ADVERTISING, QUALITY AND COMMODITY DEMAND: U.K. HOUSEHOLD CONSUMPTION OF INSTANT COFFEE 1960-68

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NUMBER 57

WARWICK ECONOMIC RESEARCH PAPERS

DEPARTMENT OF ECONOMICS

UNIVERSITY OF WARWICK
COVENTRY

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October 1974

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Introduction

If advertising merely helps to distribute predetermined demand for a commodity among brands or varieties of that commodity, its neglect in the theory of resource allocation is possibly justified. In this case, the level of advertising activity will have indirect general equilibrium effects, taking more or less resources from other industries as the level varies. But theory makes no claims to speak about the actual size of particular industries, and the important point is that advertising in this case has no direct impact on the levels of production and consumption elsewhere. That is, advertising is not an integral part of the mechanism which allocates resources among commodities. However, if there is an advertising impact at commodity level, and especially if this is the case for many commodities, the resource allocating mechanism employed in exchange and production theory is mis-specified. The consequences of correcting such a mis-specification could be, to say the least, far reaching.

The putative commodity level impact of advertising is also of interest to policy makers at a more practical level. For instance, where there are significant externalities in consumption, (e.g. cigarettes, certain drugs, private motoring)

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* Part of the research reported in this paper was carried out as one of a series of studies of advertising in the U.K. commissioned by the former Board of Trade. The views expressed and conclusions reached do not necessarily represent those of the present Department of Industry. I should like to thank Angela Edge, who was co-author of an earlier report on the research, and members of the Department of Economics and Centre for Industrial Economic and Business Research at the University of Warwick, particularly Keith Cowling, Steve Davies, Diane Ellwood, Tony McGuinness, Graham Pyatt and Paul Stoneman.

and the level of consumption is sensitive to advertising, a case for control over advertising may be made out (McGuinness and Cowling/22/). A case for controls might also be argued in markets where multilateral reductions in competitive advertising among firms would leave market shares unaffected. Whether or not commodity demand is likely to alter in such circumstances will be an important question both for policy makers and for the firms concerned.

At least one economist has no doubt that advertising does affect commodity demand. Galbraith/12/ p. 205) writes:

> "If advertising affects the distribution of demand between sellers of a particular product it must also be supposed that it affects the distribution as between products."

He leaves his readers in little doubt that the first part of this statement is true, and in his analysis advertising plays an important part in the management of demand by the technostructure, which in turn features prominently in the description of the workings of the industrial system.

The previously published evidence tends to confirm the antecedent in Galbraith's conditional; the impact of advertising at brand level is well documented by Telser/30/Lambin/19/ Cowling/10/ and others. But the evidence on commodity level effects offers Galbraith only ambiguous support. Schmalensee/28/ has recently conducted a "fairly exhaustive" survey. He cites only five relevant studies of advertising and industry demand published between 1933 and 1971, with a gap of 28 years between the first and the second: a surprisingly small total when one thinks of the attention demand analysis in general has received. Of Schmalensee's five only one study, by Nerlove and Waugh/24/was found at all successful in establishing a significant advertising effect. However, three recent studies do lend rather more support to the Galbraithian view: Ball and Agarwala/3/Gardner and Walker /13/and Lambin/20/reported significant advertising coefficients in demand functions for tea, fresh cream and gasoline. In general,

the balance of the evidence is hard to assess because of specification defects in the various published studies, which did not always allow for the possible lagged effects of current advertising, or deflate advertising expenditures successfully or consider countervailing advertising at the national level or for close substitue products. Schmalensee's own analysis at the commodity level suffers from paucity of observations.

