THE DEMAND FOR MILK IN BRITISH COLUMBIA: ESTIMATION AND IMPLICATIONS

by

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ABSTRACT

In this paper, we estimate dynamic versions of the Almost Ideal Demand System and the Linear Expenditure System in order to obtain an estimate of the demand elasticity for milk in British Columbia. This parameter has, to our knowledge, never been estimated for one province, but given the ongoning interest by the B.C. dairy industry in obtaining a larger allocation of Market Share Quota (MSQ), which is now allocated as a function of fluid milk consumption, it is timely to estimate the elasticity of demand for milk in British Columbia. Many have argued that the retail price of milk in B.C. is too high, especially when compared to prices in other western provinces, as well as the neighbouring State of Washington. The argument is that significant increases in consumption, and thereby increased allocation of MSQ could be achieved through decreases in prices. However, this depends upon the elasticity of demand which we herein estimate.

Our estimate of the elasticity of demand for milk in British Columbia is -0.33, as estimated from the dynamic Almost Ideal System, and -0.40 from the dynamic Linear Expenditure System. We note that the dynamic Linear Expenditure System estimated in this study was statistically significant and met all theoretical restrictions, in particular quasi-concavity of the utility function at each observation point. We note, however, that this elasticity estimate may be interpreted as a short run estimate owing to our limited time frame for analysis. Clearly, with an elasticity estimate in the order of -0.40, "significant" increases in consumption cannot be achieved solely through decreases in prices.

This paper, however, does more than simply relay elasticity estimates, for it also provides tips and techniques for estimating demand systems such as those estimated in this paper. These strategies are typically not found in textbooks or journal articles, and as such can be of great use to those estimating demand systems for the first time.

In addition, this study makes use of a regional data source that has previously been unavailable to applied economists. Those who have attempted to estimate the demand for milk regionally have found that Statistics Canada does not publish regional consumption figures for most commodities. This is particularly true for the consumption of beverages in British Columbia. The data for this study were obtained privately and statistically represent bi-monthly sales of beverages in British Columbia. Thus, this paper is the first to estimate the demand for milk in British Columbia by using a demand systems approach employing data obtained from a private source (i.e. not Statistics Canada or other public sector organisations).

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1.0 INTRODUCTION

Dairy products, in particular fluid milk, are a key component of the food basket in Canada, as they account for approximately sixteen percent of total food and beverage purchases. Moreover, the dairy industry remains a key sector of the economy, accounting for thirty three percent of farm cash receipts in Quebec, eighteen percent in Ontario, and approximately twenty one percent of the receipts in British Columbia. In spite of the importance attached to the Dairy industry, there has been little recent research on identifying variables affecting dairy product consumption and then estimating their effect. The majority of previous research has been focussed on a national level using data from the 1970's or earlier, and while national consumption studies are useful, they do not reflect peculiarities which are specific to each provincial market. This is particularly true in the case of the British Columbia milk market.

During the past three years, British Columbians have on average been paying fifteen percent more for their milk than consumers in the main centres of Calgary, Edmonton, Saskatoon, Regina, and Winnipeg. In fact, B.C. fluid milk prices are among the highest of any jurisdiction in North America. In addition, a major proportion of B.C.'s population lives less than twenty five miles from the U.S. border, where they can purchase U.S. milk at a price considerably lower than that charged in British Columbia. Given these price differentials, there have been questions raised from time to time about the appropriateness of pricing policy for fluid milk in B.C.. Notwithstanding the consumer interest in lower milk prices, there has been an argument put forward that the milk industry, including both producers and processors, would be better off as a result of the increase in fluid milk sales induced by a lowering of prices at the retail level. Given that B.C. has, on more than one occasion, expressed its dissatisfaction with the allocation of industrial milk quota, there is an added reason to seek the most advantageous pricing arrangement for fluid milk in B.C..

The argument, however, depends crucially upon a parameter of demand, the own-price elasticity. This parameter has not previously been estimated for B.C., and as such it is both timely and useful to estimate a demand function for fluid milk in B.C.. This is the objective of this study.

1.1 BACKGROUND

There exist two distinct markets for milk in British Columbia and Canada. Of all the milk produced, approximately sixty five percent is used in the industrial milk market, where it is manufactured into milk products such as butter, cheese, yoghurt, and ice cream, while thirty five percent is used in the fluid milk market (table milk and fresh cream). The production of industrial milk in British Columbia, as in the rest of Canada (excluding Newfoundland) is currently regulated by a national agreement, The National Milk Marketing Plan. Under the auspices of this agreement, the Canadian Milk Supply Management Committee sets national quota levels (Market Share Quota) for industrial milk and allocates this quota provincially on the basis of historical production patterns. The exception is British Columbia, who had negotiated a special membership provision in November 1984 after giving notice to opt out of the plan in 1983-1984. The provision, which is unique to B.C., allows for B.C.'s provincial market share quota (MSQ) to be determined on the basis of a 35/65 rule, i.e. B.C.'s MSQ within any dairy year will be based on 35/65th's of its average consumption of fluid milk over the previous two calendar years, calculated on the basis of butterfat. However, a companion provision provides that in years in which global Canadian MSQ does not increase, B.C.'s increase in MSQ will be restricted to a maximum of 0.1% of the global Canadian MSQ for that year. Production levels of fluid milk, however, are the responsibility of the provincial marketing boards who administer pricing formulae, quota policies and other regulations. The provincal boards oversee all aspects of the fluid milk market and aim for self-sufficiency in both table milk and fresh cream within their respective borders, while providing a stable environment for local dairy industries.

In 1986, there were 1183 dairy farms in British Columbia, of which 846 farms (72%) generated sales of over $100,000 per farm. Moreover, dairy cash receipts, as a percentage of total farm cash receipts, ranks first in B.C. (approximately 21%). In contrast, Canadian dairy cash receipts as a percentage of total farm receipts (approximately 14%) ranks second behind cattle and calves. Considering that one in every five dollars of farm receipts in B.C. (and one in every seven dollars in Canada) comes from dairying, it is not hard to see why the dairy industry is economically and politically important. In 1989, the dairy industry in Canada accounted for over 3 billion dollars in farm cash receipts. But, as Barichello (1980) points out, the magnitude of this number hides the inequality of distribution among various provinces. Of this three billion dollars in 1989, Quebec's share was approximately thirty seven percent, Ontario was second with thirty five percent, and Alberta and B.C. were equal with almost eight percent.

The current allocation of MSQ to British Columbia, where approximately twelve percent of the national population resides, is approximately 3.8% of the national total. However, Quebec and Ontario combined have approximately eighty percent of the national MSQ. With such an unequal distribution, it is not surprising to find strong debate surrounding these seemingly arbitrary provincial allocations.

1.2 PROBLEM STATEMENT

The current allocation of national MSQ quota is not the only source of discontent in the industry. Given B.C.'s status in the National Milk Marketing Plan, expansion in B.C.'s MSQ is limited to increased consumption of fluid milk, given that B.C. decides not to opt out of the existing national plan. However, per capita sales of many dairy products, milk in particular, offer little growth and in some cases even decline. This is illustrated in table 1.

Table 1 - Commercial (per capita) sales of milk in B.C.

Period	Whole Milk (l/cap)	% change	2 % Milk (l/cap)	% change	All Milk (l/cap)	% change	B.C. Pop. (000)	% change
1978	44.70	-	53.90	-	76.00	-	2542.3	-
1979	45.10	+0.89	56.40	+4.64	78.00	+2.63	2589.4	1.85
1980	44.50	-1.33	57.40	+1.77	78.10	+0.13	2666.0	2.96
1981	43.10	-3.15	58.10	+1.22	77.30	-1.02	2744.2	2.93
1982	39.70	-7.89	57.30	-1.38	73.30	-5.17	2787.7	1.59
1983	36.30	-8.56	55.60	-2.97	69.00	-5.87	2813.8	0.94
1984	33.40	-7.99	55.90	+0.54	66.20	-4.06	2847.7	1.20
1985	30.90	-7.49	56.60	+1.25	64.40	-2.72	2870.1	0.79
1986	29.60	-4.21	57.70	+1.94	63.90	-0.78	2889.0	0.66
1987	27.80	-6.08	57.80	+0.17	62.40	-2.35	2925.0	1.25
1988	26.30	-5.40	58.00	+0.35	61.20	-1.92	2980.2	1.89
1989	24.30	-7.60	58.00	+0.00	59.50	-2.78	3053.3	2.45
TOTAL	-	-45.64	-	+7.61	-	-21.71	-	+20.10

Source: The Dairy Review, various issues.

Apart from decreased sales due to the ongoing health consciousness attitude, some have argued that the product (milk) in B.C. retails at too high a price when compared to what the producer is paid. These prices have not been set at this level by an explicity policy, but rather by a formula devised in 1955. In 1989, the B.C. farmer received approximately 59c per litre for his product, yet the product retailed for just over $1 per litre. This is an enormous difference (over 70%), and is quite surprising when we find that discounts in the order of twenty to twenty five percent are being given to large accounts by processors (Shelford, 1988). Some, such as Shelford, have argued that there exists "excess fat" in the industry, and whether or not it accrues to either processor or retailer, or whether higher prices to low volume accounts helps to meet the demand of large retailers is unclear. In any event, it is a disturbing issue, and one that ties in directly with the desire for more MSQ quota in B.C.. As you may recall, MSQ quota in B.C. is allocated on the basis of fluid milk consumption, which is partially a function of its own price. It is quite clear that if the farm-retail margins were lowered, the demand/consumption of milk would increase. But, by how much? We attempt to answer this question in the chapters which herein follow.

1.3 OBJECTIVE

The objective of this study is to estimate the demand for fluid milk in British Columbia, using both a systems approach as well as a single equation method. The resulting own and cross price elasticities will then be compared with estimates from previous studies done on selected areas of Canada, those done on a Canada wide basis, as well as U.S. studies. The implications of these elasticities will then be assessed in light of both past and present concerns exhibited by the B.C. dairy industry.

1.4 RESEARCH PROCEDURE

Chapter 1 has served to provide the objective and importance of this study. Chapter 2, which follows, will provide theoretical considerations, such as the theory relevant to the problem at hand, as well as a review of related studies and what can be learnt from them. Chapter three provides the empirical model and data base used in this study, and chapter 4 serves to report the results of the estimation and their implications. Lastly, chapter 5 summarizes all findings, provides conclusions and offers recommendations for future research.

2.0 THEORETICAL CONSIDERATIONS

2.1 REVIEW OF PREVIOUS STUDIES

As has previously been mentioned, studies on the demand for milk are, if anything, sparse. A thorough literature survey uncovered no relevant studies on the B.C. demand for milk, but did result in the finding of papers on the demand for milk in other parts of Canada, Canada as a whole, and select areas of the United States. The purpose of this section is not to dwell upon these studies, nor to provide a comprehensive critique or assessment, but rather to report the various models and techniques employed, what can be learnt from them and the resulting own price, cross price, and income elasticities. The latter will be reported towards the end of the report. If for nothing else, these estimates should prove to be useful for comparison purposes.

The most recent estimate on the demand for milk in Canada was obtained by Goddard and Tielu (1988), and focussed upon Ontario. The model employed was a two stage demand system with milk, soft drinks, apple juice, tomato juice, and orange juice constituting the "market" for beverages. An attraction of the model estimated by Goddard and Tielu was the inclusion of advertising expenditures, as well as demographic variables such as percentages of the Ontario population falling between certain age groups, and the average age of the consumer in Ontario. Unfortunately, however, the method and use of data are questionable. This is not to say that the authors were negligent in their search for data, for we encountered many of the same problems ourselves in finding data specific to the region being analyzed. More often than not, Statistics Canada's data set on consumption estimates for provinces is either classified or not collected. As a result, estimates of consumption for many commodities in Canada are national in scope. Realizing this obvious drawback, the authors simply constructed consumption figures by pro-rating national figures on the basis of population. Evidence, however, suggests that this is simply not reasonable. Take for instance the British Columbia soft drink market. Figures on annual soft drink sales provided by the Canadian Soft drink association show that in 1988, B.C. consumed 8.7% of Canadian soft drink sales, while in 1989, this figure was up slightly to 9%. In per capita terms, the same source listed B.C.'s consumption as being 69.9 litres/person in 1988 and 73.5 litres/person in 1989. Using only 1989 as an illustration, had one pro-rated consumption on the basis of population, B.C.'s estimated consumption in 1989 would have been 96.12 litres/person, a difference of 24%. To be more relevant, i.e. looking at the case of Ontario, reported consumption by the C.S.D. was 106.1 litres/person in Ontario in 1989. Pro-rated consumption, however, would be 96.13 litres per person, an underestimate of 10.4%. It is not our intent to discredit the authors, but rather to point out to our readers the serious errors caused by pro-rated estimates. In effect, pro-rating consumption and using provincial price and income data is akin to asking whether Ontarios provincial data can explain changes in national consumption. A comment must also be made on the construction of the income variable used by Goddard and Tielu. In order to obtain a quarterly income figure for Ontario, which is not reported by Statistics Canada, the authors divided annual data compiled by Stats. Can. by four, on the assumption that consumers receive a fixed annual income which is evenly distributed throughout the year. This is a stark assumption, and although it may be considered by some to be valid under the circumstances, there must be alternatives to this method. For instance, some combination of wages and salaries (available monthly) could be used in conjunction with the yearly disposable income in order to obtain a proxy for personal income. Assuming equal income distribution ignores the fact that other sources of income often arise periodically, and that much of the fluctuation in income is due to individuals leaving and entering the labour force both voluntarily and involuntarily.

Apart from Goddard and Tielu, the only other relevant, as well as recent study done on the demand for milk in Canada was performed by Al-Zand and Andriamanjay in 1988. While their study did not focus directly on milk, i.e. their aim was to study the demand for dairy products in Canada, they do provide own price elasticities for milk, and more importantly compare their results with previous studies. These comparable estimates were primarily estimated in the mid. to late 1970's by authors such as Hassan & Johnson, Sahi & Hassan, and Sahi & Harrington. The estimates were primarily derived by ordinary least squares, and in some cases by seemingly unrelated equations. It is surprising to find that none of these studies estimated the demand for milk as a function of other beverages, but rather as a function of other dairy products and in one case (Spencer & Feaver), milk powder was used as a substitute for fluid milk. In general, these studies found the demand for milk to be relatively inelastic with estimates ranging between -0.30 and -0.47.

Turning to estimates of milk demand in the United States, the literature review uncovered three recent articles which were of interest. Hein and Wessells (1988) estimated the demand for dairy products in the U.S. using cross sectional data from 1977-1978 and utilizing the Almost Ideal Demand System. The data on food consumption for households in the survey were aggregated into twelve categories, and contained prices and expenditures for over 1000 food items as well as detailed demographic information on each of the households. Their results suggest that demographic variables, such as household members, age, meals eaten away from home, etc. are highly significant. Moreover, the demand for dairy products was found to generally be inelastic, and cross-price effects were moderate.

