THE ECONOMICS OF TEA AND COFFEE
CONSUMPTION IN AUSTRALIA

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Demand for non-alocoholic beverages (NAB) in Australia is analyzed
for the period 1964-89, with the use of consumption theory. The study's
findings, which generally support those of earlier studies, suggest that
demand for NAB is price-inelastic. A comparison of income elasticities
further suggest that tea is an inferior good, coffee a necessity, and softdrinks,
a luxury.

1. Introduction

This study is mainly concerned with the application of the con-
sumption theory to three non-alcoholic beverages (NAB) namely tea,
coffee and softdrinks. In particular, the paper will deal with the
estimation of demand equations for NAB for Australia. To achieve this
objective we have followed the approach taken by Clements and
Johnson (1983), Clements (1987, 1987a), E.A. Selvanathan (1987) and
S. Selvanathan (1987) who have analyzed the consumption of alcoholic
beverages. We use the DAP package (Selvanathan *et al.*, 1989) for all
analyses presented in this paper.

Demand studies for NAB are very important for a number of
reasons. First, very few such studies have previously been made in
Australia. Second, they can assist in the promotion of public policies
towards these commodities. Most of the softdrinks consumed in Aus-
tralia are domestically produced. Australian tea is already in the
market although on a very limited scale. Experiments are being carried
out in Queensland to examine the viability of producing coffee on a
commercial basis. The success of large-scale production of tea depends
on a number of things of which domestic consumption is the most
important.

We proceed by presenting in Section 2 the Australian NAB data.
In Section 3 we use the data to derive Divisia indices and in the
following Section we estimate the double-log demand equations. In
Section 5 we compare our findings with those of previous studies.
Finally, in Section 6 we briefly record our conclusion.

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2. The Basic Data

Let q_{it} be the per capita quantity consumed and p_{it} be the price of good i (i = 1, 2, 3) during year t (t = 1, . . . ,22). Tables 1 and 2 present these values.

The proportion of total expenditure on NAB devoted to beverage i is:

$$w_{it} = \frac{p_{it} q_{it}}{M_t},$$

where $M_t = \Sigma_{i=1}^{3} p_{it} q_{it}$ is total expenditure. This w_{it} is called the budget share of commodity i. (Strictly speaking, it is the conditional budget share as it refers to within NAB; for brevity the adjective conditional will be dropped here and elsewhere.) The budget shares for three commodities over the sample period are presented in Table 3. It can be seen that a large proportion of total expenditure on NAB is allocated to softdrinks. On average, softdrinks account for 94 percent of total expenditure on NAB, coffee 4 percent and tea 2 percent. Over the period the shares of softdrinks have increased by over 5 percentage points, while the shares of coffee and tea have fallen by 1.8 and 3.6 percentage points, respectively. Note that tea's share has fallen by the greatest amount.

Tables 4 and 5 present the quantity and price log-changes which are defined as:

$$Dq_{it} = \log q_{it} - \log q_{i,t-1}$$

and

$$Dp_{it} = \log p_{it} - \log p_{i,t-1}$$

Here log denotes natural logarithm. When multiplied by 100 these log changes are approximately annual percentage changes. As can be seen, average growth rates in prices are 7.0, 6.7 and 8.6 percent per annum for tea, coffee and softdrinks, respectively. It is interesting to note that on average per capita consumption of tea declined by 3.3 percent per annum during the period 1964/65-1985/86. On the other hand, per capita consumption of coffee and softdrinks each rose by an average of 3.9 percent per annum over the same period.

Table 1 - Per Capita Volume of Consumption of NAB: Australia

Year	Tea (in kgs)	Coffee (in kgs)	Softdrinks (in litres)
(1)	(2)	(3)	(4)
1964	2.60	1.10	39.60
1965	2.50	1.00	41.40
1966	2.40	1.10	43.60
1967	2.30	1.20	48.20
1968	2.30	1.20	50.00
1969	2.20	1.30	51.80
1970	2.20	1.30	56.40
1971	2.10	1.40	58.10
1972	2.00	1.20	64.70
1973	1.90	1.40	63.40
1974	2.00	1.10	59.60
1975	1.90	1.50	65.00
1976	2.00	1.80	68.10
1977	1.60	1.30	68.80
1978	1.70	1.70	67.00
1979	1.60	1.70	64.30
1980	1.50	1.90	68.00
1981	1.60	1.90	64.20
1982	1.40	2.00	65.90
1983	1.50	2.10	63.00
1984	1.40	2.00	67.20
1985	1.30	2.00	73.10

Source: *Apparent Consumption of Selected Food Stuffs*, Australian Bureau of Statistics, No. 4315.0.

