THE DEMAND FOR ALCOHOLIC BEVERAGES IN BRITISH COLUMBIA: AN EMPIRICAL INVESTIGATION

by

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ABSTRACT

In comparison with Canada as a whole, British Columbians are average consumers of beer per adult, but are above average consumers of the more potent wines and spirits. In terms of pure alcohol equivalency per adult therefore, B.C. often tops the remaining provinces.

There has been little investigation of the determinants of alcohol consumption in B.C. However, some studies do exist for both Canada and abroad. This thesis extends the methodology of these studies to an analysis of alcohol consumption in B.C. The B.C. results are then compared with those for other jurisdictions, with extra attention being paid to the results obtained by the Canadian studies.

Three demand equations are specified, one to explain the per adult consumption of each of beer, wine and spirits. The model is multiplicative and Ordinary Least Squares regression analysis is applied throughout. The analysis gives special attention to the derivation of price and income elasticities. Due to the importance of habit persistence the multiplicative model utilized is a variation of the stock adjustment model. Specifically,

alcohol consumption is assumed to be continually adjusting to some long run equilibrium value with habit persistence impeding this ongoing process.

Multicollinearity is found to be a major problem and therefore ridge regression is used. Variables whose coefficient estimates carry high standard errors and/or unexpected signs and are not subject to considerable multicollinearity are then excluded from the three equations. Final specifications are decided upon, each of which is different for the three beverages analyzed.

In all three equations, robust parameter estimates with the expected signs are obtained for own-price, income, the beer strike variable, and lagged consumption. The immigrants variable is also an apparently important influence on consumption in the negative direction. The legal drinking age dummy carries the expected positive sign and is statistically discernible in the wine and spirits equations. The only apparently significant cross-price effect in the expected direction is that for wine price in the spirits equation. The time trend variable remains only in the wine model, and possesses a positive sign. The inflation and unemployment variables only have statistically identifiable effects on spirits consumption, the former being positive and the latter negative.

The respective estimated short run own-price elasticities are -0.43, -0.75, and -0.26 for beer, wine, and spirits. Income elasticities are 0.12, 0.64, and 0.18. The spirits own-price estimate is very low in comparison with most of those calculated elsewhere. The other elasticity estimates above and all of the remaining results are in general accordance with other studies.

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DEDICATION

To my parents, Spike and Margaret Enemark, who taught me the importance of a sense of humour; to Sam, who provided me with a great opportunity; and to Peggy, who always cared.

CHAPTER I: INTRODUCTION

In 1980 Canada ranked 16th out of 35 selected industrialized countries in terms of absolute alcohol consumption per capita, with 9.1 litres of pure alcohol being consumed for every man, woman, and child. France ranked first with a figure of 14.8 litres. South Africa was last, consuming 3.8 litres per capita (Health and Welfare Canada, 1984, p. 13). By international standards Canadians are therefore not particularly heavy drinkers.

British Columbians, though, are heavier drinkers than other Canadians, with 1980 consumption by those aged 15 years and over at 13.5 litres per adult compared to the Canadian figure of 11.3 litres.

Indeed, throughout the 1970's, B.C.'s per adult consumption was continually in the area of two litres in excess of the national average and only the two Territories consistently outpaced B.C. with this dubious achievement. (During the latter half of the decade Alberta more or less matched B.C.'s consumption, however.) Breaking down total British Columbia alcohol consumption by type of beverage, we find that in relation to Canada as a whole, residents of this province are average consumers of beer but are quite high consumers of the more potent spirits and wine. Again examining the period 1970-80, B.C.'s beer consumption in terms of pure alcohol was usually slightly lower on a per adult basis than was the case for Canada overall, but by 1980 the amounts for both jurisdictions were an identical 5.7 litres. However, spirits consumption during the 1970's exceeded the national average by at least 1.5 litres of pure alcohol annually. In 1980 the figure was 5.7 litres for B.C. compared to Canada's 4.2 litres. During the decade adult wine consumption in the province was also consistently in excess of the national average, in amounts varying from 0.2 litres to 0.8 litres pure alcohol-equivalent per adult. For example, in 1980 average B.C. pure alcohol consumption in the form of wine was 2.1 litres per adult versus 1.4 litres for Canada. The bottom line is that while in absolute terms beer is almost as popular in B.C. as in the remainder of the country, the higher alcohol-content beverages comprising the spirits and wine categories are more popular among B.C. drinkers than is the case for Canadian drinkers overall (Health and Welfare Canada, 1984, pp. 15-23).

B.C.'s higher than average propensity to consume alcohol is not without its consequences. During the two-year period 1979-80, the alcohol-related death rate per 100,000 in the province was 23.0 compared to 14.4 for Canada. In 1979 and 1980 the death rates from chronic liver disease and cirrhosis for the population aged 20 and over in Canada were 15.2 and 13.5 per 100,000 respectively; the corresponding rates for B.C. are the highest in Canada in both years, being 25.4 and 26.4. Finally, in a Canada Health Survey for 1978-79, respondents who were current drinkers were asked to identify whether during the 12 months before the survey, their drinking has played a part in a number of specified problems. In B.C., 12.4% of the respondents reported that at least one problem was associated with their consumption of alcoholic beverages, this proportion being the second highest of all the provinces and considerably higher than the Canadian rate of 9.7%. (Health and Welfare Canada, 1984, pp. 37-50).

During the 1980's per adult consumption of alcoholic beverages has been on a marked downward trend in B.C., as well as in the rest of Canada and the U.S.[1] However, B.C.'ers continue to be among Canada's highest consumers of alcoholic beverages.[2]

To date, not a great deal of effort has been made to quantify the relevant determinants of the public's consumption of alcoholic beverages in Canada. Moreover, there are no studies for the B.C. market alone.[3] This is surprising since the consumption, sales, and distribution of alcoholic beverages in Canada comes under provincial jurisdiction. A contribution to public policy-making in B.C. could therefore be made through the investigation of just how the demand for beer, wine, and spirits reacts to various explanatory variables indigenous to this province. These results can then be compared with the results obtained by others for other jurisdictions.[4]

In this thesis a three-equation model of the demand for beer, wine and spirits is developed and estimated using 1952 to 1984 annual data for B.C. The model is designed specifically for estimating price, cross-price, and income elasticities of demand. Complementary objectives include shedding light on other important exogenous variables which influence alcohol consumption and evaluating the overall explanatory power of the model.

NOTES TO CHAPTER I

[1] The cover story of Time Magazine (May 20, 1985) discusses the recent trend towards lower alcohol consumption in the U.S. The article states "While (sales of) bottled water soared, distilled-spirits consumption fell from 2.88 gal. per adult in 1974 to 2.46 gal. in 1984. Brewers registered their first slump since 1957 from 36.9 gal. per person in 1980 to 35.1 gal. in 1984...(And wine) consumption grew only slightly from - 1980 to 1984..." (p.70) In Canada, according to a story contained in the Vancouver Sun (May 23, 1985) "Canadians are drinking significantly less alcohol than they used to. Most of the drop is in hard liquors. Wines and beers are generally at the same levels they were (in 1981), though beer is down a little."

[2] In B.C., from fiscal year ending March 1980 to that ending March 1984, per adult spirits consumption dropped by 18.1%, wine consumption increased by 19.0%, and beer was down by 9.9%. Nonetheless, and notwithstanding the severity of the 1981-1983 recession in the province, the figures below are illustrative of the continuing relatively hard-drinking nature of the average B.C. adult (Statistics Canada, Cat. #63-202, 1985, pp. 26-27):

Sales of Spirits in B.C. (in litres) Per Adult Aged 15+

	1980	1981*	1982	1983	1984
B.C.	13.8	14.8	13.6	12.5	11.3
Canada	10.4	10.3	10.3	9.7	8.9

Sales of Wine in B.C. (in litres) Per Adult Aged 15+

B.C.	16.3	18.7	18.3	19.3	19.4
Canada	10.8	11.1	11.7	11.9	12.0

Sales of Beer in B.C. (in litres) Per Adult Aged 15+

B.C.	110.9	91.0	107.8	103.9	99.9
Canada	111.8	106.4	108.9	105.8	105.6

*indicates a year during which there was a work stoppage in the B.C. brewing industry.

[3] According to officials at the B.C. Ministry of Consumer and Corporate Affairs and at the Liquor Distribution Branch.

[4] Apparently the only published works using Canadian data are Johnson and Oksanen (1974, 1977). These are examined in Chapter II. This thesis follows their general methodology but focusses specifically on B.C. Hence the present analysis will largely concern itself with these two studies for purposes of comparison.

CHAPTER II: REVIEW OF RELATED LITERATURE

In this chapter a survey of the related literature is undertaken. The objective is to provide an overview of the empirical research in this subject area and to provide some specific insight into what appear to be the crucial variables influencing alcohol consumption in various jurisdictions. In addition, detailed results of these works are reported where warranted.

1. Canadian Studies

Of the most relevance to the present work are those studies which utilize Canadian data, in that the results obtained are of great interest for purposes of comparison with those derived herein. It is notable that the two studies which provided the inspiration for this thesis are both Canadian, are undertaken by the same authors, and employ basically the same data set.[1] These two works model the demand for beer, wine and spirits for the country as a whole and therefore their results provide an invaluable yardstick with which to gauge B.C. demand. The only other Canadian study available utilizes Ontario data and examines only wine demand.

(i) Johnson and Oksanen (1974)

The Johnson and Oksanen (1974) study, uses Canadian annual time series data for the years 1956-1971 for each of the ten provinces. The data is pooled and analyzed using linear and log-linear regression techniques.[2] Demand equations are estimated for each of beer, wine and spirits with per capita consumption (i.e. per capita demand) by the population aged 15 years and over being the dependent variable in each case.[3] The independent variables consist of real prices and real cross-prices, real personal disposable income per adult (i.e. those aged 15 years and over), per adult consumption lagged one year as a "habit persistence" variable, a variable indicating the fraction of the over-age 15 population in the 25-54 age group, variables consisting of the proportions of the population belonging to various ethnic, religious, and educational groupings, provincial dummy variables, alcoholic beverage industry strike dummy variables, and a time trend variable. The price and income data are "real" in the sense that they have been deflated by the relevant provincial Consumer Price Index.

The authors employ the covariance analysis framework in combining time series and cross section data and apply Ordinary Least Squares estimation throughout.[4] It must be noted that all the right-hand side variables are assumed to be predetermined including prices and income. The treatment of prices and income as exogenous rather than as endogenus variables is defended by Johnson and Oksanen (1977) as follows:

> In the Canadian institutional setting, prices are established by government agencies and, consequently, the price variables can be viewed as exogenous. The extent of the feedback from expenditures to disposable income would seem sufficiently small to permit income also to be treated as exogenous. (p. 114)

In this thesis prices and incomes are also treated as exogenous for the same reasons.

The Johnson and Oksanen 1974 study yielded some interesting results.[5] First, the own-price coefficient estimates are all significant at the 1% level and have the expected negative sign. Second, income is only positive and significant in the spirits equation. Third, the lagged consumption and trend estimates are positive and highly significant in all three equations. Fourth, generally poor results are reported with respect to cross-price terms, with only wine and spirits appearing to possess some degree of substitutability. The short run own-price elasticities evaluated at the sample means are -0.224, -0.502, and -0.910 for beer, wine, and spirits, respectively. The short run income elasticities are 0.227 for spirits and virtually zero for beer and wine, the latter two parameter estimates being insignificant anyway. The long run own-price elasticities reported by Johnson and Oksanen are -0.379, -1.301, and -1.599 and the long run income elasticities are 0.060, -0.022, and 0.399 for beer, wine and spirits respectively. These estimates are quite consistent with those of two U.S. studies, Niskanen (1962) and Hogarty and Elzinga (1972).

With respect to the other explanatory variables, many of the expected results are obtained. The estimated coefficient for the variable representing the fraction of the population aged 25-54 carries the expected positive sign and is significant at the 5% level in the spirits equation only. The strike dummy coefficients are significant at the 2 1/2% level in a one-tailed test and carry the expected signs in each of the three equations.[6] As for the provincial dummies and the three groups of sociological variables, the available literature does not provide any guidance as to what signs should be expected. Using F-tests, it is reported that the provincial dummies are highly significant in all three equations, ethnic origin is significant in the beer and wine equations, religion is significant in the spirits and wine equations, and education is significant in the spirits specification only. General conclusions in regard to the directions of any of these effects overall are not drawn since each equation carries several provincial, ethnic, religious, and education variables and both negative and positive signs pervade each category.[7] The authors feel that it is sufficient to note that as far as these four groups of variables are concerned, in eight of twelve instances, each as a group is important in explaining the demand for alcoholic beverages in Canada.

Finally, the $\bar{R}^2$'s are in excess of 0.99 in all three equations. As well, tests for autocorrelation apparently reveal that there is no reason to reject the null hypothesis of zero first-order autocorrelation at the 5% level for the beer and spirits equations, but the possibility exists in the wine equation.

(ii) Johnson and Oksanen (1977)

This study analyzes the same data as their 1974 study. The model, however, while similar has some important differences. In this new specification, the provincial dummies and the variable representing the fraction of the adult population in the 25-54 age group have been dropped. The latter is not included due to its lack of explanatory power in the 1974 analysis. The provinical dummies are replaced with a "variance components estimation", a technique which is based on the assumption that the error term in the equation is composed additively of, in this case, a region effect "v_i" that is constant over time (but which varies randomly from region to region) and a component "e_{it}" which varies at random over space and time, where "i" denotes province and "t" denotes the year. This error specification is used in the estimation of three alternative models: the LSDV (see Note 4) model utilized in the 1974 paper, a simple OLS model, and a GLS (i.e. Generalized Least Squares) model.

An alternative methodology is also used in characterizing the exogenous sociological influences. In the earlier work, a time series was constructed for the sociological variables using intercensal interpolation, with 1951, 1961, and 1971 census data being the benchmarks; seven ethnic, six religious, and three schooling variables were then included in the equations and conventional analysis using variance tests on the groups were applied. A new tack is taken in the latter work by reducing each group of sociological variables through the extraction of principle components. Hence instead of a multitude of variables in each equation, there are two components replacing all of the religious affiliation variables, two replacing the ethnic variables, and one replacing the education variables. This procedure reduces some of the multicollinearity that is otherwise present.

The authors report that autocorrelation is a major problem in all three models. Consequently, first-differencing is employed (which of course eliminates the time trend variable) and autocorrelation is substantially reduced. In all nine equations (an OLS, LSDV, and GLS specification for each of beer, wine, and spirits) the own-price coefficients are always negative and highly significant while the income coefficients are again only significant in the case of spirits demand. Also consistent with the earlier results are the cross-price effects, for again they are generally poor.[8] The "religion effect" is never significant at the 5% level and the "schooling effect" is positive and significant at the 1% level in the beer estimation and is not significant in the remaining two equations. Results stemming from the ethnicity variables are quite robust and appear to indicate that the negative effects of ethnic origin outweigh the positive effects for beer and spirits, but the positive effects seem to be the more significant for wine.[9]

Short run own-price elasticity measures are in the area of -0.26 for beer, -0.68 for wine, and -1.13 for spirits. The short run income elasticities are insignificant except for spirits, that estimate being approximately 0.10. With respect to the long run elasticities at the means, the reported own-price measures are about -0.30 for beer, approximately -1.75 for spirits and from -1.36 to -1.78 for wine. The long run income elasticity of demand for spirits is in the area of 0.16. These elasticity measures are very consistent in magnitude throughout the three types of estimation techniques, and also are comparable to those obtained in the 1974 study.

The authors also conclude that the use of first differencing is an appropriate method of dealing with variables that appear to be highly autocorrelated and the OLS, LSDV, and GLS all yield very similar results for the own-price coefficients and for the income coefficient in the spirits equation. Lastly, it is noted that these results are very similar to those of other empirical studies in this subject area.

(iii) Acheson (1977)

The only other Canadian study available is the Acheson wine study. Its focus is somewhat different in that it examines the tradeoffs involved in the pricing of wine in Ontario. Of most concern to Acheson is the trade-off between the goal of maximizing government revenues from the industry and the strategy of government protection of Ontario wines against foreign competition. The idea is that markups designed for protective purposes may be inconsistent with maximizing tax revenues from the sale of the product. In the pursuit of his objectives, the author estimates wine demand equations that are of relevance to the present work.