The second article of interest was that of Kinnucan (1987), who modelled the effect of Canadian Advertising on milk demand in the Buffalo, New York market. Using a single equation method, in log form, the author found the demand for milk to be much more elastic than most previous estimates. The paper, however, fails in its attempt to clearly explain the effect of Canadian Advertising on milk demand in Buffalo. Moreover, the author states that one of his objectives is to examine the effectiveness of the Ontario milk marketing board commercials versus that of the American Dairy Association, but this never does materialize.

Lastly, Boehm estimated the demand for milk in the United States, by region, using ordinary least squares. Ethnic composition, age distribution, prices, income, and the physical environment were all found to be statistically significant. Of interest, however, was the elasticity of milk calculated for Seattle, Washington, which was found to be approximately -.27 for the OLS estimation and -.11 for the combined cross section/time series model.

2.2 RELEVANT THEORY

A fundamental premise in economic theory is that consumers are rational, and that they will select goods/services which, subject to an income constraint and predetermined prices will maximize satisfaction (or utility) from consuming these goods/services. Moreover, there is the assumption that consumers allocate a fixed amount of income across commodities which generate utility, with the demand for a particular commodity determined by a two stage budgeting process. The two step process assumes that consumers maximize a utility function which is weakly separable. In the first stage, expenditure is allocated among a broad group of goods such as food, shelter, and entertainment. At this stage, there must be an appropriate knowledge of total expenditure, as well as a defined group of prices. The second stage of the process is characterized by group expenditures being allocated among individual commodities contained within that specific group. At the second stage, individual expenditures are a function of total expenditure and prices for that group. Moreover, the result of the two stage process must be identical to what would result if the allocation was made in one step with complete information.

The voluminous literature available on demand analysis for beverages, including those already surveyed, suggests that three factors, other than price and income, significantly influence the demand for beverages:

1. The demographic make-up of society
2. The physical environment
3. The product environment

Demographics

Recent studies on fluid milk demand have found ethnicity, age and sex of the consuming unit to significantly explain differences in consumption. In the United States, it is widely held that the black population consumes less milk per capita than that does the white population. Now, while the black population in B.C. is not significant, there are other ethnic groups which tend to exhibit lower than average milk consumption. For example, it has been observed that the Asian population, specifically Chinese consume less milk than most British Columbians, an observation that is strengthened by the fact that milk is not a widely held commodity among storekeeper's in Vancouver's Chinatown. Unfortunately, Statistics Canada does not publish estimates of ethnic background on a frequent basis, and as such, data restrictions force us to exclude ethnicity as a variable. Apart from ethnicity or race, many studies have also found age and sex composition, as well as the number of people in a family to be important in explaining variations in milk consumption. While this analysis will use a population and age (% of population under 15) variable, we do not feel that a sex component is necessary in explaining consumption behaviour.

Physical environment

It is reasonable to assume that temperature plays a major role in the consumption of beverages. Hotter days undoubtedly result in increased consumption of cold beverages, while colder winter days result in greater consumption of hot drinks. As such, a variable may be included for the mean high temperature in the province.

Product environment

Recent studies on milk demand have found advertising to be a significant variable in affecting milk consumption (Goddard, Kinnucan). Since the objective of advertising is to "push out" the demand curve, it is quite reasonable to find this variable to be significant. Unfortunately, these data on advertising expenditures are very expensive, and as result we are forced to exclude advertising from the analysis.

2.3 FUNCTIONAL FORM

A problem faced by most applied economists is the choice of functional form for estimating systems of demand equations. The function chosen is desired to be general in nature, such that it may act as a second-order approximation to any arbitrary direct or indirect utility or cost function. Unfortunately, there are no clear rules for the choice of functional form, and as such most researchers base their decision on the popularity of models.

Models which are popular in current use include the Rotterdam model (Theil and Barten), the Translog (Christensen, Jorgensen & Lau), and the Almost Ideal Demand System (Deaton & Muellbauer). Given that the Almost Ideal Demand System (AIDS) has recently become quite popular with Ag. Economists, as evidenced by the large number of recent journal articles in the American Journal of Ag. Economics utilizing the AIDS, we propose to estimate fluid milk demand in B.C. using the AIDS and make a comparison with the Linear Expenditure System (LES), which we also estimate. The Linear Expenditure System has been estimated extensively in the literature.

2.3.1 THE STATIC AIDS

According to Deaton and Muellbauer (1980, 312), "Our model, which we call the Almost Ideal Demand System (AIDS), gives an arbitrary first-order approximation to any demand system; it satisfies the axioms of choice exactly; it aggregates perfectly over consumers without invoking parallel linear Engel curves; it has a functional form which is consistent with known household-budget data; it is simple to estimate, largely avoiding the need for non-linear estimation; and it can be used to test the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters. Although many of these desirable properties are possessed by one or other of the Rotterdam or translog models, neither possesses all of them simultaneously."

In budget share form, the AIDS demand functions are written as,

$$(1) \qquad w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log (X/P)$$

where,

$$w_i = (p_i q_i)/X$$
$$X = \sum p_i q_i$$

and P is a price index defined by,

$$(2) \qquad \log P = \alpha_0 + \sum_j \alpha_j \log p_j + 1/2 * \sum_j \sum_i \gamma_{ij} \log p_i \log p_j$$

Substitution of (2) into (1) yields (3),

$$(3) \qquad w_i = (\alpha_i - \beta_i \alpha_0) + \sum_j \gamma_{ij} \log p_j$$

$$+ \beta_i \{\log X - \sum_j \alpha_j \log p_j - 1/2 * \sum_j \sum_i \gamma_{ji} \log p_j \log p_i\}$$

Given economic theory, the basic restrictions needed for a theoretically valid model are as follows: [1]

$$(4)\quad \sum_{i=1}^{n} \alpha_i = 1 \qquad \sum_{i=1}^{n} \gamma_{ij} = 0 \qquad \sum_{i=1}^{n} \beta_i = 0 \qquad \text{\} adding up}$$

$$(5)\quad \sum_{j} \gamma_{ij} = 0 \qquad \text{\} homogeneity}$$

$$(6)\quad \gamma_{ij} = \gamma_{ji} \qquad \text{\} symmetry}$$

Readers interested in a detailed exposition on the construction of (1) and (2) are asked to consult Deaton & Muellbauer (1980).

The uncompensated elasticities (η_{ij}) derived from (3), in general form, are,

$$(7)\quad \eta_{ij} = \{ [\gamma_{ij} - \beta_i(\alpha_j + \sum_{i} \gamma_{ij} \log p_i)] / w_i \} - \delta_{ij}$$

where, δ_{ij} is the Kronecker delta ($\delta_{ij} = 1$ if $i=j$ and $\delta_{ij} = 0$ if $i \neq j$). The elasticities given in (7) refer to allocations within the commodity group while holding total group expenditures and all other prices constant. Derivation of η_{ij} is given in Appendix 1. The expenditure elasticities (η_{ix}) derived from (3), in general form, are

$$(8)\quad \eta_{ix} = 1 + (\beta_i / w_i)$$

and can be derived in a fashion similar to that required to find η_{ij}. Note that those goods for which $\beta_i < 0$, the expenditure elasticity will result in an estimate less than one, while positive β_i's lead to expenditure elasticities larger than one. Thus, negative

[1] Readers will notice that the imposition of symmetry makes restriction (5) redundant, for it becomes encompassed by the second term in restriction (4).

values will be ascribed to commodities which are necessities within this beverage group while positive values are ascribed to luxuries.

Since the data used in this model span only a period of three years, and given that the age composition of the population is reported annually, inclusion of an age variable in the system is clearly not practical. However, since temperatures are reported monthly, we may include a variable for the mean bi-monthly B.C. maximum temperature. The inclusion of this variable alters (1) only slightly. In fact, the only change that occurs is with respect to α_i, i.e. α_i is now defined as,

(9) $\alpha_i = \alpha_{io} + \delta_i T$

where, T is the bi-monthly B.C. mean high temperature. As a result, (3) is also transformed slightly to (3'),

$$(3') \quad w_i = (\alpha_{io} + \delta_i T - \beta_i \alpha_o) + \sum_j \gamma_{ij} \log p_j$$

$$+ \beta_i \{\log X - \sum_j \alpha_j \log p_j - 1/2 \sum_j \sum_i \gamma_{ji} \log p_j \log p_i\}$$

This imposes an added restriction on α_{i0} and $\delta_i T$ which, as a result, changes (4) to (4').

$$(4') \quad \sum_{i=1}^{n} \alpha_{i0} = 1 \qquad \sum_{i=1}^{n} \delta_i = 0 \qquad \sum_{i=1}^{n} \gamma_{ij} = 0 \qquad \sum_{i=1}^{n} \beta_i = 0 \quad \} \text{ adding up}$$

We propose the use of (3') in this study, with restrictions (4'), (5), and (6) imposed. It can be shown that estimation of a system such as that presented above results in

$(n^2+5n-4)/2$ parameters to be estimated, when homogeneity and symmetry are imposed: $(n-1)$ α_{i0}'s, $(n-1)$ δ_i 's , $(n-1)$ β_i 's , $n^2 - (1/2 * (n^2+n))$ γ_{ij} 's , 1 α_0.

2.3.2 THE DYNAMIC AIDS

In order to introduce dynamics into the system of equations represented by (3'), we extend the model by specifying the α_i's to be functions of both temperature and a time trend. It would be ideal to introduce lagged consumption in place of a time trend, but for reasons which shall be discussed below, it would be theoretically impractical.

We now define α_i as,

(10) $\alpha_i = \alpha_{io} + \delta_i T + \varepsilon_i \text{ Trend}$

where, T is temperature and Trend is a trend variable. With this change, the Dynamic Aids can be written in general form as,

(11) $$w_i = (\alpha_{io} + \delta_i T + \varepsilon_i \text{ Trend} - \beta_i \alpha_o) + \sum_j \gamma_{ij} \log p_j + \beta_i\{\log X - \sum_j \alpha_j \log p_j - 1/2 \sum_j \sum_i \gamma_{ji} \log p_j \log p_i\}$$

with restrictions as follows (see footnote 1),

(12) $\sum_{i=1}^{n} \alpha_{i0} = 1 \quad \sum_{i=1}^{n} \delta_i = 0 \quad \sum_{i=1}^{n} \varepsilon_i = 0 \quad \sum_{i=1}^{n} \gamma_{ij} = 0 \quad \sum_{i=1}^{n} \beta_i = 0$ } adding up

(13) $\sum_j \gamma_{ij} = 0$ } homogeneity

(14) $\gamma_{ij} = \gamma_{ji}$ } symmetry

Since the trend variable is the same for all equations, we see that the restriction $\sum \varepsilon_i=0$ is entirely valid. However, had we introduced a lagged variable in place of the Trend variable, the restriction $\sum \varepsilon_i=0$ could only be imposed on an ad-hoc basis, since different lagged variables appear in all equations. Blanciforti, Green, and King (1986) include lags in their Almost Ideal Demand System with the restriction $\sum \varepsilon_i (\text{lag } q_i)=0$. But, since different lags appear in all equations, the restriction $\sum \varepsilon_i=0$ must still hold since $\sum(\text{lag } q_i)$ will never equal zero. Thus, we see no way of correctly imposing the restriction $\sum \varepsilon_i=0$ when different values appear in different equations, and as such choose to use a trend variable in place of a lagged consumption variable.

2.3.3 THE DYNAMIC LINEAR EXPENDITURE SYSTEM

The linear expenditure system (LES) can be derived from the Klein-Rubin utility function, which is of the form,

(15) $$U(q_1, \ldots, q_n) = \sum a_i \log(q_i - b_i) \qquad q_i > b_i,\ a_i > 0,\ \sum a_i = 1$$

Maximizing this utility function subject to the budget constraint $X = \sum p_i q_i$ yields, after substitution,

(16) $$q_i = b_i + (a_i / p_i) * (X - \sum_j p_j b_j)$$

Multiplying through by p_i yields expenditure functions of the form,

(17) $$p_i q_i = p_i b_i + a_i * (X - \sum_j p_j b_j)$$

and budget shares,

(18) $$w_i = \frac{p_i b_i}{X} + a_i * (1 - \sum_j (p_j b_j / X))$$

The system of equations presented above can be estimated in either expenditure or budget share form. Note that the individual with a demand function of this form can be described as purchasing subsistence quantities of good q_i, in the amount of b_i, and then distributing the remaining expenditure over all other goods, in the specific grouping, in fixed proportions a_i. Therefore, the Engel curves are linear and have constant marginal shares a_i. Note that if income varies widely over the sample period being analyzed, then linearity of the Engel curves may be overly restrictive. In this study, data only span a period of three years, in which case income (expenditure) does not vary widely within the sample, and as such linearity should not pose a major problem.

Expenditure, own, and cross-price elasticities can be derived through simple differentiation, and are given in general form as,

(19) $\eta_{ix} = a_i / w_i$

(20) $\eta_{ii} = -1 + b_i * (1 - a_i) / q_i$

(21) $\eta_{ij} = - a_i * (p_j b_j / p_i q_i)$

We introduce dynamics and the effect of temperature on this demand system by specifying that $b_i = b_{io} + \delta_i T + \varepsilon_i (lag(q_i))$. Note that unlike the AIDS, no adding up restrictions are required on δ_i and ε_i, and that with temperature and dynamics included, estimation involves (4n-1) parameters:(n-1) a's, (n) b's, (n) δ's, (n) ε's.

2.3.4 CURVATURE CONDITIONS

Once estimated, it is important to check whether or not the model estimated is consistent with standard theory. Having imposed both homogeneity and symmetry (only in the AIDS), we are left with one important test, and that is of quasi-concavity of the utility function. Since symmetry of the Slutsky matrix has been imposed, we can use the eigenvalues to evaluate negative semi-definiteness of the matrix. Since the Slutsky matrix is singular, we should find that (n-1) eigenvalues are negative and one is equal to zero. This should be true for all observations. In the event that these conditions are not satisfied, at some or all observations, we may follow Diewert and Wales (1988), which interested readers are asked to consult. [2]

In the case of the LES, symmetry is automatically imposed and as such the same test as above can be employed. Alternatively, curvature conditions are also met if the estimated b_i's are less than actual consumption of good i at each observation point.

