An Analysis of Consumers' Purchasing Behavior for High- and Low-fat Milk: A Focus on Healthy Drinking

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Introduction

Household consumption theory suggests that consumers purchase different bundles of goods and services to produce desired bundles of satisfaction or utility (Becker, 1976). Widely different bundles of goods and services can lead to both similar and dissimilar bundles of satisfaction or utility. Consumer preferences, of course, determine the ultimate makeup of any purchased bundle of goods and services. These preferences, although registered in the market as purchased goods and services, are really a demand for utility or satisfaction (Becker, 1976). Observations on consumer behavior have led some economists to postulate similarity in consumers' preference functions. Becker (1976) argues that this similarity applies more to the underlying objects of choice than it does to market goods and services. For example, both wealthy and poor persons are likely to prefer a full stomach to an empty one, and both are likely to purchase market goods to produce meals to satisfy this preference. Yet the combination of goods purchased is likely to differ markedly between the two groups. Furthermore, given different opportunity costs of time, it is even optimal for individuals to achieve their objectives with different bundles of goods and services (Becker, 1976).

Although it is widely accepted that individuals have different preferences, it is often suggested that there is enough similarity in preferences to lead to similar consumption patterns. Indeed, when consumption patterns for a particular food or beverage group show considerable disparity among socioeconomic groups, it is often attributed to disparity in information dissemination among the groups. Relative to milk, the argument is advanced that consumers have collected and analyzed information about various types of milk, and they have used this information to make choices from the many types of milk. These choices, as reflected by consumer purchases, differ for socioeconomic groups because each group receives different sources of information, and these information sources are instrumental in influencing purchase decisions (Evans and Berman, 1992). Simply put, tastes and preferences are not inherited, but they are shaped and influenced by various sources of information.

Regardless of whether there is convincing evidence to support the hypothesis that consumption patterns are determined by information flows, there are cases in which higher-educated individuals have been shown to adopt healthier products at a faster pace than that shown for lower-educated individuals. Milk provides a perfect illustration of this adoption process. Higher-income consumers have been shown to move from the consumption of high-fat milk (whole and 2%) to low-fat milk (1%, 1/2% and skim) at a much faster pace than lower-income consumers have (Zho, Chern, and Jacobson, 1996). Indeed, a 1994 study of milk consumption patterns for three lower-income areas and three higher-income ones in the Columbus area show high-fat milk constituting 88 percent of total milk consumption in the lower-income areas as compared to 59 percent in the higher-income areas (Jones, Barnett, and Rashid, 1995). These percentages compare with an average consumption of high-fat milk across all income areas of 75 percent (Reger et al., 1998). Many social scientists would attribute this observed disparity in milk consumption between the two income groups to the fact that wealthier people generally receive a higher quality of information about healthy eating and are, therefore, more prone to adopt nutritious diets. Additionally, an argument has been advanced that higher-income consumers have a circle of friends who readily adopt healthy diets and, therefore, quickly and easily influence the consumption behavior of those around them (Evans and Berman, 1992). Of course, adoption theory suggests that even slow adopters will eventually catch up with fast adopters. To this end, the paper focuses on the issue of whether lower-income consumers are beginning to show consumption patterns for low-fat milk that are moving toward those of higher-income consumers. Additionally,

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this paper addresses the question of whether demand elasticities differ among lower- and higher-income consumers. Specifically, a seemingly unrelated regression (SUR) model is specified and estimated for six types of milk.

To accomplish the objective of this paper, consumption patterns of lower- and higher-income consumers are compared for low- and high-fat milk. These comparisons are made across two consumption areas, both of which were part of a previous study that used 1993–94 data. Analyses in this paper use 1997–98 data for the same two areas. Specifically, changes in sales (and, by assumption, consumption) of high- and low-fat milk for a higher- and a lower-income store are compared over two time periods. Following the arguments of adoption theory, slow adopters (lower-income consumers), as they have had more time to accumulate more and higher-quality information, should be moving toward the consumption rate of low-fat milk that mirrors that of higher-income consumers. That is, during the 1993–94 through 1997–98 period, lower-income consumers should have shown greater movement toward the consumption of 1%, 1/2% and skim milk than that shown by higher-income consumers. Ideally, consumption patterns for all six stores should be studied and compared. However, a time constraint limits this analysis to just two stores. Analyses of these two stores, while not likely to be as informative as what could be gained from all six, should nevertheless provide reasonable and unbiased assessment of changes in consumer behavior for milk.

