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FURTHER RESULTS

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Discussion Paper 89.20
July 1989

ISSN 0811-6067
ISBN 0-86422-780-9

Advertising and Alcohol Demand in the UK: Further Results

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Abstract:

Johnson (1985) presents a system-wide analysis on the effects of advertising on the demand for beer, wine and spirits in the UK. However, his results are not consistent with other studies in the area. This paper shows that his results can be improved by using a different demand equation for the alcoholic beverages group. Furthermore, this paper also considers the analysis of treating advertising as a stock rather than a flow. This analysis reveals that advertising on beer, wine and spirits depreciates in consumers' minds fully within a year.

* I would like to thank Professor K.W. Clements for his comments.

1. Introduction

Johnson (1985) used the system-wide approach to present an interesting analysis of the effects of advertising on the demand for alcoholic beverages in the United Kingdom for the period 1955-1975. He proposed some extensions of the usual differential demand equations and used them for estimation. Several articles have appeared in the last three years that analyse the demand for alcoholic beverages in the U.K. (e.g., see Clements and Selvanathan, 1988; Clements et al., 1985; Duffy, 1987; and Selvanathan, 1987b, 1988).

The following table presents the estimates of marginal share of alcohol, income flexibility and income elasticity of alcohol reported by some of the above studies.

Table 1

Estimates of Marginal Share, Income Flexibility and
Income Elasticity of Alcohol: United Kingdom

Study	Sample period	Marginal share	Income flexibility	Income elasticity
1. Johnson (1985)	1955-75	.02	-1.61	.39
2. Clements, Selvanathan & McLeod (1985)	1955-75	na	-.47	1.18
3. Duffy (1987)	1963-83	.09	-.55	1.24
4. Selvanathan (1987b)	1955-75	.06 to .09	-.64 to -.76	.87 to 1.23
5. Selvanathan (1988)	1955-85	.08	-.46	1.10

Even though the studies presented in Table 1 consider different sample periods, the approach used is more or less the same. Therefore, one would expect similar results across the studies. As can be seen from the table, the results from all studies except Johnson (1985) are broadly similar. The marginal share and income elasticity estimates of alcohol reported by Johnson are quite low compared to the others. Many studies in consumer demand analysis have found that income flexibility, which is considered to be an international constant, lies in the range of $-.5$ to $-.7$ (e.g., see Brown and Deaton, 1972; Clements and Johnson, 1983; and Theil, 1980). Thus, the estimate of income flexibility reported by Johnson is unusually high (in absolute value).

Johnson correctly points out that to extend the composite demand equation to include advertising, the appropriate advertising variable to be added would be the Frisch-advertising index which is a weighted average of the three advertising variables with weights being the corresponding unknown marginal shares. To simplify the estimation procedure, Johnson replaced the Frisch advertising index by the total alcohol advertising variable which is just the sum of the three advertising variables (see Johnson, 1985, third page, paragraph 2). In contrast to this, Selvanathan (1987a) used several approximations to the Frisch-advertising index (including the Divisia advertising index).

We suspect that the unusual values of the estimates reported by Johnson (1985) could be due to the misspecification of the advertising term used to extend the usual composite demand equation. The extended composite demand equation used by Johnson is:

$$(1) \quad \bar{w}_{At} DQ_{At} = \theta_A DQ_{At} + \sum_{j=1}^3 \phi \theta_A (1-\theta_A)^j Dp_{jt} - \phi \theta_A (1-\theta_A) DP_{ot} + \delta DA_{At},$$

where p_{it} , q_{it} , a_{it} , $M_t = \sum_{i=1}^n p_{it} q_{it}$, and $w_{it} = p_{it} q_{it} / M_t$ are the price,

quantity, advertising expenditure, total expenditure and the budget share;

$\bar{w}_{At} = \sum_{i=1}^3 \bar{w}_{it}$ with $\bar{w}_{it} = \frac{1}{2}(w_{it} + w_{i,t-1})$; $DQ_{At} = \sum_{i=1}^3 (\bar{w}_{it}/\bar{w}_{At})Dq_{it}$;
 $DQ_t = \sum_{i=1}^n \bar{w}_{it}Dq_{it}$; $Dx_t = \log x_t - \log x_{t-1}$ is the log-change in variable x ; P_{ot} is the price of all goods excluding alcohol; $A_t = \sum_{i=1}^3 a_i$ is the total advertising expenditure on alcohol; θ_A is the group marginal share; θ'_i is the conditional marginal share; ϕ is the income flexibility and n is the number of consumer goods. Selvanathan (1987a) theoretically derived the extended composite demand equation which includes advertising. Following his results we can write that equation in the form:

$$(2) \quad \bar{w}_{At}DQ_{At} = \alpha + \theta_A DQ_t + \sum_{j=1}^3 \phi \theta_A (1-\theta_A) \theta'_j Dp_{jt} - \phi \theta_A (1-\theta_A) DP_{ot} + \sum_{k=1}^3 \beta_k Da_{kt},$$

where α is a constant and the coefficient β_k measures the effect of advertising of beverage k on the total demand for alcohol. The sum of these coefficients measures the effect of an equiproportionate change in the advertising of all beverages on the demand for alcohol, when prices and real income remain constant. In other words, $\sum_{k=1}^3 \beta_k$ is the elasticity of total alcohol consumption with respect to an equiproportionate change in all advertising variables.

The aim of this paper is two fold. Firstly, we re-estimate Johnson's demand system by replacing equation (1) by equation (2) and show that the resulting estimates are consistent with other studies. Secondly, we extend the analysis to investigate the possibility that the effects of advertising last more than a year.

The organisation of the paper is as follows: Section 2 presents the revised results. In Section 3 we treat the advertising variables as stocks rather than flows and empirically analyse whether the effects of advertising last in consumers' minds for more than a year. Finally, in Section 4 we give our concluding comments.

2. Revised Estimates

In this section we estimate Johnson's conditional demand equations

$$(3) \quad \bar{w}_{it} D_{q_{it}} = \alpha_i + \theta_i' \bar{W}_{At} DQ_{At} + \sum_{j=1}^3 \pi_{ij}^A Dp_{jt} + \sum_{j=1}^3 \gamma_{ij}^A Da_{jt}, \quad i=1,2,3$$

together with the composite demand equation (2). We use the same U.K. alcohol data (1955-75) used by Johnson which is available in McGuinness (1980). We also use the same estimation approach, FIML, used by Johnson's (1985) and the estimation program RESIMUL of Wymer (1970). Table 2 presents the estimates of marginal shares, price, and advertising coefficients. For comparison we reproduce Johnson's (1985) results on the right-hand side of the same table. As can be seen, conditional marginal shares (except for beer) and conditional price coefficients are very similar across the two studies. There are, however, obvious differences in the conditional advertising coefficients. Nevertheless, the signs of the coefficients are the same in both studies (except γ_{23}^A). This study's estimates of $[\gamma_{ij}^A]$ show that beer advertising increases its own consumption and decreases the consumption of wine and spirits; and both wine and spirits advertising decrease beer consumption.

Now the estimate for the group marginal share is .08 and the estimate of income flexibility is -.40. These estimates are quite similar to those presented in Table 1. Furthermore, the estimates of the β_i 's indicate that wine and spirits advertising have significant influence on determining the demand for total alcohol but beer advertising has not.

Table 3 presents the income, price and advertising elasticities (at sample means) implied by our Table 2 estimates. The income elasticity of alcohol as a whole is 1.13, which is also acceptable to other studies.

Table 2

Conditional and Composite Demand Equations for Alcoholic Beverages

The United Kingdom, 1955-1975

$$\bar{w}_{it} DQ_{it} = \alpha_i + \theta_i' \bar{w}_{At} DQ_{At} + \sum_{j=1}^3 \pi_{ij}^A DP_{jt} + \sum_{j=1}^3 \gamma_{ij}^A Da_{jt} + \varepsilon_{it}, \quad i=1,2,3$$

$$\bar{w}_{At} DQ_{At} = \alpha + \theta_A DQ_t + \sum_{j=1}^3 \phi \theta_A (1 - \theta_A) \theta_j' DP_{jt} - \phi \theta_A (1 - \theta_A) DP_{ot} + \sum_{k=1}^3 \beta_k Da_{kt} + E_{At}$$

Beverage	Current study								Johnson (1985)						
	Marginal share	Slutsky coefficients				Advertising coefficients				Marginal share	Slutsky coefficients			Advertising elasticities	
	θ_i'	π_{i1}^A	π_{i2}^A	π_{i3}^A	γ_{i1}^A	γ_{i2}^A	γ_{i3}^A	β_i	θ_i'	π_{i1}^A	π_{i2}^A	π_{i3}^A	γ_{i1}^A	γ_{i2}^A	γ_{i3}^A
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1. Beer	.157 (.053)	-.949 (.274)	.390 (.160)	.559 (.198)	.214 (.085)	-.088 (.042)	-.126 (.058)	.106 (.067)	.339 (.041)	-1.061 (.259)	.338 (.129)	.723 (.233)	.431 (.076)	-.314 (.052)	-.116 (.071)
2. Wine	.283 (.559)		-.200 (.142)	-.190 (.127)		.045 (.034)	.043 (.030)	.190 (.078)	.247 (.027)		-.161 (.101)	-.177 (.119)		.327 (.062)	-.013 (.047)
3. Spirits	.559 (.052)			-.370 (.204)			.083 (.054)	.375 (.141)	.414 (.043)			-.546 (.273)			.129 (.089)
4. Total alcohol	$\theta_A = .075$ (.017)	$\phi = -.397$ (.154)								$\theta_A = .021$ (.005)	$\phi = -1.613$ (.700)				

All price and advertising coefficients in rows 1-3 are to be divided by 100.