2.3.5 STANDARD ERRORS FOR UNESTIMATED PARAMETERS

Standard errors for those parameters not included in the estimation directly, due to homogeneity and symmetry are calculated as follows. Recall that in general,

$$\mathrm{Var}(X+Y) = \mathrm{Var}\,X + \mathrm{Var}\,Y + 2 * \mathrm{cov}(X,Y)$$

and that the standard error is simply the square root of the variance. Then, using a parameter from the AIDS as an example, the SE(δ5) for instance, is calculated as,

$$\begin{aligned}
\mathrm{Var}(\delta_i) &= \mathrm{Var}\,(-\sum_{i=1}^{n} \delta_i) \qquad \text{since } \sum_i \delta_i = 0 \\
&= \sum_{i=1}^{n-1} \mathrm{Var}\,\delta_i + 2 * \sum_{i \neq j} \mathrm{cov}\,(\delta_i,\delta_j) \\
&= \mathrm{Var}\,\delta_1 + \mathrm{Var}\,\delta_2 + \mathrm{Var}\,\delta_3 + \mathrm{Var}\,\delta_4 \\
&\quad +2 * (\mathrm{cov}\,(\delta_1\delta_2) + \mathrm{cov}\,(\delta_1,\delta_3) + \mathrm{cov}\,(\delta_1,\delta_4)\,) \\
&\quad +2 * (\mathrm{cov}\,(\delta_2\delta_3) + \mathrm{cov}\,(\delta_2,\delta_4) + \mathrm{cov}\,(\delta_3,\delta_4)\,)
\end{aligned}$$

---

[2]The imposition of curvature conditions on some systems, the Translog in particular, results in a loss of the flexible functional form property.

Taking the square root of Var(δ5) gives us the SE(δ5). This procedure is general and can be applied to obtain standard errors of all other parameters not directly included in the model due to the imposition of homogeneity. Knowing that the sum of all δ's, β's, and γ's sum to zero and that the sum of all α's sum to 1, we can derive the unknown parameter estimates. Then, the familiar t-statistic can be calculated by simply dividing the parameter estimated by its associated standard error.

3.0 EMPIRICAL MODEL

Maximum likelihood procedures were used to estimate the nonlinear, seemingly unrelated demand systems presented in section 2 above, while ordinary least squares was used for single equation estimation. In both cases, the SHAZAM program of White (1990) was utilized.

3.1 ESTIMATION OF THE AIDS/LES

Estimation of the static and Dynamic AIDS models described in section 2 were carried out by imposing both homogeneity and symmetry. Note that since the data add up by construction, i.e. $\sum W_i=1$, the adding up restrictions are automatically and costlessly satisfied. Moreover, since the data add up by construction, only (n-1) equations are independent, and thus only (n-1) equations need to be estimated. The SHAZAM program for the static AIDS used in this study can be found in Appendix 2. Note that this is only the main program, and that all variables such as the logged prices, total expenditure and budget shares need to be generated. Estimation of the Linear Expenditure System was also carried out using SHAZAM, and as in the AIDS model, only (n-1) equations are independent and thus need to be estimated. [3]

3.1.1 DATA CONSTRUCTION FOR SYSTEMS ESTIMATION

The data on B.C. beverage consumption were aggregated into the following five categories, where the figures in brackets represent the mean share of expenditure over the sample period:

1. Coffee (10.9)
2. Soft Drinks (23.8)
3. All fluid milk (55.4)
4. Tea (2.8)
5. Ready to serve apple and orange juice (7.05)

[3] Note that since the LES is not a complicated program, we choose not to include the program in an appendix.

The above aggregations were chosen mainly due to statistical reasons, the most important of which being that under assumptions of normality(of the error terms) actual budget shares close to zero can lead to estimated budget shares which are either zero or negative. Thus, given that orange juice represented a mean budget share of 2.25% over the sample period and apple juice representing 4.8% over the same period, it was thought prudent to aggregate both juices into one category. Categories 3 and 5 were represented by a divisia index for prices with the quantity index computed residually. Readers interested in construction of the divisia index are asked to consult the SHAZAM (1990) manual. All prices were standardized so that in the first observation all prices are equal to 1.0. As well, all quantities were converted into per capita terms. Since population is reported only quarterly, intra quarter estimates of population were obtained by simple interpolation.

3.2 SINGLE EQUATION ESTIMATION

The single equation model postulated in this study takes the following form:

$Q_i = f(P_O, P_S, P_C, Y, D, Temp, Trend)$

where,

- o Q_i is the per capita consumption of milk type i (low fat, standard, total milk)
- o P_O is the real price of milk i
- o P_S are real prices of close substitutes
- o P_C are the real prices of close complements
- o Y is real income or some proxy for real income
- o D is a demographic variable, in this case the percentage of the population under the age of 15.
- o Temp is the mean high temperature.
- o Trend is a time trend.

The substitutes tested for in this study include apple juice, orange juice, soft drinks, tomato juice, and Washington State milk, while complements include coffee and tea.

The linear form is chosen over all other forms such as the log-log, because elasticities are allowed to vary at each observation point. The log-log form, in particular, is restrictive for it imposes constant elasticity over the entire period of observation. This is uninteresting from a policy perspective, for it does not relay any trends in elasticities which may help to form policy.

3.2.1 DATA CONSTRUCTION-SINGLE EQUATION ESTIMATION

All prices used are deflated by the B.C. consumer price index for all items. The proxy for income, salaries and wages, is also deflated by the B.C. CPI for all items, and is divided by population in order to obtain a per capita figure.

In order to avoid any acute consequences from rounding off errors, all variables, excluding the trend, are standardized by dividing each variable with its mean value. This is an attractive standardization technique for if the mean of the variable in interest is equal to 1, then the elasticity at the mean is simply the estimated coefficient.

3.3 DATA SOURCES

Retail prices, consumption estimates, income, demographic and temperature data used in this study were purchased from the A.C. Nielsen Company of Canada, and collected from Statistics Canada, The United States Department of Agriculture, The Canadian Meteorological service, and The British Columbia Milk Board.

Due to the fact that A.C. Nielsen data is reported only bi-monthly, the period of estimation for the demand system is from October 1987 to September 1990, on a bi-monthly basis. The single-equation system, however, focuses on the period 1979 to 1989, on a quarterly basis. All data used in this study are reported in Appendix 5.[4]

Systems Data

Consumption data on apple juice, orange juice, coffee, tea, and soft drinks were purchased from the A.C. Nielsen Company of Canada. These data represent projected British Columbian sales of the above mentioned commodities, through an audit of scanner tapes at major grocery stores in B.C., as well as a manual audit of stores not capable of providing scanner data. The purchased data was on both a dollar and physical basis. As such, prices for these commodities were derived by dividing total dollar sales by physical volume. Regular and low fat milk consumption data were obtained from the B.C. milk board annual reports. Prices for regular and low fat milk were found in Statistics Canada's (62-010), Prices and Price Indexes. Unfortunately, these prices were reported on a quarterly basis. In order to obtain bi-monthly prices, the consumer price index for standard and low fat milk was used to obtain prices within quarters. The consumer price index was obtained from Statistics Canada's CANSIM main base.

The average mean high temperature was obtained from the Canadian Meteorological Services', Annual Meteorological survey for Vancouver Airport. The mean high for the bi-monthly period was taken to be a simple average of the mean high temperature for the two months under question. The assumption made in using this variable is that the Vancouver Airport is a crude proxy for the changes in mean high temperatures in British Columbia.

[4]Due to the purchase agreement, access to A.C. Nielsen data is limited, and as such not reported.

Single-equation Data

Prices

Retail prices for commodities used in the single equation estimation (homo. milk, 2% milk, coffee, tea, orange juice, soda pop, apple juice, and tomato juice) were obtained from Statistics Canada (62-010), Prices and Price Indexes and are for Vancouver. The price of whole milk in the Seattle area was obtained from the USDA, Dairy Administration Branch. Prices for low fat milk were not available at the time of estimation. The prices were converted from $US/gallon to $CN/litre, using the Bank of Canada's published exchange rates and were adjusted to reflect differences in volume between U.S. and Imperial gallons. Note that we deflate the price of Washington State whole milk by the B.C. CPI for homogenized milk after making the above mentioned conversion. This, because it is the price seen by B.C. consumers, and because in theory exchange rates are supposed to reflect differential inflation, and as such it is wrong to simply convert the real price of Washington State milk into $can/litre. All CPI figures were obtained from Statistics Canada's CANSIM main base.

Consumption estimates

Consumption estimates for regular and low-fat milk were obtained from the B.C. milk board annual reports.

Income/Wages and Salaries

Personal disposable income for British Columbians is reported in Statistics Canada's (13-213), National Income Accounts, while figures for wages and salaries were obtained from Statistics Canada's CANSIM mini base. The former is reported only on an annual basis, while the latter is reported monthly. As such, wages and salaries were used as a proxy for changes in disposable income between quarters. Specifically, an income figure was constructed as follows,

$$Yj = PDIi * (SWj / \sum_{j=1}^{4} SWj)$$

Population

Population estimates for Canada and British Columbia were obtained from Statistics Canada's CANSIM mini base. Estimates of the population for British Columbia under the age of 15 were obtained from Statistics Canada (91-519 & 91-202). Unfortunately, estimates were available only on an annual basis, and as such it was assumed that the percentage of the population under the age of 15 did not change drastically between any quarter being analyzed in this study.

Weather

As in the case of systems estimation data, the average mean high temperature was obtained from the Canadian Meteorological Services', Annual Meteorological survey for Vancouver Airport.

3.4 DEBUGGING PROCEDURES FOR AIDS/LES ESTIMATION

Once estimated, the researcher may check whether or not the model functions properly, i.e. that the program written for SHAZAM does not contain any errors/omissions. The following tests are quite general, and can be used for testing the program.

1. Since the data add up by construction, i.e. $\sum W_i = 1$, the choice of which commodity group to exclude is arbitrary. As such, switching the n'th commodity in estimation should yield identical results. Differing parameter estimates indicate an error(s) in the program.

2. Satisfying (1) is crucial, and once satisfied, the researcher should inspect the gradient to ensure convergence. Convergence is guaranteed when the gradient is essentially equal to zero. In addition, restarting the system with the converged values as initial starting values should not increase the log of the likelihood function. While these measures ensure convergence, they do not ensure that convergence is global, i.e. as opposed to a local convergence. To test for global/local convergence, the model should be re-estimated with a variety of initial starting values. If these differing values converge to the same parameter values, then we have more faith in believing that global convergence may have been achieved.

3. Using converged parameter values, predict budget shares for each commodity. These should be similar to actual budget shares, but of course will not be exact due to the standard errors. Estimated quantities can then be calculated by recalling that,

$$w_i = (p_i q_i)/X \text{ and thus } q_i = (X^* w_i)/p_i$$

and where X is total expenditure, and w_i is the predicted share.

4. Recall that the general form, for the AIDS, as shown by equation (1) is,

$$(1) \qquad w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log (X/P)$$

Then, setting $\beta_i=0$ and predicting budget shares implies that $w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j$

Scaling prices to equal 1 in a base year ensures that in the base year, $w_i = \alpha_i$, and thus this can be checked by visual inspection.

5. If the symmetry condition has been imposed correctly, then the Slutsky matrix will be symmetric. Taking the eigenvalues of this symmetric matrix should yield at least one eigenvalue equal to 0 at each observation. This is a necessary condition, regardless of whether or not curvature conditions have been met.

Once estimated and checked using 1-5 above, one may check/correct for serial correlation, which may be a serious problem. In their original article, Deaton and Muellbauer allude to this possibility of serial correlation when homogeneity is imposed, and this is confirmed by Rossi, Blanciforti and Green. Judging from other research done with the AIDS on aggregated commodities such as food, etc. rejection of homogeneity and symmetry is commonplace in the estimation of the AIDS, and that researchers have found that forcing these restrictions can lead to the presence of serial correlation. Reasons offered for this have been omitted variables, absence of demographic statistics, and habit persistence. As such, checks/corrections can be made using the AUTO command in SHAZAM.

4.0 RESULTS & IMPLICATIONS

4.1 RESULTS FROM STATIC AIDS ESTIMATION

Table 2 reports the estimated parameters of the static Almost Ideal Demand system estimated in this study. T-statistics are reported in brackets, and as one can immediately notice are, for the most part insignificant. In particular, all variables not directly estimated in the model due to homogeneity restrictions are strongly insignificant.

Table 2 - Estimated parameters from the static AIDS estimation

GOOD i	α_i	δ_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}
COFFEE	-4.2473 (-0.77)	-.00111 (-2.58)	.08890 (1.47)	-.31487 (-0.44)	-1.2491 (-1.18)	1.5831 (0.89)	-.01226 (-0.15)	-.00687 (0.04)
SOFT DRINKS	-13.648 (-1.93)	.00279 (2.89)	.28141 (2.20)	-1.2491 (-1.18)	-3.8955 (-1.84)	4.9691 (2.58)	-.03821 (-0.17)	.213713 (0.37)
MILK	18.559 (1.68)	-.00108 (-1.73)	-.36554 (-4.23)	1.5831 (0.89)	4.9691 (2.58)	-6.3905 (-2.10)	.053154 (0.18)	-.21485 (-0.07)
TEA	-.15036 (-0.18)	-.00048 (-4.24)	.00373 (0.25)	-.01226 (-0.14)	-.03821 (-0.17)	.053154 (0.18)	.018301 (2.51)	-.02099 (-0.08)
APPLE/ ORANGE JUICE	.48666 (0.24)	-.00013 (-0.07)	-.00849 (-0.22)	-.00687 (0.04)	.213713 (0.37)	-.21485 (-0.07)	-.02099 (-0.08)	.029001
SUM	1.0	0	0	0	0	0	0	0

The estimates of β_i indicate that milk and juices are necessities within this group, while all other goods are luxuries. However, only milk and soft drinks are statistically signicant on the basis of t-values (reported in brackets). Recall that negative values of β_i are ascribed to necessities, while positive values are luxuries. Judging from other t-values , a large number of the γs are not significantly different from zero; in fact, only 3 out of 15 γs have t-values larger than 2 in absolute value. Turning to the δ's, we see that 3 out of 5 have t-values greater than 2 in absolute value, and all but δ_5 (juice) have anticipated signs. It is interesting to note that the two δ's possessing t-values less than 2 in absolute value are δ_3 (milk) and δ_5 (juice). δ_3 enters the model with a negative sign indicating that increases in temperature lead to declining consumption of milk. A priori, this is a hard variable to decide on for sign expectation, and as such we cannot use introspection to judge the validity of this sign, but we do acknowledge the insignificance of its t-value. This is however, clearly not the case with δ_5 (juices). Intuition leads us to believe that increases in temperature invariably lead to increases in the consumption of juices, and as such we would have expected a positive sign a-priori. The insignificance of the t-value on δ_5 , however, reassures us of our a-priori expectation.

Tests for curvature conditions were performed by calculating the eigenvalues of the Slutsky matrix at each observation. In order for the utility function to be quasi concave, (n-1) eigenvalues must be negative and one must be equal to zero. This should hold at each observation. Contrary to this, we found 12 observations at which there were 3 negative eigenvalues, one equal to zero and one positive value. Recall that n in our model is equal to 5. At each of the remaining 6 observations, we found 2 negative eigenvalues, 2 positive eigenvalues and one equal to zero. This was unsatisfactory. We then turned to checking/correcting for serial correlation, which SHAZAM does simultaneously. Unfortunately, the model, corrected for serial correlation would not converge, which is a problem not uncommon in non-linear models.

