HOUSEHOLD FLUID MILK EXPENDITURE PATTERNS IN THE SOUTH AND UNITED STATES

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In recent years, significant changes have taken place in the food consumption patterns of American consumers. Evidence indicates that the ongoing changes in U.S. household food expenditure patterns occurred in response not only to sudden increases in food prices in the early 1970s and the recent salient inflationary period (Buse and Fleischner; Salathe), but also to demographic shifts, tastes, and preferences (LeBovit). Changes in consumers' purchase and consumption of fluid milk have not been exempted. During the past decade, per capita sales of whole milk, on a product-weight basis, declined from 205.61 pounds in 1970 to 140.71 pounds in 1980, whereas per capita sales of lowfat milk (including skim milk) increased from 42.30 to 83.67 pounds (USDA). Changes in economic factors and other factors such as shifts in demographic distribution and increased awareness of dietary concerns, may have influenced and changed the product mix in the fluid milk market and may be reflected in the observed fluid milk consumption patterns.

Previous research suggests that consumption patterns for dairy products differ significantly among regions in the United States (Boehm; Boehm and Babb). Regional differences in consumption patterns may arise from variations in demographic composition and characteristics, income levels, relative price levels, and tastes and preferences. The U.S. Department of Agriculture 1977–78 Nationwide Food Consumption Survey (NFCS) indicates that the proportion of households consuming whole milk varies from 53.20 percent in the north central region to 76.53 percent in the northeastern region. The proportion of households consuming lowfat milk varies from 18.11 percent in the South to 44.25 percent in the north central region. Average weekly per capita consumption of fluid milk also differs substantially among regions. The survey results suggest that the Northeast and South had the highest per capita per week consumption of whole milk of 4.10 pounds and 3.35 pounds respectively. On the other hand, consumers in the South consumed an average of 0.68 pounds of lowfat milk per capita per week, compared with 2.42 pounds in the north central region.

The fluid milk market is of vital importance to the U.S. dairy industry, particularly in the South. Milk production in the South is deficit with respect to total dairy product consumption in the region; nevertheless, total consumption of dairy products, as well as of fluid milk, has remained relatively stable. The identification of socioeconomic variables and estimation of their impacts on fluid milk expenditure provide information for planning and developing marketing strategies for the mix of consumers in market areas.

The objective of this study is to examine and compare household expenditure patterns for whole milk and lowfat milk in the southern region of the U.S. as well as in the total U.S. Specifically, this study focuses on identifying and analyzing the effects of household income and other socioeconomic characteristics on whole milk and lowfat milk expenditure patterns in the South and in the total U.S. Expenditure for whole milk and lowfat milk is defined as the value of each product used by each household. The study is also designed to provide information concerning fluid milk marketing implications for the dairy industry based on empirical findings.

MODEL SPECIFICATION

A statistical model is formulated to estimate the Engel relation from cross-sectional data for two fluid milk products. The general form of the model is specified as

$$(1) \qquad Y = f(INC, HS, HSQ, ED, R, LOC, FLC) + U$$

where

- Y = household's expenditure for a particular type of fluid milk,
- INC = the logarithm of household income,
- HS = household size,
- HSQ = the square term of household size,
- ED = years of formal education of female household head,
- R = race of household, either white or non-white,
- LOC = location of residence, either central city, surburban, or rural,
- FLC = family life cycle category of the household, and
- U = normally distributed random disturbance.

The model serves as a basis for obtaining estimates of household expenditure response due to income differences and to certain identifiable socioeconomic

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characteristics. Among the socioeconomic variables, the concept of family life cycle (FLC) is employed to better delineate food expenditure patterns of the household unit. Specifically, one would expect an increasing demand for fluid milk during the early stages of the family life cycle as the family unit expands. The expenditure pattern of the peak years may be perpetuated to some extent after the family unit contracts in the later stages because of habitual continuation of past behavior. However, expenditure for fluid milk is expected to decline in the later stages, although not to the levels of the first stage of the life cycle.

The most comprehensive research relating consumer behavior to various FLC stages was published by Wells and Gubar. Their nine-stage FLC, based on the age of parents and children and employment status, has been one of the commonly used classifications. In recent years, changes in family composition and life style, including rising divorce rates and decreasing family size, suggest that further refinements in FLC stages are necessary. A revised FLC proposed by Murphy and Staples is an attempt to update the life cycle to account for current changes in demographic trends.

