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**Household Demand for Fluid Milk in Sydney:
Results of a Household Survey**

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Data obtained from a series of household surveys conducted in Sydney in 1987-88 were used to analyse household milk consumption patterns. The effects of socio-economic and demographic factors, concerns about general health and awareness of product promotion on household fresh milk consumption were analysed in a linear household demand model. Preliminary results of the analysis are presented.

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Introduction

Consumption per capita of fresh white milk in New South Wales has declined over the past decade. Pricing regulation in the New South Wales dairy industry and the fact that fresh milk is generally believed to be price inelastic leave little scope for increasing the demand for milk through pricing policies. Generic promotion, funded through a series of producer levies, has been increasingly utilised by the industry in an attempt to reverse declining consumption trends.

It has not been established that promotion in general has a positive effect on demand. Considerable research into the effectiveness of promotion in increasing consumption of milk has been conducted overseas. Evidence of the effect of advertising is conflicting. The apparent uniqueness of market characteristics and the inability to empirically evaluate the relative quality of promotion programs in separate markets suggests that the effectiveness of advertising must be evaluated on an individual market basis.

Preliminary results of an analysis of the effect of promotion on the household demand for fresh milk in the Sydney market are presented in this paper. Data obtained from a series of household consumption surveys conducted in Sydney in 1987-88 are used to analyse household milk consumption. The effects of household socio-economic characteristics, advertising and the information gained from this advertising on the consumption levels of wholemilk, lowfat milk and total milk were analysed in a linear household demand model.

An understanding of the factors affecting consumption patterns at the consumer level should allow for more effective campaigns and therefore more cost-effective advertising expenditures.

Promotion and Household Demand

The basic objective of advertising or promotion is to increase the revenue generated by a product. This increase in revenue may be achieved either directly through an expansion in consumer demand and an resulting increase in volume sales, or indirectly through reducing the consumer's sensitivity to price and increasing the per unit price. Where the price of a product is fixed, the aim of advertising is to directly expand consumer demand.

The promotion of fluid milk in NSW can be viewed as a combination of both generic and brand advertising. Milk is advertised as a homogeneous product in the general food and beverage market. In addition, specific milk products or 'brands', such as the calcium enriched white milk, *Shape*, are promoted by the state dairy industry. The provision of information is often a characteristic of advertising that is generic in nature. Milk is promoted as a healthy alternative in the beverage market and the focus of advertising is on the provision information relating to the positive health and nutritional aspects of milk. For example, the NSW promotion campaign for the low-fat, high calcium milk, *Shape*, is based on the provision of nutritional and health-related information on the calcium related disease, osteoporosis. The promotion, therefore, aims to provide information on the need for milk in the diet and to make consumers aware of the availability of the 'brand' product. The emphasis on the health giving properties of milk and dairy products has largely been an effort to combat the negative association between dairy products and high cholesterol levels.

The link between advertising and demand are explained in consumer behaviour theory. Consumers are thought to evaluate individual purchasing decisions in a staged process of product awareness, trial, and repeat purchase. Consumers are attempting to maximise utility from consumption. Information or advertising is demanded to aid in the consumption choices. Consumers gain utility from advertising and as such demand

information. The provision of health and nutrition information characteristic of generic advertising can be seen as further supplying the demand for information.

Previous Studies into the Demand for Dairy Products

Studies examining the effects of advertising on dairy product consumption have largely been based on aggregate data in an expenditure system framework. The effect of advertising expenditure on consumption has been mixed. Goddard and Tielu (1988) found that the Ontario Milk Marketing Board's decision to increase advertising expenditures in an effort to increase sales in the declining fluid milk market in Canada over the period 1971 to 1984 had met with success. Over a similar time period, Liu and Forker (1988) found that generic advertising of milk in New York city also had a positive impact on fluid milk sales. In contrast, Hessner and Mellor (1986) concluded that neither current nor lagged advertising significantly impacted liquid milk sales in England and Wales over the period 1970 to 1984. Similarly, Brodie and Moffitt (1983) were unable to find any evidence that advertising affected the consumption of fresh milk in New Zealand.

While these studies indicate that in the North American experience there has been a positive response to the generic advertising of fluid milk, the results in the other countries are not conclusive. The results of aggregate studies have indicated that habit or previous consumption is important in explaining the demand for milk products. This, coupled with the conflicting evidence regarding the effectiveness of advertising, suggests that an understanding of the consumer characteristics which affect demand may provide further information for the marketer.