Expenditure and own price elasticities (at mean values) are shown in table 3, while elasticities calculated at each observation point can be found in Appendix 3. Readers are warned to take caution when viewing these results, as they have not been corrected for serial correlation. All own price elasticities, at the mean, exhibit the necessary negative values, but there are several areas of concern. The most disturbing result from Appendix 3 is that the own price elasticity of milk exhibits a positive slope at two observation points. Clearly, this is unbelievable, for it infers that milk was a Giffen good during these two periods, a concept which is discussed only in reference to the Irish potato during the famine.

Table 3 - Expenditure & own price elasticities-static AIDS

GOOD i/j	COFFEE	SOFT DRINKS	MILK	TEA	ORANGE/ APPLE JUICE
Expend. elasticity	1.97	2.52	.41	1.14	.88
COFFEE	-0.32	-0.48	-0.64	0.02	-0.54
SOFT DRINKS	-0.29	-1.45	-1.23	0.03	0.42
MILK	0.05	0.03	-0.42	-0.01	-0.06
TEA	0.13	0.45	-0.57	-0.31	-0.83
ORANGE/ APPLE JUICE	-0.61	1.39	-0.82	-0.32	-0.53

In addition, casual observation suggests that the own price elasticity for milk in British Columbia should become more elastic over time. This, because a much cheaper (perfect) substitute is available on the other side of the border which can be crossed with relative ease. In fact, it is common knowledge that many residents living close to the U.S. border cross over to purchase cheaper gas and milk on a regular basis. In fact, some estimates have put sales of Washington State milk to B.C. residents at approximately 65,000,000 litres per year. (Shelford, 1988) This is a very large figure which may be an overestimate, but nonetheless it is significant and if this number is at all accurate then logic leads us to believe that the demand for milk should become relatively elastic over time. [5] The estimates in Appendix 3 show own price elasticities for milk to be relatively stable over the period of observation, if we exclude the last three observations. If these estimates of cross border shopping are accurate then the stability of the estimated elasticites could be due to the short observation period of three years.

Own price elasticities of soft drinks, tea and juices were shown to be relatively stable over time, and all exhibited the expected negative values. One area of concern, however, was the sudden change in the own price elasticity for soft drinks in two of the last three observation periods. These are the same observation points at which the own price elasticity of milk exhibited positive values. Comparing our elasticities for soft drinks with estimates from other work is interesting. Goddard and Tielu estimated own price elasticities for soft drinks at -0.82, while Hein and Wessels estimate was at -0.58. In terms of expenditure elasticities for soft drinks, Goddard and Tielu's estimate was 2.25 while Hein and Wessels estimate was at -0.58.

Cross price elasticities ,at each observation, estimated for the static AIDS are presented in table 3 and Appendix 4. Appendix 4 also reports the elasticity of temperature calculated from the estimated parameters of the AIDS, and these elasticities of temperature for the first two years of the sample are graphed in figures 1 and 2.

[5] Other estimates, such as those done by Agriculture Canada have sales of Washington State milk to B.C. consumers at approximately 10% of B.C. consumption. Unfortunately, we are unable to obtain a copy of this report, and must rely on personal conversation with staff at Ag. Canada.

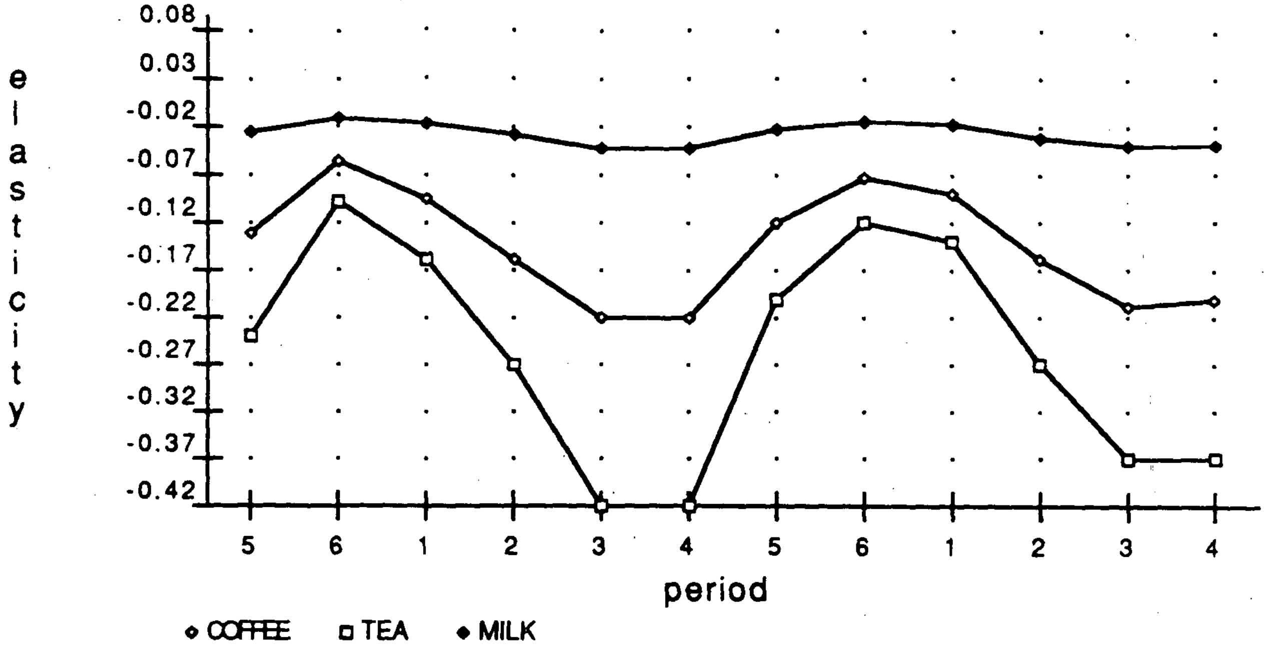

Figure 1 - Temperature Elasticities (Coffee, Tea, Milk) vs. Time

Notice the obvious trends in the graphs. Coffee and tea seem to be highly responsive to changes in temperatures, which in a moderate temperature area such as B.C., corresponds to seasons. The period #'s on the horizontal scale represent bi-monthly periods during the year, so that 1 represents December and January, 2 represents February and March, etc.. Figure 1 indicates that coffee and tea consumption decrease steadily between June/July (4) and October/November (6), as temperatures are relatively high, and increases steadily between November and May as temperatures decrease. It is quite interesting to see that tea and coffee not only move in the same direction, but also in relatively the same proportion. Milk, on the other hand seems to be relatively stable, but we can discern a noticeable pattern, where milk consumption increases during November to May when temperatures are low and consumption decreasing between June and November when temperatures are relatively high. Thus, coffee, tea and milk seem to exhibit the same patterns of consumption as temperatures change. Soft drinks, on the other hand, are much more responsive to changes in temperature, as consumption increases between June and December due to relatively high temperatures and decreases between December and June due to lower relative temperatures. Juices, as we have mentioned, go against prior expectations, increasing consumption between June and December as temperatures are relatively low, and decreasing between December and June as temperatures begin to rise.

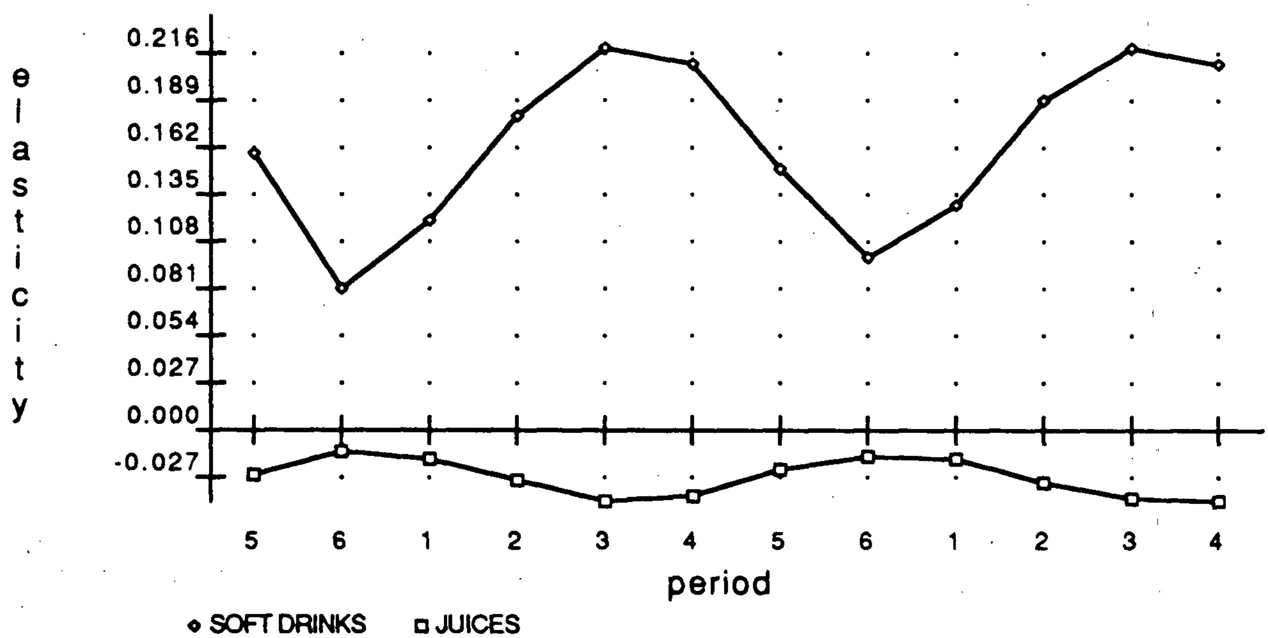

Figure 2 - Temperature Elasticities (Soft Drinks, Juice) vs. Time

4.2 RESULTS FROM DYNAMIC AIDS/DYNAMIC LES ESTIMATION

Estimated parameters from the Dynamic AIDS and Dynamic LES estimations are presented in table 4 and 5 respectively (t-statistics in brackets), while elasticity estimates from both models, at mean values, are presented in tables 6 and 7. Notice that while most own and cross price elasticities are different in sign and in magnitude, the own price elasticity for milk in both models is similar. Also note that tea, which was a luxury in the static AIDS is now a necessity in the Dynamic AIDS. Standard errors for own price elasticites, estimated in both models, are presented below.

	Dynamic AIDS		Dynamic LES	
	Estimated elasticity	Standard Error	Estimated elasticity	Standard Error
Coffee	-0.30	0.65	-0.61	0.09
Soft Drinks	-1.43	9.80	-0.68	0.13
Milk	-0.33	4.94	-0.40	0.05
Tea	-0.22	0.14	-0.32	0.11
Orange/ Apple Juice	-0.45	0.60	-0.20	0.26

We compare our elasticity estimates for milk from the dynamic specifications, at mean values, with those from other studies in table 8. For the sake of brevity, we choose not to report the own and cross price elasticities over time for the dynamic specification of both models. Temperature elasticities calculated for both models are also similar to the static AIDS, and again due to the sake of brevity are not reported. We note however, that as in the static AIDS estimation, estimated own price elasticities for milk in the dynamic AIDS are also positive at two of the last three observations, which is disturbing.

At this point, a note on substitutability/complementarity is in order. Strictly speaking, judging substitutability or complementarity on the basis of estimated Marshallian elasticities is false. Substitutability or complementarity should be based on the estimated Slutsky matrix at each observation point. For the LES, all off-diagonal elements of the Slutsky matrix are positive implying that all goods are substitutes. This is a characteristic of the LES, i.e. that it excludes Hicks-Allen complementarity. In the case of the Dynamic AIDS, coffee/tea, coffee/juices, soft drinks/tea, and soft drinks/juices were found to be substitutes throughout the sample, on the basis of the estimated Slutsky matrix. On the other hand, milk/tea, milk/juices, and tea/juices were found to be complements throughout the period of study. Lastly, coffee and soft drinks were substitutes in only 6 out of the 18 observations, coffee and milk were complements in only 4 out of the 18 observations, and soft drinks and milk were substitutes in 15 out of the 18 observations. Again, we choose to be brief and do not report the estimated Slutsky matrices.

As in the case of the static AIDS, tests for curvature conditions were performed by calculating the eigenvalues of the Slutsky matrix at each observation point. Fortuitously, it was found that (n-1) eigenvalues were negative and 1 eigenvalue was equal to zero for all observations in the dynamic LES. Unfortunately, tests on the Dynamic AIDS concluded that the system did not meet curvature conditions at any of the observation points, which is somewhat unsatisfactory. Moreover, while the dynamic LES was corrected for serial correlation, SHAZAM failed to converge when correcting for serial correlation in the dynamic AIDS.

In order to determine whether or not serial correlation is a problem, we present plots of the residuals , from each equation in the system, versus time. These plots presented in figures 3-6, indicate definite patterns and while this is not a conclusive test, it is an indication that serial correlation does exist. Moreover, the statistical significance of the correlation coefficient in the dynamic LES strengthens our suspicion of serial correlation. [6] Thus, if serial correlation is indeed a problem, and indications are that it is, our estimated parameters from the dynamic AIDS are not efficient, but they are still consistent. The problem of inefficient estimators is readily apparent from the large standard errors on the own price elasticities reported previously.

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[6]The Rho value (correlation coefficient) in the dynamic LES was estimated to have a value of -0.405 with a t-value of -2.71.