Relative to the national average of 75 percent consumption of high-fat milk, the three higher-income areas showed consumption rates of 59 percent for high-fat milk in 1993 and the three lower-income areas showed consumption rates of 88 percent. Within the higher-income areas, the one store and area used in this study had a consumption rate of 61.7 percent of high-fat milk in 1993–94, and the store and area within the lower-income areas had a consumption rate of 86.7 percent of high-fat milk (Table 1 and Figure 1). These figures, in the current analysis, are respectively 52 percent and 76 percent (Table 1 and Figure 1). Numerically, consumers in the area around the lower-income store have shown a greater movement toward low-fat milk, but statistically these differences are insignificant.

Consumption Changes

Consumption patterns for 1997–98, as compared to those for 1993–94, show fairly significant declines in whole milk for both higher- and lower-income consumers. Using figures that show the percentages of total milk consumption represented by each milk type, the 1997–98 figures show higher-income consumers with a drop in consumption of 2% milk by 11 percentage points but a slight increase in consumption of whole milk by two percentage points. By contrast, lower-income consumers showed a 9 percentage-point drop in the consumption of 2% milk but no change in the consumption of whole milk (Table 1 and Figure 1). Indeed, the net change in high-fat milk is roughly the same for higher- and lower-income consumers. These changes, however, do not support the hypothesis that lower-income consumers have gained access to and acted upon improved information about healthy diets. Of course, some nutritionists argue that observed consumption patterns for high-fat milk by lower-income consumers might indeed represent a purchasing strategy. That is, these nutritionists see the purchase of whole milk by lower-income consumers as a low-cost way of adding fat to their diets (Allred, 1996). Given no change in the consumption pattern of whole milk for lower-income consumers since 1993, this argument of a purchasing strategy does indeed seem credible.

Table 1. Milk Consumption by Milk Type.

	Store Type 1993–94		Store Type 1997–98	
Milk Type	Low-Income	High-Income	Low-Income	High-Income
	% of Total			
1%	4.38	11.23	10.81	16.98
2%	49.37	49.12	38.85	37.91
Whole	37.34	12.61	37.35	14.22
½%	1.13	8.17	0.53	2.50
Skim	7.68	18.68	9.25	25.34
All Others	0.09	0.17	3.21	3.05
Total	99.99	99.98	100.00	100.00

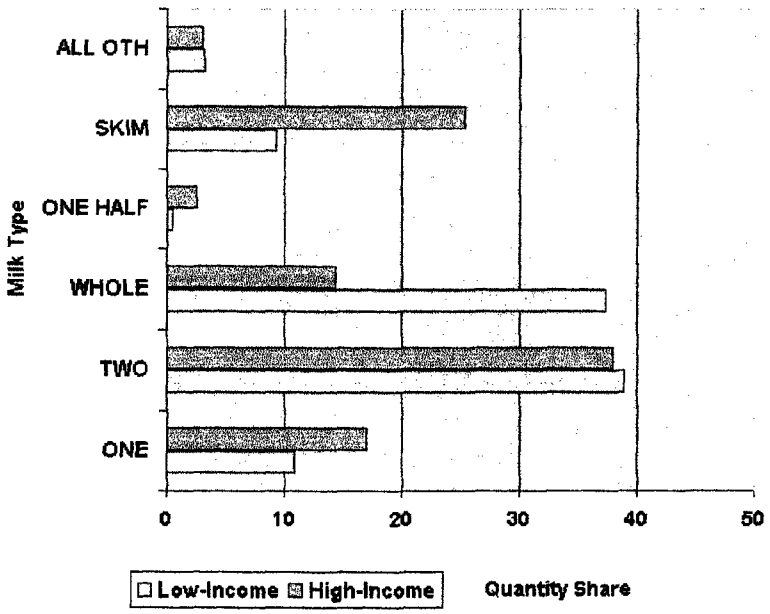

Figure 1. Milk Consumption by Milk Type, 1997–98.

Ignoring the "all other category"[1] of milk, it is of interest to note that lower-income consumers did indeed reduce their consumption of high-fat milk. Of course, this same trend is observed for higher-income consumers, but the combination of changes is much different. Higher-income consumers showed a sharp reduction in the consumption of both 2% and ½% milk but significant increases in the consumption of 1% and skim milk. These combinations led to a reduction of nine percentage points for high-fat milk and a six percentage-point increase for low-fat milk (Table 1 and Figure 1). Overall, as previously stated, the aforementioned relative changes for the two groups do suggest that lower-income consumers have gained access to much of the same information that is previously available to higher-income consumers.