Two wine equations are specified, one to explain per capita consumption of Ontario wine by Ontario residents and one to explain their foreign wine consumption. The explanatory variables are identical in each case: the real price of domestic wine, the real price of foreign wine, the number of LCBO stores per 1000 population, the number of winery-owned retail outlets (selling a particular winery's own products exclusively), the real personal disposable income per capita lagged both one and two years, and the number of days on strike by Quebec liquor store employees. The regression analysis utilizes time series data consisting of 23 annual observations for Ontario for the years 1949 to 1971. Acheson reports that the own-price coefficient estimates are negative and highly significant in both equations, the lagged income estimates are always positive but significant at the 5% level in only one of four instances,[10] the cross-price and Quebec liquor employees' strike estimates are everywhere positive but only significant at the 5% level in the domestic wine demand equation, and both the LCBO and winery stores parameter estimates are significant in the expected positive direction in the domestic specification. The only unexpected sign obtained is a positive one in the case of the winery stores variable in the foreign demand equation (recall that these outlets sell domestic wines only), and the estimate is highly significant.[11] Finally, the unadjusted $\bar{R}^2$'s are both in excess of 0.96 and there is little chance of autocorrelation.

2. U.S. Studies

The United States is undoubtedly the one country in the western industrialized world that bears the most similarities to Canada both socially and economically. It is therefore reasonable to expect the drinking habits of our neighbours to the south to be not unlike our own. Hence examined below are four studies of alcohol consumption which utilize American data, providing even greater insight into the subject at hand.

(i) Niskanen (1962)

This is the pioneer study of the subject at hand. The author undertakes a study of the demand for beer, wine, and spirits in the U.S. using a time-series framework employing 22 annual observations from the years 1934-41 and 1947-60. The model consists of seven structural equations which represent demand and supply functions for each of the three beverages in addition to a supply equation for illegally-produced spirits. In the demand equations per capita consumption is specified as a function of own-price, cross-prices, real personal disposable income per capita, and the per capita money supply (M1) as a wealth variable. The three corresponding supply equations employ the same dependent variable, expressing per capita supply as a function of own-price, combined federal and state excise taxes, beginning-of-the-year inventories, and a time trend variable. Six reduced-form equations are then estimated, with per capita consumption and own-price of each beverage comprising the dependent variables and the income, money supply, time trend, own-tax and own-inventory variables being treated exogenously.

The results and major conclusions drawn from Niskanen's work are for the most part similar to those of the Canadian studies discussed above. It is concluded that own-price is a significant influence on per capita consumption, with the final reported long run price elasticity of demand estimates for beer, wine, and spirits being -0.7, -1.0, and -2.0 respectively. The same is true of income, where the final long run elasticities noted are respectively -0.4, 0.6 and 0.3.[12] Generally poor results obtained as far as cross-price effects are concerned, with only spirits and beer appearing to be weak substitutes. Niskanen also finds the consumption of spirits to be significantly related to the level of the money supply - this particular elasticity is estimated to be about 0.4, meaning that it appears that wealth has considerable bearing on consumption of hard liquors for this data set.

(ii) Hogarty and Elzinga (1972)

This is an oft-quoted study examining the demand for beer in the U.S. Data for 45 states for the years 1956-59 are pooled and used to estimate cases of beer consumed per adult as a function of real price, real per capita income, and ethnicity. Price elasticity of demand is found to be in the area of unity in absolute value and significantly different from zero at the 1% level, not far off from Niskanen's result. The income elasticity is found to be very close to unity and highly significant. The authors are surprised at this latter result since Niskanen finds beer to be an inferior good and Horowitz (1965) finds that beer consumption is unrelated to income. The estimated income elasticity in the Hogarty and Elzinga study changes, however, once an "immigrants variable" is included in the specification. In their most preferred estimation, the one which includes the immigrants variable, the authors find the income elasticity measure to be in the area of 0.40, a value more in line with those estimated elsewhere.

The immigrants variable is defined as the proportion of the state's population that is foreign-born and is introduced to test the hypothesis that immigrants are higher per capita beer consumers than are other Americans. The coefficient estimate is indeed found to be positive and significant and results in an increase in the $\bar{R}^2$ from 0.69 to 0.76. While the inclusion of this variable results in a decrease in the income elasticity estimate, the estimated own-price elasticity remains essentially unchanged. Hogarty and Elzinga conclude that ethnicity appears to be an important determinant of beer consumption in the U.S.

(iii) McCornac (1982)

The major focus of this study is the consideration of the effect of unemployment on a society's level of alcohol consumption. In this regression analysis, the author uses U.S. cross-section data from the early 1970's. Besides the unemployment variable, the only other independent variable which has not appeared in any of the works discussed thus far is the minimum legal drinking age in each state. For McCornac the most important finding of his analysis is the significantly positive relationship between per capita alcohol consumption and unemployment in the latter years of the period examined, years during which unemployment in the U.S. was rising.

(iv) Cook and Tauchen (1982)

This is the final U.S. study to be considered. Using pooled data from 30 states over the period 1962-77, the authors provide what they believe is very strong evidence that even a heavy drinker's consumption is in general responsive to changes in alcoholic beverage prices. A reduced form model in which the log of per capita liquor consumption is expressed as a function of state liquor tax rates (in lieu of retail prices) and per capita income is specified. Two-stage Generalized Least Squares is employed and while no elasticity measures are obtained directly, the authors use their parameter estimates along with additional information to approximate a point price elasticity of demand for spirits of -1.8 and a point income elasticity of 0.43. But Cook and Tauchen are most interested in examining the influence of alcohol taxation on chronic heavy alcohol consumption. The problem they face is that there are no actual statistics available relating to the prevalence of "heavy drinking;" however, there is apparently a widely accepted measure - the mortality rate due to cirrhosis of the liver. The same model and GLS procedure are then used to measure the short term responsiveness of cirrhosis fatality rates to price and per capita income. The results of the mortality rate equation are very similar to those of the original liquor demand specification, i.e. both ordinary per capita consumption and the cirrhosis mortality rate appear to be significantly and negatively influenced by changes in the taxes on sales of spirits.

3. U.K. and Australian Studies

In addition to the Canadian and American studies discussed above, the determinants of alcohol consumption have also been analyzed with data for other countries. Most relevant are the U.K. and Australian studies, given the obvious similarities between these two countries and Canada. Moreover, the studies examined employ some additional variables not discussed up to this point and yield some interesting results.

(i) Kitchin (1981)

This is a pure time series analysis using annual data for the United Kingdom from the year 1956 to 1975, regressing per adult consumption of pure alcohol on real per capita disposable income, real own-price, the volume of advertising of alcoholic beverages, the total number of all registered deaths per annum in the U.K., the absolute number of unemployed as of mid-year, and the annual inflation rate. The latter three variables are included to test the hypothesis that stress induces greater alcohol consumption.[13] The data are entered in first-difference form due to autocorrelation problems. Most of the results are as expected, but Kitchin expresses concern at the estimated negative coefficients for the unemployment and death variables. The inflation coefficient possesses the expected positive sign in accordance with the "stress hypothesis" but is not statistically significant. The $\bar{R}^2$'s in the five reported equations are all quite high, but the Durbin-Watson statistics are inconclusive at the 5% level.

(ii) Duffy (1983)

This is also a U.K. times series study and uses quarterly data for 1963-78. Per capita demand equations for each of beer, wine and spirits are estimated, and some noteworthy explanatory variables are incorporated in addition to prices, income, et cetera. These include real per capita advertising expenditures on each respective beverage, advertising expenditures on all other goods, and seasonal dummies.

In his conclusion, Duffy states that income appears to be the most important determinant of alcoholic beverage demand, with point income elasticities exceeding unity by substantial amounts in the wine and spirits cases, while being approximately (and probably somewhat less than) unity for beer. Point estimates of the price elasticities of wine and spirits are significant at the 5% level, the range for the former being -0.65 to -0.87 and for the latter, -0.8 to -1.0. Poor results are obtained for own-price in the beer equations.[14] On the basis of these price elasticity estimates Duffy concludes that taxation appears to be an effective instrument for restraining alcohol consumption in the U.K. (in the wine and spirits cases, anyway) while at the same time raising real tax revenues. This follows from the result that the elasticities are high enough such that a price rise will reduce consumption by a substantial amount, but not so high so as to reduce the revenues accruing to government coffers. Finally, it seems that advertising has a positive effect on the British demand for beer and spirits, but the elasticities are quite low and the quality of the results are mixed.

(iii) Owen (1979)

The Owen study, a time series analysis of the demand for wine in Australia, employs annual data from 1955-77. Wine sales per capita is the dependent variable while lagged consumption, real disposable income per capita, own-price, beer-price, advertising expenditures, and the stock of immigrants as a proportion of the total population comprise the exogenous variables. Due to the presence of multicollinearity, the ridge regression results are reported. The income elasticities are 0.55 in the short run and 1.23 in the long run. Relative own-price (ratio of wine price to beer price) elasticities are -0.28 and -0.62 in the short and long runs respectively.[15] Lagged consumption is found to be significant and a large and significant positive elasticity with respect to the immigrants variable also results. However, the results for the beer cross-price effect and the advertising effect are poor.

4. Summary

It is apparent from the literature that a variety of variables seem to affect per capita alcohol consumption. There is general concensus that foremost among these are own-price, real income, and various other exogenous factors which are indicative of sociological conditions. The latter includes ethnic background, unemployment, and so forth. As well, where tested, the cross-price effects are insignificant. It is also the case that own-price elasticity estimates are always lowest for beer and highest for spirits (in absolute values), with that for wine demand being located in between. The preceding is true for both the short and long runs.

It is difficult to cite specific areas of disagreement in regard to the results obtained in these ten studies since most of the variables and many of the objectives among them differ markedly. However, two unequivocal observations can be made. First, long run income elasticities are less than unity and positive in all cases except in Niskanen's (1962) beer equation (where it is negative), in Owen's (1979) wine equation, and in all three of Duffy's (1983) estimations (the estimates exceed unity in these latter two cases). Second, both Kitchin (1981) and McCornac (1982) find unemployment to be significant in determining overall alcohol consumption, but in Kitchin's case the estimate is negative and for the latter a positive relationship is found to exist.

NOTES TO CHAPTER II

[1]Given that the studies by Johnson and Oksanen are so relevant to the present work, it is worth noting that Cook and Tauchen (1982) states that one of the best pieces of work done on modelling the demand for alcoholic beverages is the Johnson and Oksanen 1977 paper.

[2]The authors note that demand studies frequently make use of log-linear equations since judged by conventional statistical criteria, such functions often perform reasonably well. This thesis also employs this methodology, as is outlined in Chapter III.

[3]Note that from this point onward "per capita consumption by the population aged 15 years and over" is used interchangeably with "per adult consumption." As well, Johnson and Oksanen state that "We selected 15-and-over as the deflator despite the fact that the legal drinking age was 21 for most of our sample period (it was lowered to 18 in the later years). In various studies this is the age category pertinent to alcohol consumption analysis." The author agrees with this rationale and uses the 15-and-over group as the deflator.

[4]This procedure is also referred to as the Least Squares Dummy Variables technique.

[5]Note that only the linear as opposed to the log-linear estimates are reported due to the implausible cross-price effects obtained using the latter model. The own-price and income elasticities derived in both models are apparently similar, though.

[6]There are 13 strike dummies throughout the three equations, designed to take into account the effects on consumption of various strikes in all three markets. That the signs are as expected is made clear by a few examples: one dummy refers to the effect of the 1958 Ontario beer strike on beer demand in that province, and its estimate is negative; the effect of the same dummy in the wine equation is positive; still another is representative of the effect of the 1964 Quebec spirits-wine strike on the demand for spirits in P.Q., an

effect which is negative.

[7]For example, the results indicate that the greater is the proportion of Italians in the Canadian population the lower is beer consumption, while a positive effect appears to be the case the more Scandinavians there are. The Baptist coefficient is positive in the spirits equation, but the Jewish estimate is negative. Lastly, it is also indicated that the greater is the proportion of the population with post-secondary education, the lower is spirits consumption while the effects are positive in the beer and wine equations.

[8]The earlier results are poor for a number of reasons. In three of six cases, the estimates are negative (but none are significant). Of the three that possess the correct positive sign, one is insignificant and for only one beverage are the substitution effects positive and consistent across the relevant equations, i.e. the estimate for wine price in the spirits equation is positive as is the estimate (insignificant though it is) for spirits price in the wine equation. In the 1977 paper, the beer equations show a significant cross-price effect for spirits only, but the sign is negative. None of the cross-price effects is significant for the spirits equations. The only cross-price effect that is both significant and possesses the expected sign is that for beer in the wine equations.

[9]Actually, two general conclusions can be drawn here. First, paralleling the results of Johnson and Oksanen (1974), it seems that drinking habits are far from uniform among different ethnic groups. Second, the estimated coefficients of the principal components variable comprised of the observations pertaining to those ethnic groups who appear to be very low consumers of alcoholic beverages are generally more significant in the beer and spirits equations, with the opposite holding true in the wine equations.

[10]That instance being the estimate for the variable representing per capita income lagged two years in the foreign wine demand equation.

[11]It could be argued that there is a simultaneity

problem here since the number of liquor and winery stores is in part a function of per capita consumption. This criticism would then be relevant to the present work given the inclusion of the LIQSPC variable. Only two points need be made in order that this concern be dismissed. First, it is reasonable to assume that the provision of liquor outlets by the government is a response to population growth; per adult consumption, not total consumption, is the dependent variable both in the Acheson paper and in this thesis. Second, with respect to the present work only, the empirical results show LIQSPC to be an unimportant variable and hence the problem is actually a non-issue here.

[12]Note that the results of this study indicate beer to be an inferior good.

[13]The "stress hypothesis," as promulgated by Kitchin, states that "...at a macroeconomic level the level of drinking is a response to stress and thus alcohol consumption per head is a function of the number of deaths in the economy, the level of inflation, and the level of unemployment." (1981, p. 31) The author goes on to say that an alternative hypothesis is that rising inflation and unemployment lowers perceived permanent income, thus lowering spending on all normal goods, including alcohol. While Kitchin's work indicates a negative relationship between unemployment and the consumption of alcoholic beverages, recall that McCornac (1982) provides evidence in support of the stress hypothesis.

[14]Duffy states that this latter result is in accordance, "...roughly speaking, with the general impression that the price elasticity of demand for beer in the U.K. is indeed very low, if not actually zero." (1983, p. 132)

[15]As noted by the author, the own-price elasticities derived in this study are not strictly comparable with those estimated elsewhere, since a "relative prices" variable is used here. (Owen, 1981, p. 234)

CHAPTER III: THE MODEL

The model employed is comprised of three demand equations, representing beer, wine, and spirits demand respectively. The dependent variable in each case is per adult consumption of each type of alcoholic beverage by British Columbians. The explanatory variables are own-price, relative prices of the remaining two alcoholic beverages, real income per adult, the male unemployment rate, liquor stores per adult, the proportion of the adult population aged 20 to 55, the proportion of the B.C. population that is foreign-born, the annual rate of inflation, a legal drinking age dummy, a time trend variable , a beer strike variable, a lagged beer strike variable, and a lagged dependent variable. The choice of exogenous variables was influenced by the related literature in addition to other considerations discussed below.

The demand equations are estimated using a log-linear format. This functional form has two appealing aspects. First, it assumes that the effects on demand of changes in the exogenous variables depend on the values of the other variables in the demand function. For example, in the context of the present model, a $1.00 decrease in the own-price of a beverage results in a larger increase in quantity demanded if income is high than if income is low. Second, the parameters of the log-linear format are elasticities. This facilitates comparisons of the results for the three different equations.

The particular multiplicative model specified here is a variation of the stock adjustment model. In the general stock adjustment model the adjustment process involves the actual level of the dependent variable continually adjusting to some desired level. In the case of alcohol consumption, desired consumption is identical to actual consumption at any point in time. However, as the values of the explanatory variables change it takes time for the population to decide what their "long run equilibrium value" of consumption is. Hence, as the relevant exogenous factors change, actual consumption continues to adjust for some time. It is therefore realistic to consider long run equilibrium consumption in a "stock adjustment" context, whereby the population in each time period is only making a partial adjustment towards some long run amount.

Using the beer specification as an example, and letting C_E denote long run equilibrium beer consumption, the adjustment mechanism is:

$$C_t/C_{t-1} = (C_E/C_{t-1})^A e^{B_{12}BSTRIKE_t + B_{13}LBSTRIKE_t} \quad (1)$$

Taking logarithms:

$$\ln C_t - \ln C_{t-1} = A(\ln C_E - \ln C_{t-1}) + B_{12}BSTRIKE_t + B_{13}LBSTRIKE_t \qquad (1a)$$

The term in parentheses in Equation (1a) represents the notion that it is likely that current consumption, denoted by C_t, does not completely adjust to long run equilibrium consumption during each time period (each year, in this study) due to habit persistence, where A is the coefficient of adjustment. This coefficient of adjustment is a positive fraction and of course represents the rate of adjustment in each period. In theory, if A = 1 the adjustment is instantaneous and hence is completed during each period; the closer A is to zero, the slower is the process.