Three particular features of the U.K. household market for instant coffee make it an interesting area for further analysis of advertising and commodity demand. One is the existence of a putative specific substitute: tea. The evidence here is fairly strongly suggestive. Ball and Agarwala /3 / report that instant coffee has been substituted (in the everyday sense) for tea by all social classes and household types distinguished by The National Food Survey, except old age pensioners. Consistent with this is the fact that over the period of this study (1960 - 68), total expenditure on coffee and tea together changed very little, but coffee consumption rose at around 12 per cent a year while tea consumption declined at about 1 per cent a year. (Tea consumption remained seven times as great as coffee consumption in 1968). Moreover, it is significant that over the period of rapid growth of coffee sales, from the mid 1950's to mid 1960's, budget elasticities for tea in The National Food Survey were positive up to 1958 and negative thereafter / 23 /.

The second special feature of the instant coffee market is that sales in the period studied may conceivably have still been reflecting the adjustment of consumer tastes to a new consumption opportunity, not all of the adjustment being attributable to advertising. Although instant coffee

was introduced into the U.K. before the second world war, its widespread adoption by consumers did not occur until after 1954, following the entry of a second major seller. Previous researchers have generally assumed a more or less instantaneous adoption of non-durable new products, although the diffusion processes for certain durables (television, for instance) have been closely studied (e.g. Bain /1, 2/ Chow/9 / and Bonus / 5 /). Some of the methods used in these durables studies have been incorporated into the present one.

Thirdly, there is a potential problem of quality variation in the dependent variable: the physical characteristics of instant coffee have undergone considerable change since its introduction. The penalties for ignoring such quality change are arguably small if, on average, other products are undergoing quality improvement to a comparable degree. In this case the problem is that the specific substitute, tea, apparently underwent little change.

The specification problems posed by these three features of the market are considered in the next section of this paper, together with the general question of how advertising should be incorporated into empirical demand studies. Problems of measuring advertising levels are reserved for section three, and empirical results are presented in section four.

Theoretical Specification

One of the consequences of the theoreticians' neglect of advertising is a lack of theoretical guidance on the specification of empirical models. Attempts by Basmann / 4 / Quandt / 27 / and others to bring advertising into utility theory as a determinant of the parameters of the utility function have not resulted in formally derived a priori restrictions to be imposed in empirical work. Schmalensee goes so far as to say: "... utility theory ... {has}... nothing to contribute to the study of advertising effects." / 28 / p.123 . However, it is not difficult to arrive at a qualitative view of how advertising might be incorporated into partial equilibrium demand equations of the usual theoretical type. Theory tells us that at a point in time, when tastes may be taken as fixed, the individual consumer's demand for a good is a function of prices and his money income. Variations in consumption over time will occur as a result of changes in these variables, but also as the consumer's tastes change, as they are free to do now that we have stepped outside the confines of static theory. Advertising may now be recognised as an element in a vector of determinants of consumer tastes. This vector should appear in any time series analysis of demand. Usually it is at best proxied by a time trend.

In the present case the task is to develop a demand equation encompassing not only advertising, but also the existence of a close substitute.

To begin, separability of the consumer's utility function is assumed, such that the consumer goes through a hierarchy of decisions, assigning sums of money to broad general purposes before deciding the detailed disposition of these sums. Specifically, a prior allocation of income to "drinks" expenditure is assumed, and a subsequent distribution between coffee and tea. At both levels, for a given income, the consumer's decision depends on the relevant price and advertising ratios, together with any other variables included as determinants of "tastes". We then focus on the lower-level decision and the two equations (assumed to have the widely used Cobb-Douglas form):

$$(1) \quad Q_{ct} = a_1 \, P_{ct}^{\,b_{11}} P_{Tt}^{\,b_{12}} A_{ct}^{\,b_{13}} A_{Tt}^{\,b_{14}} Y_t^{*\,b_{15}}$$

$$(2) \quad Q_{Tt} = a_2 P_{ct}^{\,b_{21}} P_{Tt}^{\,b_{22}} A_{ct}^{\,b_{23}} A_{Tt}^{\,b_{24}} Y_t^{*\,b_{25}}$$

