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THE IMPACT OF INCOME ON HOUSEHOLD EXPENDITURE ON DAIRY PRODUCTS: EVIDENCE FROM THE UNITED STATES DAIRY MARKET

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Abstract

This paper uses the diary portion of the 2016 Consumer Expenditure Survey to study the impact of income on dairy product expenditure in the United States using the Tobit model. Results show that the effect of income is positive and significant. However, as income increases, households introduce more dairy products into their consumption bundle. Low-income households who are eligible for the Supplemental Nutrition Assistance Program would get benefit from this program as the effect of this program on dairy product expenditure is also positive and significant. The study suggests that this information needs to be used by public sectors when formulating their health-promoting programs, and also by food retailers when making their market strategies.

Keywords: Dairy Products, Household Expenditure, Tobit Model

JEL Classifications: C30, D12

1. Introduction

Milk and milk products are widely recognized as important sources of nutrients including vitamin D, calcium, magnesium, and potassium (Cotton *et al*. 2004). Despite the importance of dairy products in human nutrition, the share of preadolescent children who did not drink fluid milk on a given day rose from 12 percent to 24 percent in the United States between 1977-78 and 2007-08 respectively (Stewart *et al*. 2013). The food and financial crisis of 2008 and 2009 focused the United States governments' attention on the importance of food and nutrition security as a fundamental component of socioeconomic development and political stability (Muehlhoff *et al.* 2013). The Federal Government encourages dairy consumption, including fluid milk, cheese, and yogurt, among other foods, through the Dietary Guidelines for Americans, 2010, that helps consumers to meet nutrient recommendations (Thorning *et al.* 2016). As a result, during 2010-2014, the total domestic consumption of dairy products in the United States grew by 0.9 percent per year (USDA, 2016).

Household consumption of dairy products is the major component in the total sales of the United States dairy industry. Only refrigerated yogurt sales were $7.7 billion in 2015 (Mohammed, 2018). For centuries, understanding of factors associated with consumer choice has been of interest to economists. Household expenditure on dairy products is mainly affected by the socioeconomic and demographic characteristics of households. Studies show that non-

economic factors are more important in determining consumers' purchasing decisions (Bansback, 1995; Dickinson *et al*. 2003). Households in the lowest income categories, $20,000-$34,999 annually and $19,999 or less, have a positive and statistically significant influence on milk, cheese, and margarine purchases in the United States (Davis *et al*. 2010). On the other hand, household's expenditure on dairy products, in general, is steady across most income groups in the United States; only in the two highest income groups are increases in expenditures remarkable (Frazao *et al.* 2007). The question that arises here is whether dairy products are normal goods. Studies show that income is the key determinant of dairy consumption in major Asian countries (Dong, 2005; Fuller *et al*. 2007).

However, this study is going to identify the relationship between household dairy products expenditure and their socioeconomic and demographic characteristics, the main objective of this study is testing the hypothesis that dairy products are normal goods, i.e., expenditure on dairy products is income responsive. This paper further aims to study whether an increase in household income caused by the Supplemental Nutrition Assistance Program (SNAP) that is initially designed to reduce the food insecurity[1] would increase household expenditure on dairy products. SNAP can play a crucial role in enhancing the dietary quality of low-income households. To the best of my knowledge, this paper is the first study that assesses the association between SNAP participation and expenditure on dairy products. The result of this study is important for the United States federal government to adjust their health-promoting programs to achieve nutrition security goals for its inhabitants.

The most recent study by Garasky *et al.* (2016) on household food expenditure shows that, in general, dairy products represent 9 percent and 10 percent of food typically purchased by SNAP households and non-SNAP households respectively in 2016 that makes $3,828.6 million collectively. Fluid milk ranked 9 out of 30 by category expenditure where the total household expenditure was $1,044.9 million by SNAP and non-SNAP households collectively. Yogurt, other fast-growing markets in the United States, per capita consumption was 14.4 (lb/person) in 2015 (Mohammed and Murova, 2019a). A recent study shows that the main U.S. national brands of yogurt are considered normal goods as an increase in income will increase the household expenditure on yogurt (Mohammed and Murova, 2019b). In this study, the Tobit model is applied to the 2016 Consumer Expenditure Survey to analyze the impact of income on dairy product expenditure. In the next section, the Tobit model is explained followed by data definitions and sources. Then, the main findings of the study are presented followed by the conclusion of this study.