Table 3

Conditional Income, Price and Advertising Elasticities of Alcohol

The United Kingdom, 1955-1975

Beverage	Income elasticity	Price elasticities			Advertising elasticities		
	$\theta_i' \bar{w}_{At} / \bar{w}_{it}$	$\pi_{i1}^A / \bar{w}_{it}$	$\pi_{i2}^A / \bar{w}_{it}$	$\pi_{i3}^A / \bar{w}_{it}$	$\gamma_{i1}^A / \bar{w}_{it}$	$\gamma_{i2}^A / \bar{w}_{it}$	$\gamma_{i3}^A / \bar{w}_{it}$
	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)							
1. Beer	.27	-.25	.10	.14	.06	-.02	-.03
2. Wine	2.10	.43	-.22	-.21	-.10	.05	.05
3. Spirits	2.00	.30	-.10	-.20	-.07	.02	.04
Total alcohol	1.13		-.45				

In conclusion, the above results show that the main reason for the difference in Johnson's results from those of other studies is indeed the advertising variable included in Johnson's composite demand equation.

3. Advertising in Stock Form

In this section we investigate the possibility that the effects of advertising last more than one year. We do this by considering a stock of advertising which depreciates in the consumer's mind with the passage of time. The annual flow of advertising plays the role of investment which serves to increase the stock. This approach is to be contrasted with the previous treatment whereby it was only the current flow of advertising which played any role. Indeed, this previous treatment is a special case of the stock approach in the sense that when the annual depreciation rate is 100 percent, the stock coincides with the flow.

We denote by $\log s_{it}$ the logarithm of the stock of advertising of beverage i , $i=1,2,3$, in year t . This stock is equal to what it was last year ($\log s_{i,t-1}$) minus a depreciation component ($\lambda_i \log s_{i,t-1}$, $0 \leq \lambda_i \leq 1$) plus this year's advertising ($\log a_{it}$).

$$\log s_{it} = (1 - \lambda_i) \log s_{i,t-1} + \log a_{it}.$$

In finite-change form the above equation becomes

$$(4) \quad Ds_{it} = (1 - \lambda)Ds_{i,t-1} + Da_{it}.$$

Assuming $Ds_{it} = 0$ for $i=1,2,3$ and $t=0$ (the initial observation), we evaluate Ds_{it} by specifying the value of λ .

We now reinterpret Da_{jt} in equations (2) and (3) as Ds_{jt} and re-estimate those equations for various values of the depreciation rate.

The results are presented in Table 4.

Table 4

Conditional and Composite Demand Equations for Alcoholic Beverages

The United Kingdom, 1955-1975

$$\bar{w}_{it} Dq_{it} = \alpha_i + \theta_i \bar{w}_{it} DQ_{it} + \sum_{j=1}^3 \pi_{ij}^A Dp_{jt} + \sum_{j=1}^3 \gamma_{ij}^A Ds_{jt} + \varepsilon_{it}, \quad i=1,2,3$$

$$\bar{w}_{At} DQ_{At} = \alpha + \theta_A DQ_{At} + \sum_{j=1}^3 \phi_{Aj} (1 - \theta_A) \theta_j^A Dp_{jt} - \phi_{Aj} (1 - \theta_A) Dp_{ot} + \sum_{k=1}^3 \beta_k Ds_{kt} + \varepsilon_{At}$$