Table 4 - Estimated parameters from Dynamic AIDS estimation

GOOD i	α_i	δ_i	ε_i	β_i	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}
COFFEE	-1.1319 (-.78)	-.72e-3 (-2.64)	-.00141 (-4.86)	.04374 (1.26)	.02511 (0.24)	-0.5245 (-1.14)	0.4762 (0.87)	0.0190 (1.97)	.0041 (0.09)
SOFT DRINKS	-11.059 (-1.86)	.00180 (2.75)	.00351 (6.08)	.3876 (3.8)	-.5245 (-1.14)	-4.354 (-2.12)	4.638 (2.37)	.1073 (.88)	.1332 (0.35)
MILK	12.588 (1.95)	-.6e-03 (-1.03)	-.0015 (-2.95)	-.4143 (-4.9)	.4762 (.87)	4.638 (2.37)	-4.824 (-2.27)	-.1305 (-1.15)	-.1597 (-0.4)
TEA	.29461 (1.14)	-.4e-03 (-5.08)	-.4e-03 (-6.02)	-.0089 (-.82)	.0190 (1.97)	.1073 (.88)	-.1305 (-1.15)	.01941 (3.3)	-.0152 (-0.5)
APPLE/ ORANGE JUICE	.3083 (0.33)	-.8e-04 (-0.05)	-.2e-03 (-0.07)	-.8e-02 (-0.3)	.0041 (0.09)	.1332 (0.35)	-.1597 (-0.4)	-.0152 (-0.5)	-0.376
SUM	1.0	0	0	0	0	0	0	0	0

Table 5 - Estimated parameters from Dynamic LES estimation

GOOD i	b_{i0}	δ_i	ε_i	a_i
COFFEE	-1.2410 (-1.20)	.21269 (3.5)	-.14246 (-1.76)	.17790 (6.03)
SOFT DRINKS	-3.7848 (-.71)	.73761 (2.81)	-.65846 (-6.89)	.46086 (6.76)
MILK	4.2822 (0.73)	.39112 (2.40)	.19374 (1.08)	.32906 (9.8)
TEA	0.52980 (4.48)	0.0143 (2.67)	-.28080 (-4.16)	.025397 (2.83)
APPLE/ ORANGE JUICE	2.7498 (2.32)	0.0102 (0.236)	-.36768 (-2.30)	.006783

Table 6 - Expenditure and own price elasticities - Dynamic AIDS

GOOD i/j	COFFEE	SOFT DRINKS	MILK	TEA	ORANGE/ APPLE JUICE
Expend. elasticity	1.4	2.63	0.25	0.68	0.89
COFFEE	-0.30	-0.41	-0.67	0.06	-0.08
SOFT DRINKS	-0.32	-1.43	-0.94	-0.01	0.06
MILK	-0.01	0.16	-0.33	-0.02	-0.06
TEA	0.31	0.33	-0.66	-0.22	-0.45
ORANGE/ APPLE JUICE	-0.07	0.64	-0.82	-0.18	-0.45

Table 7 - Expenditure and own price elasticities - Dynamic LES

GOOD i/j	COFFEE	SOFT DRINKS	MILK	TEA	ORANGE/ APPLE JUICE
Expend. elasticity	1.97	1.75	0.54	1.14	0.47
COFFEE	-0.61	-0.27	-0.94	-0.04	-0.12
SOFT DRINKS	-0.09	-0.68	-0.83	-0.03	-0.11
MILK	-0.03	-0.07	-0.40	-0.01	-0.03
TEA	-0.06	-0.15	-0.54	-0.32	-0.07
ORANGE/ APPLE JUICE	-0.03	-0.06	-0.22	-0.01	-0.2

Table 8 - Price and Income Elasticities for milk-Comparison with Previous Studies

AUTHOR	PERIOD	REGION	OWN PRICE	INCOME	METHOD
This study	1987-1989	B.C.	-0.40	0.54	L.E.S.
This study	1987-1989	B.C.	-0.33	0.25	AIDS (1)
Perkins et. al	1957-1966	CANADA	-0.28	-1.1	(2)
Lu & Marshall	1966-1971	ONTARIO	-0.20	0.36	CROSS X./ TIME SERIES(3)
Sahi & Harrington	1958-1972	CANADA	-0.32	0.83	2SLS
Spencer & Feaver	1961-1974	CANADA	-0.30	0.44	OLS
Hassan & Sahi	1958-1972	CANADA	-0.44	0.63	OLS
Hassan & Johnson	1974	CANADA	-0.47	-0.21	CROSS X.
Stonehouse et. al	1958-1975	CANADA	-0.76	0.21	(2)
Kinnucan	1978-1981	BUFFALO	-0.73	0.35	OLS
Boehm	1966-1975 1966-1975	SEATTLE U.S. AVG.	-0.27 -0.30	0.13 0.14	OLS OLS
Hein & Wessells	1977-1978	U.S.	-0.63	0.77	AIDS
Goddard & Tielu	1971-1984	ONTARIO	-0.29	0.43	TRANSLOG
George & King	1955/1965	U.S.	-0.35	0.37	CROSS X.
Al-Zand & Andriamanjay	1968-1982	CANADA	-0.21	0.49	OLS(4)

1- dynamic AIDS-uncorrected for serial correlation

2-estimate obtained from Lane & Fox-model unknown.

3-demand at the farm level; authors claim that if retail price =2*farm price then η=-0.40

4-partly skimmed milk

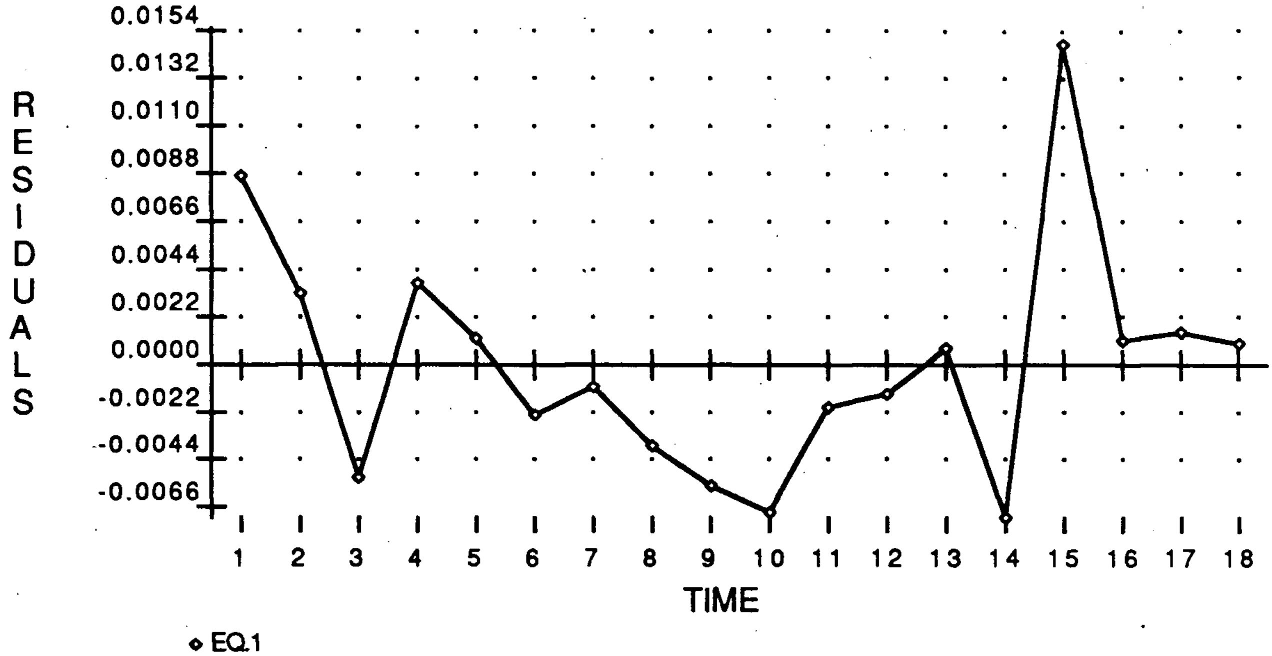

Figure 3 - Coffee equation residuals v. Time

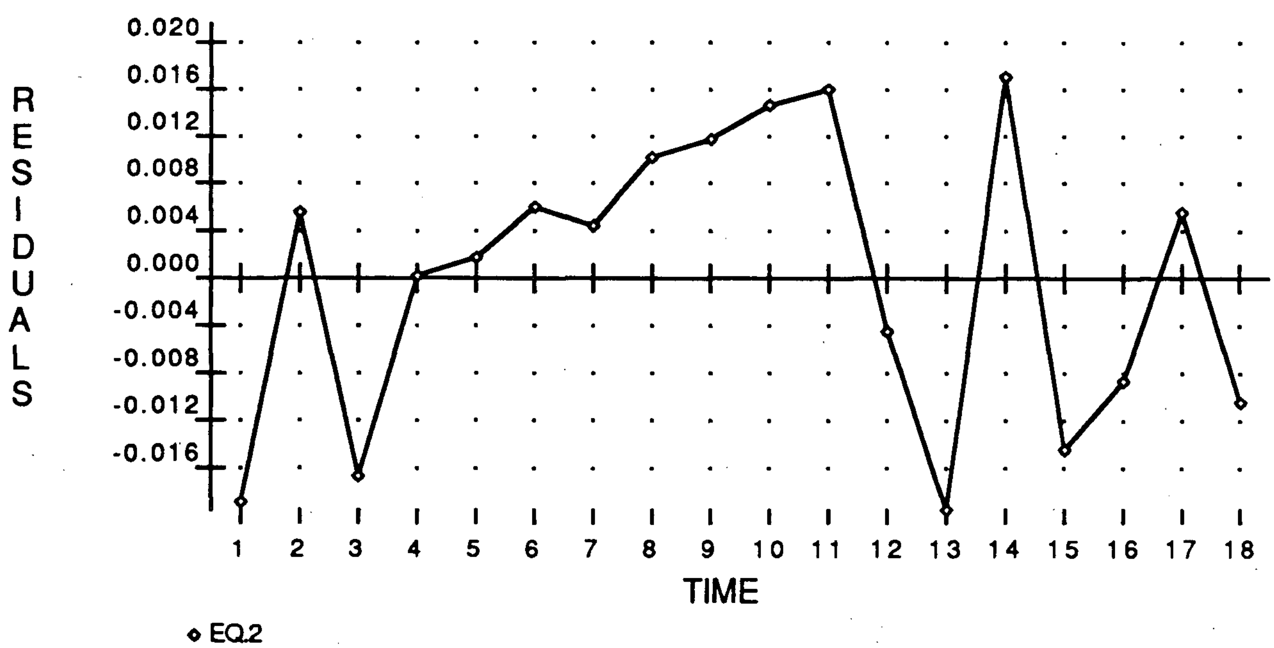

Figure 4 - Soft Drink equation residuals v. Time

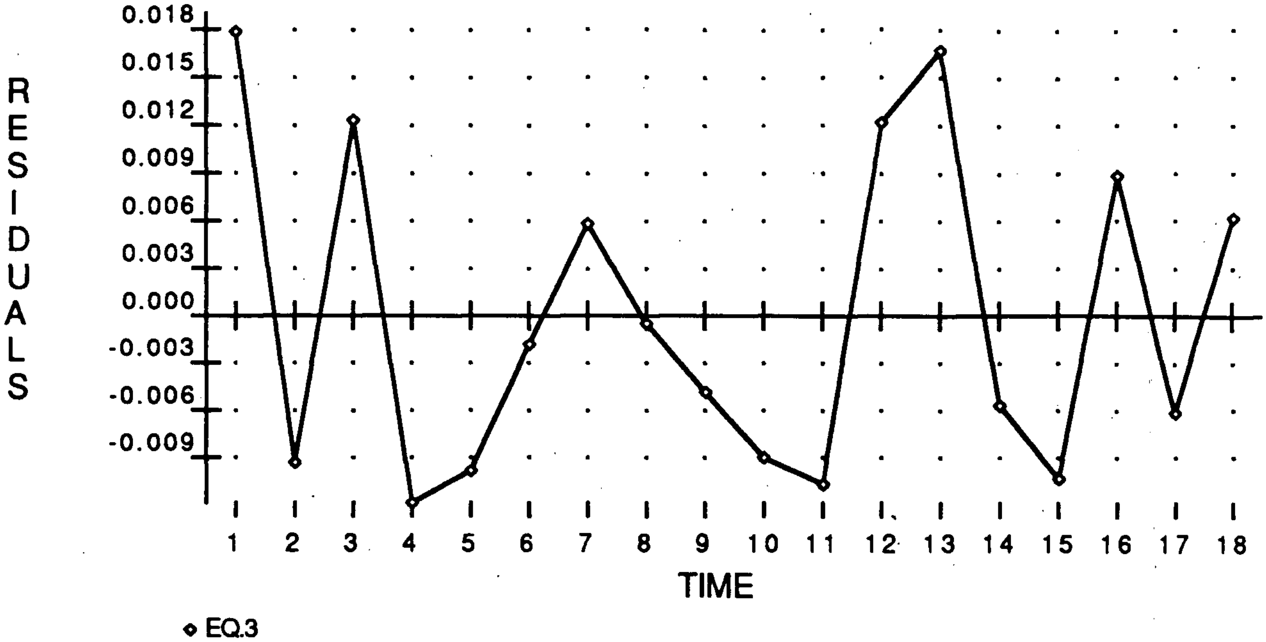

Figure 5 - Milk equation residuals v. Time

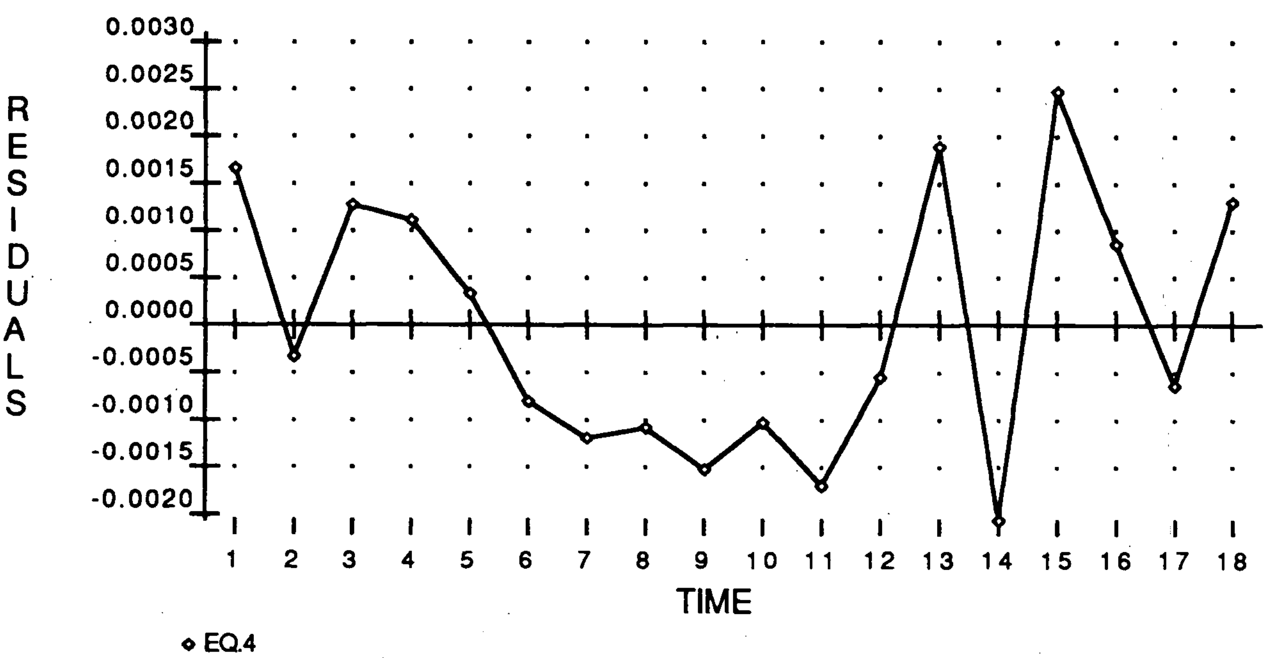

Figure 6 - Tea equation residuals v. Time

4.3 RESULTS FROM SINGLE EQUATION ESTIMATION

Single equation estimation data was unfortunately plagued with a high degree of multicollinearity, which resulted in insignificant variables, wrong signs, and unbelievable elasticity estimates. We admit at this point that we in fact engaged in a "specification search" by estimating various functional forms, such as the log-log and log-linear forms, none of which were successful in yielding "believable"estimates. An attempt was also made at imposing homogeneity of degree zero in income and prices, on the single equation being estimated, by dividing all prices and income by income, and using these normalized prices as dependent variables, along with temperature, and population under the age of 15. Unfortunately, this too was to no avail. Since our objective is to obtain reliable elasticity estimates, and not simply prediction, multicollinearity in such a high degree poses a serious problem. As such, we do not present results from single equation estimation, but conclude that this may perhaps be the reason for no previous estimates on the demand for milk in British Columbia. The data used in this study for single equation estimation are readily available from Statistics Canada catalogues, which would be the most obvious data source for researchers wanting to estimate the demand for milk in British Columbia. Since it seems surprising that no one has ever attempted to estimate the demand for milk in British Columbia, we believe that perhaps this estimation has been attempted, but yielded insignificant and unbelievable results such as those found in this study's attempt at single equation estimation.