In this study, the Murphy and Staples classification of FLC stages was used. Slight modifications were made because the survey data did not distinguish among divorced, separated, and never-married single persons. The nonmarried with children could be single parents who have adopted children, or separated or divorced parents. Thus, households in those three conditions were classified as "single with children." Households were classified into ten life cycle stages: Young Single, Young Married Without Children, Young Married with Children, Middle-Aged Married With Children, Middle-Aged Married Without Children, Older Married, Older Single, Young Single With Children, Middle-Aged Single With Children, and Middle-Aged Single. Moreover, the age of the household head was used for the definition of the age groups, with the following division of groups: young (under 35 years old), middle-aged (35–64 years old), and older (65 years old and over).

ESTIMATION PROCEDURE

The ordinary least squares (OLS) procedure is frequently used to estimate equation (1). However, analysis of cross-sectional data reveals the problem that the error term associated with the dependent variable in the econometric model is censored normal; that is, the dependent variable has a number of its values clustered at a limiting value, usually zero. To circumvent this problem, zero observations in the sample are usually eliminated and, hence, the analysis provides parameter estimates reflecting only the change for consuming or purchasing households (Boehm). Average food expenditure for the total market population represents both the average expenditure of all households and the extent of their participation in the market. Analysis of household food expenditure behavior should take both into account. Thus, to account for the underlying structure of a stochastic model in which the dependent variable has some limited values, equation (1) is rewritten as

$$(2) \quad Y_j = X_{ij}\beta + e_{ji}, \quad \text{if } X_{ij}\beta + e_j > 0$$

$$= 0, \quad \text{if } X_{ij}\beta + e_j \leq 0$$

where Y_j is a vector of n household's weekly whole milk or lowfat milk expenditures; X_{ij} represents a matrix of the socioeconomic characteristics of the sample households specified in equation (1); β is an unknown parameter vector; and e_j represents a vector of normal error terms with zero mean; constant variance σ^2 and $i = 1,2,\ldots,k$; $j = 1,2,\ldots n$.

The model assumes that there is an underlying index equal to $(X\beta + e)$ which is observed only when it is positive. As Amemiya shows, the conditional expectation of Y, denoted as E(Y*), in equation (2), given that Y is greater than zero, is

$$(3) \quad E(Y^*) = E(Y \mid Y>0) = X\beta + E(e \mid Y>0),$$

and

$$E(e \mid Y>0) = \sigma f(z) / F(z),$$

where $z = X\beta/\sigma$, f(z) is the unit normal density function, and F(z) is the cumulative normal distribution function. It is evident that the conditional expectation of the error term in equation (3) will generally not be zero. Thus, application of OLS to equation (2) yields biased and inconsistent estimators (Greene). Specifically, the difficulties of using OLS in estimating the parameters of equation (2) arise because the usual OLS assumptions of $E(e) = 0$, and $E(e^2) = \sigma^2$ do not hold when the dependent variable is limited.

The Tobit maximum likelihood procedure is designed to provide more accurate and efficient estimations of parameters of limited dependent variable models than can be obtained from OLS regression. An important aspect of Tobit analysis is that it accounts for the fact that the dependent variable is affected by both the size of nonlimit responses and the probability of nonlimit responses occurring.

Adjustments in Tobit regression coefficients are required to compute the marginal effect of a change in the ith variable of X on Y, and, hence, the elasticity of Y with respect to X_i (McDonald and Moffitt). The computations differ from the procedure used with OLS regression coefficients because the unconditional expected value E(Y) in equation (2) is no longer equal to $X\beta$, a property of OLS. The unconditional expected value, E(Y), according to Amemiya is

$$(4) \quad E(Y) = X\beta F(z) + \sigma f(z) = E(Y^*) F(z).$$

Thus, the unconditional expected value of Y in equation (2) is equal to the conditional expected value of Y, E(Y*), adjusted for the probability that Y is observed

to be greater than zero. The effect of a change in the ith variable of X on Y is

$$(5) \quad \delta E(Y) / \delta x = F(z)\,[\delta E(Y^*) / \delta x] + E(Y^*)\,[\delta F(z) / \delta x].$$

Equation (5) suggests that the total effect of a change in X on Y can be decomposed into two components. The first component of the marginal effects of X on Y measures the change in the value of the dependent variable, if it is already above the limit, weighted by the probability of being above the limit. The second component measures the change in the probability of being above the limit weighted by the conditional expected value of Y. The elasticity of Y with respect to X, hence, can be evaluated by

$$(6) \quad \eta_i = [\delta E(Y^*) / \delta X]\,[X / E(Y^*)] + [\delta F(z) / \delta X]\,[X / F(z)],$$

where η_i is the elasticity of Y with respect to the ith variable of X. The first component of equation (6) is referred to as the conditional elasticity associated with actual expenditure. The second component represents the elasticity of change in the probability of being a consuming household associated with a change in the ith independent variable.

