980) "An Econometric Analysis of Total Demand for Alcoholic Beverages in the U.K. 1956-75," Journal of Industrial Economics 29,85-109.

Owen, A. (1979) "The Demand for Wine in Australia 1955-77," Economic Journal 55, 230-235.

Phlips, L. (1974) Applied Consumption Analysis. (Amsterdam: North Holland.).

Selvanathan, E.A., "Alcohol Consumption in the U.K., 1955-85: A System-Wide Analysis," Applied Economics 20, 1071-1086.

Stone, J.R.N. (1954a) The Measurement of Consumer Expenditure and Behavior in the U.K. 1920-1938, Vol. 1. (Cambridge University Press: Cambridge).

Stone, J.R.N. (1954b) "Linear Expenditure Systems and Demand Analysis- An Application to the Pattern of British Demand," Economic Journal 64, 511-27.

Thomas, R.L. (1987) Applied Demand Analysis. (New York: Longman).

Varian, H. (1984) Microeconomic Analysis. (New York: W.W. Norton).

VITA

Surname: PAL **Given Names:** Stephen Edward

Place of Birth: Calgary, Alberta

Date of Birth: January 7, 1964

Educational Institutions Attended:

UNIVERSITY OF VICTORIA, B.C.	1987 to 1991
UNIVERSITY OF CALGARY, ALBERTA	1982 to 1987

Degrees Awarded:

B.A. (Economics)	1987	University of Calgary

Honours and Awards:

Canadian Pacific Scholarship	1987-88

Publications:

PARTIAL COPYRIGHT LICENCE

I hereby grant the right to lend my thesis to users of the University of Victoria Library, and to make single copies only for such users or in response to a request from the Library of any other university, or similar institution, on its behalf or for one of its users. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by me or a member of the University designated by me. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Title of Thesis:

Consumer Demand, Government Revenues, and Welfare Effects from Sectoral Free Trade: The Case of Alcoholic Beverages in British Columbia.

Author

Signature

Stephen E. Pal
Name

December 30, 1991
Date