This adjustment process is crucial to the model. As the values of the relevant explanatory variables change, it takes time for people to begin to explore substitutes due to ingrained habits. Thus what the mechanism says explicitly is that the change from actual past consumption to actual present consumption (i.e. from C_{t-1} to C_t) arising from a change in exogenous factors is in reality only part of the adjustment from actual past consumption to long run equilibrium consumption (i.e. from C_{t-1} to C_E) given the new values of the variables. The impediment in the movement to C_E is, of course, caused by what is referred to as "habit persistence."

Since beer strikes do not interfere with long run equilibrium consumption, but represent anomolies in the adjustment process, the term $B_{12}BSTRIKE_t + B_{13}LBSTRIKE_t$ is included outside of the adjustment mechanism.[1] Beer strikes interfere with that portion of the adjustment that actually occurs each year, namely the movement from C_{t-1} to C_t, and hence these incidences must be directly incorporated into the model. Also, in any year following a beer strike, the previous year's consumption can never be a long run equilibrium value, and the adjustment mechanism must take this into account. This is accomplished by the inclusion of LBSTRIKE, which is simply BSTRIKE lagged one period. What is at stake here is the fact that in the year after a beer strike, the lagged consumption observation is not truly representative of habit persistence. Utilization of LBSTRIKE should pick up that part of the change in C_t that would have been accounted for by C_{t-1} under non-strike conditions. For example, again considering the beer equation, if we are in long run equilibrium with $C_t = C_{t-1} = C_E = 50$, we have $50/50 = (50/50)^A$. Now if there is a beer strike the following year (referred to as year t) and consumption falls to 30, the adjustment mechanism takes the form $30/50 = (50/50)^A e^{B_{12}BSTRIKE}$ where B_{12} is a negative parameter estimate, picking up the downward movement in actual consumption. When the strike has ceased in year t+1, the mechanism becomes 50/30 = $(50/30)^{A} e^{B_{13}LBSTRIKE}$ with the estimate B_{13} being positive, representing the fact that C_{t-1} = 30 cannot be a value describing last period's long run equilibrium consumption.

For estimation purposes, i.e. in order to render the model linear in the parameters, natural logarithms of the components of the entire model are taken, as in Equation (1a). Solving for $\ln C_t$ yields:

$$\ln C_t = A \ln C_E + (1 - A) \ln C_{t-1} + B_{13} BSTRIKE_t + B_{13} LBSTRIKE_t \qquad (1b)$$

Long run equilibrium (LRE) consumption, as denoted by C_E, is simply a theoretical level of beer consumption attainable in each period once the changes in all exogenous factors are complete and once the population has finished exploring its multitude of other consumption choices. In this model LRE consumption is a function of the remaining explanatory variables as noted in the opening paragraph of this Chapter. The expression is, of course, identical for the wine and spirits equations, the only modification being the substitution of the relevant price variables. The three demand equations are specified in Table 1.

As shown in Table 1, three demand equations (one for

TABLE 1

The Regression Equations

Dependent Variable		Independent Variables
$lnPCCONSB_t$	=	$B_0 + B_1 lnPBEER_t + B_2 lnRPWINEB_t + B_3 lnRPSPIRB_t + B_4 lnPDICAP_t + B_5 lnUNEMP_t + B_6 lnLIQSPC_t + B_7 lnAGE_t + B_8 lnIMM_t + B_9\ INFL + B_{10} DAGE_t + B_{11} TREND_t + B_{12} BSTRIKE_t + B_{13} LBSTRIKE_t + B_{14} lnLAGCB_t + e_t$
$lnPCCONSW_t$	=	$B_0 + B_1 lnPWINE_t + B_2 lnRPBEERW_t + B_3 lnRPSPIRW_t + B_4 lnPDICAP_t + B_5 lnUNEMP_t + B_6 lnLIQSPC_t + B_7 lnAGE_t + B_8 lnIMM_t + B_9 INFL_t + B_{10} DAGE_t + B_{11} TREND_t + B_{12} BSTRIKE_t + B_{13} LBSTRIKE_t + B_{14} lnLAGCW_t + e_t$
$lnPCCONSS_t$	=	$B_0 + B_1 lnPSPIR_t + B_2 lnRPBEERS_t + B_3 lnRPWINES_t + B_4 lnPDICAP_t + B_5 lnUNEMP_t + B_6 lnLLIQSPC_t + B_7 lnAGE_t + B_8 lnIMM_t + B_9 INFL_t + B_{10} DAGE_t + B_{11} TREND_t + B_{12} BSTRIKE_t + B_{13} LBSTRIKE_t + B_{14} lnLAGCS_t + e_t$

where:

$PCCONSB_t$ = annual beer consumption (in gallons) per adult in year t

$PCCONSW_t$ = annual wine consumption (in gallons) per adult in year t

$PCCONSS_t$ = annual spirits consumption (in gallons) per adult in year t

$PBEER_t$ = real price of beer per gallon (in dollars) in year t

$PWINE_t$ = real price of wine per gallon (in dollars) in year t

$PSPIR_t$ = real price of spirits per gallon (in dollars) in year t

$RPWINEB_t$ = relative price per gallon (in dollars) of wine to beer in year t

$RPSPIRB_t$ = relative price per gallon (in dollars) of spirits to beer in year t

$RPBEERW_t$ = relative price per gallon (in dollars) of beer to wine in year t

$RPSPIRW_t$ = relative price per gallon (in dollars) of spirits to wine in year t

$RPBEERS_t$ = relative price per gallon (in dollars) of beer to spirits in year t

$RPWINES_t$ = relative price per gallon (in dollars) of wine to spirits in year t

$PDICAP_t$ = real personal disposable income (in 1971 dollars) per adult in year t

$UNEMP_t$ = annual B.C. adult male unemployment rate (in percentage form) in year t

$LIQSPC_t$ = total number of government liquor outlets per adult in year t

AGE_t = proportion of the adult population (i.e. those aged 15 years and over) in the age group 20 to 54 in year t

IMM_t = estimated proportion of the total B.C. population born outside of Canada as of year t

$INFL_t$ = the percentage change in the Consumer Price Index for Vancouver in year t

$DAGE_t$ = change in drinking age dummy variable (0 if legal age is 21, 1 if legal age is 19 in year t)

$TREND_t$ = time trend variable (1 to 33, since there are 33 observations)

$BSTRIKE_t$ = beer strike severity variable (see p.44)

$LBSTRIKE_t$ = BSTRIKE lagged one year

$LAGCB_t$ = PCCONSB lagged one year

$LAGCW_t$ = PCCONSW lagged one year

$LAGCS_t$ = PCCONSS lagged one year

B_0 to B_{14} = the parameters to be estimated

e_t = the true error term in year t

t = 1,...,33

ln = natural logarithm (all consumption, own-price, cross-price, PDICAP, UNEMP, LIQSPC, AGE, and IMM data is in log form)

each of beer, wine and spirits) are specified with per capita consumption by the provincial population aged 15 years and over as the endogenous variable in each case (see Note 3 in Chapter II). Annual B.C. time series observations for fiscal year 1952/53 to 1984/85 inclusive comprise the data base.

Consumption of each beverage (PCCONSB, PCCONSW, and PCCONSS) is deflated by the adult population in each regression equation in order to focus on alcoholic beverage consumption by individuals, thereby removing the exogenous effect of population growth. This assumes that the true model is homogenous of degree one in the population variable (i.e. multiplying per adult consumption by the provincial adult population gives us total provincial consumption). The observations on the endogenous variable in each of the three equations are constructed by dividing the total sales volume for each fiscal year by the B.C. population aged 15 years and over as at June 1 of the fiscal year in question. Note that in all of the related literature discussed in Chapter II, a similar measure of per capita consumption is utilized as the dependent variable.

Economic theory holds that the demand for a good is a function of a number of important variables, most notably its own-price, the prices of related goods, income, and tastes. Microdata on alcoholic beverage prices back to 1952/53 are unavailable from the provincial authorities. However, given the very highly aggregated nature of this study what is needed is a separate price index for each of beer, wine and spirits. This index is constructed by dividing annual current dollar B.C. liquor store sales by annual sales volume, both time series being available on a fiscal year basis.[2] In order to discount the effects of general price inflation, the observations generated are divided by the annualized Consumer Price Index (1971 = 100) for Vancouver; as an example, the 1952/53 current price is deflated by the 1952 level of the CPI.[3] Inclusion of an own-price variable (denoted here as PBEER, PWINE, and PSPIR in the beer, wine and spirits equations respectively) is of course fundamental for any demand function. Negative signs are expected for the own-price variables.[4]

The cross-prices included in each of the three demand functions are those of the remaining two general types of alcoholic beverages. Appealing to simple consumer utility theory,[5] relative cross-prices are employed as opposed to absolute cross-prices. While it is conceivable that beer, wine and spirits can be considered as complements, it is generally agreed that their substitutability properties are much more justifiable in an empirical context.[6] It is therefore expected that the signs of the two cross-price coefficient estimates in each equation should be positive. The cross-price observations are calculated from the own-price data; for example, in the beer equation the relative price of wine is the own-price of wine divided by the own-price of beer.

Economic theory predicts that real income is also an important determinant of demand. If alcoholic beverages are non-inferior goods, a positive relationship should exist between the real income variable (PDICAP) and per capita consumption of beer, wine, and spirits. The income variable used is real provincial personal disposable income per adult. The observations are calculated by obtaining personal disposable income figures for B.C., which are available on an annual basis for the duration of the study period. These figures are deflated first by the CPI measure corresponding to each year and then by the population aged 15 years and over.[7]

The so-called "stress variables" (see Note 13, Chapter II) are the rates of inflation and unemployment. The unemployment rate variable is perhaps the more intuitively obvious in the context of the stress hypothesis. If the hypothesis indeed holds, i.e. if during the periods of unemployment British Columbians react by drinking more alcohol, ceteris paribus the coefficient of this variable should be positive. But it is also reasonable to assume that the population associates high unemployment with lower future real permanent income, causing lower levels of consumption of all non-inferior goods, including alcoholic beverages. Hence, the net effect depends on the relative strengths of these two opposing forces. This argument is also applicable to the inflation variable, in that inflation may well cause increased alcohol consumption due to stress, but there is also a downward effect on real income at any point in time. There is, however, an additional complication with respect to inflation. If B.C.'s wage/salary earners are actually experiencing real income gains (as has indeed been the case throughout the vast majority of the sample period) during inflationary periods, higher future incomes may come to be expected. This latter phenomenon may be the cause of more drinking, then, as opposed to "inflation stress" being the causal factor. Therefore there are three forces at work in the case of the inflation variable, two in the positive direction and one in the negative direction. It was noted earlier that Kitchin's (1981) U.K. study provides evidence contradicting the stress hypothesis in the case of the unemployment rate and a positive but insignificant estimate for the inflation rate variable. In contrast, McCornac's (1982) work using U.S. data results in a significantly positive coefficient estimate with respect to unemployment (no inflation variable is tested, however).

The observations comprising the inflation variable (INFL) are on a calendar year basis and are simply the percentage changes in the Vancouver CPI each year. As for the unemployment rate variable (UNEMP), due to the structural changes in the labour force over the study period the unemployment rate for males aged 15 years and older is used as the explanatory variable.[8]

The number of liquor stores per person aged 15 years and over appears in the demand equations. On the hypothesis that the greater the accessibility of alcoholic beverages to the population, the lower the transactions costs of purchasing alcohol. It is therefore reasonable to expect a positive relationship between this variable (LIQSPC) and per adult consumption of all alcoholic beverages.[9] Acheson (1977), Kitchin (1981), and McCornac (1982) all employ a similar variable. These studies find the sign of the coefficients for this variable to be positive as expected.

A variable included by Johnson and Oksanen (1974) is the proportion of the adult population aged 25 to 54, an age span which is generally considered to be the prime imbibing years for the average person. A similar variable is included in the present work, (AGE), the only difference being that the age group under consideration is enlarged to include those young adults aged 20 to 24, for it is acknowledged that this lowest stratum of the drinking age population consists of relatively high consumers of alcoholic beverages (Health and Welfare Canada, 1984, p.25). The adult population is again defined as being those British Columbians aged 15 years and over.[10] Assuming that the 20-55 age group have the greatest propensity for alcohol consumption relative to other adult age groups in B.C., a positive coefficient is expected for AGE. Of the related studies examined, only Johnson and Oksanen (1974) test such a variable and it is found to be significant at the 5% level in the spirits equation only. Hence the variable is dropped from their subsequent 1977 study.

The proportion of the overall population of immigrant origin, or variations on this same theme, is an explanatory variable that is included in some of the studies discussed in Chapter II (see Johnson and Oksanen 1974, 1976; Hogarty and Elzinga, 1972; and Owen, 1979).[11] In this study, this variable (denoted as IMM) is included to test the hypothesis that foreign-born British

Columbians differ significantly in their drinking habits from those B.C.'ers born in Canada. Note that this variable could be representing a variety of factors. It could be picking up differences in tastes, or it could also be indicative of differences in permanent income and/or wealth. Hence the sign of the coefficient for IMM cannot be predicted.

Data problems are encountered in constructing the IMM variable. Ideally, the time series should consist of the actual stock of immigrants as a proportion of the overall provincial population in each year. The difficulty is that data on the actual stock of immigrants is available only for the census years 1951, 1961, 1971, and 1981.[12] Johnson and Oksanen (1974, 1977) generate their annual observations by simply interpolating their census data on ethnic groups between census years (1974: Data Appendix). This strategy is also followed in the present work, but an improvement to the "data" is made by pro-rating the annual observation by the proportion (relative to the decade's total in-migration) of immigrants entering the province each year.[13] While this method makes an implicit assumption regarding out-flows of foreign-born residents, namely that whenever gross immigration rises net immigration follows suit, surely it is more accurate to assume differing levels of net immigration at the margin as opposed to constant increments throughout the sample period.

There are two reasons to incorporate a "habit persistence" variable (LPCCONSB, LPCCONSW, and LPCCONSS) into the model. First, it is needed to test for the stock adjustment process built into the model being estimated. Recall that this particular model is argued to be appropriate on the hypothesis that due to habit persistence, consumers only partially adjust their annual consumption of alcohol to some long run equilibrium. Implicit in the OLS modelling of this process is the inclusion of the lagged dependent variable on the right-hand-side of the equation. Second, the notion of habit persistence can also be viewed in the context of a demand study for a potentially addictive substance. It is generally acknowledged that alcohol (like other drugs, tobacco, coffee, et cetera) is a substance on which a relatively large segment of the population of the western world have become both physically and psychologically dependent. It is therefore reasonable to believe that this habit persistence is a strong motivator in the consumption of alcoholic beverages; in other words, it is logical to include last period's consumption of a particular beverage as an explanatory variable in the model. Therefore, per adult consumption of the own-beverage lagged one period is chosen to represent habit persistence in each of the demand functions.

Given both these phenomena, ie. that consumers are always in the process of aiming towards a long run optimum level of consumption (thus taking last period's consumption into consideration) and that alcohol is a habit-forming consumption good, a positive coefficient is expected for the lagged dependent variable. Note that Johnson and Oksanen (1974, 1977) and Owen (1979) all found positive and significant coefficients for lagged consumption.[14]

A variable (BSTRIKE) indicating the severity of the various work stoppages in the industry is also included in each equation.[15] Since the industry has grown over the sample period and given that some strikes were not industry-wide, use of a dummy variable would not be appropriate since the implicit assumption would be that each stoppage had the same effect on availability. Use of the length of the stoppage would also not preclude this concern. The problem is therefore dealt with by specifying the observations using the following procedure: first, the number of man-days lost is divided by beer sales in the preceding year in order to standardize for growth in the industry; second, this fraction is divided by that obtained for the 1975/76 strike-year (chosen arbitrarily). Thus in order that the observations be indicative of the severity of the work stoppage, BSTRIKE only equals one in 1975/76. The variable is therefore an index with the 1975/76 strike as the base.

In the wine and spirits demand functions, BSTRIKE is an actual demand-side variable in that beer strikes act to restrict the availability of a substitute, hence stimulating the demand for the own-good. It is therefore expected that the parameter estimates will carry positive signs in these two estimations. In the beer equation however, the variable is in reality operating on the supply-side of the market since in this case the availability of the own-good is restricted; in other words, the supply curve for beer is shifting upward. Still, BSTRIKE must be included in the demand for beer equation because even though the demand function is unaffected by a beer strike, quantity consumed is affected. Given that there have been years in which beer strikes in B.C. have been severe enough such that quantity supplied became zero (i.e. inventories were exhausted) it is expected that the inclusion of this variable will impinge negatively on per adult beer consumption.[16]

The beer strike variable is lagged one period

(LBSTRIKE) in order to account for some of the movement in current consumption that should have been picked up by the lagged dependent (habit persistence) variable, but is not in the year following a beer strike. This is because the observations for lagged consumption in those years are not truly indicative of habit persistence given the aberration caused by the previous year's beer strike. In the beer equation, then, the observation for the lagged dependent variable will be "too low" the year after a beer strike and hence LBSTRIKE will pick up that portion of habit persistence that the lagged consumption observation fails to account for. A positive coefficent is therefore expected for the LBSTRIKE variable. In the wine and spirits equations, assuming that consumption is stimulated by a beer strike, lagged consumption will be "too high" and the LBSTRIKE estimate should register a negative sign. This assertion follows from the notion that there will be a downward movement in a current consumption the year following a beer strike which the habit persistence variable will not pick up.