Table 2 - Prices of NAB: Australia*

(Cents per 250 grams for tea, per 150 grams for coffee, and per litre for softdrinks)

Year	Tea	Coffee	Softdrinks
(1)	(2)	(3)	(4)
1964	34.63	111.33	45.08
1965	34.61	111.65	45.16
1966	34.61	111.83	46.85
1967	34.47	110.00	49.81
1968	34.03	109.20	52.34
1969	32.36	109.61	55.80
1970	32.69	106.83	59.75
1971	36.00	109.72	62.36
1972	35.26	109.34	64.14
1973	33.74	109.61	72.23
1974	43.87	122.96	88.72
1975	46.17	139.50	101.91
1976	63.46	221.76	112.76
1977	95.41	318.06	126.71
1978	78.75	256.18	137.52
1979	74.39	284.11	153.65
1980	75.07	292.21	172.18
1981	77.91	280.64	196.80
1982	89.25	301.31	221.82
1983	117.13	329.00	239.98
1984	149.69	370.47	255.14
1985	150.34	458.63	276.06

Sources: For tea and coffee: *Average Retail Prices of Selected Items in Eight Capital Cities,* Australian Bureau of Statistics, No. 6403.0.
For softdrinks: *Consumer Price Index,* Australian Bureau of Statistics, No. 6401.0.

*The price statistics on tea, coffee and softdrinks refer to absolute prices.

Table 3 - Budget Shares of NAB: Australia
(Percentages)

Year	Tea	Coffee	Softdrinks
(1)	(2)	(3)	(4)
1964	4.51	6.13	89.36
1965	4.18	5.40	90.42
1966	3.69	5.47	90.47
1967	3.04	5.05	91.91
1968	2.77	4.64	92.59
1969	2.29	4.59	93.12
1970	2.01	3.88	94.11
1971	1.96	3.99	94.05
1972	1.62	3.02	95.36
1973	1.34	3.20	95.46
1974	1.59	2.45	95.95
1975	1.27	3.02	95.71
1976	1.55	4.86	93.59
1977	1.64	4.45	93.90
1978	1.37	4.45	94.18
1979	1.14	4.61	94.26
1980	.91	4.49	94.60
1981	.94	4.01	95.05
1982	.81	3.93	95.26
1983	1.10	4.32	94.58
1984	1.16	4.09	94.75
1985	.92	4.31	94.77
Mean	1.90	4.28	93.77

Table 4 - Price Log-Changes of NAB: Australia

Year	Tea	Coffee	Softdrinks
(1)	(2)	(3)	(4)
1965	-.06	.29	.18
1966	.00	.16	3.67
1967	-.41	-1.65	6.13
1968	-1.28	-.73	4.95
1969	-5.03	.37	6.40
1970	1.01	-2.57	6.84
1971	9.64	2.67	4.28
1972	-2.08	-.35	2.81
1973	-4.41	.25	11.88
1974	26.25	11.49	20.56
1975	5.11	12.62	13.86
1976	31.81	46.35	10.12
1977	40.78	36.06	11.66
1978	-19.19	-21.64	8.19
1979	-5.70	10.35	11.09
1980	.91	2.81	11.39
1981	3.71	-4.04	13.36
1982	13.59	7.11	11.97
1983	27.18	8.79	7.87
1984	24.53	11.87	6.13
1985	.43	21.35	7.88
Mean	6.99	6.74	8.63

All entries are to be divided by 100.

Table 5 - Per Capita Quantity Log-Changes of NAB: Australia

Year	Tea	Coffee	Softdrinks
(1)	(2)	(3)	(4)
1965	-3.92	-9.53	4.45
1966	-4.08	9.53	5.18
1967	-4.26	8.70	10.03
1968	.00	.00	3.67
1969	-4.45	8.00	3.54
1970	.00	.00	8.51
1971	-4.65	7.41	2.97
1972	-4.88	-15.42	10.76
1973	-5.13	15.42	-2.03
1974	5.13	-24.12	-6.18
1975	-5.13	31.02	8.67
1976	5.13	18.23	4.66
1977	-22.31	-32.54	1.02
1978	6.06	26.83	-2.65
1979	-6.06	.00	-4.11
1980	-6.45	11.12	5.59
1981	6.45	.00	-5.75
1982	-13.35	5.13	2.61
1983	6.90	4.88	-4.50
1984	-6.90	-4.88	6.45
1985	-7.41	.00	8.42
Mean	-3.30	2.85	2.92

All entries are to be divided by 100.