4.4 IMPLICATIONS

We turn now to assessing the implications of the estimated elasticity. Recall that the general definition of the price elasticity of demand is:

$$\eta_{ii} = \frac{\partial q}{\partial p} * \frac{p}{q}$$

where p is the price of the product, q is the quantity consumed and $(\partial q/\partial p)$ is the slope of the demand curve. Then, given our elasticity estimate, assuming linear demand curves for the sake of simplicity, and using mean values for p and q used in estimation, we can find $(\partial q/\partial p)$. The question we now ask is, what would be the elasticity of demand for milk in B.C. if the price of milk in B.C. was equal to the price of milk in Seattle. The data on milk prices suggest that Seattle milk is approximately thirty percent cheaper than the milk in B.C.. With this knowledge, and an estimated B.C. elasticity of -0.40, we calculate q to be

$$q=q * (1+(0.4*30)) \text{ when } p =0.7 * p.$$

We now have all three parameters needed to estimate the elasticity of demand for B.C. milk when B.C. prices equal Seattle prices. This elasticity is estimated at -0.25, which is remarkably similar to Boehm's estimate of -0.27 for Seattle. We also find that with a price differential of approximately thirty percent and an estimated elasticity of -0.4, we can assert that a thirty percent decline in B.C. milk prices would lead to an increased consumption of B.C. milk in the order of twelve percent. Readers will recall that Ag. Canada's estimate of milk purchased in Washington State by B.C. consumers was approximately ten percent of B.C. consumption, which is not far from our estimate of twelve percent. We note in passing, however, that this twelve percent increase is based on the entire B.C. population, whereas the part of the population purchasing milk in Washington State is primarily restricted to the Lower Mainland. Thus, we consider this estimate of twelve percent to be an upper bound on the amount of milk purchased in Washington State by B.C. consumers.

We now ask whether or not expansion in fluid milk production is profitable at the estimated elasticity of -0.40. Recall that the allocation of B.C. MSQ quota is based upon 35/65 th's of its fluid milk consumption. Thus, issuing an additional unit of fluid milk quota, in this case via a decrease in the fluid milk price, leads not only to an increase in B.C. fluid milk sales (along with a decrease in revenue) and increased production costs, but also to an increase in industrial milk sales. We proceed as follows:

Let $\pi = p^f q^f + p^i q^i - C(q^f + q^i)$

where, π = industry profit
p^f = farm price of fluid milk
p^i = farm price of industrial milk (assumed constant because B.C. production is a very small part of Canadian production)
C = variable cost of production
q^f, q^i = quantity of fluid and industrial milk sold

Then, differentiating π with respect to q^f leads to,

$$\frac{\partial \pi}{\partial q^f} = p^f + q^f \frac{\partial p^f}{\partial q^f} + p^i \frac{\partial q^i}{\partial q^f} - \frac{\partial C}{\partial q^f} \qquad \text{(a)}$$

which states that for profit maximization, the sum of the marginal revenues for fluid and industrial milk must equal the marginal cost of producing fluid and industrial milk.

Now, $$\eta_{ii} = \frac{\partial q}{\partial p} * \frac{p}{q} \implies \frac{\partial p}{\partial q} * q = \frac{p}{\eta_{ii}} \qquad \text{(b)}$$

and by virtue of B.C.'s agreement in the National Milk Marketing Plan,

$$\frac{\partial q^i}{\partial q^f} = \frac{35}{65} \qquad \text{(c)}$$

Since fluid and industrial milk are the same good at the farm level, and are only classified on the basis of end use, the costs of production at the farm level are the same. Thus,

$$\frac{\partial C}{\partial q^f} = C + \frac{35}{65}C \qquad \text{(d)}$$

Substituting (b), (c), and (d) into (a) yields (e),

$$\frac{\partial \pi}{\partial q^f} = \frac{p^f}{\eta_{ii}}(\eta_{ii} + 1) + p^i\frac{35}{65} - C - \frac{35}{65}C \qquad \text{(e)}$$

We assume C to be $0.25/litre, a figure quoted by some industry analysts, and use current values for fluid and industrial milk which are $0.59/litre and $0.41/litre respectively. Note that we choose not to add to this last term the value of gain in the stock of MSQ quota, since the value of the increased profits from industrial milk sales will inherently become capitalized into the price of MSQ quota, and as such addition would result in "double counting". Moreover, note that we do not discount the flow presented by the last term above, since it does not alter the result. At these prices and cost figures, the resulting change in profit is negative implying that a unit increase in fluid milk quota leads to a decrease in profit. Given this result, we now ask what elasticity estimate is needed for the change in profits to equal zero, which would be the required estimate at which it would be just profitable (from the industry perspective) to increase fluid quota by one unit? Using the above mentioned prices and cost figures, we vary η_{ii}, and find this "critical" elasticity to be -1.4. Note that since we use farm gate prices and costs, this is the "critical" elasticity at the farm gate. This figure is quite high, particularly when we attempt to convert it into a retail level elasticity. We do this by observing that the retail price is approximately 80% of the farm gate price, and therefore a crude method for conversion would be to multiply this elasticity of -1.4 by 1.8, implying that the "critical" elasticity at the retail level is -2.52.

Lastly, a note on the perceived consequences of our short data set is in order. Some may argue that our period of observation, three years, can only yield short run elasticity estimates. The argument is that with a commodity grouping containing non-perishable goods such as coffee, tea and soft drinks, the effects of storage or inventory on the part of a household could, in the long run, yield more elastic estimates for these (non-perishable) commodities, and by virtue of the adding up constraint yield different long run elasticity estimates for perishable commodities such as milk.[7] It seems rational to expect that households will respond to lower prices for non-perishable commodities by purchasing more than is required for immediate consumption. With a data set containing bi-monthly data and spanning only a period of three years we would expect that these "stock adjustments" will not be picked up in the data, and thus if stocks are really a matter of common occurence, we cannot refute the argument that the elasticity estimate for milk in this study is short run. Only when more data is gathered for future estimation can this argument be validated.

[7] Economic theory requires that the own-price, cross-price and income(expenditure) elasticities sum to zero.

5.0 SUMMARY AND CONCLUSIONS

5.1 SUMMARY

This study has attempted to estimate the demand for milk in British Columbia, and in particular to obtain an estimate of the elasticity of demand for milk. An Almost Ideal Demand System in both static and dynamic form, along with a dynamic Linear Expenditure System were estimated using data on apple juice, orange juice, coffee, tea, soft drinks, low fat milk and standard milk. We note that the Linear Expenditure System estimated met all theoretical restrictions, in particular quasi-concavity of the utility function at each observation point. In addition, an attempt was made at employing ordinary least squares to estimate the demand for milk in British Columbia, but failed to yield credible results. We believe that researchers who may have previously attempted to estimate the demand for milk in B.C. may have also run into this problem and abandoned their empirical investigation. This, because The A.C. Nielsen Co. is an unknown data source to many researchers, and without data from this source, researchers would be forced to resort to the Statistics Canada's data set, which in this case yielded insignificant results.

An elasticity estimate for the demand for milk in B.C. has, to our knowledge, never been estimated or published, perhaps due in part to the reason mentioned above. Thus, using an alternate source of data other than Statistics Canada, this study has attempted to take the first step at estimating this parameter which is of great interest to policy analysts. Many have argued that the retail price of milk in B.C. is too high relative to other provinces and the bordering United States, and that decreasing the price can lead to significant increases in consumption which have ramifications for the Market Share Quota allocated to British Columbia. However, these assertions are only valid if there is a parameter to base the argument upon, in this case the elasticity.

5.2 CONCLUSIONS

The results of this study are both credible and interesting. The elasticity of demand for milk in British Columbia is estimated to be between -0.33 and -0.40, which is in the order of most estimates done for Canada and the United States. Moreover, our analysis suggests that there is a likelihood that B.C. and Seattle milk consumers may lie on the same demand curve. Our analysis also suggests that twelve percent of B.C. consumption is an upper bound on the amount of milk purchased by B.C. consumers in Washington State. This estimate is in line with a study done by Agriculture Canada, who have estimated sales of Washington State milk to B.C. consumers at approximately ten percent of B.C. consumption.[8] In volume terms, this is approximately thirty million litres, a figure well below Shelford's 1988 rough estimate of sixty five million litres of milk.

Unfortunately, with an elasticity estimate of -0.40, significant increases in consumption cannot be achieved through decreased prices. Only with a more elastic estimate and a resulting net benefit to society, which includes both producers and consumers, can the calls for lower milk prices be justified by the dairy industry. It is easy to see why many believe the elasticity of demand for milk in B.C. to be elastic. Close proximity to the U.S. border where milk is much cheaper, and relatively high milk prices in comparison to other western provinces are some of the reasons.

We end this study by offering recommendations for future research and restating that the elasticity of demand for milk in British Columbia has been estimated to be between -0.33 and -0.40..

[8]Because we have been unable to secure a copy of this report, details of its estimation cannot be provided.

5.3 RECOMMENDATIONS FOR FUTURE RESEARCH

In view of the developments from this study, we have many recommendations for future research, some of which are listed below.

1. The data obtained from the A.C. Nielsen Co. of Canada is probably the best, if not the only data available on beverage consumption in B.C.. Statistics Canada data is generally reported on a Canada wide basis, and as we have found, what little provincial data that is available, does not yield reliable or credible results. Given the lack of "good" available data and in view of the issue raised regarding the possible consequence of a short data set, it is critical that this data set be updated periodically in order for future research to be successful in providing long run elasticity estimates for milk in B.C.. Judging from discussions with Nielsen personnel, back data on bi-monthly consumption is available only for a period of three years, after which it is turned into annual data.

2. Data on milk prices and consumption are, unfortunately, not available from the A.C. Nielsen Co., and as such we were forced to resort to Statistics Canada Data. There are some lingering doubts about this data, in particular, the sudden drop in prices in two of the last three observation periods, which can be seen from Appendix 5, as well as from the CPI figures for milk in British Columbia (not included). Disturbed by these figures, we contacted Overwaitea, Safeway, and Dairyland who unfortunately could not provide us with necessary data on prices. It seems odd that prices of a staple commodity such as milk would not be collected or recorded by anyone other than Statistics Canada. One option that has not been tried is to contact a consumer advisory group that may have data on the prices of milk in British Columbia, which could corroborate Statistics Canada data.

3. The fact that the SHAZAM model could not converge when correcting for serial correlation in both AIDS models is still disturbing, even though we fully realized before attempting this project that these types of exercises are not always

deterministic. Perhaps the same model written for SHAZAM could be written for another econometrics/statistics package such as S.A.S. or the Non Linear Monitor. Non convergence could merely be due to the algorithm used by SHAZAM.

4. Since there are no other comparable estimates on the demand for milk in British Columbia, it may be a worthwhile exercise to attempt estimation with another functional form, such as the Normalized Quadratic with concavity imposed. Estimation of alternate functional forms is something not done by most researchers, which is odd in many ways, for we always hear about dilemmas on the choice of functional form. When it comes to estimating a model, most researchers simply pick a model on the basis of popularity, but then do nothing to test the robustness of their results by using alternate models.

5. Given that we now have an estimate of the elasticity of demand for milk in British Columbia, it may be a worthwhile exercise to determine the net benefit/loss to society due to an increase in the fluid milk quota, which would result from a decrease in the retail price for milk. This study would, of course, take into account the gain to consumers from lower milk prices, as well as the gain to producers from increased MSQ quota allocation and industrial milk sales, as well as the loss in fluid milk revenue by producers.

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APPENDIX 1 - DERIVATION OF PRICE ELASTICITIES FOR THE AIDS

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log (X/P)$$

where,

$$w_i = (p_i q_i)/X$$
$$X = \sum p_i q_i$$

and P is a price index defined by,

$$\log P = \alpha_0 + \sum_j \alpha_j \log p_j + 1/2 * \sum_j \sum_i \gamma_{ij} \log p_i \log p_j$$

So, $q_i = w_i X/p_i \implies \log q_i = \log w_i + \log X - \log p_i$

$$\text{Now, } \eta_{ij} = \frac{d \log q_i}{d \log p_j} = \frac{d \log w_i}{d \log p_j} + \frac{d \log X}{d \log p_j} - \frac{d \log p_i}{d \log p_j}$$

$$\frac{d \log w_i}{d \log P_j} = [\gamma_{ij} - \beta_i(\alpha_i + \sum_i \gamma_{ij} \log p_i)] / w_i$$

$$\frac{d \log X}{d \log P_j} = 0 \text{ since X is held constant}$$

$$\frac{d \log P_i}{d \log P_j} = \delta_{ij} \qquad \text{Kronecker delta;} \qquad \begin{aligned} &= 0 \quad \text{if } i \neq j \\ &= 1 \quad \text{if } i = j \end{aligned}$$

$$\implies \eta_{ij} = \{ [\gamma_{ij} - \beta_i (\alpha_j + \sum_i \gamma_{ij} \log p_i)] / w_i \} - \delta_{ij}$$