DATA

Data for empirical implementation of the present study were from the 1977–78 NFCS. Two types of at-home fluid milk expenditure data, for whole milk and lowfat milk, were selected for this analysis. A sample of 10,760 households was selected from approximately 15,000 households that participated in the nationwide survey. Nearly 25 percent of the households surveyed were excluded from the empirical analysis because household income was not reported. Other households that reported inconsistent information or apparently incorrect information were also deleted. Among the 10,760 households that provided complete information for statistical analysis, 3,677 households are in the southern region of the U.S. Households located in the South accounted for about the same proportion of total survey sample, 34.71 percent and 34.17 percent, before and after eliminating those households without complete records, respectively.

Summary statistics of the households that reported fluid milk expenditures are presented in Table 1. The number of households reporting fluid milk expenditure during the survey week differed considerably for the two types of fluid milk and between the southern region sample and the total U.S. sample. Households in the southern region, on the average, spent less for fluid milk than households in the total U.S. The proportion of households reporting whole milk expenditure was 75.5 percent in the South versus 67.2 percent nationwide, whereas the proportions of households reporting lowfat milk expenditure were 18.11 percent and 29.97 percent in the southern region and in the U.S., respectively. The shift to lowfat milk is not as pronounced in the South as it is nationally. These selected statistics suggest that fluid milk expenditure patterns may be quite different in the South than in the total U.S. Note that Table 1 indicates a preponderance of households reporting expenditure for only one of the fluid milk type products. Among all the households that reported expenditures for fluid milk, only about 6.5 percent of those households had expenditures for both whole milk and lowfat milk.

Table 1. Selected Means and Standard Deviations, Whole Milk and Lowfat Milk Expenditures per Household per Week in the Southern Region of the U.S. and in the Entire U.S., 1977–78

	Southern Region		United States	
Variable	Household reported whole milk expenditure	Household reported lowfat milk expenditure	Household reported whole milk expenditure	Household reported lowfat milk expenditure
Whole milk ($)	2.56 (2.27)[a]	0.50 (1.35)	2.69 (2.54)	0.48 (1.41)
Low fat milk ($)	0.07 (0.42)	2.04 (2.00)	0.13 (0.58)	2.37 (2.33)
Household income ($)	11,951 (9,395)	15,368 (11,695)	13,477 (9,935)	17,260 (11,638)
Household size (persons)	3.07 (1.72)	2.81 (1.37)	3.07 (1.69)	3.04 (1.55)
Education of female head (years)	10.11 (4.23)	11.78 (3.82)	10.59 (4.25)	12.20 (3.79)
White households (percent)	76.23	89.04	81.84	95.19
No. consuming households	2,776	666	7,231	3,225
Percent households consuming	75.50	18.11	67.20	29.97

[a] Numbers in parentheses are the standard deviations.
Source: Compiled from the 1977–78 USDA Nationwide Food Consumption Survey.

RESULTS

The statistical model of equation (2) was estimated based on the southern regional sample and the total U.S. sample for the whole milk and lowfat milk. The regression results of the Tobit analysis suggest that fluid milk expenditure patterns were quite distinct for the two product types and for households in the South and in the total U.S. (Table 2). The findings are generally in agreement with previous studies based on different sample data (Boehm; Boehm and Babb; Hassan and Johnson; Salathe).