Research into the factors or characteristics which affect milk consumption at the household level in overseas markets and market research studies conducted in the Sydney market were used as a basis for forming a hypothesis of the factors which may affect milk consumption at the household level in this study.

Heien and Wessells (1988) using data from the 1977-78 USDA Household Food Consumption Survey estimated a complete demand system focussing on dairy products. They found that the household composition and the proportion of meals eaten at home were highly significant in determining expenditure on dairy products. As was expected, income was found to have little effect on expenditure and households were relatively insensitive to the price of milk. Although they did not include advertising in the demand system, Heien and Wessells concluded that a positive effect from advertising was dependent on changing consumer tastes.

Lund and Derry (1985) estimated food expenditure equations for Great Britain using the 1982 National Food Survey. They established that income, household composition, region, housing tenure, freezer ownership and the age of the housewife were the major determinants of expenditure on individual food groups. It was found that older housewives were more likely to spend larger amounts on milk and cream.

Huang and Raunika (1983) found that fluid milk expenditure was related to household income, the size of the household and the stage of household lifecycle (that is, age and sex composition of the household), race, the education level of the female head, and whether the household was urban or rurally located. Of particular interest they found that the factors which affect expenditures on whole milk were distinct from those which affect low-fat milk expenditures. Households consuming whole milk were likely to be larger in size and lower in income levels than those consuming low-fat milks. The education level of the female household head was higher in household consuming low-fat milk. Regional patterns also emerged with low-fat milk consuming households being largely suburban as opposed to metropolitan or rural based.

Laraki and Ranney (1986) also estimated household expenditure equations for whole milk and low-fat milk in the United States. Demand was estimated as a function of income, participation in the food stamp program, the age and sex composition of the household, the education level of the female head of the household, race and region using a tobit framework. Only race, region, the education of the shopper and the age of the two oldest household members were found significant. In a similar result to Huang and Raunikar, they found the education level of the shopper had a positive effect on low-fat milk expenditure but a negative effect on whole milk expenditure. The effects of household size were specifically examined. They found the effects on expenditure for additional household members did not vary with household size or, on other words, that economies of household size do not exist for milk expenditures.

Also using data from the 1977-78 USDA Household Food Consumption Survey, Bunch and Hall (1983) focused on the factors which affect nutrient consumption which is of interest considering the emphasis on calcium in milk promotion in New South Wales. They found that the nutrient composition of a household's consumption was affected by the proportion of food eaten outside of the home, as well as by urbanisation, race, household income and the number of hours worked outside of the household by the female household head. Purchasing patterns of food purchased for the household were largely related to income and to the education level of the female household head which was considered as a proxy for nutritional awareness. Bunch and Hall found that there was a positive relationship between the education level of the female household head and the amount of calcium in the household diet.

Although the characteristics of overseas markets are not necessarily transferable to the Australian market, they provide a useful basis. Market research studies in New South Wales were examined to determine if there were any additional factors which should be considered in this analysis.

Market research into consumer perceptions of *Shape* since its introduction to the New South Wales market in 1984 has been conducted. Shapetrak IV (SRG Australia, 1989) indicated that the primary *Shape* user was female, over 25 years of age, without children at home and of a white collar household. The primary motivation for both trial and repeated purchase was the low fat content. The high calcium content was secondary. Project Doorstep (AGB, 1988) examined home delivery in the Sydney area. It was noted that households utilising home delivery service had higher than average milk consumption and it was believed that a decline in the service was partially responsible for the decline in milk sales between 1983 and 1988. The decline in home deliveries was found to be the result of dissatisfaction in reductions in the number of delivery days and changes in the delivery time from morning to afternoon. It appears that purchases of milk from alternate sources and not the delivery level itself accounted higher consumption levels in households receiving deliveries. Therefore, it was concluded that there was no evidence that the decline in home deliveries was the cause of the decline in milk sales.

Survey Background

Data collected in a series of household surveys conducted in 1987 and 1988 by the University of Sydney are used in this analysis. The aim of the surveys was to collect household data to establish the patterns of milk consumption of Sydney households. The survey consisted of a personal interview with the shopper/s of the household and a two-week diary to record food purchases. The diary was left with the household and later collected. Data were collected on the social and economic characteristics unique to the household; household consumption of dairy products; awareness of the health-related properties of milk, awareness of available products, and recall of advertising of dairy products. The questionnaire was designed to provide a profile of milk consumers which could then be matched to dairy product consumption through the diary of

purchases of dairy product and related items. The emphasis of the survey was on consumer response to products and promotion.