APPENDIX 2 - SHAZAM PROGRAM FOR A 5 GOOD AIDS SYSTEM

```
NL 4/NCOEF=23 ouT=15 ITER=5000 piter=100
EQ W1= ((a1+d1*TEMP)-(b1*a0)) &
+g11*(LP1-LP5)+g12*(LP2-LP5)+g13*(LP3-LP5)+g14*(LP4-LP5) &
+b1*(LTEXP-(a1+d1*TEMP)*LP1-(a2+d2*TEMP)*LP2-(a3+d3*TEMP)*LP3) &
+b1*(-(a4+d4*TEMP)*LP4) &
+b1*(-((1-a1-a2-a3-a4)+(-d1-d2-d3-d4)*TEMP)*LP5)&
-.5*b1*g11*(lp1*lp1+lp5*lp5-2*lp1*lp5) &
-.5*b1*g22*(lp2*lp2+lp5*lp5-2*lp2*lp5) &
-.5*b1*g33*(lp3*lp3+lp5*lp5-2*lp3*lp5) &
-.5*b1*g44*(lp4*lp4+lp5*lp5-2*lp4*lp5) &
-.5*b1*g12*(2*lp1*lp2+2*lp5*lp5-2*lp1*lp5-2*lp2*lp5) &
-.5*b1*g13*(2*lp1*lp3+2*lp5*lp5-2*lp1*lp5-2*lp3*lp5) &
-.5*b1*g14*(2*lp1*lp4+2*lp5*lp5-2*lp1*lp5-2*lp4*lp5) &
-.5*b1*g23*(2*lp2*lp3+2*lp5*lp5-2*lp2*lp5-2*lp3*lp5) &
-.5*b1*g24*(2*lp2*lp4+2*lp5*lp5-2*lp2*lp5-2*lp4*lp5) &
-.5*b1*g34*(2*lp3*lp4+2*lp5*lp5-2*lp3*lp5-2*lp4*lp5)
*
EQ W2=((a2+d2*TEMP)-(b2*a0)) &
+g12*(LP1-LP5)+g22*(LP2-LP5)+g23*(LP3-LP5)+g24*(LP4-LP5) &
+b2*(LTEXP-(a1+d1*TEMP)*LP1-(a2+d2*TEMP)*LP2-(a3+d3*TEMP)*LP3) &
+b2*(-(a4+d4*TEMP)*LP4) &
+b2*(-((1-a1-a2-a3-a4)+(-d1-d2-d3-d4)*TEMP)*LP5)&
-.5*b2*g11*(lp1*lp1+lp5*lp5-2*lp1*lp5) &
-.5*b2*g22*(lp2*lp2+lp5*lp5-2*lp2*lp5) &
-.5*b2*g33*(lp3*lp3+lp5*lp5-2*lp3*lp5) &
-.5*b2*g44*(lp4*lp4+lp5*lp5-2*lp4*lp5) &
-.5*b2*g12*(2*lp1*lp2+2*lp5*lp5-2*lp1*lp5-2*lp2*lp5) &
-.5*b2*g13*(2*lp1*lp3+2*lp5*lp5-2*lp1*lp5-2*lp3*lp5) &
-.5*b2*g14*(2*lp1*lp4+2*lp5*lp5-2*lp1*lp5-2*lp4*lp5) &
-.5*b2*g23*(2*lp2*lp3+2*lp5*lp5-2*lp2*lp5-2*lp3*lp5) &
-.5*b2*g24*(2*lp2*lp4+2*lp5*lp5-2*lp2*lp5-2*lp4*lp5) &
-.5*b2*g34*(2*lp3*lp4+2*lp5*lp5-2*lp3*lp5-2*lp4*lp5)
*
EQ W3=((a3+d3*TEMP)-(b3*a0)) &
+g13*(LP1-LP5)+g23*(LP2-LP5)+g33*(LP3-LP5)+g34*(LP4-LP5) &
+b3*(LTEXP-(a1+d1*TEMP)*LP1-(a2+d2*TEMP)*LP2-(a3+d3*TEMP)*LP3) &
+b3*(-(a4+d4*TEMP)*LP4) &
+b3*(-((1-a1-a2-a3-a4)+(-d1-d2-d3-d4)*TEMP)*LP5)&
-.5*b3*g11*(lp1*lp1+lp5*lp5-2*lp1*lp5) &
-.5*b3*g22*(lp2*lp2+lp5*lp5-2*lp2*lp5) &
-.5*b3*g33*(lp3*lp3+lp5*lp5-2*lp3*lp5) &
-.5*b3*g44*(lp4*lp4+lp5*lp5-2*lp4*lp5) &
-.5*b3*g12*(2*lp1*lp2+2*lp5*lp5-2*lp1*lp5-2*lp2*lp5) &
-.5*b3*g13*(2*lp1*lp3+2*lp5*lp5-2*lp1*lp5-2*lp3*lp5) &
-.5*b3*g14*(2*lp1*lp4+2*lp5*lp5-2*lp1*lp5-2*lp4*lp5) &
-.5*b3*g23*(2*lp2*lp3+2*lp5*lp5-2*lp2*lp5-2*lp3*lp5) &
-.5*b3*g24*(2*lp2*lp4+2*lp5*lp5-2*lp2*lp5-2*lp4*lp5) &
```

```
-.5*b3*g34*(2*lp3*lp4+2*lp5*lp5-2*lp3*lp5-2*lp4*lp5)
*
EQ W4=((a4+d4*TEMP)-(b4*a0)) &
+g14*(LP1-LP5)+g24*(LP2-LP5)+g34*(LP3-LP5)+g44*(LP4-LP5) &
+b4*(LTEXP-(a1+d1*TEMP)*LP1-(a2+d2*TEMP)*LP2-(a3+d3*TEMP)*LP3) &
+b4*(-(a4+d4*TEMP)*LP4) &
+b4*(-((1-a1-a2-a3-a4)+(-d1-d2-d3-d4)*TEMP)*LP5)&
-.5*b4*g11*(lp1*lp1+lp5*lp5-2*lp1*lp5) &
-.5*b4*g22*(lp2*lp2+lp5*lp5-2*lp2*lp5) &
-.5*b4*g33*(lp3*lp3+lp5*lp5-2*lp3*lp5) &
-.5*b4*g44*(lp4*lp4+lp5*lp5-2*lp4*lp5) &
-.5*b4*g12*(2*lp1*lp2+2*lp5*lp5-2*lp1*lp5-2*lp2*lp5) &
-.5*b4*g13*(2*lp1*lp3+2*lp5*lp5-2*lp1*lp5-2*lp3*lp5) &
-.5*b4*g14*(2*lp1*lp4+2*lp5*lp5-2*lp1*lp5-2*lp4*lp5) &
-.5*b4*g23*(2*lp2*lp3+2*lp5*lp5-2*lp2*lp5-2*lp3*lp5) &
-.5*b4*g24*(2*lp2*lp4+2*lp5*lp5-2*lp2*lp5-2*lp4*lp5) &
-.5*b4*g34*(2*lp3*lp4+2*lp5*lp5-2*lp3*lp5-2*lp4*lp5)
*
end
```

APPENDIX 3 - OWN PRICE / EXPENDITURE ELASTICITIES-STATIC AIDS

***UNCORRECTED FOR SERIAL CORRELATION

OWN PRICE ELASTICITIES:

PERIOD	COFFEE	SOFT DRINKS	MILK	TEA	APPLE/ ORANGE JUICE
O/N '87	-0.42	-1.29	-0.32	-0.29	-0.51
D/J '88	-0.48	-1.20	-0.25	-0.40	-0.51
F/M '88	-0.37	-1.01	-0.13	-0.35	-0.56
A/M '88	-0.38	-1.24	-0.28	-0.31	-0.53
J/J '88	-0.40	-1.39	-0.39	-0.21	-0.51
A/S '88	-0.37	-1.26	-0.27	-0.20	-0.54
O/N '88	-0.43	-1.52	-0.47	-0.33	-0.53
D/J '89	-0.45	-1.27	-0.31	-0.41	-0.52
F/M '89	-0.39	-1.13	-0.24	-0.40	-0.52
A/M '89	-0.36	-1.04	-0.15	-0.33	-0.51
J/J '89	-0.33	-1.01	-0.09	-0.28	-0.51
A/S '89	-0.39	-1.21	-0.24	-0.27	-0.49
O/N '89	-0.48	-1.61	-0.54	-0.32	-0.49
D/J '90	-0.47	-1.36	-0.36	-0.41	-0.49
F/M '90	-0.38	-1.14	-0.23	-0.40	-0.55
A/M '90	-0.21	-0.55	0.36	-0.37	-0.58
J/J '90	-0.28	-0.91	0.05	-0.31	-0.52
A/S '90	-0.31	-1.11	-0.13	-0.23	-0.52

APPENDIX 3 - CONT.

EXPENDITURE ELASTICITIES:

PERIOD	COFFEE	SOFT DRINKS	MILK	TEA	APPLE/ ORANGE JUICE
O/N '87	1.81	2.24	0.36	1.14	0.87
D/J '88	1.7	2.27	0.34	1.11	0.87
F/M '88	1.80	2.28	0.35	1.13	0.89
A/M '88	1.84	2.17	0.34	1.14	0.88
J/J '88	1.86	2.07	0.33	1.16	0.87
A/S '88	1.85	2.06	0.32	1.16	0.88
O/N '88	1.85	2.25	0.36	1.13	0.88
D/J '89	1.76	2.32	0.36	1.11	0.88
F/M '89	1.80	2.41	0.38	1.11	0.88
A/M '89	1.81	2.22	0.35	1.13	0.88
J/J '89	1.84	2.11	0.33	1.14	0.87
A/S '89	1.82	2.08	0.32	1.14	0.87
O/N '89	1.81	2.25	0.36	1.13	0.87
D/J '90	1.76	2.33	0.36	1.11	0.87
F/M '90	1.82	2.33	0.36	1.12	0.88
A/M '90	1.83	2.06	0.29	1.12	0.89
J/J '90	1.86	2.02	0.30	1.13	0.88
A/S '90	1.88	1.99	0.30	1.15	0.88

APPENDIX 4 - CROSS PRICE AND TEMPERATURE ELASTICITIES FROM THE STATIC AIDS

CROSS PRICE ELASTICITIES (η_{ij})

GOOD i = COFFEE:

PERIOD	SOFT DRINKS	MILK	TEA	APPLE/ ORANGE JUICE
O/N '87	-0.36	-0.60	0.15E-01	-0.46
D/J '88	-0.26	-0.58	0.10E-01	-0.40
F/M '88	-0.17	-0.81	0.15E-01	-0.46
A/M '88	-0.35	-0.65	0.16E-01	-0.48
J/J '88	-0.50	-0.50	0.17E-01	-0.48
A/S '88	-0.38	-0.63	0.18E-01	-0.49
O/N '88	-0.53	-0.43	0.13E-01	-0.48
D/J '89	-0.31	-0.58	0.10E-01	-0.43
F/M '89	-0.24	-0.73	0.12E-01	-0.46
A/M '89	-0.20	-0.81	0.16E-01	-0.46
J/J '89	-0.18	-0.87	0.19E-01	-0.48
A/S '89	-0.33	-0.66	0.17E-01	-0.46
O/N '89	-0.57	-0.33	0.11E-01	-0.45
D/J '90	-0.36	-0.51	0.97E-02	-0.42
F/M '90	-0.26	-0.73	0.13E-01	-0.47
A/M '90	0.19	-1.33	0.21E-01	-0.50
J/J '90	-0.99E-01	-1.01	0.20E-01	-0.49
A/S '90	-0.28	-0.80	0.20E-01	-0.50

APPENDIX 4 - CONT.

GOOD i = SOFT DRINKS

PERIOD	COFFEE	MILK	TEA	APPLE/ ORANGE JUICE
O/N '87	-0.22	-1.10	0.26E-01	0.34
D/J '88	-0.21	-1.22	0.21E-01	0.34
F/M '88	-0.14	-1.49	0.27E-01	0.33
A/M '88	-0.19	-1.09	0.24E-01	0.32
J/J '88	-0.22	-0.78	0.24E-01	0.30
A/S '88	-0.17	-0.94	0.25E-01	0.28
O/N '88	-0.29	-0.82	0.21E-01	0.35
D/J '89	-0.24	-1.20	0.21E-01	0.36
F/M '89	-0.20	-1.48	0.24E-01	0.38
A/M '89	-0.14	-1.39	0.26E-01	0.33
J/J '89	-0.10	-1.32	0.27E-01	0.30
A/S '89	-0.16	-1.03	0.24E-01	0.30
O/N '89	-0.32	-0.68	0.20E-01	0.36
D/J '90	-0.27	-1.09	0.20E-01	0.37
F/M '90	-0.19	-1.37	0.23E-01	0.35
A/M '90	0.50E-01	-1.84	0.28E-01	0.25
J/J '90	-0.54E-01	-1.35	0.26E-01	0.27
A/S '90	-0.11	-1.05	0.25E-01	0.27

APPENDIX 4 - CONT.

GOOD i = MILK

PERIOD	COFFEE	SOFT DRINKS	TEA	APPLE/ ORANGE JUICE
O/N '87	0.44E-01	-0.11E-01	-0.73E-02	-0.66E-01
D/J '88	0.41E-01	-0.61E-01	-0.46E-02	-0.66E-01
F/M '88	0.96E-03	-0.16	-0.74E-02	-0.57E-01
A/M '88	0.34E-01	-0.29E-01	-0.73E-02	-0.64E-01
J/J '88	0.63E-01	0.80E-01	-0.85E-02	-0.71E-01
A/S '88	0.37E-01	-0.44E-02	-0.99E-02	-0.67E-01
O/N '88	0.77E-01	0.10	-0.46E-02	-0.67E-01
D/J '89	0.45E-01	-0.29E-01	-0.39E-02	-0.64E-01
F/M '89	0.21E-01	-0.98E-01	-0.48E-02	-0.60E-01
A/M '89	0.33E-02	-0.14	-0.78E-02	-0.62E-01
J/J '89	-0.94E-02	-0.16	-0.99E-02	-0.63E-01
A/S '89	0.30E-01	-0.39E-01	-0.86E-02	-0.69E-01
O/N '89	0.97E-01	0.16	-0.40E-02	-0.72E-01
D/J '90	0.59E-01	0.13E-01	-0.33E-02	-0.68E-01
F/M '90	0.21E-01	-0.90E-01	-0.50E-02	-0.59E-01
A/M '90	-0.11	-0.48	-0.12E-01	-0.48E-01
J/J '90	-0.38E-01	-0.24	-0.11E-01	-0.63E-01
A/S '90	0.42E-02	-0.93E-01	-0.11E-01	-0.67E-01

APPENDIX 4 - CONT.

GOOD i = TEA

PERIOD	COFFEE	SOFT DRINKS	MILK	APPLE/ ORANGE JUICE
O/N '87	0.14	0.47	-0.60	-0.86
D/J '88	0.12	0.40	-0.51	-0.72
F/M '88	0.13	0.46	-0.58	-0.78
A/M '88	0.14	0.46	-0.59	-0.84
J/J '88	0.14	0.50	-0.64	-0.96
A/S '88	0.16	0.53	-0.67	-0.97
O/N '88	0.12	0.42	-0.53	-0.81
D/J '89	0.11	0.40	-0.50	-0.72
F/M '89	0.12	0.41	-0.52	-0.72
A/M '89	0.14	0.47	-0.594	-0.80
J/J '89	0.15	0.51	-0.65	-0.87
A/S '89	0.14	0.49	-0.62	-0.88
O/N '89	0.12	0.41	-0.53	-0.82
D/J '90	0.11	0.39	-0.49	-0.71
F/M '90	0.12	0.41	-0.53	-0.73
A/M '90	0.15	0.50	-0.64	-0.77
J/J '90	0.15	0.51	-0.65	-0.84
A/S '90	0.16	0.53	-0.67	-0.93

APPENDIX 4 - CONT.