In addition to the time trend variable (TREND), designed to capture the influence of changes in tastes and the effects of all other omitted variables, there is one dummy variable specified, a legal drinking age dummy (DAGE). The legal drinking age in B.C. was lowered from

21 years to 19 years in the summer of 1970. Thus the observations on DAGE equal zero to fiscal year 1969/70 inclusive, and one from 1970/71 onward. Ceteris paribus, this legislative action should stimulate the demand for all three beverages since the population legally entitled to participate in the demand side of the market is as a result larger. A positive parameter estimate is therefore expected for DAGE.

The empirical model developed above is estimated by using OLS on each equation. OLS can be used because all the right-hand-side variables are exogenous. This is clearly the case for all but the price variables.[17] Nevertheless, the own-price and cross-prices are also considered exogenous. In Canada, prices of alcoholic beverages are determined not in a market setting, but institutionally by the provincial governments.[18] In addition, a very large proportion of the final prices paid by the consumer of beer, wine, and spirits are comprised of various taxes imposed by the provincial and federal governments.[19] Prices can therefore be treated as pre-determined in this model, enabling the researcher to directly estimate the structural equations using OLS. Also recall that Acheson's (1977) Ontario wine demand study makes the same assumptions implicitly, while in both Johnson and Oksanen's (1974, P. 296; 1977, p. 114)

Canadian studies, the above case is made explicitly.

NOTES TO CHAPTER III

[1]Ceteris paribus, the presence of a beer strike does not affect the long run equilibrium value of consumption of beer, wine, and spirits since this value is really a desired value of consumption and as such is independent of occurrences on the supply side of any market. This is, of course, why BSTRIKE is included as part of the adjustment mechanism instead of being part of the actual model describing long run equilibrium consumption. However, in reality these strikes mean that if the B.C. population is to consume alcoholic beverages for the duration, their choices are restricted to wine and spirits. This "forced exposure" may alter tastes and hence may alter long run equilibrium consumption.

[2]This strategy is also used by Johnson and Oksanen (1974, 1977: Data Appendix).

[3]The B.C. LCB fiscal year lasts from 1 April to 31 March, meaning that per adult consumption of beer, wine, and spirits and nominal prices of same are calculated on a purely fiscal year basis. But when nominal prices are deflated to obtain real prices, the Vancouver CPI measure used had been estimated on a calendar year basis. This in unavoidable since monthly Vancouver CPI observations are not available back to 1952/53, according to the Central Statistics Bureau of B.C.'s Ministry of Industry and Small Business. Thus since calendar years are utilized, there is an overlap of eight months with the corresponding fiscal year. Johnson and Oksanen (1974, 1977: Data Appendix) are also forced to use this procedure. The preceding also implies that the inflation observations are specified by calendar year. Moreover, the same applies to the personal disposable income data and to some of the unemployment rate observations (see Note 10 below). With respect to LIQSPC, AGE, and IMM, the observations are simply "stocks" as of the same point during each fiscal year and therefore the problem is irrelevant in these cases.

[4]The basic neoclassical assumptions regarding the relationship between own-price and quantity demanded are valid here, implying that the (compensated) demand curve is downward sloping. (The income effect can be treated as negligible in that alcoholic beverages account for only a

small portion of the typical consumer's total expenditures.) In other words the substitution effect of a change in the price of any commodity is non-positive. For a formal proof (inherent in which is the derivation of the Slutsky equation) see Chiang (1974, pp. 397-401). As an addendum, even if the income effect is significant, it is generally acknowledged that alcoholic beverages are non-inferior goods meaning that the income effect will reinforce the substitution effect, empirically speaking.

[5]It is one of the basic tenets in the determination of consumer equilibrium that assuming constant real income and ceteris paribus, relative rather that absolute prices influence consumer choice; this is a consequence of the fact that demand functions are homogeneous of degree zero in prices and income. Thus, ignoring the income effect (see Note 4 above) and assuming some degree of substitutability (implying a consistently negative Marginal Rate of Substitution along each two-good indifference curve inherent in the present model), a change in the relative cross-price will cause a change in the same direction in the quantity of the own-good being consumed.

[6]It is of course assumed that these beverages are not inferior goods.

[7]Again following the lead of Johnson and Oksanen (1974, 1977), income is deflated by the population aged 15 years and over. While no explanation for this particular age group is provided by the authors, it is reasonable on the grounds that for all practical purposes, this age group earns all the income in society and comprises all the consumers of alcoholic beverages.

[8]The UNEMP observations are constructed as follows. Since male unemployment rates are available monthly from 1966 onward, monthly rates are averaged/annualized to coincide with the fiscal years by which the dependent variables are organized. However, a calendar year basis must be used for the years 1952 to 1965 (coinciding respectively with the fiscal years 1952/53 to 1965/66) since only annual data are available for this time span.

The most important structural change in the labour force over the sample period is of course the increased female participation rate. This has resulted in a gradual increase in the overall natural rate of unemployment (or what until recently was referred to as the full employment rate of unemployment). Additional factors that have changed the natural rate are: an influx of baby-boomers into the labour market, a more generous social welfare system, a higher incidence of structural unemployment, et cetera. It therefore would have been most ideal to use the unemployment rate for males aged (for example) 25 to 55 in order that the data be more indicative of actual demand-deficient unemployment, but data limitations preclude this possibility.

[9]There have been massive capital infusions into the infrastructure for the distribution and sales of alcoholic beverages by the B.C. government over the sample period, especially during the 1970's. During the latter portion of the period, not only were there large increases in the number of LDB outlets around the province, but a significant number of agency stores and several winery stores were also established, all of which are counted as retail outlets for alcoholic beverages for purposes of this thesis.

[10]Again, given that alcohol consumption by those aged 14 years and lower is negligible, it makes sense to consider the 20-55 age group as a fraction of the actual drinking population, namely those aged 15 years and older.

[11]As noted by Johnson and Oksanen (1974, p. 259), "...sociological variables...are frequently accorded importance in the psychological and sociological literature."

[12]Although the number of immigrants reporting B.C. as their final destination is known on a year by year basis, the number of foreign-born citizens leaving the province is not recorded.

[13]Therefore instead of merely dividing the total change in immigrant population between two census years by ten and using the resulting figure as the absolute annual increase in the stock of immigrants each year, the amount of gross immigration into B.C. is taken into account. Specifically, the gross number of immigrants

entering the province during each decade is determined and the proportion of this total entering each year is calculated. Each of these proportions for each intercensal year is then multiplied by the actual net change in the number of immigrants over the decade according to census data, resulting in proxies for the annual increment in the stock of immigrants. Annual stocks are then determined and these figures are then expressed as a proportion of the annual B.C. population for estimation purposes.

[14]Except in Johnson and Oksanen's (1977, p. 116) LSDV and GLS beer equations, where the estimates are positive but not significant.

[15]During the sample period, seven fiscal years were characterized by beer strikes. It is judged that three of these bouts had no effect on the supply of beer available to the B.C. consumer, in that the most severe lasted only 18 days. It is therefore safe to assume that accumulated inventories were sufficient to meet demand during these short stoppages.

[16]It must be noted that while there have been work stoppages by distillery workers in B.C. during the study period (but not by winery workers), in no case was any dispute prolonged enough to affect supply, hence only a beer strike variable is needed. In addition, a large segment of the B.C. demand for wine and spirits is satisfied by producers located outside of the province while due to provincial government decree, virtually all of the Canadian beer sold in B.C. must be produced within the province. Hence, given a strike in any of these three industries, availability is only affected in the case of beer.

[17]As noted earlier, a case might also be made that LIQSPC is not truly exogenous. However, this possibility is deemed to be of no concern; for an explanation see Note 11 in Chapter II.

[18]Recall from Chapter II that Johnson and Oksanen (1977) put forth this same argument to justify their exagenous treatment of alcoholic beverage pricing in Canada. However, this does not preclude the need for a

brief description of the administrative aspects of product pricing by B.C.'s Liquor Distribution Branch (LDB). According to officials at the Branch, selling prices even prior to the 1950's were established by the Liquor Control Branch (the predecessor to the LDB), subject to the approval of the Provincial Cabinet; this system remained intact until 1971. Since 1971, the Branch has retained the responsibility for price-setting, but it is no longer necessary to receive Cabinet approval. Markups on alcoholic beverages are determined with two criteria in mind, namely alcohol content and area of origin. The extent to which these markups and other provincial and federal taxes comprise the final price paid by the B.C. consumer is discussed in Note 19 below. Therefore it is evident that the setting of the final price paid by the consumer is very much out of the hands of the beverage producers.

[19]As at 31 March 1984 the combination of federal and provincial taxes of various forms (specifically, federal excise tax/duty, federal sales tax, LDB markup, and provincial sales tax) accounted for 53% of the final price to the B.C. consumer of a 12-bottle case of domestic beer; for a 750 ml bottle of B.C. table wine the figure is 52%; and for a 710 ml bottle of domestic spirits the proportion is a whopping 84% (B.C. Liquor Distribution Branch, 1984, p.8). In the case of imports, the figures are either comparable or higher due to federal import duties and larger LDB markups. Similar breakdowns for the early years of the same period are not included in the annual reports for those years, but an indirect demonstration of the extent to which final price is comprised of commodity taxes is possible. In Fiscal Year 1984/85, the percentage gross profit margin (the ratio of total sales less cost of goods sold to total sales) was 44% (B.C. Liquor Distribution Branch, 1985, pp. 3, 28). At the beginning of the sample period, in Fiscal Year 1952/53, the figure was 32% (B.C. Liquor Distribution Branch, 1953, p. R10). It is therefore obvious that throughout the period under consideration, a very high proportion of the final prices of alcoholic beverages sold through the LDB have consisted of taxes. Also note that the "cost of goods sold" includes commodity taxes paid to the federal government, meaning that the actual profit margin accruing to the overall public sector is larger than the above percentages would indicate.

CHAPTER IV: EMPIRICAL RESULTS

1. The Full Model

The full model[1] shown in Table 1 is estimated using OLS and B.C. annual data for the sample period. The results are shown in Table 2, with the absolute values of the t-ratios contained in parentheses below the coefficient estimates. (Tables 2 through 5 are placed at the end of the chapter.) Consider first the beer (Equation 2-1) results. Of the fourteen parameter estimates, only those for RPWINEB, PDICAP, IMM, and TREND are significant at the 5% level or better in a two-tailed test. RPWINEB, though, carries an unexpected negative sign. The remaining two price variable estimates carry the expected sign but neither is significant; the LAGCB estimate is also not significantly different from zero. Other results worth noting include a highly significant income effect in the expected positive direction, significant negative estimates for IMM and TREND, while the possibility of autocorrelation cannot be diagnosed at this point[2].

In Equation 2-2, the wine equation, only the TREND estimate is significant at the 5% level, in the positive direction. Two of the three price variable estimates carry the expected signs but none of the three is significant. The PDICAP coefficient is unexpectedly negative, but is not significant. As is the case for the beer equation, the coefficient for the lagged dependent variable is insignificant, but in Equation 2-2 it does carry the expected sign. Again, Durbin's h-statistic cannot be computed, but as in Equation 2-1, this is not a concern at this stage for assuming the existence of positive autocorrelation, the implications are that the t-scores are upward biased and the goodness-of-fit (i.e. R^2 and $\bar{R}^2$) is overly optimistic. Therefore in this phase of the analysis, when variables possessing insignificant coefficients are being considered for exclusion from the model, the possible presence of positive autocorrelation is not relevant to the decisions made.

In Equation 2-3, the initial spirits model, PSPIR, UNEMP, LIQSPC, DAGE, BSTRIKE, LBSTRIKE, and LAGCS are all significant at the 5% level or better and only the LIQSPC estimate takes on an unexpected sign (negative). Both of the cross-price effects are also in the unexpected direction, but are not significantly different from zero. While the income effect is not significant, it is positive.

The results in Table 2 lead to some general observations. First, in each equation the own-price coefficient possesses the expected sign, while the PDICAP estimate is positive in two of three instances. The results are decidedly mixed for the cross-price effects, however. Second, BSTRIKE always carries the expected sign and is only insignificant in the wine equation. Third, the coefficient for LBSTRIKE also only carries the unexpected sign once, but in that instance the estimate is not significant. Fourth, the most surprising results are that the parameter estimates for both LIQSPC and AGE are negative in all three equations.

2. The Multicollinearity Problem

For at least some of the variables, the lack of statistical significance could be due to multicollinearity. A careful examination of simple correlation coefficients (see Appendix II) reveals collinearity between several variable pairs.[3] In Appendix III the variable-pairs for each model for which the simple correlation coefficient is at least as large as the simple correlation coefficient between one or both of the variables and the dependent variable are listed.[4] These correlation coefficients indicate that multicollinearity problems exist with respect to (in all three models) PDICAP, TREND, IMM, DAGE, the cross-prices, and lagged consumption, INFL in the beer and wine specifications, and PSPIR in the spirits equation.

Appendix IV is the Table of Multiple Correlation

Coefficients, derived by regressing each exogenous variable on all the remaining exogenous variables.[5] The greater is the R-value, the more likely is the probability of multicollinearity among the left-hand side and right-hand side variables. Hence, we have an additional test for the problem at hand.

The data in Appendix IV tell virtually the same story as those of Appendix III. The evidence again indicates that multicollinearity is present in all three equations, with the worst offenders being TREND, PDICAP, IMM, some of the cross-prices, and lagged consumption. Relative to the other variables, DAGE and INFL do not appear to be as seriously at fault as discussed above, but still their R-values are very high in absolute terms. AGE also possesses an R-value in excess of 0.97 in all three models, and it would seem that the own-price variables presents problems throughout the estimations as well.

3. The Full Model Using the Ridge Regression

Before any variables are excluded from the model, ridge regression is employed in order to help discern which variables must remain, given that so many are subject to multicollinearity. The results of the process are shown in Table 3. The equation displayed in each case is that where coefficient stabilization occurs; in the beer estimations, this occurs at a k-value of 0.09 while in the wine and spirits cases k is equal to 0.07.

Some general results are worth noting at the outset. First, autocorrelation does not appear to be a problem in any of the equations. Second, the $\bar{R}^2$'s are comparable to those Equations 2-2 and 2-3, but the statistic does drop quite substantially in comparison with 2-1. Third, the ridge regression assists greatly in bringing to light the importance of own-price and income to the entire model, but the cross-price results are still mixed. Lastly, many more of the parameter estimates now appear to hold impressive amounts of explanatory power, attesting to the degree of multicollinearity present in the data.

Note that the coefficient estimates are biased due to the use of the ridge technique,[7] and in the ridge regression the t-ratio is not distributed according to the Student's t-distribution, rendering the standard hypothesis test in valid. The resulting t-scores are hence referred to as "pseudo t-ratios" for this reason.

Of the three ridge regressions, the beer equation (Equation 3-1) bears the most similarity to its non-ridge counterpart in Table 2 in terms of standard errors of the coefficients. The estimates for PDICAP, IMM, BSTRIKE, and TREND again have high (pseudo) t-ratios while those for

PBEER and LAGCB become substantially larger. Also note that the RPWINEB estimate still carries the unexpected negative sign, but the standard error is much higher.

In Equation 3-2, the ridged wine equation, several variables now appear to possess a high degree of explanatory power, including TREND as before. PWINE, RPBEERW, RPSPIRW, PDICAP, LIQSPC, AGE IMM, INFL, DAGE and LAGCW also have pseudo t-ratios in excess of two in absolute value. Of these, RPSPIRW and AGE carry unexpected negative signs, though.

The spirits equation now has the greatest number of estimates which are at least twice their standard error, as is apparent from Equation 3-3. These are comprised of PSPIR, RPWINES, PDICAP, UNEMP, LIQSPC, AGE, IMM, INFL, DAGE, BSTRIKE, TREND, and LAGCS. LIQSPC and AGE possess the wrong (i.e. negative) relationship with consumption, however. Of these twelve variables, only six were significant at the 5% level or better in Equation 2-3.