where Q_c and Q_T are instant coffee and tea consumption, P_c, P_T their respective prices and A_c, A_T their respective advertising levels, and

$$Y_t^* = Y_t - \sum_{j}^{n=2} P_{jt} \, Q_{jt} \qquad (j = 1, 2, \ldots, n-2)$$

i.e. Y_t^* is defined as personal disposable income less expenditure on goods produced by the remaining n-2 industries. As estimating equations (1) and (2) raise potentially formidable problems of multicollinearity and identification. These can be ameliorated if we assume symmetric price and advertising elasticities for coffee and tea (i.e. $b_{11} = -b_{12}$, $b_{21} = -b_{22}$, $b_{13} = -b_{14}$ and $b_{23} = -b_{24}$), combine equations (1) and (2) and estimate:

$$(3)\left(\frac{Q_{ct}}{Q_{tt}}\right) = \alpha\left(\frac{P_{ct}}{P_{Tt}}\right)^{\beta_1}\left(\frac{A_{ct}}{A_{Tt}}\right)^{\beta_2} Y_t^{*\,\beta_3}$$

where, on the foregoing assumptions, $\beta_1 = (b_{11}-b_{21})$, $\beta_2 = (b_{13}-b_{23})$ and $\beta_3 = b_{15} - b_{25}$. Sign expectations for β_1 and β_2 are unambiguously negative and positive respectively. The expected sign for β_3, which is the budget elasticity for coffee minus that for tea, is strictly speaking ambiguous. However, independent indications that tea is an inferior good imply $\beta_3 > 0$ *a fortiori*. The chief loss by proceeding in this way is that we lose track of any impact of advertising on instant coffee demand in the determination of Y_t^*, which is taken as datum.

Three ways of allowing for the "newness" of instant coffee were considered for this study, based on previous analysis of diffusion processes. These were a "log-normal"

model, the model used by Chow / 9 / and a log-reciprocal model. All three produced broadly consistent results, and only the last will be reported in detail.

Equation (3), which is rooted in orthodox utility theory, must be understood to refer to consumers who have adopted instant coffee in the sense that their consumption decisions are based on a full awareness of the characteristics of the new product.(2) During the diffusion period for a new product the proportion of the total population who are "adopters" in this sense will be growing. The observed values of the coffee/tea consumption ratio will therefore be the product of the consumption ratio for adopters (Q_{ct}/Q_{Tt}) and the relative proportions of coffee and tea adopters. That is:

$$\frac{Q^1_{ct}}{Q^1_{Tt}} = \frac{Q_{ct}}{Q_{Tt}} \cdot \frac{M}{N}$$

where Q^1_{ct} Q^1_T are observed values, M is the proportion of coffee adopters and N the proportion of tea adopters. (In the U.K. the latter can fairly safely be equated with the total population). Especially since instant coffee has become a product consumed in a wide range of social situations, the ratio M/N might be expected to follow an 'S' shaped time path, typical of word-of-mouth learning and contagion processes.

In the log-reciprocal model the time path is described by the equation(3):

$$\frac{M}{N} = e^{\alpha - b_\tau}$$

where τ measures time since introduction of the product. This produces a non-symmetrical, somewhat inflexibile 'S'-shaped curve, with a relatively early point of inflexion where $\tau = \frac{b}{2}$. The main advantage of this specification is that the logarithmic transformation:

$$\log \frac{M}{N} = \alpha - \frac{b}{\tau}$$

is very readily combined with a Cobb-Douglas type demand equation such as (3):

$$(4) \quad \log \frac{Q^1_{ct}}{Q^1_{Tt}} = \alpha - b\frac{1}{\tau} + \beta_1 \log \frac{P_{ct}}{P_{Tt}} + \beta_2 \log \frac{A_{ct}}{A_{Tt}} + \beta_3 \log Y^*_t$$

Moreover the rate of diffusion b can be allowed to interact with economic variables, especially advertising, albeit in a rather restricted way. Thus we can let $b = \frac{b^1}{A}$ so that $\frac{M}{N} = e^{\alpha - b^1/A\tau}$ or $\log \frac{M}{N} = \alpha - b^1 (\frac{1}{A\tau})$, and substitute in (4) appropriately.