The income coefficient for lowfat milk was positive and statistically significant at the 0.05 significance level for both the southern region and the total U.S. In contrast, the income coefficient for whole milk was negative and significant in the total U.S. equation, but positive and insignificant in the southern region equation. The results suggest that whole milk is considered an inferior good, whereas lowfat milk is considered a normal good. The implications are consistent with the changes in fluid milk consumption patterns observed during the past decades. As previously noted, whole milk consumption has declined with increased real per capita income. One would expect the results of this study to conform with what might be expected from time-series data analysis. The estimated negative income effect for whole milk in the total U.S. is consistent with findings from previous studies. Boehm estimates an income elasticity of -0.07 for whole

Table 2. Regression Results of Tobit Analysis for Whole Milk and Lowfat Milk Expenditures per Household per Week in the Southern Region of the U.S. and in the U.S., 1977–78[a]

Variable	Southern Region		United States	
	Whole milk	Lowfat milk	Whole milk	Lowfat milk
Constant	-1.460	-11.175	2.097	-13.628
Log(income)	0.032	0.633*	-0.268*	0.726*
	(0.472)	(4.270)	(-5.554)	(9.467)
Household size	1.083*	-0.185	1.257*	0.147
	(7.932)	(-0.530)	(13.009)	(0.940)
Household size squared	-0.035*	-0.003	-0.044*	0.007
	(-2.663)	(-0.074)	(-4.745)	(0.483)
Education of female head	-0.046*	0.181*	-0.075*	0.148*
	(-4.085)	(7.125)	(-9.744)	(11.879)
North Central			-1.582*	1.908*
			(-18.945)	(15.468)
South			-0.485*	-0.271*
			(-6.342)	(-2.121)
West			-1.193*	1.463*
			(-13.166)	(10.876)
Metropolitan	0.110	0.024	-0.173*	0.349*
	(0.922)	(0.096)	(-2.322)	(3.076)
Rural	0.189	-0.477*	-0.055	0.045
	(1.717)	(-2.005)	(-0.715)	(0.378)
White household	0.423*	1.623*	-0.020	2.368*
	(3.704)	(5.824)	(-0.230)	(13.681)
Young single	-0.216	-1.016	-0.126	-0.087
	(-0.648)	(-1.356)	(-0.564)	(-0.249)
Young married without children	-0.096	-1.315*	-0.020	-0.710*
	(-0.391)	(-2.562)	(-0.124)	(-2.888)
Young married with children	-0.221	-0.738*	-0.314*	-0.122
	(-1.645)	(-2.635)	(-3.432)	(-0.899)
Middle age married w/o children	-0.121	-0.776	0.104	-0.582*
	(-0.638)	(-1.911)	(0.788)	(-2.865)
Older married	0.043	-0.629	-0.079	-0.247
	(0.236)	(-1.545)	(-0.597)	(-1.178)
Older single	0.196	-0.528	-0.030	-0.238
	(0.739)	(-0.852)	(-0.160)	(-0.771)
Young single w/children	0.110	-1.638*	0.142	-0.597*
	(0.471)	(-2.595)	(0.886)	(-2.095)
Middle age w/children	0.034	-0.240	0.292*	-0.262
	(0.183)	(-0.571)	(2.200)	(-1.190)
Middle age single	-0.020	-0.717	-0.063	-0.261
	(-0.070)	(-1.061)	(-0.305)	(-0.780)
Standard error of estimate	2.411	3.693	2.792	3.553
Sample size	3,677	3,677	10,760	10,760

[a] Numbers in parentheses are asymptotic t-ratios.
* Significant at 0.05 significance level.

milk, and Salathe reports that income elasticity for whole milk varies from −0.096 to −0.043 in the U.S.

The variables representing educational attainment of female head and white household display a different pattern between whole milk and lowfat milk (Table 2). The effects of educational level of the female head suggest that as educational level increases, household whole milk expenditure decreases, and lowfat milk expenditure increases. Similar results were reported by Boehm for the southern region. Assuming that higher educational levels may lead to more nutritional awareness and diet-conscious behavior, the results provide some insights that help explain the observed different expenditure patterns. For the southern region, the results suggest that white households had relatively greater expenditures for fluid milk than nonwhite households, *ceteris paribus*. For the total U.S. sample, however, no statistically significant difference in whole milk expenditure was found between white and nonwhite households.