GOOD i = APPLE/ORANGE JUICE

PERIOD	COFFEE	SOFT DRINKS	MILK	TEA
O/N '87	-0.64	1.46	-0.85	-0.33
D/J '88	-0.64	1.44	-0.84	-0.33
F/M '88	-0.58	1.28	-0.73	-0.30
A/M '88	-0.61	1.38	-0.81	-0.32
J/J '88	-0.64	1.48	-0.87	-0.33
A/S '88	-0.60	1.37	-0.80	-0.31
O/N '88	-0.61	1.42	-0.84	-0.32
D/J '89	-0.62	1.41	-0.83	-0.32
F/M '89	-0.62	1.39	-0.80	-0.32
A/M '89	-0.64	1.41	-0.81	-0.33
J/J '89	-0.65	1.42	-0.81	-0.33
A/S '89	-0.67	1.51	-0.87	-0.34
O/N '89	-0.66	1.56	-0.93	-0.35
D/J '90	-0.66	1.51	-0.89	-0.34
F/M '90	-0.59	1.33	-0.77	-0.31
A/M '90	-0.5	1.15	-0.62	-0.28
J/J '90	-0.64	1.38	-0.78	-0.32
A/S '90	-0.63	1.41	-0.81	-0.32

APPENDIX 4 - CONT.

TEMPERATURE ELASTICITIES

PERIOD	COFFEE	SOFT DRINKS	MILK	TEA	APPLE/ ORANGE JUICE
O/N '87	-0.13	0.16	-0.25E-01	-0.24	-0.25E-01
D/J '88	-0.57E-01	0.81E-01	-0.13E-01	-0.98E-01	-0.12E-01
F/M '88	-0.94E-01	0.12	-0.18E-01	-0.16	-0.16E-01
A/M '88	-0.16	0.18	-0.29E-01	-0.27	-0.28E-01
J/J '88	-0.22	0.22	-0.41E-01	-0.42	-0.40E-01
A/S '88	-0.22	0.21	-0.41E-01	-0.42	-0.37E-01
O/N '88	-0.12	0.15	-0.22E-01	-0.20	-0.22E-01
D/J '89	-0.74E-01	0.10	-0.15E-01	-0.12	-0.15E-01
F/M '89	-0.89E-01	0.13	-0.16E-01	-0.14	-0.16E-01
A/M '89	-0.16	0.19	-0.30E-01	-0.27	-0.30E-01
J/J '89	-0.21	0.22	-0.39E-01	-0.37	-0.38E-01
A/S '89	-0.20	0.21	-0.40E-01	-0.37	-0.40E-01
O/N '89	-0.12	0.15	-0.22E-01	-0.20	-0.23E-01
D/J '90	-0.69E-01	0.96E-01	-0.14E-01	-0.11	-0.14E-01
F/M '90	-0.86E-01	0.11	-0.16E-01	-0.13	-0.15E-01
A/M '90	-0.16	0.16	-0.32E-01	-0.25	-0.25E-01
J/J '90	-0.22	0.21	-0.43E-01	-0.37	-0.39E-01
A/S '90	-0.24	0.22	-0.46E-01	-0.44	-0.41E-01

APPENDIX 5 - DATA USED IN SYSTEM /SINGLE EQUATION ESTIMATION

DATA USED IN DEMAND SYSTEM ESTIMATION:

RESTRICTED ACCESS TO DATA

APPENDIX 5 - CONT.

DATA USED IN DEMAND SYSTEM ESTIMATION:

RESTRICTED ACCESS TO DATA

APPENDIX 5 - CONT.

DATA USED IN SINGLE EQUATION ESTIMATION:

Std. Milk $/lt	Low Fat $/lt	Wash State $c/lt	Coffee ($/ 369g)	Tea ($/ 100 bags)	O.J. ($/ 1.36 litre)	Soft Drink ($/ 750 ml.)	A.J. ($/ 1.36 litre)	Tom. Juice $/lt
0.63	0.63	0.58	3.39	3.32	1.30	0.50	1.13	0.99
0.67	0.65	0.58	3.00	3.45	1.35	0.53	1.23	1.04
0.67	0.67	0.59	2.91	3.42	1.36	0.54	1.22	1.06
0.69	0.68	0.61	3.74	3.50	1.39	0.57	1.33	1.11
0.71	0.70	0.61	3.76	3.55	1.41	0.56	1.34	1.06
0.75	0.72	0.62	4.04	3.47	1.42	0.65	1.47	1.17
0.75	0.76	0.61	4.11	3.47	1.45	0.70	1.47	1.21
0.78	0.78	0.63	3.90	3.48	1.47	0.74	1.45	1.3
0.78	0.80	0.65	3.86	3.55	1.48	0.75	1.48	1.32
0.83	0.82	0.65	3.16	3.52	1.67	0.73	1.47	1.34
0.83	0.84	0.66	3.07	3.63	1.73	0.75	1.43	1.35
0.88	0.86	0.66	3.00	3.75	1.75	0.77	1.72	1.46
0.88	0.89	0.67	3.31	3.73	1.78	0.78	1.59	1.52
0.92	0.88	0.71	4.10	3.77	1.85	0.80	1.66	1.65
0.91	0.93	0.72	3.37	3.80	1.92	0.86	1.69	1.64
0.96	0.93	0.71	3.35	3.73	1.96	0.77	1.76	1.68
0.98	0.95	0.71	3.27	3.75	1.95	0.86	1.74	1.74
0.98	0.95	0.71	3.29	3.68	1.95	0.84	1.75	1.77
0.99	0.96	0.71	3.24	3.67	1.95	0.89	1.72	1.75
1.00	0.97	0.72	3.23	3.75	2.00	0.80	1.66	1.73
1.00	0.97	0.73	3.33	3.85	2.08	0.89	1.66	1.7
1.02	0.99	0.76	3.43	4.13	2.13	0.89	1.69	1.8
1.02	0.99	0.77	3.50	4.50	2.11	0.92	1.65	1.85
1.03	1.00	0.78	3.75	4.92	2.22	0.91	1.62	1.7
1.03	1.00	0.80	3.69	5.10	2.18	0.83	1.61	1.78
1.04	1.01	0.81	3.67	5.07	2.23	0.85	1.60	1.83
1.04	1.01	0.80	3.57	5.00	2.24	0.86	1.62	1.79
1.05	1.02	0.81	3.62	4.87	2.23	0.95	1.61	1.79
1.05	1.02	0.82	3.66	3.94	2.24	0.91	1.59	1.87
1.08	1.05	0.81	4.21	4.81	2.14	0.87	1.57	1.88
1.08	1.05	0.81	4.76	4.65	2.26	0.79	1.56	1.95
1.08	1.05	0.81	4.48	4.10	2.18	1.07	1.57	1.74
1.08	1.05	0.79	4.02	4.00	1.95	0.96	1.58	1.77
1.08	1.05	0.78	3.80	3.96	2.21	0.87	1.63	1.93
1.07	1.04	0.78	3.46	3.71	2.38	0.97	1.49	1.95

1.07	1.04	0.77	3.20	3.72	2.41	1.05	1.48	1.87
1.07	1.04	0.75	3.27	3.78	2.21	0.94	1.49	1.74
1.07	1.04	0.72	3.17	3.79	2.51	1.03	1.50	1.9
1.08	1.05	0.71	3.02	3.58	2.42	0.99	1.55	1.96
1.07	1.04	0.72	2.71	3.86	2.45	0.77	1.52	1.8
1.14	1.13	0.73	2.71	3.86	2.52	0.98	1.48	1.83
1.12	1.09	0.73	2.96	4.01	2.54	0.84	1.29	2.03
1.10	1.09	0.72	3.26	3.99	2.57	0.89	1.35	1.98
1.12	1.10	0.74	3.08	4.04	2.34	0.99	1.45	2.11

APPENDIX 5 - CONT.

DATA USED IN SINGLE EQUATION ESTIMATION

CPI ALL ITEMS B.C.	CPI HOMO. MILK B.C.	CPI LOW FAT B.C.	CPI COFFEE B.C.	CPI TEA B.C.	CPI APPLE JUICE B.C.	CPI O.J. B.C.	CPI NON-ALCOH. B.C.	CPI CAN VEG B.C.
77.80	76.30	76.10	90.40	96.20	80.20	78.70	72.30	76.10
79.40	78.30	77.90	82.60	94.90	82.80	81.20	75.00	77.10
80.90	80.70	80.30	91.10	94.80	86.80	81.80	79.00	79.80
82.10	82.30	81.90	105.50	95.30	91.40	84.10	78.20	82.10
83.70	84.30	84.00	106.60	96.10	93.50	85.40	81.60	84.20
86.20	87.50	87.30	102.00	96.30	94.50	85.70	85.50	85.00
88.70	91.30	91.20	104.80	95.60	93.50	87.40	90.60	87.30
91.40	93.70	93.70	106.40	97.00	95.90	88.60	99.60	89.70
95.20	96.40	96.40	104.50	99.30	97.00	89.30	98.70	93.20
98.60	98.60	98.50	101.50	98.40	96.90	101.00	98.70	97.90
101.60	101.00	101.00	98.80	100.80	98.10	104.10	99.00	102.10
104.60	104.00	104.00	96.40	101.50	108.10	105.70	103.60	106.70
107.10	107.10	107.20	98.80	100.80	115.30	107.60	107.70	113.40
109.80	109.60	110.00	102.10	104.90	120.30	111.60	109.70	117.80
111.90	111.80	112.20	104.30	103.00	122.70	112.20	110.30	120.50
113.30	114.60	115.00	104.30	103.50	127.70	112.80	106.90	124.00
114.20	115.70	116.10	104.20	103.70	126.50	115.30	114.30	126.30
115.90	116.50	116.60	104.40	101.80	127.10	115.30	120.20	125.90
117.70	117.60	118.10	101.90	102.70	125.00	112.30	116.90	127.40
118.20	118.10	118.20	102.10	105.50	120.70	113.60	109.30	127.20
119.40	119.40	119.80	105.20	109.40	121.00	117.00	110.70	130.20
120.60	120.50	121.00	107.30	117.40	122.90	117.40	112.40	132.50
122.10	121.10	121.40	110.20	125.90	120.10	121.90	119.20	136.10
122.60	121.60	122.10	111.60	132.90	117.70	124.20	114.70	132.40
123.40	122.10	122.90	112.40	138.30	117.30	126.50	113.70	134.50
124.70	122.80	123.50	109.60	141.50	116.80	126.60	115.90	133.00
125.50	123.30	123.10	107.90	134.40	117.90	129.20	118.30	134.00
126.30	123.70	124.20	107.50	136.30	117.60	130.60	118.50	132.60
127.20	125.40	125.80	112.50	138.10	116.10	133.20	124.20	134.00
128.20	126.30	127.00	135.80	137.60	114.20	130.70	120.20	133.90
129.50	127.00	127.80	138.10	134.50	113.70	132.80	119.20	134.80
129.90	127.20	128.10	133.30	127.30	114.40	133.90	133.40	134.80
130.80	127.20	128.10	124.80	125.20	115.40	133.00	131.50	139.60
131.90	126.30	127.30	112.20	122.80	118.60	135.30	128.90	145.30
133.20	125.70	126.80	108.30	121.30	108.30	141.00	136.80	148.50
134.20	126.10	126.60	104.10	119.70	107.80	141.40	132.00	148.90
135.60	126.00	126.80	103.70	117.20	108.30	143.90	139.10	147.00
136.80	126.20	126.60	96.30	121.90	109.60	144.30	140.50	149.90

138.10	128.20	129.20	84.50	119.20	112.60	148.80	136.50	151.20
139.00	123.80	126.30	79.60	122.80	111.10	147.90	128.40	150.90
140.70	126.00	127.40	86.80	123.90	108.20	152.00	137.20	153.80
142.40	120.50	122.80	84.40	127.20	94.10	149.50	125.40	148.30
144.60	120.20	125.80	88.10	129.80	98.70	149.30	132.90	155.30
146.20	123.50	128.90	83.50	129.70	105.50	150.00	133.20	153.90

APPENDIX 5 - CONT.

DATA USED IN SINGLE EQUATION ESTIMATION

STANDARD MILK CONSUMP. l/cap/qtr.	LOW FAT MILK CONSUMP. l/cap/qtr.	POP. B.C. 000'S	POP. B.C. <15 YEARS %	INCOME (SEE §3.3) 000's	TEMP. VAN. AIRPORT (°c)
11.52	14.13	2572.1	22.1	3883925	7.3
11.63	13.96	2581.8	22.1	4018468	16.6
12.17	14.01	2593.6	22.1	4238490	21.4
11.92	14.75	2614.8	22.1	4406162	10.4
11.39	14.55	2636.4	21.8	4552207	7.0
11.46	14.26	2654.1	21.8	4736641	16.0
11.79	14.50	2672.2	21.8	5010559	20.0
11.60	14.98	2694.2	21.8	5257799	10.6
11.09	14.61	2717.7	21.4	5379278	9.5
11.27	14.37	2733.2	21.4	5678414	15.3
11.45	14.37	2784.9	21.4	5666347	20.9
11.32	15.10	2763.2	21.4	6023885	9.9
10.66	14.83	2774.1	21.2	6050464	6.8
10.61	14.55	2781.4	21.2	5968214	16.5
10.65	14.72	2790.8	21.2	5661493	20.1
10.26	15.04	2798.2	21.2	5824550	9.4
9.95	14.99	2802.7	20.9	5925862	10.0
9.66	14.47	2808.7	20.9	5975925	16.8
9.98	14.48	2817.3	20.9	5967699	19.9
9.71	14.85	2826.9	20.9	5867864	8.9
9.28	14.99	2833.8	20.8	5867961	9.2
9.14	14.81	2840.9	20.8	6077305	15.3
9.14	14.63	2851	20.8	6139590	20.6
8.93	15.21	2858.2	20.8	6275517	8.1
8.50	15.23	2863	20.6	6341102	6.7
8.48	15.21	2867	20.6	6384926	16.0
8.62	15.27	2873.4	20.6	6558414	21.3
8.33	16.10	2879.8	20.6	6583022	6.5
8.17	15.71	2883.4	20.5	6627681	9.2
8.26	15.84	2886.4	20.5	6705731	15.8

8.57	16.26	2893	20.5	6660149	20.5
8.17	16.30	2902.6	20.5	6710879	10.3
7.68	16.06	2908.7	20.3	7066840	9.5
7.76	16.03	2917.1	20.3	7154866	17.2
8.00	16.15	2929.3	20.3	7299202	21.3
8.01	16.76	2945.9	20.3	7438697	10.8
7.66	16.66	2960.9	20.2	7585354	8.5
7.42	16.10	2972.7	20.2	7733184	16.5
7.54	16.43	2988.9	20.2	7858604	21.0
7.39	16.52	3009.1	20.2	8079366	10.2
7.23	16.71	3029	20.2	8286296	8.7
7.16	16.47	3044.2	20.2	8428246	17.1
7.34	16.66	3061.1	20.2	8613220	19.7
7.12	16.51	3085.3	20.2	8986540	10.2