The remaining specification problem is that concerning quality variation. The relevant quality attributesof instant coffee (appearance, texture, blend, solubility, pack size, container-type, etc.) do not lend themselves to quantification. There is consequently no prospect of estimating demand responsiveness to quality variables. Rather, the problem is to purge the estimated

price, income and advertising coefficients of any bias arising from unmonitored quality variations in the dependent variable. This can be attempted with the aid of an implicit quality variable, derived by deflating an average brand price series by a "constant quality" brand price series for the relevant period, assuming that we can identify a "constant quality" brand with reasonable confidence.* The reasoning underlying this procedure is that, following the Lancaster /21/ and Ironmonger /15/ approaches, individual and average brand prices can be interpreted as the weighted sum of the quantities of different characteristics multiplied by their implicit prices. Deflation of the average by the constant quality brand price series then removes the element in the former which comes from increases in the characteristics prices, to leave a weighted index of the quantity of characteristics in the average brand. The concept of "quality" is evidently very much broader than in everyday parlance. Moreover, some changes which in everyday terms would be looked upon as quality improvements could make the quality index, as defined, decline. For instance, promotional strategies like temporary price offers become added characteristics which the consumer presumably might approve of but which reduce average brand price (assuming this captures transactions rather than list prices for brands). With an implicit quality variable included in the estimating equation, the appropriate price variables are the series for the constant quality brands.

Measuring Advertising Levels.(4)

The conceptually appropriate measure of advertising levels would be in units of advertising messages received by consumers (Telser /30/). Ideally, messages would be of constant quality and "advertising" would be very broadly defined to include all types of promotional activity. In practice, it is possible in the present case to observe only media

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* This procedure is based on a suggestion made by Graham Pyatt

advertising expenditures. At least three problems are immediately apparent: moving from expenditures to some real measure; the omission of non-media expenditures; and the possibility of quality variation among messages delivered at different times. A fourth problem area concerns the lagged effects of current advertising.

The usual method of moving from expenditure to a real measure of a variable is, of course, to deflate by a suitable cost index. However on certain assumptions this is unnecessary in cases such as the present one where advertising variables are in ratio form. The main assumption which is required is that the relative cost of advertising different products (in this case, coffee and tea) remains the same.(5)

The omission of non-media expenditures will be a source of specification bias in the parameter estimates of the empirical model. As is well known the direction bias depends on two relationships: that between the excluded variable and included variables with which it is correlated, and that between the excluded and the dependent variables. In the present context it would be reasonable to expect both media and non-media expenditures to be positively related to the dependent variable. But the relationship between the two types of promotional activity is *a priori* ambiguous. It depends on whether media and non-media activities are complementary with or substitutes for each other, about which we have little firm *a priori* or empirical knowledge. If the answer is that the two are complements, then the estimated advertising parameter will have upward bias; if they are substitutes the bias will be negative. Without knowing the answer to this question we can do no more than recognise the possibility of bias of unknown direction. However, the magnitude of the bias will be the less, the more non-media promotional activity is captured by other variables. Some comfort may be drawn from this in

the present study, insofar as temporary price reductions appear to have been an important element in non-media promotional activity, and these will have been captured in the transactions price series from which price and quality regressors were derived.

If the quality of advertising messages has varied systematically over time within the same period, the formal consequences for regression estimates are once again of the omitted variable kind.(6) Since evidence on any trend in quality is lacking, we are again confronted with the possibility of bias of uncertain direction. If, however, quality variation over time is random (due, for instance, to the chance success or failure of particular campaigns) the formal problem is one of errors-in-variables, in which case the bias will be unambiguously negative. Once again there may be some grounds for optimism over the magnitude of bias, whatever its direction. This is because the behaviour of advertisers over time can be expected to keep quality variation within reasonable bounds. Unsuccessful campaigns and agencies will not survive long, and advertisers will presumably seek to equalize the marginal returns of advertising among different media, advertising themes etc. Especially as the observation period in this study is three months rather than, say, a week, there is a reasonable hope that a good deal of quality variation washes out.