2. Model

In this study, the dependent variable is the weekly household's expenditure on all kinds of dairy products while explanatory variables include sociodemographic characteristics. Households not recording dairy products purchases during the specified period, but having otherwise completed records of sociodemographic variables are included in the sample. The reason for non-purchasing might be due to sufficient household inventory, response to market prices, or general non-preference for dairy products. About 50% of the households reported no dairy product expenditures during a two-week period. Containing zero values in the dependent variable will make parameter estimates to be inconsistent when using the Ordinary Least Squares method (Greene, 2007). Thus, to examine how income affects the dairy expenditure after controlling the key sociodemographic variables, a censored normal regression model or the Tobit Model (Tobin, 1958) is suitable to deal with the censored dairy expenditure (Greene, 2003). The empirical model is shown in Equation 1:

$$y_i = \begin{cases} y_i^* = \beta x_i + u_i & if \quad y_i^* > 0 \\ 0 & if \quad y_i^* \leq 0 \end{cases} \tag{1}$$

[1] SNAP program is a federal program that aimed to help eligible low-income U.S. households to get access to more food and nutrition.

where y_i represents the latent variables of weekly household expenditure on dairy products, x_i is a matrix containing vectors of explanatory variables describing household i, β is a vector of unknown coefficients to be estimated, and u_i is assumed to be an *iid* noise term following a normal distribution with zero mean and unknown σ^2 variance. The model was estimated using maximum likelihood by STATA Tobit program.

3. Data

The data used in this paper have been collected from the diary portion of the 2016 Consumer Expenditure Survey (CES) administrated by the United States Department of Labor, Bureau of Labor Statistics. The consumer expenditure program was begun in 1980 and its principal objective is to collect information on the buying habits of American consumers (US Department of Labor, 2005). The Diary survey is designed to capture expenditures on small, frequently purchased items that are normally difficult for respondents to recall.

Table 1. Descriptive statistics of the household's characteristics (N=13546)

Variable	Definition	Mean	Std. Dev.
Size	Number of household members	2.476	1.447
Income	After tax income ($/week)	1273	1175
Snap	Snap allowance ($/week)	5.103	21.714
Age	Age of reference person	49.899	17.351
Urban	=1 if a household lives in urban areas	0.950	0.217
Rural	=1 if a household lives in rural areas	0.050	0.217
Hs	=1 for single person	0.291	0.454
Hw	=1 for husband and wife family	0.220	0.415
Hwc	=1 for husband and wife own children oldest child under 6	0.046	0.210
Hwt	=1 for husband and wife own children oldest child 6 to 17	0.125	0.330
Hwa	=1 for husband and wife own children oldest child over 17	0.064	0.245
Northeast	=1 if household lives in Northeast	0.196	0.397
Midwest	=1 if household lives in Midwest	0.236	0.425
West	=1 if household lives in West	0.223	0.416
South	=1 if household lives in South	0.345	0.476
School	=1 for high school or lower education reference person	0.358	0.480
College	=1 for at college or higher education reference person	0.639	0.480
White	=1 if race of reference person is white	0.815	0.388
Black	=1 if race of reference person is black	0.121	0.326
Other	=1 if race of reference person is other	0.010	0.102

Source: Author's calculation from US Department of Labor (2005)

Data represent non-institutional U.S. population households (Zan and Fan, 2010) who report their expenditures on food items for two consecutive weeks. The dataset also provides information on socioeconomic and demographic characteristics of the households like annual income, level of education, age of members, family size, and region of residence. About 13,761 households have surveyed in the 2016 diary survey, but only 13,546 of them have been used in this study after removing those with incomplete information. The survey does not account for spending on dairy products purchased in a food service facility. Therefore, these data may underestimate all dairy product spending. The sample statistics of variables used in this study are presented in Table 1, while Table 2 presents the per capita weekly expenditures on dairy products. This information is obtained by averaging the household's weekly spending on dairy products over the two-week survey period and then dividing this measure by the number of members in the household.