Surveying took place in 18 separate areas in the Sydney Metropolitan region with 20 households selected in each of the 18 clusters. The survey methodology was developed with the assistance of the Statistical Branch of the Australian Bureau of Statistics (ABS). The 18 areas were Census Collector Districts selected randomly by the Australian Bureau of Statistics. Household surveying was conducted over three separate periods during 1987 and 1988. Six of the clusters were surveyed in each period.

The selection of the survey sample and nature of the of the survey itself resulted in several places for non-response to occur. A number of households could either not be contacted or refused to take part in the survey. Further surveys were unable to be utilised in this analysis due to incomplete diaries. A survey sample of 146 complete surveys and diaries was used in this analysis.

The data used in this analysis have been previously analysed in a market research study using contingency tables and Chi-squared tests of independence (MacIntosh, forthcoming). Socio-economic characteristics of the household, health and product awareness, and promotion were found to be significantly related household milk consumption. In addition to identifying various household characteristics that possibly explain the quantity of milk consumed by the household, the results indicated that the type or 'brand' of milk purchased was also related to the characteristics of the household. These results indicated that the demand for wholemilk and the demand for lowfat milk in the Sydney market are distinct demand functions.

The quantity of milk consumed by the household was found to be related positively to the household characteristics: household size; both the absolute number of children in the household and the proportion of the household comprised of children; and the education of the household shopper. Education of the household shopper has been used as a proxy for general awareness in previous household consumption studies. Meals consumed away from home and full-time employment of the shopper were found to impact negatively on household milk consumption levels.

Household income and total food expenditure was significantly related to the type of milk consumed by the household. Households spending larger amounts on food were less likely to purchase lowfat milk. Lowfat milk appeared more likely to be consumed by the middle income households. The education of the shopper and meals consumed away from home also were related to the type of milk consumed. Shoppers with a lower education level appeared less likely to purchase lowfat milk. Households consuming meals away from home more than once a week appeared more likely to consume only lowfat milk.

General health knowledge assessed by a composite variable of health awareness from questions about the health properties of milk was found to be related to choice of milk type. Shoppers with higher levels of health awareness appear more likely to purchase lowfat milk. Awareness of specific health properties of milk were also found to be related to both the quantity and type of milk purchased by the household. Awareness of the daily recommended consumption levels of milk for an adult male, an adult female and a child was found to be positively related to household consumption levels. Knowledge of osteoporosis was associated with consumption of lowfat milk. Both the quantity of milk and the type of milk consumed by the household were associated with recall of the *Shape* advertising. A positive relationship between household expenditure on dairy products and general health awareness and advertising recall was found.

Dependent and Explanatory Variables

The specification of the dependent and explanatory variables used in this analysis are presented in Table 1 and explained below.

Consumption

Milk was defined as fresh fluid white milk and includes whole milk, *Hi-Lo*, *Shape* and skim milk, as well as all types of traditional bottled milk. Milk purchases recorded over the two week period were allocated to the two broad categories: whole milk purchases or lowfat milk purchases. Lowfat milk includes *Shape*, *Hi-Lo* and skim milk. Although the individual 'brand' of milk purchased was known, the small sample of households purchasing individual milk 'brands' and the fact lowfat users did not appear to exhibit 'brand' loyalty required aggregation. In addition, it should be noted that the majority of households purchasing lowfat milk also purchased whole milk and this was expected to influence the estimation of lowfat milk demand. Consumption is litres of milk purchased by the household in the two-week survey period. It was assumed that what was purchased was consumed by the household.

Household budget

Utility theory indicates that both income and relative prices should be included in a demand function reflecting the household's budget constraint. Milk prices are fixed at the retail level in New South Wales which implies that there is no variation in the price of milk faced by individual households. In this study, relative prices across households were assumed constant. Total net income was used as a measure of the budget available to the household. The household budget variable was specified as the logarithm of income.

Household characteristics

Household size or the number of people in the household is obviously a major explanatory factor of household consumption. Laraki and Ranney (1986) found that there were no economies of household size for fluid milk expenditure patterns which indicates that the relationship between household size and consumption is linear.

