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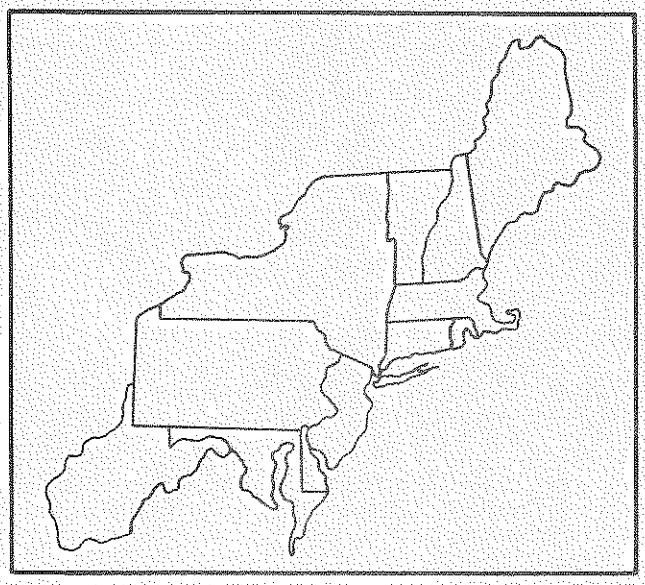

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DEMAND FOR FLUID MILK PRODUCTS IN THE NORTHEAST

by

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Introduction

One of the basic problems facing those involved in the marketing of agricultural products is that they must maintain current knowledge on the products and quantities that the "sovereign" consumer will purchase. This paper will attempt to provide information on the consumer demand for fluid milk in the Northeastern United States. Accurate information on the demand for fluid dairy products will enable dairy marketing agencies to increase their efficiency and provide a basis for policy makers to help the dairy industry.

This paper contributes to the NE-126 regional dairy marketing study which is concerned with the long range adjustments the Northeast dairy industry should make in developing the marketing potential of the dairy industry. Since the focus of the NE-126 study is on long run adjustments this paper will focus on the long run determinants of demand for fluid milk products in the Northeast. More specifically, the objective of this study is to quantitatively measure the long run relationship between the quantity of fluid milk demanded and the relevant variables determining the demand for fluid milk in the Northeastern states.

The remainder of this paper will be divided into three sections. The first section will include a discussion of the variables which are hypothesized to determine the demand for fluid milk consumption and the methodology used to quantitatively estimate the demand specification. In the second section the results of the estimation procedure will be reported and analyzed. The final section will provide a brief summary.

Estimation Procedures

Three basic categories of variables were considered a priori as being determinants of long run demand; economic, demographic and product variables. The economic variables used include price of the product, income and the price of a substitute. The effects of these variables are, in general, well known. However, several studies (Boehm and Babb, Prato, Wilson and Thompson, and Rojko) have suggested that there may be no income effect for the demand for fluid milk. However, Boehm has found nominal income to be a significant determinant of fluid milk consumption. In contrast to income, the price of fluid milk has been estimated to be a significant factor in determining fluid milk consumption. Demographic variables such as age or racial composition of the population may

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also have an effect on fluid milk consumption thus, these variables were included in the analysis. Schrimper has discussed the effects of age composition of the population, and since blacks lack enzymes that breakdown lactose, a milk carbohydrate, they have lower consumption levels.

A product variable, such as the environment in which milk is consumed, also has an impact on the level of consumption. When meals are eaten away from home less milk is consumed. Recently, consumers have been eating out more often. Data showing the trend of consumers' home and away from home eating habits was not available on a regional or state basis thus, a proxy, the number of women employed, was utilized. The work of Kinsey suggested that this may be a good proxy.

The dependent variable used was per capita consumption of all fluid milk products. This data was obtained from Gineo (1980 and forthcoming).

The statistical model used in specifying the determinants of the demand for fluid milk was a single equation and was estimated using ordinary least squares. The single equation model requires the assumption that retail price is not simultaneously determined in the market by the interaction of present demand and supply. Since eighty percent of the milk marketed in the Northeast is under federal milk marketing order jurisdiction, where farm prices are administered, this assumption is not unrealistic.