Summing up, the evidence provided in Table 3 permits the following general observations to be made: the own-price, income, and lagged consumption estimates are always well in excess of twice their standard errors and carry the expected signs; the DAGE and BSTRIKE estimates always carry the expected signs, but each possesses a large standard error in one of the three equations; IMM and TREND have large pseudo t-ratios everywhere, with the former always carrying a negative sign and the latter a positive sign; the "stress variables" (UNEMP and INFL) seem to be important in three of six instances; the LBSTRIKE coefficient always carries the correct sign but is never twice its standard error; finally, generally poor/unexpected results are obtained for LIQSPC, AGE, and the cross-prices. It should be noted that the actual magnitudes of the coefficient estimates have not been discussed thus far. This discussion will occur after a decision has been made regarding the composition of the final model.

4. The Best Intermediate Model Using the Ridge Regression

The basic strategy followed in paring down the model is to exclude those variables which possess little explanatory power and are not subject to multicollinearity. However, it seems that virtually all of the variables tend towards being multicollinear and thus a good deal of judgement must be exercised, based both on the apparent relative amount of multicollinearity present in particular cases and on a priori gounds.

A good example is provided by LIQSPC which is dropped from all three equations. While the evidence contained in Appendices II through IV by no means indicates that the variable is free of multicollinearity, in relative terms it is not the problem several other variables are. The coefficient also carries the wrong sign in two of the three equations in Table 3 and its importance is definitely questionable in the wine equation. Moreover, one would not expect this variable to play a major role in the public's demand for alcoholic beverages.[8]

Also dropped are four of the six cross-price terms: RPWINEB in the beer equation, RPBEERS in the spirits case, and both RPBEERW and RPSPIRW in the wine specification. While it can be argued that all of these are affected quite strongly by multicollinearity, much experimentation not reported herein [9] demonstrates that these cross-prices simply do not possess the explanatory power to warrant inclusion in the model. The ridge results support this conclusion as far as RPWINEB, RPSPIRW, and RPBEERS are concerned. While one might express some doubt as to the exclusion of RPBEERW, the standard errors of the coefficient estimates are indeed very high in the various intermediate specifications tested.

AGE is also excluded from all three equations. In all three cases, the parameter estimate carries the unexpected negative sign. Thus use of the ridge technique to deal with the variable's multicollinear tendencies does nothing to alter this inexplicable relationship.

The "stress variables," UNEMP and INFL, are dropped from the beer and wine equations. As is apparent from Table 3, the UNEMP variable clearly does not belong in both cases, as is the case for INFL in the beer equation. In a number of unreported intermediate wine regressions INFL is also found to be disappointing in terms of explanatory power, as is TREND in the beer and spirits equations, which is also dropped in these cases. Finally, DAGE is excluded from the beer equation due to the poor results displayed in both Table 3 and in other intermediate specifications not reported.

In the beer and wine cases, the decision to drop these variables is also supported by F-tests of the statistical significance of each group of excluded variables in the respective equations. For both of these equations the null hypothesis that as a set, the variables to be excluded are statistically insignificant is accepted at the 1% level for beer and at the 5% level for wine. The null hypothesis cannot be accepted for spirits, though.[10]

With respect to the variables retained at this stage, in addition to those that are obviously significant, the following points are relevant. RPSPIRB is kept on a priori grounds given that it carries the expected sign in Equation 3-1; some intermediate specifications also prove it to be relatively robust. The same is true of BSTRIKE. As well, since the lagged dependent variable is retained, so must BSTRIKE and LBSTRIKE.[11]

The results of this refined set of equations are shown in Table 4. Again, each of these equations is a ridge regression and coefficient stabilization occurs at a k-value of 0.07 in each case. In terms of goodness of fit, the $\bar{R}^2$'s are very similar to those of Table 3 for the wine and spirits equations, while there has been a substantial improvement for that of beer. Autocorrelation appears to be a problem at this point in the wine and spirits equations.[12]

The own-price and income estimates again carry the expected signs and possess high pseudo t-ratios, except for that of PSPIR which is now less than twice its standard error. The only cross-price term that exceeds twice its standard error is RPWINES. Continuing to hold much explanatory power are IMM, BSTRIKE, lagged consumption, DAGE (in the wine and spirits equations), and TREND (in the wine equation). The "stress variables" are also important to the spirits equation again. The LBSTRIKE coefficients continue to be disappointing, and now the estimate carries an unexpected positive sign in the wine equation.

5. The Final Model

The regression equations which comprise the final model are contained in Table 5. Again each is a ridge regression, with coefficient stabilization being complete at K = 0.07 for beer and spirits, and at K = 0.09 for wine.

The beer specification in Table 5 differs from that of Table 4 only to the extent that RPSPIRB has been excluded. The actual estimates of Equation 5-1 are also very similar to those of Equation 4-1, with only the own-price and income estimates changing by noticeable amounts. It therefore appears that the short run own-price elasticity of the per capita demand for beer in B.C. is very close to -0.40. With respect to the income elasticity of demand, it is concluded that it is also quite low in the short run, in the area of 0.10 to 0.15. These and the remaining estimates and their implications for consumption are discussed further in Chapter V. LBSTRIKE remains in the final model notwithstanding its high standard errors since its exclusion results in Durbin h-statistics in excess of 1.65 throughout all the beer equations as the ridge regression iterates over the values of K. In addition it is important to the adjustment mechanism and the estimate does carry the expected positive sign. It should also be noted that leaving the variable in the model affects the magnitudes of the parameter estimates only marginally.

For the final wine model LBSTRIKE is dropped. This is the sole difference between Equations 4-2 and 5-2.[13] In Equation 5-2, the inclusion of LBSTRIKE has little effect on the h-statistic. As well, the estimate carries the unexpected sign in Equation 4-2 and dropping the variable has negligible effects on the remaining estimates and on the $\bar{R}^2$. The final wine equation indicates that the short run own-price and income elasticities of wine demand in B.C. are approximately -0.75 and 0.64 respectively. These are both somewhat more elastic than for beer demand.[14]

There are two final spirits models, Equations 5-3 and 5-4. Both are the same specification as Equation 4-3, with one important exception - in order that the ceteris paribus assumption with respect to the own-price variable is not violated, RPWINES is replaced with PWINE in Equation 5-4.[15] The results of the two final spirits specifications are almost identical, the major difference being that the PSPIR coefficient estimate is larger and has a much lower standard error in Equation 5-4, as expected. The only other notable discrepancy is a noticeable drop in the pseudo t-ratio for the wine cross-price term; however, it would appear that the estimate is still significant in a one-tailed test. Therefore PWINE remains in Equation 5-5. LBSTRIKE remains for the indentical reasons as discussed above for the final beer model. The results of Equation 5-3 then, show that the short run own-price elasticity of the demand for spirits is very low in B.C., possibly as low as -0.26. The estimated income elasticity is also small, probably in the area of 0.18, comparable to that for beer.

TABLE 2: RESULTS USING FULL MODEL

BEER EQUATION (2-1):

CONSTANT	PBEER	RPWINEB	RPSPIRB	PDICAP
8.84	-0.62	-0.42	0.07	1.32**
(2.60)	(1.70)	(2.88)	(0.25)	(3.96)
UNEMP	LIQSPC	AGE	IMM	INFL
0.03	-0.06	-0.02	-1.82**	-0.002
(0.73)	(0.33)	(0.21)	(3.41)	(0.55)
DAGE	BSTRIKE	LBSTRIKE	TREND	LAGCB
-0.05	-0.03**	-0.006	-0.03**	-0.18
(1.51)	(5.78)	(0.77)	(3.30)	(0.88)

$\bar{R}^2$ = .9694; DURBIN'S H-STATISTIC CANNOT BE COMPUTED; DEGREES OF FREEDOM = 17

WINE EQUATION (2-2):

CONSTANT	PWINE	RPBEERW	RPSPIRW	PDICAP
0.24	-0.42	0.02	-0.12	-0.49
(0.05)	(0.62)	(0.06)	(0.24)	(1.01)
UNEMP	LIQSPC	AGE	IMM	INFL
-0.09	-0.24	-3.27	-0.51	0.006
(1.56)	(0.71)	(1.75)	(0.49)	(0.90)
DAGE	BSTRIKE	LBSTRIKE	TREND	LAGCW
0.13	0.21	-0.004	0.06	0.26
(2.04)	(1.88)	(0.47)	(2.52)	(1.14)

BSTRIKE $\bar{R}^2$ = 0.9960; DURBIN'S H-STATISTIC CANNOT BE COMPUTED; DEGREES OF FREEDOM =17

SPIRITS EQUATION (2-3):

CONSTANT	PSPIR	RPBEERS	RPWINES	PDICAP
-3.30	-0.90**	-0.10	-0.07	0.32
(1.61)	(3.14)	(0.86)	(0.38)	(1.56)

UNEMP	LIQSPC	AGE	IMM	INFL
-0.09**	-0.41**	-0.87	-0.02	0.002
(4.08)	(2.98)	(1.15)	(0.05)	(1.56)
DAGE	**BSTRIKE**	**LBSTRIKE**	**TREND**	**LAGCS**
0.04*	0.01*	-0.01*	-0.003	0.44**
(2.51)	(2.51)	(2.28)	(0.47)	(4.35)

$\bar{R}^2$ = 0.9936; DURBIN'S H-STATISTIC = -1.46; DEGREES OF FREEDOM = 17

* Indicates Significance @5% Level
** Indicates Significance @1% Level

TABLE 3: THE FULL MODEL USING THE RIDGE REGRESSION

BEER EQUATION (3-1):

CONSTANT	PBEER	RPWINEB	RPSPIRB	PDICAP
-0.36	-0.34	-0.10	0.08	0.13
(0.42)	(3.09)	(1.26)	(1.29)	(5.27)
UNEMP	LIQSPC	AGE	IMM	INFL
-0.02	-0.11	-0.63	-0.58	0.0009
(0.98)	(1.22)	(1.16)	(4.91)	(0.35)
DAGE	BSTRIKE	LBSTRIKE	TREND	LAGCB
0.04	-0.026	0.007	0.002	0.17
(1.81)	(4.49)	(1.16)	(3.76)	(2.97)

$\bar{R}^2$ = 0.9269; DURBIN'S H-STATISTIC = 1.40;
DEGREES OF FREEDOM = 17 K = 0.09

WINE EQUATION (3-2):

CONSTANT	PWINE	RPBEERW	RPSPRIW	PDICAP
-2.87	-0.97	0.34	-0.42	0.43
(2.12)	(4.31)	(2.26)	(3.55)	(8.54)
UNEMP	LIQSPC	AGE	IMM	INFL
0.0003	0.30	-5.77	-1.87	0.012
(0.007)	(2.20)	(6.16)	(8.71)	(2.79)
DAGE	BSTRIKE	LBSTRIKE	TREND	LAGCW
0.16	0.012	-0.005	0.014	0.17
(4.36)	(1.33)	(-0.57)	(16.49)	(15.37)

$\bar{R}^2$ = 0.9935; DURBIN'S H-STATISTIC = 0.33;
DEGREES OF FREEDOM = 17 K = 0.07

SPIRITS EQUATION (3-3):

CONSTANT	PSPIR	RPBEERS	RPWINES	PDICAP
-2.28	-0.31	-0.08	0.32	0.16
(3.64)	(5.91)	(1.30)	(5.38)	(6.32)

UNEMP	LIQSPC	AGE	IMM	INFL
-0.07	-0.18	-1.85	-0.29	0.008
(4.48)	(2.42)	(4.23)	(2.93)	(3.67)

DAGE	BSTRIKE	LBSTRIKE	TREND	LAGCS
0.05	0.014	-0.005	0.002	0.21
(2.88)	(3.24)	(1.23)	(4.68)	(7.29)

$\bar{R}^2$ = 0.9865; DURBIN'S H-STATISTIC = -0.03;
DEGREES OF FREEDOM = 17 K = 0.07

TABLE 4: THE BEST INTERMEDIATE MODEL USING THE RIDGE REGRESSION

BEER EQUATION (4-1):

CONSTANT	PBEER	RPSPIRB	PDICAP	IMM
-0.04	-0.34	0.08	0.16	-0.88
(0.11)	(3.39)	(1.43)	(5.38)	(6.53)

BSTRIKE	LBSTRIKE	LAGCB	$\bar{R}^2$	h	DF
-0.02	0.008	0.22	0.9569	1.38	24
(4.93)	(1.60)	(3.67)	K = 0.07		

WINE EQUATION (4-2):

CONSTANT	PWINE	PDICAP	IMM	DAGE
-6.65	-0.74	0.61	-2.27	0.17
(8.80)	(4.0)	(9.98)	(8.82)	(4.91)

BSTRIKE	LBSTRIKE	TREND	LAGCW	$\bar{R}^2$
0.03	0.007	0.02	0.23	0.9950
(3.32)	(0.80)	(13.34)	(18.47)	

h	DF	K = 0.07
2.28	23	

SPIRITS EQUATION (4-3):

CONSTANT	PSPIR	RPWINES	PDICAP	UNEMP
-1.12	-0.13	0.20	0.16	-0.11
(2.68)	(1.67)	(2.67)	(4.50)	(5.68)

IMM	INFL	DAGE	BSTRIKE	LBSTRIKE
-0.88	0.007	0.07	0.01	-0.007
(6.84)	(2.77)	(2.98)	(2.62)	(1.30)

LAGSC	$\bar{R}^2$	h	DF	K = 0.07
0.26	0.9763	1.94	21	
(6.75)				

TABLE 5: FINAL MODEL USING RIDGE REGRESSIONS

BEER EQUATION (5-1):

CONSTANT	PBEER	PDICAP	IMM	BSTRIKE
0.57	-0.43	0.12	-0.89	-0.02
(2.01)	(4.75)	(2.93)	(6.50)	(5.05)

LBSTRIKE	LAGCB	$\bar{R}^2$	h	DF	K = 0.07
0.007	0.22	.9442	1.62	25	
(1.53)	(3.66)				

WINE EQUATION (5-2):

CONSTANT	PWINE	PDICAP	IMM	DAGE
-6.76	-0.75	0.64	-2.23	0.17
(9.98)	(4.30)	(12.18)	(9.48)	(5.46)

BSTRIKE	TREND	LAGCW	$\bar{R}^2$	h	DF
0.03	0.02	0.22	.9932	2.47	24
(3.27)	(15.78)	(21.18)			

K = 0.09

SPIRITS EQUATION WITH RELATIVE WINE PRICE (5-3):

CONSTANT	PSPIR	RPWINES	PDICAP	UNEMP
-1.12	-0.13	0.20	0.16	-0.11
(2.68)	(1.67)	(2.67)	(4.50)	(5.68)
IMM	INFL	DAGE	BSTRIKE	LBSTRIKE
-0.88	0.008	0.07	0.01	-0.007
(6.84)	(2.77)	(2.98)	(2.62)	(1.30)
LACCS	$\bar{R}^2$	h	DF	K = 0.07
0.26	.9763	1.94	21	
(6.75)				

SPIRITS EQUATION WITH ABSOLUTE WINE PRICE (5-4):

CONSTANT	PSPIR	PWINE	PDICAP	UNEMP
-1.42	-0.26	0.21	0.18	-0.11
(2.44)	(3.31)	(1.75)	(5.33)	(5.03)

IMM	INFL	DAGE	BSTRIKE	LBSTRIKE
-0.81	0.008	0.08	0.01	-0.007
(5.69)	(2.76)	(3.45)	(2.68)	(1.27)

LAGCS	$\bar{R}^2$	h	DF	K
0.28	.9767	1.59	21	0.07
(7.37)				

NOTES TO CHAPTER IV

[1]In unreported specifications of the model, experimentation with alcoholic beverage advertising dummy variables was undertaken. The estimated coefficients were not significantly different from zero, even in the ridge regressions. Some background is in order here. In Canada, federal regulations prohibit T.V. or radio advertising of distilled spirits. Thus provinces may permit electronic media advertising of beer and wine and print advertising of any beverage. In B.C., advertising of alcoholic beverages in the print media has been allowed since at least the early 1950's. The one exception was a 14-month period lasting from 1 September 1971 to 31 October 1972, during which time there was a ban on alcoholic beverage advertising in newspapers and magazines published within the province. The ban was therefore in effect for part of both fiscal years 1971/72 and 1972/73; use of a dummy showed no significant effects of this decree on the consumption of either beer, wine or spirits. A second dummy was included only in the beer and wine equations for an entirely different reason. The provincial government prohibited the advertising of beer and wine over the airwaves until the Fall of 1982, when the pertinent regulations were relaxed. A dummy was set up to test the effect of this action on beer and wine consumption, the results again showing no discernable consequences. Other studies, employing both Canadian and U.S. data (see for example Smart and Cutler, 1976, and Ogborne and Smart, 1980) also reach the conclusion that "...advertising restrictions were unrelated to per capita beer, wine, or spirits consumption, to total per capita consumption or to alcoholism rate." (Traffic Injury Research Foundation of Canada, 1985, p.64)

[2]The common Durbin-Watson statistic cannot be employed as a test for autocorrelation when a lagged dependent variable is included as an exogenous variable, since the test statistic is biased against finding autocorrelation. In its stead, Durbin proposes that the "h-statistic" be used, defined as

$$h = \left(1 - \frac{DW}{2}\right)\sqrt{\frac{T}{1 - T(\text{Var } b)}}$$

where DW is the Durbin-Watson statistic, T is the number of observations, and Var b is the square of the standard error of the estimated coefficient of the lagged dependent variable. (see Pindyck and Rubinfeld, 1981, pp. 193-195). This statistic follows approximately the standard normal distribution. At the 5% level the critical value of this distribution is 1.645 and thus if the h-statistic for a particular regression is less than 1.645 in absolute value, the null hypothesis of no autocorrelation may be accepted. In the present work the 5% level of statistical significance is used.