The household size variables were found to have significant impacts on whole milk expenditure. The effects of variables representing household size and household size squared suggest that household expenditure for whole milk increases at a decreasing rate as household members increase. The results imply that there are economies of scale associated with whole milk expenditure with respect to the size of household. In contrast, no statistically significant relationships existed between the household size variables and lowfat milk expenditure, either in the South or in the total U.S. The results suggest that the likely presence of children in a larger household has a positive impact on household expenditure for whole milk, but not for lowfat milk. Furthermore, the results reveal few consistent patterns for fluid milk expenditures among households at various FLC stages. *A priori* expectations are that fluid milk expenditures will increase or decrease as household units advance through various FLC stages. The lack of statistically significant effects of FLC on fluid milk expenditures may be attributed to the fact that FLC stages closely follow the expansion and contraction of the household units, and hence, most of its effects were captured by the household size variables.

Based on empirical evidence presented in this study, the differences in fluid milk expenditure patterns between households in the South and in the total U.S. are evident. Because of the nonlinear specification, it is important to examine the effects of changes in household size and income on fluid milk expenditures at various household sizes and income levels. Three household sizes and four income levels are considered in the study. The marginal effects of household size and income variables on fluid milk expenditures and their corresponding elasticities are evaluated at the means within each household size and household income groups. The estimated marginal effects of change in household size on whole milk expenditure derived from Tobit model as defined by equation (5) are presented in Table 3. The results suggest that the impact of an additional household member on whole milk expenditure varies from $0.520 per week to $0.676 per week in the South, depending on the size of the household. Similarly, the results suggest a slightly greater marginal response for the total U.S. sample, except for 1–2 person households, ranging from $0.476 per week to $0.691 per week.

By decomposing the Tobit effects into effects conditional upon being above zero and effects on the probability of being above zero, the analysis provides further insights into the effects of household size and household income on fluid milk expenditures. The additional information derived from disaggregated Tobit effects should help the dairy industry in understanding the importance of the differential responses and aid the industry in the design and implementation of its marketing strategies. As shown in Table 3, households in the South have greater probabilities of consuming whole milk than households in the total U.S. Furthermore, the probability of consuming whole milk increased quite rapidly from 1–2 person households to households with 3 or more persons. The relative importance of conditional marginal effect to uncondi-

Table 3. Estimated Components of Marginal Effect of Household Size on Weekly Whole Milk Expenditure in the South and the Total U.S., by Household Size, 1977–78

Item	1–2 persons		3–4 persons		5 or more persons		Average	
	South	U.S.	South	U.S.	South	U.S.	South	U.S.
Unconditional marginal effect ($) $\partial E(Y)/\partial x$	.520	.476	.676	.691	.643	.680	.653	.664
Conditional marginal effect ($) $F(z)[\partial E(Y^*)/\partial X]$	.222	.176	.405	.355	.513	.477	.342	.291
Market participation effect ($) $E(Y^*)[\partial F(z)/\partial x]$	.298	.300	.271	.336	.130	.203	.311	.373
Conditional expected value ($) $E(Y^*)$	1.872	1.888	2.848	2.947	4.178	4.310	2.614	2.802
Probability of consuming $F(z)$	.568	.460	.811	.726	.946	.900	.739	.644
Changes in probability of consuming $\partial F(z)/\partial x$	.159	.159	.095	.114	.031	.047	.119	.133

tional marginal effect for whole milk also shows substantial differences among household size groups. For example, in the South, the conditional marginal effect due to change in household size for 1–2 person households accounts for about 42.7 percent ($0.222/$0.520) of the unconditional marginal effect for whole milk, whereas for 3–4 person households this ratio increases to almost 60.0 pecent.

The results suggest that for large households a greater proportion of the impact of household size on whole milk expenditure can be attributed to the increases in the amount expended by households that are already consuming whole milk. On the other hand, for small households, a greater proportion of the impact of household size on whole milk expenditure is attributed to the increases in the probability of consuming whole milk rather than the magnitudes of the expenditure. The analysis implies that the presence of children in larger households is an important factor affecting whole milk expenditures.

The estimated marginal effect of household income on lowfat milk expenditure and its decomposition effects are presented in Table 4. The results indicate that a given change in household income has a smaller impact on unconditional marginal expenditure in the South than in the total U.S. In terms of disaggregated effects, a quite different pattern exists between the southern sample and the national sample. Specifically, the effect of income change on conditional expenditures (or probability of consuming) for lowfat milk in the South appears to be opposite that for the total U.S. In the South, the relative importance of conditional expenditure first increases from about 21.1 percent ($0.004/$0.019) to 23.1 percent, then decreases to 14.3 percent as household income level increases from less than $5,000 to over $15,000. Conversely, for the U.S. the relative importance of conditional expenditure to unconditional marginal expenditure first decreases from 31.0 percent as household income level increases from less then $5,000 to over $15,000 (Table 4).