That advertising's impact is not wholly exhausted in the current period is not hard to establish either by a priori reasoning (e.g. Palda /25/) or by reference to previous results (e.g. Vidale and Wolfe /31/ and Cowling /10/). Previous research has suggested two main alternative methods of dealing with this problem. One is the use of some form of Koyck transformation /18/, in which we begin with a distributed lag function of all past values of advertising plus other explanatory variables, and end up with some combination of current explanatory variables

and the lagged dependent variable. The other approach is by generating direct estimates of advertising goodwill stock (G_t) from current advertising data (A_t). Thus, for instance, with geometrically declining weights[7] we could define:

$$G_t = \sum_{i=0}^{\infty} (1 - \lambda)^i \; A_{t-i}$$

where $0 < \lambda < 1$ is the rate of decay of advertising messages per period. The choice between these alternatives for any particular application is a fairly complicated trade-off involving the strengths and weaknesses of the two methods. Where there is more than one explanatory variable, the simplest form of Koyck transformation can be unduly restrictive in imposing identical lagged effects on all explanatory variables. More complicated formulations which allow for different lagged impacts for each explanatory variable have been developed (e.g. Peles /26/) but may raise multicollinearity problems in estimation. The Koyck transformation also introduces well-known econometric problems associated with the inclusion of the lagged dependent variable among the regressors. On the other hand it permits the decay rate λ to be estimated rather than imposed. The need to impose the value of λ is one of the main problems associated with the goodwill stock approach. A second is the need to truncate the string of past advertising variables at some point, thus producing an underestimate of the goodwill stock. This problem is the more serious with low values of λ.[8]

On balance the goodwill stock approach was chosen for the present study. The decisive factor was the gain in tractability of the empirical models, which involved various other transformations to take account of the diffusion effects discussed in the previous section. Alternative goodwill stock estimates were compiled for a wide range of values of λ

within the interval $0 < \lambda < 1$. Data restrictions would not permit summation over more than nine observations for any value of λ.

Empirical Results

Estimates were obtained for the period 1960 (first quarter) to 1968 (final quarter). For earlier periods instant coffee consumption data was unavailable and for later years there were problems with the advertising series. Advertising data was taken from Statistical Review of Press and T.V. Advertising (Legion Publising Co.). Coffee and tea price series were taken from the National Food Survey, as were tea and coffee consumption series. Coffee bean prices were derived from volume and value series in the U.K. Trade and Navigation Accounts. Wage and consumer price indexes were taken from the Monthly Digest of Statistics, consumer's disposable income from the National Income Blue Book and population statistics from the Annual Abstract of Statistics.

Table 1 reports six regressions for a highly conventional model which ignores the specific substitute. Price and income coefficients have generally credible values and are well determined, and all six equations are highly satisfactory in terms of $\bar{R}^2$, the F test and D.W. scores. Equation (2) tends to vindicate the adjustment for quality variation, raising explanatory power while generating highly significant price and quality coefficients. As outlined earlier, the negative quality coefficient is not a priori implausible. As well as the "price offers" effect cited earlier, it may be that the quality coefficient is picking up a trend towards consumption in larger pack sizes over the period. Because of the mathematical relationship between the surface area and volume of a vessel or container, buyers would then have been consuming less "tin" per ounce. Consequent reductions in producers' packaging costs might be

approximated by the well known "six-tenths"rule in engineering cost analysis (Chilton /8/). If these were passed on to consumers they would tend to produce a "six-tenths" type relationship between average brand price (reflecting the savings) and constant quality brand price (which was for a two ounce tin of Nescafe), i.e.:

$$p_c = a\ p_c^{*b}$$

where p_c^* is constant quality price, p_c is averagr brand price, and with $b = 0.6$. A regression of the constant quality on average price series yielded $\hat{b} = 0.4645$ with a standard error of 0.1133, thus supporting the six-tenths hypothesis in this case. However, more is not to be made of this result than that the trend to increased pack size may well be a factor contributing to the negative quality coefficient.