A somewhat surprising result was the six percentage-point reduction in the consumption of ½% milk for the higher-income store. With both skim and 1% milk showing significant increases in consumption and ½% milk being in the middle of these two products in terms of butterfat, it seems reasonable to postulate that this phenomenon has some underlying cause. Indeed, the data suggests that price is the culprit. Price per gallon for ½% milk averaged $2.18, as compared to the next highest price of $2.05 for 2% milk. Similar pricing patterns for ½% and other milk types were revealed for the lower-income store, though the price of 2% milk was roughly the same as that of whole milk (Table 2 and Figure 2). These prices, of course, partly reflect the quantity size of purchases. For example, the revealed higher price for ½% milk could simply reflect the fact that more of it was purchased in half-gallon, quart, and pint sizes than in gallon sizes.[2] However, since there is no evidence to suggest that ½% milk was not available in the same sized proportions as that of the other milk types, it seems reasonable to conclude that price was a determining factor. Indeed ½% milk was the lowest-priced milk type in the earlier study. Furthermore, the relative odd size and butter content of ½% milk probably make it a less popular type of product in consumers' preference functions.

[1]Unlike the 1993–94 data set, the 1997–98 data showed a significant increase in flavored milk—strawberry, chocolate, etc. These milk types, although sometimes labeled as 1%, 2%, etc., were invariably placed in the "all other category."

[2] The data used for this study allow for the testing of a hypothesis that ½% milk prices are influenced by the size of package purchases. These additional analyses, however, have not yet been conducted.

Table 2. Average Milk Prices for Two Stores Over 65 Weeks.

Type	Price per Gallon
Low-Income Store	
1%	$1.88
2%	2.05
Whole	2.05
½%	2.11
Skim	1.96
All Others	1.58
High-Income Store	
1%	1.98
2%	2.05
Whole	2.01
½%	2.18
Skim	1.99
All Others	1.63

Regression Results

The revealed higher price for ½% milk was unexpected, since previous studies have found all types of low-fat milk to be either lower or equal in price to high-fat milk (Jones, Barnett, and Rashid, 1995; Reger, et al., 1998). Given this higher price of milk, several regression equations were run to examine the impact of prices on purchases. With each type of milk being quite similar in terms of satisfying consumers' dietary requirements for calcium, a seemingly unrelated regression system was specified and estimated. These results are shown in Tables 3 and 4. Although the equations are fairly simple in specification, the included variables explain most of the variation in the dependent variables (quantity purchased).

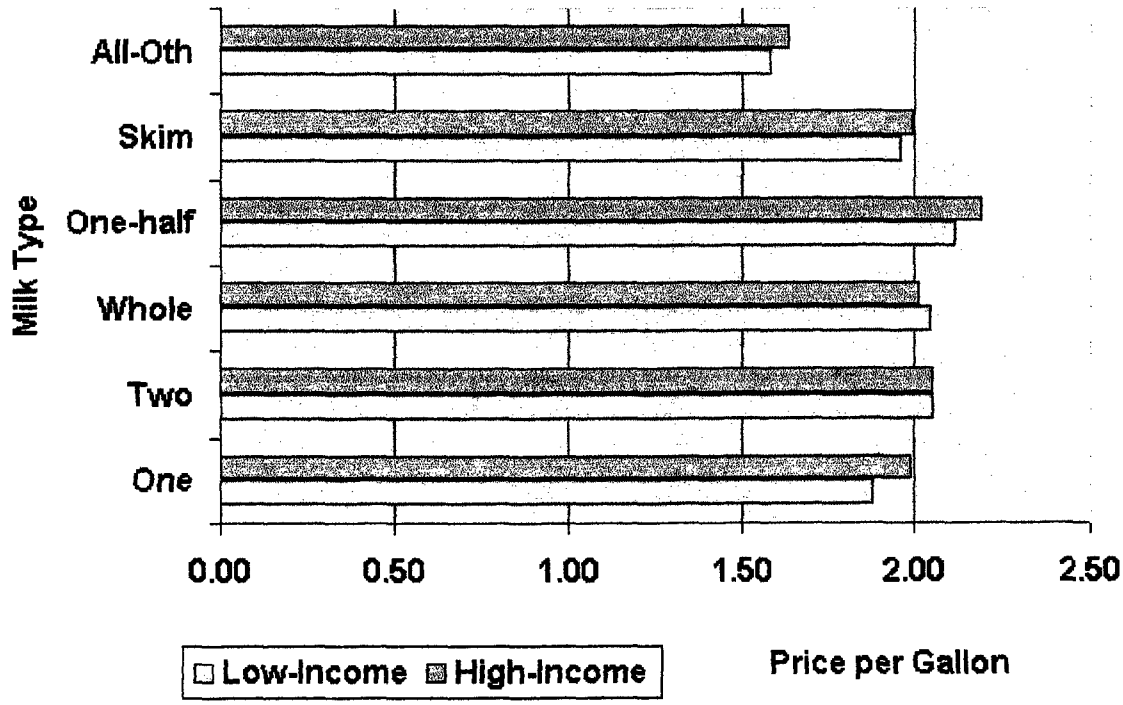

Figure 2. Milk Prices for Low- and High-Income Stores.