Note that if T(Var b) exceeds unity the statistic cannot be calculated since one cannot take the square root of a negative number. An alternative test proposed by Durbin is to regress the error term (e_t) on the error term lagged one period in addition to the other explanatory variables inherent in the model. A t-test is then performed on the estimated coefficient of the lagged error term and if it is judged to be not significantly different from zero, the null hypothesis of no first-order autocorrelation is accepted.

[3]The simple correlation coefficient between two variables, ranging between -1 and +1, provides an indication as to how closely the two are either negatively or positively related (correlated). Simple correlation can be between either two explanatory variables or between the dependent variable and one explanatory variable. The concept should not be confused with that of partial correlation, which describes the extent of the relationship between the dependent variable and an explanatory variable <u>ceteris paribus</u>, i.e. after removing the effects on the dependent variable of the remaining explanatory variables on the model.

[4]Using this simple criterion as stated would result in several more variable pairs being included in Table 3, obviously resulting in additional candidates exhibiting multicollinear tendencies. In the interests of brevity only those expanatory variable pairs with a simple correlation coefficient between them of 0.70 or greater are entered in the Table. While this figure is quite arbitrary, it is the author's opinion that based upon the evidence contained in Table 3 and in the Table of Multiple Correlation Coefficients (Appendix III), those variables which are the greatest offenders in terms of multicollinearity are very apparent.

[5]These are simply the square roots of the coefficient of determination (referred to as r^2 or, more

commonly, $\bar{R}^2$), the latter representing the explained portion of the variation in the logarithm (except in the cases of INFL, DAGE, BSTRIKE, DAFTER, and TREND, with the raw data forming the regressors) of the left-hand-side variable accounted for by the variables on the right-hand-side of the repective regression equations.

[6]The coefficient of variation for a given variable is the standard deviation of the observations comprising the variable divided by the mean, the data being in natural logarithm form for the purposes of the present work. The larger is the coefficient, the greater is the variance of the observations, i.e. the more the observations change over the sample period.

[7]Multicollinearity is only one of the many problems that arise in econometrics where one is forced to trade off bias and variance of the estimators. When the ridge regression is utilized in the OLS model, biased estimates are produced but in general variance is reduced. Considering the extent of the multicollinearity problem in the present work, it is the opinion of the author that an estimator with a lower variance and some bias has net benefits in comparison with an unbiased (complications introduced by the lagged dependent variable aside) estimator with a high variance. The overall goal in this context is the minimization of mean square error, i.e. reduction in the combination of bias and variance of the estimator b. Using matrix notation, in the classical OLS model $b = (x'x)^{-1}(x'y)$ where x is the matrix of independent variable observations, x' is the transpose of this matrix, (-1) indicates inversion of matrix x'x, and y is the column vector of dependent variable observations. The ridge estimator, b^r, is somewhat different, being defined as $(x'x + kI)^{-1}(x'y)$ where I is the Identity Matrix and k is some arbitrarily small constant. The introduction of k breaks up some of the multicollinearity among the independent variables and by varying k, a trace of the coefficient estimates against k can be obtained. The "optimal" value of k is found when the estimates have stabilized. Therefore while the ridge technique produces biased estimates in the classical OLS model, it generally reduces variance and this allows for the possibility of reductions in mean square error. (Owen, 1979, p. 233)

[8]During the sample period, alcoholic beverages have

always been readily accessible to the vast majority of the population in British Columbia, if not through government liquor stores in some areas, certainly through licensed retail establishments; i.e. drinkers are not bound to patronize liquor stores in order to consume alcoholic beverages. In other words, there have certainly been an ample number of liquor stores to satisfy demand in B.C. for at least the last 35 years and where there were (are) only licensed retail outlets, it is unlikely that provision of the government service would influence overall consumption of alcoholic beverages to any great extent.

[9] In that substitutability would seem to be such an integral facet of this model, a variety of strategies were undertaken in the attempt to extract meaningful relationships between the cross-prices and own-consumption. These included lagging the cross-price variables one time period, use of absolute real rather than relative real cross-prices, use of a linear rather than a log-linear specification (which was employed and was met with some success by Johnson and Oksanen, 1974), and of course use of the ridge technique. However, no encouraging results are obtained with respect to the four now-excluded cross-price variables; all four possess high standard errors and/or carry the wrong sign.

[10] Comparing the non-ridged specifications of the unrestricted model with those of the restricted model, F-tests are performed to help determine the plausibility of the restricted equations of Table 4. For the beer F-test, the 1% and 5% critical values are 3.93 and 2.61 since there are seven degrees of freedom in the numerator and 17 degrees of freedom in the denominator; in the wine test, the respective critical values are 4.10 and 2.70 since the degrees of freedom are six and 17; and for spirits, the values are 4.67 and 2.96 given that the degrees of freedom are four and 17. The calculated F-statistics for the beer, wine, and spirits tests are respectively 3.05, 1.67, and 11.29. Thus the null hypothesis is acceptable for beer and wine, but not for spirits. In the latter case, the decision to exclude the four variables is not affected, given the unexpected results obtained (as explained in the text) in Equation 3-3 with respect to RPBEERS, LIQSPC, and AGE and the insignificant TREND estimate which results if only RPBEERS, LIQSPC, and AGE are dropped. Moreover, the drop in the $\bar{R}^2$ is small, the decrease being from 0.9965 to

0.9872.

[11]Recall that since the lagged dependent variable is included to capture the mitigating effect of habit persistence which "impedes" the population's adjustment from a particular level of long run equilibrium consumption to another level when the values of the relevant exogenous variables change, a beer strike in the previous year implies that consumption is not indicative of its true long run equilibrium value for that year. Thus in the year after a beer strike, the observation for the lagged dependent variable is not truly indicative habit persistence. In theory, use of LBSTRIKE will augment the "incorrect" lagged consumption observation, accounting for the change in current consumption which would have normally been picked up by the lagged dependent variable. If lagged consumption is dropped, LBSTRIKE must also be dropped. Note that BSTRIKE will remain, however, since logic of the preceding discussion does nothing to alter the fact current consumption is altered by beer strikes.

[12]Since there is a lagged dependent variable included in this model, autocorrelation causes the OLS regression parameter estimates to be not only rendered inefficient (meaning upwardly biased t-ratios in the presence of positive autocorrelation) but also biased (i.e. where the expected value of the estimated parameter is not the true parameter) and inconsistent (where as the sample size increases, the t-ratios do not become larger). Therefore when autocorrelation appears to be present both the magnitudes of the coefficient estimates and their levels of significance must be considered suspect.

[13]Dropping the TREND variable has negligible effects on the remaining estimates in the beer and spirits models. Leaving TREND out of the wine equations raises the PWINE and PDICAP estimates (in absolute value) quite substantially. Hence, considering the high significance level of the estimate in Tables 3 and 4, it is concluded that the variable belongs in the wine specification.

[14]Recall the problems discussed in Note 12 above when a regression equation with an autocorrelated error term also contains a lagged dependent variable and note

that an autoregressive transformation cannot be made in conjunction with a ridge regression. Given these unfortunate phenomena, it would appear that the parameter estimates must be considered unreliable. However credibility is provided by the fact that these estimates are very similar in magnitude to those derived from a variety of unreported specifications, for many of which the null hypothesis of the absence of autocorrelation could not be rejected.

[15] The own-price elasticity estimate for spirits assumes that the relative price of wine to spirits remains constant as the price of spirits changes, i.e. that the price of wine changes proportionately with the price of spirits. To obtain the correct own-price elasticity, then, the price of wine must be held constant. This is accomplished by substituting PWINE for RPWINES. Mathematically:

$$\ln PCCONSS = B_0 + B_1 \ln PSPIR + B_3 \ln RPWINES \ldots$$

$$\begin{aligned} \ln PCCONSS &= B_0 + B_1 \ln PSPIR + B_3 \ln \frac{PWINE}{PSPIR} \\ &= B_0 + B_1 \ln PSPIR + B_3 \ln PWINE - B_3 \ln PSPIR \\ &= B_0 + (B_1 + B_3) \ln PSPIR + B_3 \ln PWINE \end{aligned}$$

Therefore the correct own-price elasticity for spirits demand is represented by the coefficient estimate for PSPIR in Equation 5-4.

CHAPTER V: INTERPRETATIONS AND CONCLUSIONS

1. Price and Income Elasticities

It would appear that short run own-price elasticities of demand for alcoholic beverages in B.C. are less than unity in absolute value. The final estimates are -0.43, -0.75, and -0.26 for beer, wine, and spirits respectively. Demand is also income inelastic in all three cases, the final estimates being respectively 0.12, 0.64, and 0.18. The standard errors of the own price and income estimates are low in each case. The only cross-price effect which has both a low standard error and carries the expected positive sign is that for RPWINES in the spirits equation, the final estimate being 0.20.[1] Since the coefficient for the lagged dependent variable carries sufficient explanatory power in each equation, long run elasticities can also be calculated.[2] The estimated long run own-price elasticities are -0.55, -0.96, and -0.36 for beer, wine, and spirits respectively. The estimated long run income elasticities are 0.15, 0.82, and 0.25. The long run cross-price elasticity of the demand for spirits with respect to the absolute price of wine is 0.29. In all three demand equations, the differences between the long and short run values of the estimates is not substantial due to the low magnitudes of the estimates for the lagged dependent variables.

Possibly the most startling result of this entire exercise is the very low spirits own-price elasticity estimate. This result can only be rationalized by the fact that British Columbians have traditionally been very high consumers of hard liquors in comparison with the residents of most other provinces. In other words, the evidence suggests that B.C.'ers wish to consume a given volume of spirits per head and changes in real price do very little to alter their consumption patterns in this case.[3]

The above result, along with the statistically significant low own-price elasticities of demand for beer and wine[4] have direct implications for liquor policy-making in B.C. If tax revenue maximization is the primary goal, increased markups are in order since per adult consumption should not suffer that greatly in either the short, or long, run.[5] If discouraging consumption is the objective, then given the negative relationships between own-price and consumption found in all three cases, raising the markups would be most successful in reducing wine demand, followed by that for beer, with a marginal effect on the demand for spirits. Another interesting implication of the low (short and long run) price elasticity estimate for spirits demand in

B.C. is that a substantial increase in the markup is needed to discourage consumption by any appreciable amount. Discouraging consumption in this manner would also result in a boon to the provincial treasury. Also, if it is desirable to restrain the drinking of hard liquor vis-a-vis that of the less potent beer and wine, high markups on the former relative those on beer and wine are in order, as indeed is the current policy of the Liquor Distribution Branch.

The low values of the income elasticities imply that consumption of beer and spirits will rise slowly with real income. Wine sales will rise at a faster pace, but will still lag behind real income growth. Hence it appears that revenue potential vis-a-vis increases in real incomes per adult is greatest for wine, with substantially lower potentials for beer and spirits. This income inelastic demand for alcoholic beverages can be explained using the analytic economic concept of "necessities versus luxuries", bypassing the moral connotations that hover over the everyday ideas of luxuries and necessities. It would seem that lifestyles of British Columbians have become such that these beverages have become basic items in the consumption baskets of the province's households. This implies that even at quite low levels of income, consumption is stable in the face of fluctuating real incomes. Rising incomes therefore do not stimulate the demand for alcoholic beverages to a substantial degree, especially for beer and spirits. Wine should be classified more towards the luxury end of the spectrum.

As noted at the beginning of this Chapter, the only statistically significant cross-price elasticity estimate possessing the expected positive sign is for wine-price in the spirits equation. Furthermore, even if the perverse signs and lack of statistical significance are ignored, the directions of the cross-price effects are not consistent across the equations. For example, the RPWINES estimate is positive in the spirits equation, but the RPSPIRW is negative in the wine equation. The unavoidable conclusion therefore is that B.C.'ers do not treat these beverages as substitutes for one another. This lack of substitutibility is certainly consistent with the fairly low own-price elasticity estimates as described above in that basic economic theory states that less widespread is the perception that a commodity has viable substitutes, the less elastic will be the demand for that commodity with respect to own-price.

Briefly, in comparison with the other studies, these estimated elasticities are similar in magnitude, with one exception. Others have generally found the own-price elasticity to be lowest (in absolute value) for beer and highest for spirits with that for wine somewhere in the middle. The present results are consistent with this trend as far as beer and wine are concerned, these particular estimates being somewhat higher than the Johnson and Oksanen (1974, 1977) estimates for all of Canada. The anomoly, as discussed above, is with respect to very low spirits estimate generated here. As well, as in most other studies, the income elasticity of demand estimates are significant and are often less than unity in accordance with the findings here. The income effect for spirits conforms very closely to that of Johnson and Oksanen (1974, 1977). The generally poor cross-price effects found here also correspond to those derived elsewhere.

2. The Immigrants Variable

In all cases the estimated coefficient for this variable is negative with a low standard error. It would therefore appear that B.C.'s immigrant population purchases less of all alcoholic beverages than does the Canadian born population. The strongest effect is with respect to wine where it seems that for each percentage increase in the proportion of the province's population that is foreign-born, per adult wine consumption drops by about two per cent. The figures for beer and spirits are both approximately one per cent.

Recall that Hogarty and Elzinga's (1972) U.S. beer study and Owen's (1979) Australian wine demand analysis show a positive relationship between alcohol consumption and the immigrants variable. A possible explanation for the opposite relationship in the present work is that the composition of B.C.'s immigrant population is significantly different from those of the other two countries. More specifically, it would appear that B.C.'s stock of immigrants are less secure financially and/or have quite different tastes than the indigenous population. In Johnson and Oksanen's two studies, both negative and positive signs are generated for the various ethnic groups tested. This again makes it difficult to generalize as to just what is plausible and what is not in regard to this variable.

3. The Beer Strike Variable (BSTRIKE)

This variable also holds much explanatory power in all three models and carries the expected sign in each case. The estimate for beer demand is -0.02, 0.03 for wine, and 0.01 for spirits. The results therefore indicate that beer strikes affect not only beer consumption (in a downward direction), but also positively affect wine and spirits consumption in the year during which the strike occurs. Given the manner in which this variable has been designed, the impact of the 1975/76 beer strike was to decrease per adult consumption of beer by about 2% and to raise wine and spirits consumption by about 3% and 1% respectively.[6] This implies that the more prolonged beer strikes of the summers of 1977 and 1978, ceteris paribus, resulted in a decrease in the year's beer consumption per adult of about 10%, while wine and spirits demand increased by approximately 15% and 5% respectively. The directions of these effects are in accordance with those of other studies.

4. The Lagged Beer Strike Variable (LBSTRIKE)

While in possession of quite low pseudo t-ratios in all of the three equations, the estimate carries the expected positive sign in the beer equation and the expected negative sign in the spirits equation. Recall that the unexpected positive sign was derived in the wine equation, before the variable is dropped. Moreover, the estimates of 0.007 for beer and -0.007 for spirits are both almost twice their standard errors. The small size of the estimates (including the zero estimate in the wine equation) relative to those of BSTRIKE imply that an interruption of beer supplies due to a strike do alter the tastes of the B.C. population. In other words, in the year following a beer strike, it seems that B.C.'ers are in no rush to abandon their newly acquired preferences for wines and spirits in favour of a return to beer. If tastes were not altered it is expected that the size of the coefficient estimates would be in accordance with those of BSTRIKE. This would imply a more or less complete switch back to beer after a strike. Therefore, the interpretation is that "forced" consumption of wine and spirits instead of beer alters tastes in favour of the former two beverages once the strike has ceased.

5. The Legal Drinking Age Dummy Variable (DAGE)

It is surprising that the estimate does not hold more explanatory power in the beer model given that casual observation suggests that this beverage is very popular amongst the younger generation. However, it should be noted that in Equation 3-1 where the full model is run using the ridge regression, the estimate does carry the expected positive sign. In the wine and spirits models, the estimate carries a low standard error with the expected positive sign in each case. The coefficients indicate that the lowering of the drinking age in 1970 has led to a permanent increase in per adult wine consumption of about 17 per cent and in spirits consumption of approximately seven per cent. Given that the legislation enlarged the B.C. population legally entitled to drink by only approximately 5.3 percent, it appears that those aged 19 and 20 are heavier than average consumers of wine and spirits.