Equations (3) and (4) of table 1 show non-significant advertising effects. In these equations goodwill stock was calculated for a decay rate (λ) of 0.05 per period. All other available goodwill stock estimates were tried without producing significant advertising coefficients. Equations (4) to (6) report the effects of introducing time trends to capture diffusion and other taste change effects. Evidently these are best proxied by a simple time trend in this model (equation (4)) rather than by a log-reciprocal version (equation (5)) or a log-reciprocal model with interaction between time and advertising (equation (6)). Evidence from the zero-order correlation matrix suggests that whereas the relatively poorer performance in equation (5) could be attributable to multicollinearity, the same cannot be said for equation (6). Linear versions of equations (1) - (4) produced broadly similar results.

In general, these results seem acceptable and indicative of no statistically descernible advertising impact. Of course, they ignore

the putative close substitute product and might therefore be challenged on ground of mis-specification. They might also be held susceptible to simultaneous equation bias.

Precautionary experiments with simultaneous equation models were reassuring on the latter score. In general, the supply equations were poorly determined,while OLS and TSLS estimates of the demand equation were very close. An example is reported in Table 2. The supply function is of the production cost type, with coffee raw materials price and wages as the main arguments. In some cases a user cost of capital variable was also included (Cable /6/). Various interpretations of the TSLS results are possible, one being that because of a large volatile element in supply costs, reflecting price variations in world commodity markets, it is the demand function which will tend to be revealed in the observations.

When explicit account was made of tea as a close substitute, the main drift of the empirical results was the same. Price, quality and income variables continued to behave well, although the significance level of the price coefficient dropped to around the 10% level. Table 3 reports two equations which include the log reciprocal transformation to capture diffusion effects. The advertising variables in the equilibrium part of the model are here of wrong sign. The first signs of a significant advertising impact appear in equation (1) of table 3, where the interaction term between advertising and time is of correct sign and highly significant. However, this is a short-lived result, since equation (2) shows that with the log reciprocal time trend variable on its own the t, F and $\bar{R}^2$ statistics all increase. The equations in Table 3 also include a zero-one dummy variable intended to pick up the fact that from 1965 third quarter onwards the Tea Council undertook some generic advertising for tea. Neither this nor any other of the methods used to incorporate this behaviour were

Table 1. O.L.S. estimates[1] Dependent variable : logarith of instant coffee consumption per head. (t values in parenthesis)

	Constant	Logarith of:					Time Trend	1/τ	Adv.-time interaction term	R^{-2}	F	D.W.
		Relative Coffee price	Relative constant quality coffee price	Coffee quality index	Real disposable income per head	Advertising good-will						
(1)	4.429 (4.188)	-1.995 (-9.763			1.524 (3.626)					.937	108.63	2.057
(2)	9.586 (9.100)		-1.761 (-8.601)	-2.947 (-6.335)	1.021 (2.248)					.945	105.24	1.978
(3)	9.776 (8.716)		-1.780 (-8.469)	-2.925 (-6.190)	1.053 (2.271)	0.017 (0.547)				.944	88.07	1.974
(4)	6.399 (3.228)		-1.410 (-5.200)	-2.456 (-4.861)	2.107 (3.476)	0.032 (1.046)	0.009 (2.020)			.950	86.05	2.304
(5)	-0.304 (-0.065)		-1.567 (-4.550)	-2.559 (-3.973)	0.819 (1.442)	0.019 (0.603)		-4.123 (0.451)		.945	77.97	2.077
(6)	0.570 (1.417)		-1.767 (-7.095)	-2.607 (-5.597)	0.781 (1.863)				-0.171 (-0.875)	.927	116.15	2.008