In general, the results suggest that the marginal effect of a given change in household income diminishes as household income increases. The decomposition of the marginal effect implies that as household income increases, the partial impact of a change that induces more households to consume lowfat milk becomes rel-

Table 4. Estimated Components of Marginal Effect of Household Income on Weekly Lowfat Milk Expenditure in the South and the U.S., by Household Income, 1977–78 [a]

Item	Income < $5,000		$5,000 < Income < $10,000		$10,000 < Income > $15,000		Income ≥$15,000		Average	
	South	U.S.	South	U.S.	South	U.S.	South	U.S.	South	U.S.
Unconditional marginal effect ($) $\partial E(Y)/\partial x$	.019	.029	.013	.022	.010	.020	.007	.013	.009	.016
Conditional marginal effect ($) $F(z)[\partial E(Y^*)/\partial X]$	.004	.009	.003	.006	.002	.004	.001	.003	.002	.003
Market participation effect ($) $E(Y^*)[\partial F(z)/\partial x]$	.015	.020	.010	.016	.008	.016	.006	.010	.007	.013
Conditional expected value ($) $E(Y^*)$	1.380	1.151	1.639	1.741	1.972	2.586	3.240	3.477	2.289	2.692
Probability of consuming $F(z)$	.117	.187	.152	.239	.174	.271	.201	.316	.161	.264
Changes in probability of consuming $\partial F(z)/\partial x$	.011	.017	.006	.009	.004	.006	.002	.003	.003	.005

[a] Weekly expenditures are evaluated on the basis of per $1,000 increase in average annual household income.

atively more important at high income levels than at low income levels. Thus, as income increases, the effect of change in household income on lowfat milk expenditure is dominated by increasing the probability of being a consuming household rather than by increasing the magnitude of expenditure. In other words, the analysis suggests that as income increases, high-income households are more likely to consume lowfat milk than low-income households, *certeris paribus*. The effect of change in household income on the amount expended among consuming households is relatively unimportant.

Household size elasticities for whole milk and household income elasticities for lowfat milk evaluated according to equation (6) are presented in Table 5. In the case of whole milk, the results suggest that household size elasticities vary among household size groups in a similar pattern in the South as well as in the total U.S. The analysis suggests that the household size elasticities averaged 0.981 for the southern regional sample and 1.086 for the national sample. The national average compares favorably with Salathe's estimates, which vary from 1.024 to 1.090.

However, the analysis of lowfat milk expenditure patterns indicates that household income elasticities differ between income groups in the South and in the total U.S. The income elasticities for lowfat milk in the South are of similar magnitude at income level less than $15,000, whereas in the total U.S. the magnitude of income elasticities decreases consistently as household income increases. The income elasticity for lowfat milk averaged 0.293 in the South and 0.316 in the total U.S. (Table 5). Boehm reports that income elasticities for 2 percent milk were 0.16 and 0.40 for the U.S. and southern region, respectively. Salathe's estimates of income elasticities for other fluid milk in the U.S. vary from 0.360 to 0.384. The elasticities reported in this study lie between those reported by Boehm and by Salathe.

Differences in results may be attributed partially to the procedures and data used by the different authors. Boehm included only consuming households in his sample and used OLS procedure for parameter estimation. Although both consuming and nonconsuming households were included in Salathe's study, OLS was also used in the regression analysis. By using the total sample and the Tobit regression analysis, the present study not only overcomes the shortcomings of the previous studies, but also provides further insights into how fluid milk expenditures may respond differently with respect to changes in socioeconomic variables.

Table 5. Household Size Elasticity for Whole Milk and Household Income Elasticity for Lowfat Milk in the South and the U.S., 1977–78 [a]

Household size and income	Conditional elasticity		Market participation elasticity		Total elasticity	
	South	U.S.	South	U.S.	South	U.S.
			Whole milk			
1–2 persons	.334	.324	.448	.553	.781	.877
3–4 persons	.613	.581	.410	.550	1.023	1.130
5 or more persons	.763	.714	.193	.304	.956	1.018
Average	.514	.476	.467	.610	.981	1.086
			Lowfat milk			
Income < $5,000	.074	.133	.277	.296	.351	.429
$5,000 ≤ Income < $10,000	.087	.104	.290	.277	.377	.381
$10,000 ≤ Income < $15,000	.070	.069	.281	.275	.351	.344
Income ≥ $15,000	.036	.065	.214	.215	.250	.280
Average	.065	.059	.228	.257	.293	.316

[a] Elasticities are evaluated at the means.