Beverage	Marginal share θ_i^A	Slutsky coefficients			Advertising coefficients			
		π_{11}^A	π_{12}^A	π_{13}^A	γ_{11}^A	γ_{12}^A	γ_{13}^A	β_1
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Depreciation rate = 100 percent per annum								
Beer	.157 (.053)	-.849 (.274)	.390 (.160)	.559 (.198)	.214 (.085)	-.088 (.042)	-.126 (.058)	.106 (.067)
Wine	.283 (.027)		-.200 (.142)	-.190 (.127)		.045 (.034)	.043 (.030)	.190 (.078)
Spirits	.559 (.052)			-.370 (.205)			.093 (.054)	.375 (.141)
Total alcohol	$\theta_A = .075$ (.017)		$\phi = -.397$ (.154)		Log-likelihood value = 170.81			
Depreciation rate = 75 percent per annum								
Beer	.145 (.054)	-.985 (.310)	.370 (.183)	.615 (.213)	.147 (.077)	-.055 (.035)	-.092 (.050)	.069 (.048)
Wine	.286 (.029)		-.196 (.160)	-.174 (.135)		.029 (.027)	.026 (.023)	.137 (.062)
Spirits	.569 (.050)			-.441 (.206)			.066 (.042)	.272 (.116)
Total alcohol	$\theta_A = .076$ (.017)		$\phi = -.421$ (.156)		Log-likelihood value = 170.05			
Depreciation rate = 50 percent per annum								
Beer	.127 (.054)	-.927 (.345)	.308 (.200)	.619 (.230)	.082 (.058)	-.027 (.024)	-.055 (.039)	.039 (.031)
Wine	.291 (.030)		-.160 (.171)	-.148 (.141)		.014 (.017)	.013 (.015)	.089 (.050)
Spirits	.582 (.049)			-.471 (.211)			.041 (.031)	.179 (.097)
Total alcohol	$\theta_A = .076$ (.016)		$\phi = -.458$ (.160)		Log-likelihood value = 169.51			
Depreciation rate = 25 percent per annum								
Beer	.113 (.055)	-.847 (.356)	.261 (.204)	.585 (.239)	.046 (.036)	-.014 (.015)	-.032 (.025)	.024 (.019)
Wine	.293 (.029)		-.134 (.173)	-.127 (.143)		.007 (.011)	.007 (.009)	.062 (.039)
Spirits	.594 (.050)			-.459 (.217)			.025 (.020)	.125 (.079)
Total alcohol	$\theta_A = .072$ (.017)		$\phi = -.530$ (.185)		Log-likelihood value = 169.48			
Depreciation rate = 10 percent per annum								
Beer	.102 (.061)	-.800 (.362)	.263 (.204)	.538 (.248)	.039 (.027)	-.013 (.012)	-.026 (.018)	.020 (.014)
Wine	.291 (.029)		-.135 (.172)	-.128 (.145)		.007 (.009)	.006 (.008)	.056 (.031)
Spirits	.608 (.056)			-.410 (.227)			.020 (.015)	.118 (.067)
Total alcohol	$\theta_A = .062$ (.019)		$\phi = -.638$ (.247)		Log-likelihood value = 169.96			
Depreciation rate = 5 percent per annum								
Beer	.102 (.065)	-.754 (.368)	.250 (.207)	.504 (.256)	.031 (.022)	-.010 (.010)	-.020 (.015)	.016 (.012)
Wine	.290 (.029)		-.130 (.173)	-.120 (.146)		.005 (.008)	.005 (.007)	.046 (.025)
Spirits	.608 (.060)			-.384 (.236)			.016 (.012)	.097 (.055)
Total alcohol	$\theta_A = .061$ (.019)		$\phi = -.645$ (.242)		Log-likelihood value = 170.10			

All entries in columns 3-9 are to be divided by 100.

For $\lambda = 1$, equation (4) implies that $Ds_{it} = Da_{it}$. Therefore, the estimates corresponding to 100 percent depreciation presented in Table 4 are exactly the same as those of Table 2. Looking at Table 4 we see that, the estimates of the marginal shares and price coefficients are broadly the same for all values of λ . The estimates of the advertising coefficients decrease with decreasing values of λ (in absolute value) and all of them became statistically insignificant at low-level depreciation rates. The estimates of marginal share of alcohol and income flexibility are reasonably stable and statistically significant at all depreciation rates.

Looking at the log-likelihood values, we see that the maximum of 170.81 is achieved when $\lambda = 1$. Thus, we can interpret this as the ML-estimate of λ . This result implies that the advertising stock depreciates fully in one year.

The conclusion of this section is that, with the U.K. data, we are unable to reject the hypothesis that the depreciation rate is in fact 100 percent. Consequently, the preferred estimates are still those given in Table 2 which treated advertising as a flow.

4. Concluding Comments

In this paper we re-estimated Johnson's (1985) demand equation with a different advertising variable in the composite demand equation and showed that the results are improved and consistent with the previous alcohol studies for the U.K. The results show that beer advertising increases its own demand and decreases the demand for wine and spirits; and both wine and spirits advertising decrease the demand for beer. We then extended Johnson's analysis by considering advertising as a stock rather than a flow and found that in the U.K. the advertising on alcoholic beverages depreciates in consumers' minds fully in one year.

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