A reasonable conjecture with respect to why the lowering of the drinking age led to only a small or even no permanent increase in beer consumption per adult may be that those 19 and 20 year-olds who are prone to drinking beer did so, more or less to their satisfaction, illegally before the law was changed.[7] What is more alarming from a sociological point of view are the sizes and the apparent statistical significance of the effects of the legislation on the consumption of the more potent wines and spirits.

6. The Time Trend Variable (TREND)

The only final model within which the TREND variable remains is that for wine demand, the coefficient estimate being 0.02 and positive. This indicates that, ceteris paribus, wine consumption increased by two percent annually during the sample period due to the influence of omitted variables. It is believed that changing tastes are the primary force at work due to the apparent trend in North American society towards wine consumption (see Chapter I) that has been manifest for some time. Recall that Owen (1979) also finds the time trend variable to be significant in determining wine consumption, as does Johnson and Oksanen (1974). The latter also finds the trend variable to be significant for beer and spirits demand, however.

7. The Lagged Dependent Variable (LAGCB, LAGCW, LAGCS)

"Habit persistence" is a factor in all three models, being especially important in the cases of wine and spirits consumption. The sizes of the coefficients are also comparable in each case, the final estimates being 0.22 in the beer and wine equations, and 0.28 in the spirits equation; the effects are all in the expected positive direction. These estimates for lagged consumption are quite small, implying that B.C. consumers react quickly to the relevant exogenous changes in these markets. The differences between the short and long run values of the remaining coefficient estimates are therefore not large. Owen (1979) and Johnson (1974, 1977) also find habit persistence to be an important factor in affecting consumption.

8. The "Stress Variables" (UNEMP and INFL)

One of the more noteworthy results of the regression analysis is the high degree of explanatory power and negative sign for UNEMP in the spirits equation, especially considering the apparently insignificant effects found in both the beer and wine equations. In Equation 5-3 and 5-4 the estimate stabilizes at a value of -0.11, not a substantial deviation from that of Equation 2-3, the full model. It thus seems that British Columbians associate unemployment with lower perceived future incomes, causing them to curtail spirits consumption in the order of 11 per cent given a doubling of the rate of male unemployment. While this effect might seem small at face value, it is expected that this coefficient be substantially less than unity. If the coefficient were -1.0, the implication would be that per adult consumption is halved with a doubling of the rate of male unemployment, hardly a plausible occurrence. Moreover, a coefficient of even -0.11 implies a significant drop in consumption for each unemployed person. In 1984 for example, the drop in total consumption for each unemployed person was in excess of average per adult consumption during the 1984/85 fiscal year.[8] The negative effect on spirits consumption is in contrast with the "stress hypothesis" and hence with the results of McCornac (1982) but is in accordance with the findings of Kitchin (1981).

While the theory behind the stress hypothesis is tenuous at best, the INFL estimate is positive and is over twice its standard error in the final spirits model, stabilizing at 0.008. This means that for each percentage point increase in the B.C. rate of inflation (e.g. from 10 per cent to 11 per cent), per adult consumption of spirits increases by just under one per cent. While this phenomenon can conceivably be explained by the "stress hypothesis," the "real income gain" hypothesis advanced earlier (see the discussion of INFL in Chapter III) is also plausible. The positive effect does coincide with that of Kitchin (1981), although his estimate is not significant.

9. The Remaining Variables (LIQSPC and AGE)

These last variables do not play a statistically discernible role in the expected positive direction in the determination of alcoholic beverage consumption in British Columbia. Robust results for LIQSPC were not expected given that alcohol has been readily available throughout the province throughout the sample period. The poor results with respect to AGE are surprising, but recall that Johnson and Oksanen (1974) also have little success with a similar variable and in fact drop it from their 1977 study.

NOTES TO CHAPTER V

[1]In order to be certain that five of the six cross-price effects are not significant in the positive direction, the relevant variables are inserted into the final model and estimates are generated. They are; with the pseudo t-ratios in parentheses: -0.02 (-0.25) for RPWINEB, 0.08 (1.39) for RPSPIRB; 0.006 (0.05) for RPBEERW, -0.46 (-4.54) for RPSPIRW; and -0.24 (-4.0) for RPBEERS, 0.25 (3.99) for RPWINES.

[2]An assumption inherent in a model of this nature is that in the long run, after all adjustments in the values of the explanatory variables are complete, the current value of the dependent variable will equal the lagged value. Using the notation of Equation (1a) in Chapter III, this means:

$$lnC_t = lnC_{t-1}$$

which implies that after rearranging Equation (1a),

$$(1 - (1 - A))lnC_t = AlnC_E + B_{12}BSTRIKE_t + B_{13}LBSTRIKE$$

and therefore that in the long run, lnC_t is represented by the right hand side of the estimated regression divided by(1 - (1 - A)), which is simply one less the parameter estimate for the lagged dependent variable. In other words, the long run parameter estimates are the short run estimates divided by this expression.

[3]While the estimated own-price elasticity of the demand for spirits generated in this study is much lower than those derived in the studies summarized in Chapter II, including those of Johnson and Oksanen (1974, 1977), a recently completed Canadian study is more in accordance with the present work in this respect. Utilizing Canadian data for the years 1961-1979, Fuss and Waverman (1983) estimate own-price elasticities for spirits of -0.41 and -0.58 in the short and long runs respectively. Short run beer and wine own-price elasticity estimates are -0.27 and -0.88, and in the long run are -0.43 and -0.91 respectively; the estimates for these latter

beverages are even closer to those derived here. (The work of Fuss and Waverman is not reviewed in Chapter II since details pertaining to the methodology employed are not provided.)

[4]Neglecting the influence of time, there are three main determinants of the own-price elasticity of demand for a commodity; (i) the willingness of the population to utilize substitutes, (ii) the number of its uses, and (iii) the proportion of consumer's budgets accounted for by the commodity (Watson, 1963, p. 40). That the demand for beer, wine, and spirits should be relatively price inelastic is in accordance with (ii) and (iii) since alcoholic beverages have basically only one use and do not comprise a large proportion of the average household's budget. In B.C., it also seems that (i) has applicability given the poor cross-price effects emanating from this study.

[5]With respect to these price-inelastic demands, the policy-maker should be aware of the social consequences of the taxation of alcoholic beverages. Specifically, "...the tax may be paid out of funds that would otherwise be used to provide necessities of life for the family, particularly for the lower income groups...," "...while these goods may be regarded as luxuries, they are widely consumed in the lower income groups...(and the absolute)...burden may well be regressive...," and "the very high rates encourage illegal production..."(Due and Friedlaender, 1981, p. 396)

[6]The parameter estimates for INFL, DAGE, TREND, BSTRIKE, and LBSTRIKE are interpreted as the proportionate change in consumption caused by a one unit change in the explanatory variable, rather than as elasticities. This is shown as follows:

Each equation to be estimated is of the form

$$\begin{aligned} \ln C_t = {} & B_0 + B_1 \ln x_1 + \ldots + B_8 \ln x_8 + \\ & B_9 \text{INFL} + B_{10} \text{DAGE} + B_{11} \text{TREND} + \\ & B_{12} \text{BSTRIKE} + B_{13} \text{LBSTRIKE} + B_{14} \ln C_{t-1} \end{aligned}$$

where x_1 through x_8 represent the first eight explanatory variables. The total differential is

$$dlnC_t = B_1 dlnx_1 + \ldots + B_8 dlnx_8 + B_9 dINFL$$
$$B_{10} dDAGE + B_{11} dTREND + B_{12} dBSTRIKE +$$
$$B_{13} dLBSTIKE + B_{14} dlnC_{t-1}$$

Therefore the elasticity of demand, for example, with respect to x_1 (i.e. the proportionate change in C_t divided by the proportionate change in x_1) is thus

$$\frac{dlnC_t}{dlnx_1} = B_1$$

And

$$\frac{dlnCt}{dINFL} = B_9, \quad \frac{dlnCt}{dDAGE} = B_{10}, \quad \frac{dlnCt}{dTREND} = B_{11},$$

$$\frac{dlnCt}{dBSTRIKE} = B_{12}, \text{ and } \frac{dlnCt}{dDAFTER} = B_{13}$$

meaning that B_9 through B_{13} represent the proportionate change in consumption given a one-unit change in the exogenous variable. Note that dlnCt = dCt/Ct represents the rate of change in comsumption at time t.

[7]A recent Canadian research effort states that "These data on drinking behaviour demonstrate that minimum drinking age laws do not deter the majority of underage youth from consuming alcohol, nor the older underage consumers from heavy drinking." (Traffic Injury Research Foundation of Canada, 1985, p. 32)

[8]Mathematically, the reduction in spirits consumption due to an additional unemployed person in B.C. is represeted by the expression

$$dC = -0.11 \frac{C}{U}$$

where "C" is total consumption and "U" is the total number of unemployed. During the fiscal year 1984/85 total spirits consumption was 5,444,000 gallons and the number of unemployed was approximately 208,000 persons.

Therefore the effect was to decrease total consumption by about 2.88 gallons per unemployed person during that time. Since per adult consumption was 2.39 gallons in 1984/85, this means that the effect on consumption was equal to the hypothetical combination of the unemployed cutting back their spirits consumption to zero and those still working also cutting back, but less drastically. The latter effect is due to pessimistic expectations regarding the economy by the population during a period of high unemployment.

CHAPTER VI: POLICY IMPLICATIONS

The results of the preceding analysis indicate that British Columbians in general regard alcoholic beverages to be quite "basic" commodities in their consumption baskets. This conclusion is even more alarming in light of the fact that B.C.'ers are such high consumers of alcoholic beverages in comparison with most of the remaining Canadian provinces. The implication is that should a decrease in per adult alcohol consumption be a policy goal, means other than increasing mark-ups (such as advertising, education in public schools, etc.) may well be more successful.

The insensitivity of consumption to price changes and the inference that B.C.'ers of all income levels perceive alcoholic beverages to be a "basic" commodity also appear to demonstrate that the poor suffer significantly from price increases, given the increased proportion of their incomes which they will devote to purchases of alcohol. Moreover, while government revenues should increase with higher mark-ups due to the relative insensitivity of quantities demanded to price hikes, the detrimental effect on private sector spending must also be taken into account.

Regarding the issue of government revenue enhancement, the results also indicate continued strong growth in per adult wine consumption. This conclusion stems from two of the preceding results: (1) future increases in real income should stimulate wine demand to a much greater extent than demand for beer and spirits, and (2) the trend with respect to changing tastes of the population also appears to favour wine consumption. The provincial government would thus do well to continue their marketing efforts in this sector.

The analysis also indicates that B.C.'ers are not by and large willing to substitute one of beer, wine, or spirits for another in their consumption baskets given price changes. In other words, B.C. consumers show little deviation from their "normal" consumption patterns when the prices of any of the three beverage types fluctuate relative to one another. Since the Liquor Distribution Branch handles the distribution and sales of alcoholic beverages and collects a good deal of revenue in the process, this conclusion is of some relevance to this government body. For example, it seems changes in relative prices have little effect in shelf space considerations or on relative revenue shares accounted for by the three beverages; marketing considerations are also obviously involved here.

An additional result emanating from this study which have implications for public policy are with respect to the legal drinking age in B.C. The analysis indicates that the lowering of the legal age from 21 to 19 in 1970 led to a permanent increase in per adult alcohol consumption in B.C., implying that young people in that age group are heavier than average imbibers. It is therefore reasonable to assume that raising the age would have the opposite effect. Given the problems associated with alcohol abuse by the younger generation (traffic deaths, suicide, property damage, etc.) a move in this direction may be a rational course of action for the province as a whole. However, since traffic deaths among young people seem to be of the most concern of all the problems pertaining to teenage alcohol abuse, a more easily enforceable law (and one with fewer moral overtones) would be to simply raise the legal driving age.

Finally, a few words with respect to the advertising of alcohol beverages in B.C. Some analysis pertaining to the effects of alcohol advertising on consumption was undertaken for purposes of this thesis (see Note 1 of Chapter IV) but the results are very inconclusive. Given that the airwaves and published material available in this province are permeated with alcoholic beverage advertising from the rest of North America, it is not surprising that changes in provincial policies in this area probably have a negligible effect on consumption. In fact, there is much evidence to show that there is indeed likely no relationship between advertising and per adult consumption. The B.C. policy-maker must therefore look to studies of other jurisdictions and/or commission further analysis into the question in order to gain further understanding of this controversial aspect of the demand for alcoholic beverages in B.C.

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APPENDIX I: DATA COMPRISING THE VARIABLES

Fiscal Year	PCCONSB	PCCONSW	PCCONSS	PBEER	PWINE	PSPIR
1952/53	16.450	0.429	1.751	2.800	9.716	37.354
1953/54	15.581	0.472	1.755	2.918	10.222	38.693
1954/55	15.433	0.524	1.676	2.882	10.465	38.875
1955/56	16.315	0.535	1.768	2.901	10.391	38.489
1956/57	18.671	0.546	1.820	2.802	10.122	38.641
1957/58	18.829	0.583	1.718	2.752	9.855	39.488
1958/59	18.374	0.631	1.665	2.788	9.335	38.210
1959/60	18.379	0.665	1.624	2.698	9.240	39.005
1960/61	18.068	0.738	1.631	2.772	9.037	38.778
1961/62	18.554	0.779	1.661	2.773	9.105	38.656
1962/63	19.203	0.909	1.703	2.772	9.006	38.982
1963/64	20.611	1.028	1.758	2.702	8.630	38.172
1964/65	20.294	1.161	1.824	2.705	8.609	38.413
1965/66*	19.279	1.499	2.140	2.697	8.355	37.571
1966/67	21.697	1.438	2.201	2.625	8.579	36.437
1967/68	21.839	1.478	2.199	2.581	8.908	36.420
1968/69	21.245	1.667	2.207	2.598	8.992	37.137
1969/70	22.815	1.907	2.315	2.557	8.927	35.716
1970/71	23.872	2.153	2.353	2.471	8.877	34.735
1971/72*	24.571	2.431	2.578	2.577	9.211	34.240
1972/73	25.100	2.636	2.617	2.539	9.364	34.791
1973/74*	26.068	2.705	2.916	2.437	9.472	32.910
1974/75*	25.655	2.709	3.171	2.328	9.430	30.950
1975/76*	24.535	3.161	3.224	2.151	9.133	31.683
1976/77	23.316	2.833	2.979	2.387	9.744	30.912
1977/78	25.617	3.234	3.081	2.321	9.033	28.914
1978/79*	20.831	3.657	3.289	2.615	9.162	28.002
1979/80	24.980	3.666	3.112	2.479	9.225	28.196
1980/81*	20.676	4.253	3.365	2.953	9.246	28.363
1981/82	24.163	4.110	3.056	2.658	9.259	28.437
1982/83	23.194	4.300	2.791	2.853	8.344	28.420
1983/84	22.353	4.348	2.529	2.919	8.082	28.995
1984/85	22.337	4.496	2.394	2.929	7.719	28.759

* indicates a work stoppage in the brewing industry

Fiscal Year	RPWINEB	RPSPIRB	RPBEERW	RPSPIRW	RPBEERS	RPWINES
1952/53	3.470	13.341	0.2882	3.845	0.0750	0.2601
1953/54	3.503	13.260	0.2855	3.789	0.0754	0.2642
1954/55	3.631	13.489	0.2754	3.715	0.0741	0.2692
1955/56	3.582	13.267	0.2792	3.704	0.0754	0.2700
1956/57	3.612	13.791	0.2770	3.812	0.0725	0.2620
1957/58	3.581	14.349	0.2793	4.007	0.0697	0.2496
1958/59	3.348	13.705	0.2987	4.093	0.0730	0.2443
1959/60	3.424	14.457	0.2920	4.221	0.0691	0.2369
1960/61	3.260	13.989	0.3067	4.291	0.0715	0.2330
1961/62	3.284	13.940	0.3046	4.246	0.0717	0.2355
1962/63	3.249	14.063	0.3078	4.328	0.0711	0.2310
1963/64	3.194	14.127	0.3131	4.423	0.0708	0.2261
1964/65	3.182	14.201	0.3142	4.462	0.0704	0.2241
1965/66	3.097	13.931	0.3228	4.497	0.0718	0.2224
1966/67	3.268	13.881	0.3060	4.247	0.0720	0.2355
1967/68	3.451	14.111	0.2897	4.089	0.0709	0.2446
1968/69	3.461	14.294	0.2889	4.130	0.0700	0.2421
1969/70	3.491	13.968	0.2864	4.000	0.0716	0.2499
1970/71	3.592	14.057	0.2784	3.913	0.0711	0.2556
1971/72	3.574	13.287	0.2798	3.717	0.0753	0.2690
1972/73	3.687	13.703	0.2711	3.715	0.0730	0.2692
1973/74	3.887	13.504	0.2573	3.475	0.0741	0.2878
1974/75	4.050	13.295	0.2469	3.282	0.0752	0.3047
1975/76	4.247	14.729	0.2355	3.469	0.0679	0.2883
1976/77	4.082	12.950	0.2450	3.172	0.0772	0.3152
1977/78	3.892	12.458	0.2570	3.200	0.0803	0.3124
1978/79	3.504	10.708	0.2854	3.056	0.0934	0.3272
1979/80	3.721	11.374	0.2687	3.057	0.0879	0.3272
1980/81	3.131	9.605	0.3194	3.068	0.1041	0.3260
1981/82	3.483	10.669	0.2871	3.071	0.0935	0.3256
1982/83	2.925	9.961	0.3419	3.406	0.1004	0.2936
1983/84	2.769	9.933	0.3612	3.587	0.1007	0.2787
1984/85	2.635	9.812	0.3795	3.726	0.1019	0.2684