The data for the model are a combination of time series and cross sectional data. Timewise, there are five observation periods beginning in 1960 with each period being a five year interval (i.e. 1960, 1965, 1970, 1975 and 1980). Cross sectionally, the data consists of observations on sixteen states in each of the five time periods, except for 1960 when consumption data for three states was unavailable. Whenever possible, observations on the variables were taken as three year simple averages of the variable centered on the year of observation.

Rather than considering demand functions for each state separately, the states were partitioned into four groups based on their inclusion in a federal milk market order. The estimation of demand functions for these four regions, enabled the identification of those variables which commonly affected the demand in each of the groups. If the magnitude of a common variable is the same, then the observations from these groups may be pooled and one coefficient may be estimated for the groups. By pooling observations, an aggregate demand equation for the Northeast could be formed. However, before pooling observations, statistical tests must be performed to determine if the effects of common variables are the same. The statistical tests used to identify pooling possibilities in this study are described in Gineo (1980).

Results and Analysis

The final specification of each order is reported below. The numbers in parenthesis below the coefficients are the t-ratios, with "**" signifying significance at the 1% level and "*" signifying significance at the 5% level. the regional estimates are as follows;

Region 1 - Middle Atlantic States (MD, VA, DE, DC, PA)

$$\underset{\quad (9.0)^{**}}{PCC = 271.5} \underset{\quad (-3.0)^{**}}{- 0.84(PM)} \underset{\quad (2.46)^{**}}{+ 4.15(PA5)} \underset{\quad (2.47)^{**}}{+ 0.48(POJ)} \underset{\quad (1.11)}{+ 0.01(PB)} \underset{\quad (-1.40)}{- 0.06(PWE)}$$

Adjusted R-squared = .92 n = 25

Region 2 - Equation 1 - Eastern Ohio-Western Pennsylvania (OH, WV, PA)

PCC = 336.8 - 0.57(PM) + 0.04(POJ) - 0.29(PA5) + 0.21(PB) - 0.14(PWE)
(8.5)** (-1.85) (0.28) (0.10) (2.00)* (-3.19)**

Adjusted R-squared = .97 n = 12

Region 2 - Equation 2 - Eastern Ohio-Western Pennsylvania (OH, WV, PA)

PCC = 367.3 - 0.95(PM) + 0.16(POJ) - 2.57(PA5) + 0.06(PWE)
(8.4)** (-3.21)* (0.90) (-0.83) (-2.75)*

Adjusted R-squared = .96

Region 3 - New England States (ME, NH, VT, RI, MA, CT)

PCC = 300.4 - 1.28(PM) + 0.46(POJ) + 3.64(PA5) - 0.05(PB) + 0.09(PWE)
(3.66)** (2.24)** (1.41) (0.72) (-0.40) (1.10)

Adjusted R-squared = .87 n = 30

Region 4 - New York-New Jersey (NY, NJ)

PCC = 265.8 - 1.16(PM) + 0.85(POJ) + 10.1(PA5) - 0.15(PB) - 0.03(PWE)
(2.92)* (-2.77)* (2.42)* (2.06) (-0.83) (-0.32)

Adjusted R-squared = .99 n = 10

where:

PCC = per capita consumption of all fluid milk (pounds)
PM = retail price of a half gallon of milk (cents)
POJ = retail price of 6 ounces of frozen orange juice (cents)
PA5 = percentage of the population under five years of age
PB = percentage of blacks in the population
PWE = percentage of women employed

(Note the association of region numbers and state groups. This association will be used through the remainder of this study.)

Those variables which were significantly different from zero at the 5% level in the individual estimations were carried over to the aggregate specification. Some variables appeared to be significant in the individual estimations but in the aggregate equation they were not. This could be due to the large sample efficiency of the aggregate equation. The results of the testing procedure indicate that, in the aggregate demand specification, certain coefficients are statistically the same in different regions. Thus, these observations were pooled and a single coefficient was estimated. The pooling possibilities are reflected in the results reported for the aggregate equation. The results of the aggregate specification are as follows:

$$PCC = 262.2 + 72.9(D2) + 112.1(D3) - 1.01(PM124) - 1.38(PM3) + 0.51(POJ134) + 4.78(PA5\text{-}14)$$
$$(11.9)^{**}\ (4.66)^{**}\ (4.88)^{**}\ (-6.74)^{**}\ (9.48)^{**}\ (3.58)^{**}\ (2.92)^{**}$$