3. Divisia Moments

The Divisia price index is a budget share-weighted average of the three price log-changes,

$$DP_t = \sum_{i=1}^{3} \overline{w}_{it} \, Dp_{it}$$

where $w_{it} = (w_{it} + w_{it,t-1})/2$ is the arithmetic average of the budget share of i. This index measures the overall growth in prices of NAB. The analogous Divisia volume index is:

$$DQ_t = \sum_{i=1}^{3} w_{it} \, Dq_{it}$$

which measures the overall growth in per capita consumption of NAB. These indices are given in columns 2 and 3 of Table 6. On average, per capita NAB consumption increased by 2.8 percent per annum, while prices rose by 8.5 percent.

The Divisia variances of the price and quantity log-changes are:

$$\Pi_t = \sum_{i=1}^{3} \overline{w}_{it} \, (Dp_{it} - DP_t)^2.$$

$$K_t = \sum_{i=1}^{3} \overline{w}_{it} \, (Dq_{it} - DQ_t)^2.$$

These variances measure the degree to which the prices and quantities of individual goods of NAB change disproportionately. When all prices and quantities change equiproportionately, the variances vanish. Previous studies have found that the quantity variances systematically exceed the corresponding price variances (see, for example, Clements, 1982, 1983; Meisner, 1979; E.A. Selvanathan, 1987; Theil, 1980; and Suhm, 1979). In Table 6, out of 22 observations in 14 cases quantity variance K_t exceeds the price variance Π_t, which agrees with the results of the studies mentioned above.

The Divisia price-quantity covariance is:

$$\Gamma_t = \sum_{i=1}^{3} \overline{w}_{it} \, (Dp_{it} - DP_t) \, (Dq_{it} - Dq_t),$$

which measures the co-movement of prices and quantities. As can be seen from the last column of the table, on average the covariance is negative. This reflects the tendency of the consumer to move away from those beverages having above-average price increases.

Table 6 - Divisia Moments of NAB: Australia

Year	Price index DP_t	Quantity index DQ_t	Price variance Π_t	Quantity variance K_t	Price-quantity covariance Γ_t
(1)	(2)	(3)	(4)	(5)	(6)
1965	.17	3.28	.00	12.94	-.01
1966	3.34	5.05	1.09	4.39	.47
1967	5.50	9.48	4.22	6.66	3.34
1968	4.50	3.38	2.49	.96	1.54
1969	5.83	3.54	4.66	2.53	1.07
1970	6.32	7.96	4.20	4.33	4.17
1971	4.32	2.99	.67	1.93	-1.09
1972	2.62	9.56	.74	26.94	4.03
1973	11.28	-1.53	7.76	9.35	-5.26
1974	20.39	-6.52	2.77	10.85	5.48
1975	13.70	9.09	1.11	16.22	1.03
1976	11.85	5.20	55.40	6.98	18.60
1977	13.27	-.91	38.70	57.43	-45.90
1978	6.45	-1.21	47.86	37.75	-40.22
1979	10.85	-3.95	3.49	.79	.31
1980	10.89	5.72	4.22	2.86	-.80
1981	12.54	-5.39	13.04	2.65	-5.04
1982	11.79	2.57	.93	2.48	-.72
1983	8.09	-4.00	3.55	4.63	2.35
1984	6.58	5.83	5.01	7.02	-5.23
1985	8.37	7.90	7.96	5.31	-3.28
Mean	8.51	2.76	9.99	10.71	-3.10

All entries in columns 2 and 3 are to be divided by 100; columns 4-6 are to be divided by 10,000.

4. Demand Analysis

We now use the data to estimate demand equations for tea, coffee and softdrinks. A double-log demand equation has been used for this purpose. A double-log demand equation for commodity i takes the form:

$$Dq_{it} = \alpha_i + \eta_i DQ_t + \gamma_i Dp^*_{it} + e_{it}$$

where α_i is a constant term representing an autonomous trend, η_i is the income elasticity, γ_i is the own-price elasticity, $Dp_{it}^* = Dp_{it} - Dp_t$ is the change in the relative price of i, and e_{it} is a disturbance term. Note that only the own-price is included in this demand equation. Note also that this demand equation is formulated in terms of change over time. As there are $i = 1, 2, 3$ commodities, we use LS to estimate three demand equations of the above form. The results are presented in Table 7.

The own price elasticities are all of the expected negative sign and are all less than one indicating that the three beverages are price-inelastic. The income elasticities reveal interesting results. The income elasticities for coffee and softdrinks are positive; within the group of NAB, coffee is a necessity and softdrinks is a luxury. The negative income elasticity for tea implies that tea is an inferior good. Whether this is due to negative income elasticity for high-income persons out-weighting the positive income elasticities of lower-income persons cannot be determined in this study. Further research is needed in this direction.