It is the age and sex composition of the household that is of interest in relation to milk consumption levels. Various methods of specifying these relationships including equivalent scales models and family lifecycle stages have been used in household demand analysis. These approaches while detailed in their specification of household composition suffer from the shortcomings of requiring assumptions of the relative consumption levels the age and sex groupings, and difficulties in interpreting the variable coefficients. The family lifecycle is based on categorising households into groups such as single, married without children, married with children and including these categories in the demand equation as dummy variables. The results of a changing society in terms of household composition, and the varied lifestyles found in cities like Sydney require such a large number of categories as to make it impractical.

The age and sex composition in this study was specified simply as the number of children in the household and the proportion of females in the household. These variables allow for testing of the commonly held beliefs that children have a positive impact on household consumption and that females in general consume less milk than males.

Concisely specifying the ethnic background of a household in a city with the diversity of backgrounds found in Sydney is difficult. Consumption of milk varies markedly across cultures and some attempt to capture this was made. The survey respondent was asked to nominate the ethnic background or backgrounds of the household with regards to cultural identification and eating habits. Households were then grouped as Australian, Australian plus at least one other culture, or totally another culture.

Table 1 - Definition of the Variables

Variable	Definition
Q_{IJ}	= the quantity of milk type j in litres per fortnight purchased by the jth household
Income	= the logarithm of total net household income per fortnight
Children	= the number of children under 18 years of age in the household
Females	= the proportion of females in the household
Ethnic	= 1 if Australian only or Australian and other 0 if other than Australian only
Employment	= the employment status of the household shopper who is the least employed 0 if not employed outside of the home 1 if employed part-time outside of the home 2 if employed full-time outside of the home
Delivery	= the number of days per week which milk is delivered to the household
Medical	= 1 if at least one member of the household had been medically encouraged to reduce milk consumption 0 if no medical advice received
Pets	= the number of dogs and cats which are fed milk in the household
Awareness	= the cumulative grading on questioning on the general nutritional and health properties of milk assigned to the survey respondent
Advertising	= the cumulative grading of unprompted recall of dairy product advertising

Employment status was believed to affect milk consumption levels through changes in food purchasing and consumption patterns. The variable was specified as part-time or full-time employment outside of the home of the shopper or the employment status of the shopper who was the least employed when there was more than one shopper.

Advertising and awareness

The advertising variable was specified as a cumulative variable from 0 to 9. Households were assigned a cumulative grade based on their unprompted recall of dairy product advertising. The graded categories included generic milk advertising, 'brand' milk advertising of lowfat and flavoured milks, and advertising of cheese, butter and yoghurt. The grade was weighted in favour of white milk advertising. The awareness variable was specified in a similar manner with households assigned a

cumulative grade from 0 to 17. The grade was established through responses to questioning on knowledge of the recommended daily consumption levels of milk, the vitamins and minerals found in milk, recommended daily calcium intake levels, the causes and effects of the disease osteoporosis, and the characteristics of available milk types.

Model Specification

A simple linear model in which advertising is included as an argument in the demand equation was chosen. This specification implies that promotion and the information provided in promotion is part of the household utility function.

Household demand of wholemilk, lowfat milk and total milk products were specified as a function of the traditional socio-economic household characteristics, advertising, and awareness of the nutritional properties of milk, such that

$$Q_{ij} = f (X_i, A_i, I_i)$$

where Q_{ij} = the quantity of milk j demanded by household i
 X_i = a matrix of socio-economic characteristics unique to household i
 A_i = advertising recalled by household i
 I_i = nutritional awareness of household i

Results

The results of the parameter estimates of the wholemilk, lowfat milk and total milk equations are presented in Table 2. The full equations for total milk and wholemilk demand as compared to the equation restricted to the effect of the constant are significant at the 1% level. The equation for lowfat milk demand is not significant. It was expected that there would be difficulties in estimating the for lowfat milk due to both the small sample size and the fact that the majority of households consuming lowfat milk also consumed some amount of wholemilk. As the coefficients of the lowfat milk equation cannot be interpreted with any confidence, examination of the differences in the coefficients of the wholemilk and total milk equations provide the only indication of the effects of the parameters on lowfat consumption. Total milk demand includes both wholemilk and lowfat milk demand.

The coefficients for the number of children, employment, delivery service, pets and advertising are significant in the total milk equation. Only the number of children, delivery service, pets and advertising are significant in the wholemilk equation. The signs of the coefficients are all as expected.