Table 2. Per capita weekly expenditure on dairy products

Variable	Mean	Std. Dev
All Dairy	1.802	2.410
Milk	0.643	0.971
Other Dairy	1.159	1.901

Source: Author's calculation from US Department of Labor (2005)

4. Results

The estimation results of the Tobit model are presented in Table 3. The highly significant σ parameter indicates that the Tobit model provides a more efficient estimation than the OLS regression (Fernandes da Costa *et al.* 2011).

Table 3. Estimation results of expenditure on all dairy product, milk, and other dairy product

	All Dairy	Milk	Other Dairy
Variable	Socio-economic Factors		
Income	0.001***	0.001***	0.002***
	(0.00)	(0.00)	(0.00)
College	0.536***	-0.043	1.595***
	(0.14)	(0.14)	(0.27)
	Demographic Factors		
Size	1.169***	1.238***	1.643***
	(0.05)	(0.05)	(0.10)
Age	0.028***	0.022***	0.048***
	(0.00)	(0.00)	(0.01)
Urban	-0.454	-0.612**	-0.165
	(0.28)	(0.28)	(0.55)
Hw	1.209***	0.827***	2.529***
	(0.16)	(0.16)	(0.31)
Hwc	1.399***	1.522***	2.010***
	(0.30)	(0.30)	(0.59)
Hwt	1.691***	1.228***	3.039***
	(0.22)	(0.22)	(0.42)
Hwa	1.109***	0.780***	2.172***
	(0.27)	(0.27)	(0.52)
Northeast	0.666***	0.204	1.426***
	(0.17)	(0.17)	(0.34)
Midwest	0.583***	0.145	1.603***
	(0.16)	(0.16)	(0.32)
West	0.480***	0.204	0.959***
	(0.17)	(0.17)	(0.33)
White	1.732***	0.490*	4.373***
	(0.25)	(0.25)	(0.51)
Black	-0.247	-1.282***	0.776
	(0.31)	(0.31)	(0.62)
Constant	-6.073***	-5.082***	-17.829***
	(1.52)	(1.53)	(3.15)
	Parameter		
Sigma	6.624***	6.431***	12.400***
	(0.05)	(0.06)	(0.11)

Note: Number in parentheses are standard errors. * p<0.10, ** p<0.05, *** p<0.01.
Source: Author's own calculation from Tobit estimation.

The explanatory variable of primary interest is a household's weekly per capita income. Dairy products are expected to be normal goods, i.e., household expenditure on dairy products is increasing in income. As expected, income has a positive and significant effect on dairy product expenditure. This indicates that high-income households tend to pursue a healthier diet and consume more dairy products. Furthermore, there is an argument that education is correlated with an awareness of the importance of healthy eating where better-educated people tend to spend more on dairy products due to superior knowledge of health issues. Well-educated households are found to spend $0.53 more on dairy products every week than those households with high school or lower education degrees.

Besides socioeconomic factors, most demographic characteristics also have a statistically significant influence on dairy product expenditure. The size variable controls for variations in the number of members across households. As expected, larger households are likely to spend more on dairy products than smaller households. People of different ages have different health requirements (see, Variyam *et al.* 2002). Results showed that older households tend to spend more on dairy products than younger households. There is not a statistically significant difference in expenditure on dairy products between urban and rural households. Compared to a single person, couples spend more on dairy products, even if they do not own any children.

Expenditure on dairy products is also different according to the region. Households in different parts of the U.S. spend more on dairy products than those households who live in the South. This result is consistent with the old study conducted by Boehm (1975) who revealed that household consumption of dairy products in the South tends to be lower than the national average due to the higher prices of dairy products and lower household income in the South compared to the national household income. Households in the Western, Eastern, and Central regions of the United States are more likely to purchase refrigerated yogurt, natural cheese, cottage cheese, and butter than those in the Southern region (Davis *et al.* 2010). Finally, households with the white race spend more on dairy products than other races while the difference in dairy products expenditure between households with the black race and other races is not statistically significant. The robustness of the results was tested by separately examining the effect of income on milk and other dairy products household expenditure as shown in Table 3 using the same explanatory variables. Income tends to be significant in both categories, which means milk and other dairy products expenditures of households are income responsive. This indicates that it is likely that households would be responsive to an increase in their SNAP allowance.