Fiscal Year	PDICAP	UNEMP	LIQSPC	AGE	IMM	INFL
1952/53	2640.31	4.7	0.0000975	0.6462	0.289	2.9
1953/54	2754.73	4.6	0.0000949	0.6472	0.284	-1.2
1954/55	2757.91	5.9	0.0001039	0.6480	0.279	1.1
1955/56	2975.26	4.3	0.0001042	0.6491	0.275	0.5
1956/57	3119.23	2.8	0.0001038	0.6502	0.271	1.4
1957/58	3178.98	5.9	0.0001014	0.6529	0.270	2.5
1958/59	3080.31	9.6	0.0000994	0.6521	0.265	2.5
1959/60	3140.08	6.9	0.0000981	0.6495	0.264	1.8
1960/61	3151.36	9.7	0.0000975	0.6458	0.262	0.8
1961/62	3139.47	9.6	0.0000982	0.6413	0.260	0.2
1962/63	3253.96	7.4	0.0000983	0.6356	0.257	0.4
1963/64	3346.96	6.8	0.0000986	0.6306	0.253	1.5
1964/65	3488.73	5.3	0.0000981	0.6271	0.250	0.7
1965/66	3676.60	4.3	0.0000974	0.6259	0.247	1.9
1966/67	3787.68	4.5	0.0000962	0.6258	0.242	2.4
1967/68	3824.84	5.2	0.0000972	0.6266	0.239	3.7
1968/69	3812.34	5.4	0.0000958	0.6259	0.236	3.7
1969/70	3958.09	4.9	0.0000932	0.6241	0.234	3.4
1970/71	3979.28	8.3	0.0000928	0.6222	0.230	3.4
1971/72	4186.83	6.3	0.0000965	0.6206	0.227	3.2
1972/73	4456.28	7.1	0.0000944	0.6209	0.227	5.3
1973/74	4814.46	5.4	0.0000928	0.6223	0.230	7.2
1974/75	4943.18	6.4	0.0000969	0.6246	0.231	11.7
1975/76	4986.39	8.0	0.0001008	0.6246	0.232	11.1
1976/77	5048.85	7.3	0.0001138	0.6229	0.233	9.7
1977/78	5195.56	7.4	0.0001150	0.6219	0.234	7.2
1978/79	5319.12	7.3	0.0001151	0.6227	0.233	7.7
1979/80	5532.60	6.4	0.0001231	0.6238	0.233	7.7
1980/81	5675.19	5.2	0.0001213	0.6274	0.232	9.4
1981/82	5554.28	6.3	0.0001225	0.6316	0.230	14.3
1982/83	5364.11	14.0	0.0001251	0.6344	0.230	10.5
1983/84	5196.41	14.5	0.0001263	0.6372	0.230	5.5
1984/85	5114.62	15.5	0.0001319	0.6387	0.230	4.4

N.B.: Agency stores are included in the calculation of the variable "LIQSPC" as described in Chapter III. Where these stores sell only one type of alcoholic beverage (either beer, wine or spirits) the observations differ for each of the three respective equations. This latter sort of agency store has only been in existence since fiscal year 1981/82. Hence, only the last four observations comprising the sample period are affected. To minimize confusion, up to this point this variable has been referred to simply as "LIQSPC" and has been treated as being identical in each of the three demand equations. Note that in Appendix II, though, the variable is divided into "BLIQSPC, WLIQSPC, and SLIQSPC" for the beer, wine, and spirits equations respectively. The last four observations in the above column are relevant to the beer model; the observations for 1981/82 through 1984/85 in the wine and spirits specifications are 0.0001248, 0.0001292, 0.0001312, 0.0001363 and 0.0001229, 0.0001255, 0.0001267, 0.0001319 respectively.

Fiscal Year	DAGE	TREND	BSTRIKE	LBSTRIKE
1952/53	0	1	0	0
1953/54	0	2	0	0
1954/55	0	3	0	0
1955/56	0	4	0	0
1956/57	0	5	0	0
1957/58	0	6	0	0
1958/59	0	7	0	0
1959/60	0	8	0	0
1960/61	0	9	0	0
1961/62	0	10	0	0
1962/63	0	11	0	0
1963/64	0	12	0	0
1964/65	0	13	0	0
1965/66	0	14	3.092	0
1966/67	0	15	0	3.092
1967/68	0	16	0	0
1968/69	0	17	0	0
1969/70	0	18	0	0
1970/71	1	19	0	0
1971/72	1	20	0	0
1972/73	1	21	0	0
1973/74	1	22	0	0
1974/75	1	23	0	0
1975/76	1	24	1	0
1976/77	1	25	0	1
1977/78	1	26	0	0
1978/79	1	27	5.138	0
1979/80	1	28	0	5.138
1980/81	1	29	4.862	0
1981/82	1	30	0	4.862
1982/83	1	31	0	0
1983/84	1	32	0	0
1984/85	1	33	0	0

APPENDIX II: TABLE OF SIMPLE CORRELATION COEFFICIENTS

(Data in natural log form, except for INFL, DAGE, TREND, BSTRIKE and DAFTER)

(1) PCCONSB	1						
(2) PCCONSW	.84	1					
(3) PCCONSS	.81	.91	1				
(4) PBEER	-.70	-.40	-.56	1			
(5) PWINE	-.41	-.53	-.19	-.03	1		
(6) PSPIR	-.67	-.92	-.90	.27	.33	1	
(7) RPWINEB	.25	-.05	.28	-.76	.68	.02	1
(8) RPSPIRB	-.24	-.66	-.55	-.33	.35	.82	.47
(9) RPBEERW	-.25	.05	-.28	.76	-.68	-.02	-1
(10)RPSPIRW	-.47	-.66	-.83	.30	-.21	.85	-.36
(11)RPBEERS	.24	.66	.55	.33	-.35	-.82	-.47
(12)RPWINES	.47	.66	.83	-.30	.21	-.85	.36
(13)PDICAP	.83	.98	.95	-.42	-.41	-.96	.05
(14)UNEMP	.31	.45	.18	.02	-.61	-.44	-.41
(15)BLIQSPC	.20	.57	.47	.23	-.29	-.78	-.37
(16)WLIQSPC	.20	.58	.46	.26	-.33	-.77	-.40
(17)SLIQSPC	.20	.57	.47	.24	-.29	-.78	-.37
(18)AGE	-.80	-.74	-.74	.67	.36	.50	-.26
(19)IMM	-.92	-.95	-.85	.52	.54	.76	-.03
(20)LAGCB	.85	.88	.86	-.58	-.42	-.72	.15
(21)LAGCW	.85	.99	.92	-.40	-.50	-.93	-.04
(22)LAGCS	.79	.92	.97	-.49	-.20	-.94	.23
(23)INFL	.72	.81	.89	-.50	-.12	-.84	.29
(24)DAGE	.77	.88	.88	-.42	-.21	-.89	.18
(25)BSTRIKE	-.01	.32	.43	.08	-.02	-.39	-.07
(26)LBSTRIKE	.49	.38	.50	-.56	.09	-.36	.47
(27)TREND	.80	.99	.88	-.32	-.55	-.94	-.12
	(1)	(2)	(3)	(4)	(5)	(6)	(7)

(8) RPSPIRB	1						
(9) RPBEERW	-.47	1					
(10)RPSPIRW	.66	.36	1				
(11)RPBEERS	-1	.47	-.66	1			
(12)RPWINES	-.66	-.36	-1	.66	1		
(13)PDICAP	-.68	-.05	-.77	.68	.77	1	
(14)UNEMP	-.44	.41	-.12	.44	.12	.39	1
(15)BLIQSPC	-.90	.37	-.64	.90	.64	.63	.45
(16)WLIQSPC	-.91	.40	-.62	.91	.62	.63	.48
(17)SLIQSPC	-.90	.37	-.64	.90	.64	.63	.45
(18)AGE	.09	.26	.33	-.09	.33	-.67	-.03
(19)IMM	.43	.03	.49	-.43	.49	-.89	-.39
(20)LAGCB	-.37	-.15	-.52	.37	.52	.86	.41
(21)LAGCW	-.67	.03	-.68	.67	.68	.98	.45
(22)LAGCS	-.62	-.23	-.86	.62	.86	.96	.30
(23)INFL	-.53	-.29	-.81	.53	.81	.88	.27
(24)DAGE	-.62	-.18	-.81	.62	.81	.89	.45
(25)BSTRIKE	-.43	.07	-.40	.43	.40	.36	-.07
(26)LBSTRIKE	-.02	-.47	-.42	.02	.42	.44	-.01
(27)TREND	-.73	.12	-.67	.73	.67	.98	.52
	(8)	(9)	(10)	(11)	(12)	(13)	(14)

(15)BLIQSPC	1						
(16)WLIQSPC	.99	1					
(17)SLIQSPC	.99	.99	1				
(18)AGE	.02	.03	.02	1			
(19)IMM	-.32	-.33	-.32	.84	1		
(20)LAGCB	.24	.25	.24	-.79	-.91	1	
(21)LAGCW	.59	.60	.59	-.72	-.94	.86	1
(22)LAGCS	.59	.58	.59	-.64	-.23	.81	.93
(23)INFL	.53	.52	.53	-.50	-.72	.74	.82
(24)DAGE	.54	.54	.54	-.57	-.79	.80	.88
(25)BSTRIKE	.27	.24	.27	-.25	-.22	.37	.29
(26)LBSTIKE	.11	.10	.11	-.39	-.39	.33	.42
(27)TREND	.66	.67	.66	-.65	-.91	.84	.99
	(15)	(16)	(17)	(18)	(19)	(20)	(21)

(22)LAGCS	1					
(23)INFL	.92	1				
(24)DAGE	.90	.80	1			
(25)BSTRIKE	.33	.29	.28	1		
(26)LBSTRIKE	.54	.59	.41	-.10	1	
(27)TREND	.91	.81	.86	.30	.36	1
	(22)	(23)	(24)	(25)	(26)	(27)

APPENDIX III:

"MULTICOLLINEAR TENDENCIES" AS EVIDENCED BY DATA FROM THE TABLE OF SIMPLE CORRELATION COEFFICIENTS

N.B.: The numbers in parentheses are the coefficients of simple correlation between the explanatory variable and the dependent variable; the underlined numbers are the coefficients of simple correlation between the two explanatory variables.

BEER MODEL

PBEER(-.70)/RPWINEB(.25):	-.76
LIQSPC(.20)/RPSPIRB(-.24):	-.90
PDICAP(.83)/IMM(-.92):	-.89
PDICAP(.83)/.LAGCB(.85):	-86
PDICAP(.83)/INFL(.72):	.88
PDICAP(.83)/DAGE(.77):	.89
PDICAP(.83)/TREND(.80):	.98
IMM(-.92)/AGE(-.80):	.84
IMM(-.92)/LAGCB(.85):	-.91
IMM(-.92)/DAGE(.77):	-.79
IMM(-.92)/TREND(.80):	-.91
INFL(.72)/LAGCB(.85):	.74
INFL(.72)/DAGE (.77):	.80
INFL(.72)/TREND(.80):	.81
TREND(.80)/DAGE(.77):	.86
TREND(.80)/LAGCB(.85):	.84
DAGE(.77)/LAGCB(.85):	.80

WINE MODEL

RPSPIRW(-.66)/INFL(.72):	-.81
RPSPIRW(-.66)/PDICAP(.98):	-.77
RPSPIRW(-.66)/DAGE(.88):	-.81
PDICAP(.98)/LAGCW(.99):	.98
PDICAP(.98)/INFL(.81):	.88
PDICAP(.98)/DAGE(.88):	.89
PDICAP(.98)/TREND(.99):	.98
IMM(-.95)/AGE(-.74):	.84
LAGCW(.99)/INFL(.81):	.82
LAGCW(.99)/DAGE(.88):	.88
LAGCW(.99)/TREND(.99):	.99
TREND(.99)/INFL(.81):	.81

SPIRITS MODEL

PSPIR(-.90)/RPBEERS(.55):	-.82
PSPIR(-.90)/RPWINES(.83):	-.85
PSPIR(-.90)/PDICAP(.95):	-.96
PSPIR(-.90)/LIQSPC(.47):	-.78
PSPIR(-.90)/LAGCS(.97):	-.94
PSPIR(-.90)/DAGE(.88):	-.89
PSPIR(-.90)/TREND(.88):	-.94
RPBEERS(.55)/LIQSPC(.47):	.90
RPWINES(.83)/LAGCS(.97):	.86
PDICAP(.95)/IMM(-.85):	-.89
PDICAP(.95)/LAGCS(.97):	.96
PDICAP(.95)/DAGE(.88):	.89
PDICAP(.95)/TREND(.88):	.98
IMM(-.85)/AGE(-.74):	.84
IMM(-.85)/TREND(.88):	-.91
LAGCS(.97)/INFL(.89):	.92
LAGCS(.97)/DAGE(.88):	.90
LAGCS(.97)/TREND(.88):	.91
TREND(.88)/RPBEERS(.55):	.73

APPENDIX IV: TABLE OF MULTIPLE CORRELATION COEFFICIENTS

(data in natural log form except for INFL, DAGE, TREND BSTRIKE, and DAFTER)

Rank	BEER EQUATION		WINE EQUATION		SPIRITS EQUATION	
(1)	TREND	(.9994)	TREND	(.9994)	TREND	(.9994)
(2)	PDICAP	(.9988)	LAGCW	(.9989)	PDICAP	(.9985)
(3)	IMM	(.9968)	PDICAP	(.9983)	IMM	(.9974)
(4)	LRPSPRIB	(.9905)	IMM	(.9973)	PSPIR	(.9945)
(5)	PBEER	(.9884)	RPSPIRW	(.9902)	LAGCS	(.9934)
(6)	LAGCB	(.9792)	PWINE	(.9802)	RPWINES	(.9871)
(7)	AGE	(.9759)	AGE	(.9737)	AGE	(.9716)
(8)	RPWINEB	(.9665)	DAGE	(.9706)	RPBEERS	(.9656)
(9)	DAGE	(.9660)	INFL	(.9556)	INFL	(.9552)
(10)	UNEMP	(.9657)	UNEMP	(.9508)	UNEMP	(.9530)
(11)	INFL	(.9529)	LIQSPC	(.9474)	DAGE	(.9530)
(12)	LIQSPC	(.9423)	RPBEERW	(.9379)	LIQSPC	(.9347)
(13)	BSTRIKE	(.6684)	LBSTRIKE	(.7131)	LBSTRIKE	(.6022)
(14)	LBSTRIKE	(.6339)	BSTRIKE	(.6503)	BSTRIKE	(.5471)

APPENDIX V: TABLE OF COEFFICIENTS OF VARIATION
(data in natural log form except for INFL, DAGE, TREND, BSTRIKE, and DAFTER)

RANK	VARIABLE	COEFFICIENT
(1)	DAFTER	1.92
(2)	LAGCW	1.87
(3)	DAGE	1.08
(4)	INFL	0.87
(5)	TREND	0.54
(6)	BSTRIKE/LBSTRIKE	0.33
(7)	LAGCS	0.32
(8)	RPSPIRW/RPWINES	0.093
(9)	RPWINEB/RPBEERW	0.084
(10)	PBEER	0.079
(11)	RPSPIRB/RPBEERS	0.051
(12)	LAGCB	0.050
(13)	IMM	0.050
(14)	AGE	0.038
(15)	PSPIR	0.036
(16)	PWINE	0.031
(17)	PDICAP	0.028
(18)	LIQSPC	0.012

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THE DEMAND FOR ALCOHOLIC BEVERAGES IN BRITISH COLUMBIA: AN EMPIRICAL INVESTIGATION

Author: [redacted]

GORD ENEMARK

Date: OCT. 10, 1986