Table 7 - Least-Squares Estimates of Double-Log Demand Equations: Australia
(Standard errors are in parenthesis)

Commodity	Constant term	Income elasticity	Price elasticity	R^2	See	DW
(1)	(2)	(3)	(4)	(5)	(6)	(7)
With Constant						
1. Tea	-2.341 (.830)	-.410 (.297)	-.114 (.112)	.13	6.69	3.21
2. Coffee	-.466 (1.932)	.959 (.645)	-.375 (.249)	.16	14.15	2.85
3. Softdrinks	.112 (.085)	1.035 (.029)	-.422 (.190)	.99	.64	2.56
No Constant						
1. Tea		-.611 (.273)	-.102 (.117)		7.02	2.87
2. Coffee		.916 (.553)	-.368 (.242)		14.16	2.86
3. Softdrinks		1.044 (.025)	-.397 (.188)		.65	2.58

All entries in columns 2 and 6 are to be divided by 100.

5. Previous Studies

In general, our findings are more or less consistent with previous conclusions. In this section we compare our findings with those of some earlier studies (see Table 8). Kenny (1988) used the differential demand approach to estimate the demand for beverages and tobacco in

Australia for the period 1964/65-1985/86. He found that the own price elasticities of tea, coffee and softdrinks were all price-inelastic. He also observed that within the group of beverages and tobacco, tea is an inferior good, coffee is a necessity and softdrinks is a luxury. Stone (1954) found that the income elasticity for tea (obtained from the 1937-39 household budget survey) was very small in the U.K. Tea is also price-inelastic in his study. The income elasticity for coffee in the U.K. is well above unity. The own-price elasticity of coffee is positive, but not significant.

Comparing the prewar (average 1930-1934) and postwar data on relative prices and relative quantities consumed of tea and coffee in nine high-income countries (including Australia) FAO concluded that "despite a general decline in the price of tea relative to the price of coffee from pre-war to 1955, tea has lost ground in relation to coffee in almost all countries" (FAO, 1960). The price of tea did not decline in Australia during the period under our review. Instead, data in Table 4 reveal that the prices of both tea and coffee increased by 6.9 and 6.7 percent per annum, respectively. However, from Table 5 we find that while the increase in the price of coffee was followed by an increase in the consumption of coffee (by 2.9 percent per annum) during 1964/65-1985/86, the consumption of tea declined sharply (by over 3 percent per annum) over the same period. It appears that the increase in the consumption of coffee took place at the cost of tea, which is supported by the findings of FAO as mentioned above.

One explanation for this may be that as tea consumption was already high in Australia at the start of the period, further income increases could not have been expected to raise consumption. On the other hand, the demand for coffee was somewhat income-elastic as consumption in the mid-1960s was fairly modest. Moreover, the gradual increase in coffee consumption may have been due to the emergence of instant coffee. Note also that the decline in tea consumption may be deceptive. With the emergence of new technology associated with tea bags, it may well be that now less tea is required for preparing one cup of tea.

A number of other studies for the U.S.A. have found a price-inelastic demand for coffee (see Table 8) which is consistent with our findings. The income elasticity of demand for coffee in the U.S.A. is also inelastic.

Table 8 - Summary of Previous Studies of Demand
for Tea and Coffee in Selected Countries*

Author	Country	Period	Functional Form	Price Elasticity		Income Elasticity		Special Notes
				Tea	Coffee	Tea	Coffee	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Kenny	Australia	1964-85	Log linear	-.168	.198	-1.74	.41	
Stone	U.K.	1920-38	Linear	-.26	.55	.04	1.42	Price elasticity of
		1937-39	Log Linear					tea is significant at the 95% probability level.
FAO	Canada	1924-39 and 1948-56	Linear	-.13				
Daly	U.S.A.	1922-41	Linear		-.14			All coefficients are significantly different from zero at the 5% level.
Hughes	U.S.A.	1949-66	Linear		-.113		.315	The original coefficients are significantly different from zero at the 5% significance level.
Lovasy	U.S.A.	1920-40	Log linear		-.26		.23	All coefficients are significantly different from zerp at the 5% level of significance.
Viton	U.S.A.	1920-41 1937-39	Log linear		-.29		.52	Both elasticities are significantly different from zero at the 5% level of significance.

*All these studies are based on annual observations. Income elasticity for tea in the study of Stone is based on the 1937-39 survey. For details, see Stone (1954).

6. Conclusions

In this study we have analyzed demand for non-alcoholic beverages (NAB) in Australia for the period 1964/65-1985/86. Our results suggest that demand for NAB is price-inelastic. Within the NAB group, the demand for tea is more inelastic than coffee and softdrinks. The results for the income elasticities suggest that tea is an inferior good, coffee is a necessity and softdrinks is a luxury. Again, the income elasticity of tea is lower than that of coffee and softdrinks.

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