Table 3. Seemingly Unrelated Regression Results for Lower-Income Store.[a]

Variable	Coefficient	Std. Error	T-Ratio
CONSTANT	-5.91513	2.554422	-2.316
LPONE	-1.106504	0.157484	-7.026
LMSALES	1.223079	0.258136	4.738
LPAOTH	0.663946	0.329265	2.016
AONE	0.096673	0.024688	3.916
LQONEL	0.13177	0.055724	2.365
CONSTANT	-0.191373	0.868947	-0.22
LPTWO	-0.890689	0.054117	-16.459
LMSALES	0.855876	0.088021	9.724
LPAOTH	0.365173	0.10713	3.409
ATWO	-0.013487	0.008227	-1.639
LQTWOL	0.034964	0.034355	1.018
CONSTANT	-0.299296	0.669076	-0.447
LPWHLE	-0.862919	0.04346	-19.856
LMSALES	0.874371	0.068858	12.698
LPAOTH	0.28555	0.083061	3.438
AWHLE	-0.014329	0.006507	-2.202
LQWHLEL	0.023523	0.029566	0.796
CONSTANT	-2.818694	1.223504	-2.304
LPSKIM	-0.840552	0.105186	-7.991
LMSALES	0.974611	0.125603	7.759
LPAOTH	-0.161731	0.159675	-1.013
ASKIM	-0.025002	0.011422	-2.189
LQSKIML	0.07666	0.056715	1.352
CONSTANT	-13.598858	9.316692	-1.46
LPOHLF	2.097895	0.641948	3.268
LMSALES	1.337715	0.944578	1.416
LPAOTH	1.913234	1.041155	1.838
AOHLF	0.418371	0.191293	2.187
LQOHLFL	0.395652	0.101992	3.879
CONSTANT	-10.848763	2.348053	-4.62
LPAOTH	-0.087246	0.258616	-0.337
LMSALES	1.675371	0.24679	6.789
LPOHLF	-0.002141	0.120026	-0.018
AAOTH	0.010904	0.002991	3.645
LQAOTHL	-0.014235	0.066393	-0.214

[a] Dependent Variable is Quantity—Measured in Gallons.

Table 4. Seemingly Unrelated Regression Results for Higher-income Store. [a]

Variable	Coefficient	Std. Error	T-Ratio
CONSTANT	-2.745582	1.606312	-1.709
LPONE	-1.174694	0.089011	-13.197
LMSALES	1.099474	0.165418	6.647
LPAOTH	0.009784	0.153893	0.064
AONE	0.014061	0.010698	1.314
LQONEL	-0.01554	0.059184	-0.263
CONSTANT	0.113568	0.66865	0.17
LPTWO	-0.859034	0.044185	-19.442
LMSALES	0.830043	0.070386	11.793
LPAOTH	-0.129277	0.065057	-1.987
ATWO	0.00002828	0.007091	0.004
LQTWOL	0.045256	0.03865	1.171
CONSTANT	0.014478	0.83403	0.017
LPWHLE	-0.926483	0.055939	-16.562
LMSALES	0.745082	0.08592	8.672
LPAOTH	0.089617	0.079302	1.13
AWHLE	0.00819	0.007987	1.025
LQWHLEL	0.030148	0.044267	0.681
CONSTANT	-0.554824	0.931266	-0.596
LPSKIM	-0.836571	0.068819	-12.156
LMSALES	0.867758	0.095081	9.127
LPAOTH	-0.147125	0.086868	-1.694
ASKIM	0.002798	0.00685	0.409
LQSKIML	0.029363	0.045722	0.642
CONSTANT	0.0558	3.564218	0.016
LPOHLF	-1.166168	0.245764	-4.745
LMSALES	0.489426	0.37696	1.298
LPAOTH	-0.405201	0.385109	-1.052
AOHLF	-0.053126	0.069109	-0.769
LQOHLFL	0.274877	0.10118	2.717
CONSTANT	-8.527569	1.709826	-4.987
LPAOTH	1.430497	0.176202	8.119
LMSALES	1.304632	0.195725	6.666
LPOHLF	-0.152297	0.072461	-2.102
AAOTH	0.018212	0.002488	7.321
LQAOTHL	0.093276	0.077233	1.208

[a] Dependent Variable is Quantity—Measured in Gallons.