The effect of income is positive but insignificant on both total milk and wholemilk consumption. Income appears to have a greater effect on total milk consumption than on wholemilk consumption. This could indicate that the effect of income on lowfat milk consumption is greater than for wholemilk.

The household composition effects were as expected. The number of children in the household has a significantly positive effect on consumption levels. It should be noted that the number of children in the household is positively correlated to the household size. The effect of children appears slightly greater on wholemilk consumption than on total milk consumption. The proportion of females in the household have a negative although insignificant effect on consumption. The relationship between consumption and at least partial identification with Australia in terms of cultural background is positive.

Table 2 - OLS Estimation Results

Dependent Variable	TOTAL MILK*	WHOLE MILK*	LOWFAT MILK
No. of Observations	138	130	42
VARIABLE			
Constant	-5.13 (8.61)	-1.44 (9.02)	23.77 (14.16)
Income	1.71 (1.31)	0.76 (1.36)	-2.46 (2.16)
Children	2.26*** (0.59)	2.32*** (0.60)	-0.86 (0.60)
Females	-3.80 (2.33)	-3.19 (2.46)	1.07 (2.46)
Ethnic	1.19 (2.20)	0.91 (2.44)	-2.22 (2.25)
Employment	-3.76** (1.57)	-2.42 (1.67)	-1.86 (1.50)
Delivery	0.98*** (0.33)	1.00*** (0.33)	-0.09 (0.34)
Pets	1.74*** 0.63	1.63*** 0.64	0.19 (0.53)
Medical	-1.19 (1.96)	-1.48 (2.06)	-0.23 (1.56)
Advertising	0.94** (0.38)	0.88** (0.39)	0.06 (0.41)
Awareness	-0.003 (0.15)	0.14 (0.16)	-0.061 (0.15)
R ² Adjusted	0.3009	0.2711	0.0217

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

Employment outside of the home of the shopper or shoppers of the household has a negative effect on both the consumption of total milk and of wholemilk. This effect is significant for

total milk demand but not for lowfat milk demand. Employment outside of the home is believed to reflect the effects of both less available time for shopping and for food preparation. Home delivery of milk has a significantly positive effect on consumption as does the number of pets consuming milk in the household. The effect of pets in the household is greater on total milk consumption than on wholemilk consumption implying pets have a positive effect on lowfat milk consumption. The relatively large coefficient of pets was unexpected and possible reasons for such a large coefficient were examined. The number of pets is not highly correlated with any of the other explanatory factors and does not appear to be reflecting any other variable.

Advertising was found to have a relatively small but positive and significant effect on consumption levels. The effect is greater on total milk than on wholemilk alone again implying a positive relationship between advertising and lowfat milk consumption. The awareness coefficient was insignificant in both equations. The coefficient of the awareness variable is negative in the total milk equation but positive in the wholemilk equation. Interpretation of these effects suggests that although the effect of advertising is positive that it is the direct effect of advertising and not the effect of increased awareness of the health giving properties of milk through the provision of information in advertising that has the effect on consumption levels. It would be expected that consumers who have a greater awareness of the positive benefits of consuming milk also have a greater awareness of the negative health aspects of milk. Awareness of the negative health effects of milk consumption are not accounted for in the awareness variable. The expected correlation between positive and negative awareness of the health related aspects of milk may account for the signs of the awareness coefficients. Medical advice to reduce milk consumption was negatively related to consumption levels although the coefficient was insignificant. This further suggests that there are both positive and negative effects of awareness of health related issues and that further examination of the specification of health and nutrition awareness variables needs to be considered.

Conclusion

Household demand equations for wholemilk, lowfat milk and total milk in the Sydney market were estimated using ordinary least squares regression techniques. The results of the lowfat milk equation estimation were not significant. The number of children in the household, employment of the household shopper or shoppers, use of the home delivery service, the number of pets in the household and advertising were significant in explaining household consumption of total white milk. The number of children in the household, use of the home delivery service, the number of pets in the household and advertising were significant in explaining household consumption of wholemilk. The effects of children, use of delivery service and pets on consumption levels are positive. Employment outside of the home of the household shopper has a negative impact on consumption levels. Differences in the effects of the factors on total milk and wholemilk consumption levels were observed.

A small positive relationship between advertising and household consumption was found. Awareness of the positive health and nutritional properties of milk was found not to be significant in determining household milk consumption levels. This result implies that attempts to alter consumer beliefs about the health and nutritional benefits of milk through advertising have not been successful. The positive impact of advertising is a direct result of advertising.

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