CONCLUSION

Fluid milk expenditure patterns in the southern region and in the total U.S. were examined for two product types, whole milk, and lowfat milk. The analysis was based on the application of the Tobit maximum likelihood procedure to the 1977–78 USDA NFCS data.

Results of the analysis suggest that distinct expenditure patterns exist between whole milk and lowfat milk and between the southern region and the total U.S. Specifically, the analysis suggests that household size and household income affect the forms of fluid milk expenditures quite differently. The study results indicate that while the effects of increased income on lowfat milk expenditure in the total U.S. may be largely offset by decreases in whole milk expenditures in the South, fluid milk expenditure may be expected to increase as household income in the region increases.

By decomposing the marginal effects, the analysis identifies the differential response patterns of household size and income on whole milk and lowfat milk expenditures, respectively. The results suggest that as household size increases, the effect of increasing whole milk expenditure due to conditional expenditure dominates the effect of increasing expenditure due to increases in the probability of consuming. On the other hand, household expenditure for lowfat milk responds primarily to changes in household income, not household size. The analysis suggests that the income effect on lowfat milk expenditure is dominated by the effect that higher income induces greater probability to consume lowfat milk rather than to consume greater amounts. Thus, the effect of income on conditional expenditure of lowfat milk is of little importance as opposed to the effect of household size on conditional expenditure of whole milk.

This study has important economic and marketing implications for the dairy industry in the South in that market segments may be defined for each type of fluid milk, thus giving the dairy industry an opportunity for market strategy planning and development of promotional campaigns. The target market for whole milk may be composed of households with the following socioeconomic characteristics: large in size, low in income and educational levels, and probably residing in central cities and rural areas. On the other hand, households with higher income and educational levels, residing in metropolitan areas, appear to constitute a prime market for lowfat milk. Based on the analysis of this study, the dairy industry would benefit from directing its efforts in the promotion of fluid milk consumption on the basis of demographic and socioeconomic characteristics of the consuming markets.

REFERENCES

Amemiya, T. "Regression Analysis When the Dependent Variable is Truncated Normal." *Econometrica* 41(1973):997–1016.

Boehm, W. T. "The Household Demand for Major Dairy Products in the Southern Region." *S. J. Agr. Econ.* 7(1975):187–96.

Boehm, W. T., and E. M. Babb. "Household Consumption of Beverage Milk Products." Purdue University, Dept. of Agr. Econ., Agr. Exp. Sta. Bull. No. 75, Mar. 1975.

Buse, R. C., and A. Fleischner. "Factors Influencing Food Choices and Expenditures." University of Wisconsin-Madison, Dept. of Agr. Econ., *Econ. Issues* No. 68, May 1982.

Greene, W. H. "On the Asymptotic Bias of the Ordinary Least Squares Estimator of the Tobit Model." *Econometrica* 49(1981):505–13.

Hassan, Z. A., and S. R. Johnson. *Urban Food Consumption Patterns in Canada.* Agriculture Canada, Economics Branch Publication 77/1, Ottawa, January 1977.

Lebovit, C. B. "The Impact of Some Demographic Changes on U.S. Food Consumption: 1965–75 and 1975–90." In *Natl. Food Sit.*, USDA, ERS, NFS-156, May 1976, pp. 25–29.

McDonald, J. F., and R. A. Moffitt. "The Uses of Tobit Analysis." *Rev. Econ. Stat.* 62(1980):318–21.

Murphy, P. E., and W. A. Staples. "A Modernized Family Life Cycle." *J. Consumer Res.* 6(1979):12–22.

Salathe, L. E. *Household Expenditure Patterns in the United States.* USDA, ESCS, Tech. Bull. No. 1603, April 1979.

U.S. Department of Agriculture, ERS. "Food Consumption, Price, and Expenditures, 1960–80." Stat. Bull. No. 672, September 1981.

Wells, W. C., and G. Gubar. "Life Cycle Concept in Marketing Research." *J. Mkting. Res.* 3(1966):355–63.