Note 1. Seasonal dummy coefficients are not reported.
2. $\lambda = 0.05$

Table 2. TSLS vs OLS estimates[1] Dependent variable : logarithm of instant coffee consumption per head. (Asymptotic standard errors or t values in parenthesis)

	Constant	Logarithm of:				
		Relative coffee price	Real disposable income per head	Advertising goodwill	Wage Rate	Coffee raw material price (lagged one period)
Demand (TSLS)	-0.180 (0.043)	-1.947 (0.262)	1.522 (0.485)	-0.008 (0.048)		
Supply	-0.033 (0.065)	-0.934 (0.931)			2.182 (1.412)	-0.101 (0.333)
Demand (OLS)	-0.163 (-4.108)	-2.003 (3.472)	1.493 (3.472)	0.0003 (0.006)		

Note 1. Seasonal dummy coefficient are not reported.
2. $\lambda = 0.05$

Table 3. OLS estimates[1] (log-reciprocal model). Dependent Variable = logarithm of instant coffee/tea consumption ratio
(t values in parenthesis)

	Constant	Logarithm of:									
		Ratio of constant quality coffee & tea prices	Ratio of coffee & tea quality indexes	Real disposable income less "non-drinks" expenditure	Ratio of coffee & tea advertising goodwill(2)	$1/\tau$	Adv.-time interaction term	Tea Council Dummy	$\bar{R}^2$	F	D.W.
(1)	-5.059 (-3.063)	-0.675 (-1.727)	-2.189 (-2.894)	1.215 (2.042)	-9.009 (-6.681)		-27.595 (-8.326	0.035 (0.614)	.945	70.463	1.549
(2)	-5.179 (-3.295)	-0.575 (-1.529)	-2.027 (-2.780)	1.333 (2.348)		-33.473 (-8.868)			.950	77.641	1.585

Note (1) Seasonal dummy coefficients are not reported.
(2) $\lambda = 0.025$

successful in establishing a significant, independent influence on consumption or an interaction with other advertising variables.

It remains to report very briefly the results obtained with the lognormal model (strictly an approximation) and the Chow model*. The lognormal model is based on the equation

$$\log\left(\frac{p_{ct}\,Q_{ct}}{Y^{*}_{t} - p_{ct}\,Q_{ct}}\right) = \alpha + \beta \log \theta$$

with θ defined as "diffusion time" which is then "accelerated" or "decelerated" by economic variables:

$$\theta = t^{\alpha_1}\ A^{\alpha_2}\ p^{\alpha_3}\ Y^{\alpha_4}$$

Again explanatory power was high, price and quality variables performed much as in previous models, and advertising coefficients proved unrepentently non-significant. In the Chow model there is a partial adjustment mechanism:

$$(5)\quad \log\left(\frac{Q_{ct}}{Q_{Tt}}\right) - \log\left(\frac{Q_{ct-1}}{Q_{Tt-1}}\right) = \alpha\left(\log\ \frac{Q^{*}_{ct}}{Q^{*}_{Tt}} - \log\ \frac{Q_{ct-1}}{Q_{Tt-1}}\right)$$

into which is substituted an "equilibrium" equation for desired consumption:

$$(6)\quad \log\left(\frac{Q^{*}_{ct}}{Q^{*}_{Tt}}\right) = \beta_0 + \beta_1\ \log\left(\frac{p^{*}_{ct}}{P^{*}_{Tt}}\right) + \beta_2\ \log\left(\frac{V_{ct}}{V_{Tt}}\right) + \beta_3 \log\left(\frac{A_{ct}}{A_{Tt}}\right) + \beta_4 \log\ Y^{*}_{t}$$

where the term V_{ct}/V_{Tt} is the coffee/tea quality index ratio. Empirical results with this model produced an estimate of α not significantly different from unity and, consistently with this, price quality and advertising coefficients which were almost identical when estimated with the aid of equation (6) on its own and with the complete model. Once again there was no evidence of a significant advertising effect, either in the "equilibrium"

* Thanks are due to Steve Davies and Paul Stoneman for suggesting these alternative methods.

part of the equation or when the assumption of a constant adjustment coefficient was dropped in favour of letting α vary with economic variables including advertising (Stone and Rowe /29/).