SNAP is mainly designed to increase the food purchasing power of low-income households. Studies have shown that cash and SNAP are imperfect substitutes (Wilde and Ranny, 1996). Does this mean that households who qualified for the SNAP program would substitute some of the cash previously committed to dairy products for purchasing more non-dairy products? Stewart *et al*. (2003) showed that households who get benefit from food stamps programs do not increase their expenditure on fruit and vegetable. To check whether the household’s expenditures on dairy products would increase by getting the SNAP program, a new model was estimated using the same explanatory variables, in addition, to SNAP as a separate explanatory variable. For this Tobit model, only those households who received SNAP have included which are about 1149 households. In the new model, the variable income has revised by subtracting the SNAP value from it.

Although Stewart *et al*. (2003) have shown that food stamps are not associated with increased fruit and vegetable expenditures by poor households; we assumed that SNAP has an effect on the dairy product expenditures based on our results. Estimates from the new Tobit model confirm that SNAP is associated with increased dairy product expenditures by eligible households as shown in Table 4. The robustness of the results was tested by separately examining the effect of SNAP on milk and other dairy products household expenditure using the same explanatory variables. As shown in Table 4, SNAP tends to be significant in both categories.

Table 4. Effect of SNAP on household's dairy products expenditure

	All Dairy	Milk	Other Dairy
Variable	Socio-economic Factors		
Income	0.001*	0.0004	0.002
	(0.001)	(0.001)	(0.001)
SNAP	0.019***	0.017***	0.025**
	(0.005)	(0.006)	(0.010)
College	1.486***	0.322	4.030***
	(0.426)	(0.462)	(0.836)
	Demographic Factors		
Size	0.655***	0.714***	1.019***
	(0.177)	(0.190)	(0.345)
Age	0.021	0.026*	0.022
	(0.014)	(0.015)	(0.029)
Urban	-0.534	-1.444	1.004
	(0.828)	(0.885)	(1.673)
Hw	0.398	0.956	-0.341
	(0.965)	(1.034)	(1.978)
Hwc	0.205	-1.540	2.318
	(1.153)	(1.284)	(2.199)
Hwt	3.112***	2.002**	5.435***
	(0.743)	(0.797)	(1.431)
Hwa	1.799*	3.683***	0.695
	(1.005)	(1.059)	(1.975)
Northeast	1.480***	1.260**	2.762**
	(0.557)	(0.602)	(1.098)
Midwest	1.246**	0.656	3.429***
	(0.562)	(0.612)	(1.098)
West	0.264	0.579	0.121
	(0.596)	(0.641)	(1.182)
White	0.844	0.781	0.107
	(0.931)	(1.015)	(1.785)
Black	-1.024	-0.975	-3.252*
	(1.005)	(1.095)	(1.946)
Constant	-3.805***	-3.827**	-11.200***
	(1.520)	(1.645)	(3.003)
	Parameter		
Sigma	6.408***	6.694***	11.861***
	(0.175)	(0.211)	(0.395)

Note: Number in parentheses are standard errors. * p<0.10, ** p<0.05, *** p<0.01.
Source: Author's own calculation from Tobit estimation.

5. Conclusion

Since the health benefits of dairy products consumption is well known, integrating these high-nutrition foods in the existing diet is of decisive importance. Therefore, several studies try to identify the determinants of specific food consumption in depth. The main goal of this paper is to study if income matters on expenditure on dairy products among the United States households. The Tobit model is used on data from the diary portion of the 2016 Consumer Expenditure Survey. Results show that income has a positive and significant impact on dairy product expenditure. Low-income households who are eligible for Supplemental Nutrition Assistance Program would get benefit from this program by spending more on healthy food as the effect of this program on dairy products expenditure is also positive and significant, which means an increase in income will likely induce low-income households to spend more on dairy products.

Beyond income and SNAP, dairy product expenditure is also determined by the household's demographic factors.

The results of the study suggest that health programs associated with promoting dairy product consumption are suggested to target neighborhoods with low-income households. However, increasing household income seems an efficient way of promoting dairy products consumption in the United States. Estimated coefficients related to the household demographic suggest that promotional programs need to highly target low-income households who live in the West and South since their expenditure on dairy products is significantly lower than households residing in the Northeast and Midwest. Similarly, these programs need to encourage households with the black race to spend more on other types of dairy products. Likewise, these results can also help food retailers in making their market strategies. Dairy products promotion should target the household in high-income neighborhoods, while dairy products sales need to focus on low-income neighborhoods.

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