Referring to Tables 3 and 4, it can be seen that all equations include quantity purchases of the respective milk types as the dependent variable and own price, a cross price, total milk sales, milk promotion, and lagged quantity as independent variables. Specifically, all variables except the advertising/promotion variable, are expressed in log form. Prices are determined by expressing each product sale as a ratio of all product sales within a given product group. In essence, all prices are weighted by container size and quantity of purchase.

All equations are expressed in the same form. Using equation (1) of Table 3 as an example, LPONE is the log price of 1% milk; LMSALES is the log price of milk sales for a given store; LPAOTH is the log price of "all other milk types" that are not included in 1%, 2%, skim, whole, or ½%; AONE is a dummy variable for the promotion of 1% milk, and it equals 1 during weeks of promotion and zero otherwise; and LQONEL is a one-period lag of the dependent variable. It should be noted that the first variable following the constant is always the own-price variable. All other equations are similarly defined and, therefore, the specified acronyms should be self-explanatory.

A review of Tables 3 and 4 for the lower- and higher-income stores will show the own price elasticities to be consistently negative for all milk types, except "½%" and "all other" milk types. These latter two products sometimes yielded positive and statistically significant elasticities; sometimes negative and statistically significant; and sometimes negative and statistically insignificant. Fortunately, both of these milk types represent small shares of consumers' total milk consumption.

As cross-price variables, all equations include prices for either "all other milk" or "½%". These milk types are included because correlation analyses showed these two products to be only marginally correlated with the other milk types. By contrast, 1%, 2%, skim, and whole milk prices are highly correlated. This correlation among the variables, however, had little to no impact on the regression results among the equations. Indeed, R^2 values in the first stage of estimation (ordinary least squares) are consistently in the .85 to .93 range. More importantly, all of the own-price elasticities are negative, statistically significant, and inelastic, save for 1% milk, which is slightly above unitary for both lower- and higher-income consumers.

Despite the fact that some nutritionists argue that lower-income consumers find whole milk to be a low-cost way of adding fat to their diets, a fairly recent study suggests that lower- and higher-income consumers respond alike to health information. More specifically, a study of a large group of West Virginia consumers showed that all consumers of high-fat milk switched to low-fat milk at the same pace, regardless of income, education, gender, or employment status (Reger et al., 1998). This finding suggests that all consumers have the same motivation to move to healthier diets when presented with compelling reasons for doing so. In the West Virginia study, this motivation was stimulated by information presented on the danger of elevated blood cholesterol, saturated fat, and heart disease. Indeed, this same study found 2% and whole milk to be two of the leading sources of saturated fat. A simple switch from these two high-fat products to low-fat milk, according to scientists, can reduce the fat intake as a percentage of total calories from an average of 12 percent to the recommended level of 10 percent (Reger et al., 1998).

Summary and Conclusions

Despite obvious improvement in information flows during the past four years, milk consumption patterns among lower- and higher-income consumers in the Columbus, Ohio area continue to show considerable disparity. Indeed, whole milk consumption among lower-income consumers in one Columbus area showed no change during the past four years. This phenomenon offers support to the argument advanced by some food scientists that lower-income consumers purchase whole milk as a low-cost way of adding fat to their diets. Indeed, if one combines 2% and whole milk and considers the two as the category of high-fat milk, then consumers in this lower-income area have moved fairly close to the national average of 75 percent high-fat milk. That is, these two types of milk represent 76 percent of total milk consumption for this lower-income area. However, this movement from 86.7 percent in 1993–94 to 76 percent in 1997–98 has come entirely

from a reduction in the consumption of 2% milk. Thus, it is conceivable that lower-income consumers are purchasing whole milk as a low cost way of adding fat to their diets.

To add additional insight into the purchasing behavior and consumption patterns of milk for lower- and higher-income consumers, several geographical areas need to be studied over several time periods. Indeed, as a follow-up study, these researchers are expanding their analyses to include six geographical areas in the Columbus, Ohio area. Three of these will be in lower-income areas, and three will be in higher-income areas. With these additional analyses, a more definitive conclusion can be drawn about milk consumption for all consumers.

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