Conclusions

A fairly thorough search has revealed no statistical support for the hypothesis of a significant advertising impact on household demand for instant coffee, although other variables performed reasonably well in the models used. This outcome is consistent with the finding, drawn from less extensive investigations by Ball and Agarwala, that coffee advertising does not appear to have been a factor in the decline of tea consumption.

Thus, the conclusion from the present study is, on the face of it, an amiable and comforting one for general equilibrium theorists. Of course, no presumptions arise from this study about actual or prospective results in other markets. For reasons discussed at some length elsewhere /7/ we may expect considerable variation across markets in industry-level advertising elasticities within the non-negative range. Obviously, there is no basis for expecting an impact of the same magnitude in all markets, or even that either advertising has a statistically significant effect in all markets or that the market level impact is universally zero. Moreover a point to be remembered in interpreting market demand studies with advertising is that the observed coefficients will reflect in part the size structure and inter-firm organisation of producers. Given the market response curve of total sales to advertising in any particular case, the optimal level of advertising for the firm will vary with the degree of seller concentration and whether or not collusion or quasi-collusion occurs (see Cowling, Cable, Kelly and McGuinness /11/ Ch. 2 and Cable /7/). Thus assuming optimising behaviour by firms, market structure and the

organisation of sellers will affect total advertising by the industry, and determine which part of the market advertising-response curve is observed in industry demand studies. On the reasonable assumption that advertising's productivity diminishes over the relevant range, it is possible that we could observe small and/or non-significant advertising coefficients in a case where optimising firms have pushed industry advertising beyond the range where the effect on demand is large and significant. Needless to say, this is by no means the only explanation of such a result, but it is certainly one possible explanation in the present case. The structure of the instant coffee industry in the period studied was essentially duopolistic. According to the present author's previous findings /7/, advertising intensity tends to be at a maximum under duopoly conditions ceteris paribus. In fact, the value of the Herfindahl concentration index in the instant coffee market in 1963 was 0.3946. This compares with predicted H- values from two equations in the previous study of 0.3931 and 0.4066 for maximum advertising intensity. If it were to turn out that, in general, advertising has a significant impact on commodity demand except where there is a marked degree of imperfect competition of an oligopolistic sort life would no doubt be busy for theoreticians; however it would perhaps be something less than amiable and comforting.

The results of the experiment with an implicit quality index in the present study might be regarded as encouraging. At least there would seem to be grounds for further experiment.

Footnotes.

1) For a discussion and references on the type of separability assumption see Green /14/.

2) Notice that "adoption", as defined, has to do with the completeness property of the preference ordering. It does not necessarily imply a non-zero consumption level for any particular consumer.

3) See eg, Johnston /16/ p52 on the properties of the log-reciprocal transformation.

4) The problems and alternative solutions in this section are discussed at greater length in Cowling, Cable, Kelly and McGuiness /11/.

5) Use of ratio variables carries the implicit assumption of homogeneity of degree zero in advertising, which would be inappropriate in some cases, e,g.where some products are unadvertised.

6) See e.g.Kmenta /17/ p395 .

7) Schmalansee concludes that the Koyck or geometric lag structure may be a fair approximation to the dynamic impact of advertising when the time periods involved are fairly long /28/ p123.

8) For $\lambda \geq 0.4$ less than one per cent of advertising in time period t-9 will be active at time t.

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