Adjusted R-squared = .89 n = 77

where:

PCC	=	per capita consumption of fluid milk products (pounds)
D2	=	differential intercept term for region 2 (EOWP)
D3	=	differential intercept term for region 3 (New England)
PM124	=	retail price of a half gallon of milk in regions 1, 2 and 4
PM3	=	retail price of a half gallon of milk in region 3
POJ134	=	retail price of 6 ounces of frozen orange juice in regions 1, 3 and 4
PA5-14	=	percent of the population under five years of age in regions 1 and 4.

The individual results indicate that the effects of certain variables are significant (statistically different from zero at the 5% level) in some regions, yet insignificant in others. But, the retail price of milk appeared to be a determinant of demand in each group of states. Table 1 gives estimates of the own price elasticities of demand for each of the regions separately and in the aggregate specifications. Previous studies have estimated price elasticities of demand for fluid milk products ranging from -0.11 to -0.28. The estimates in this study range from -0.15 to -0.31. The elasticities of this study may be considered long run elasticities and can be expected to be slightly larger than those obtained in other studies which have considered a shorter time period. The price elasticity of -0.28 for regions 1, 2 & 4 estimated in the aggregate equation implies that, ceteris paribus, a ten percent increase in the retail price of milk would result in a 2.8% decline in the consumption of fluid milk. The 2.8% decline suggests that 1981 per capita consumption for the Northeast would decline approximately 6 pounds from 233 to 227 pounds per capita. Overall, this would translate into a decline of 303 million pounds of fluid milk consumed in the Northeast.

TABLE 1. Price Elasticities of the Demand for Fluid Milk (Calculated from the mean)

Region	Elasticity
1 Middle Atlantic	-0.24
2 Eastern Ohio-Western Pennsylvania	-0.15
3 New England; equation 1	-0.27
4 New York-New Jersey	-0.31
1,2,4	-0.28
3 New England; equation 2	-0.29

The coefficient for POJ134 in the aggregate specification suggests that, ceteris paribus, a 10% increase in the price of orange juice results in a 0.6% or 1.5 pound increase in the per capita consumption of fluid milk. The age

composition variable (PA5) has a significant impact on per capita consumption in New York, New Jersey and the Middle Atlantic States. The estimated coefficient for PA5-14, of 4.78, suggests that, ceteris paribus, if PA5 in these states increases by 1 percent, per capita consumption will increase by 4.8 pounds per capita.

Per capita income did not appear to be a determinant of per capita consumption in the estimation procedures. This result is consistent with several other studies. Two other variables, PB and PWE, which were hypothesized to be determinants of demand did not appear to have an effect on fluid milk consumption. PWE may be a poor proxy for the number of meals eaten away from home. PB may have been insignificant because, the variable was relatively constant in several states over the observation period.

The results of the demand estimates for fluid milk reveal two interesting points. First, compared to the demand for fluid milk products at the national level, the long run fluid milk demand in the Northeast is determined by relatively few variables (own price, age composition and the price of substitutes). Previous studies have illustrated this point by identifying a greater number of determinants when estimating the demand for fluid milk at the national level. Second, the effects of the determinants of fluid milk demand are similar in magnitude throughout much of the Northeast. Evidence of consumers in the Northeast responding similarly to marginal changes in the variables is given in the aggregate specification where the coefficients for PM, POJ, and PA5 were estimated jointly for each region in which they were determinants.

Summary

This study is a portion of the Regional Project NE-126, which is concerned with determining the least cost spatial organization of the Northeast dairy industry. The objective of this study was to quantitatively measure the relationship between the quantity of fluid milk demanded and the long run determinants of demand.

The demand functions for all fluid milk products on a pounds per capita basis were estimated for each of four groups of states within the Northeast. Through a testing procedure, the data was pooled and an aggregate demand function for the Northeast was estimated. The results of the demand estimations indicate that there are relatively few determinants of the demand for fluid milk products in the Northeast. The variables which affect the demand for fluid milk products are the retail price of milk, the age composition of the population and the price of substitutes. In addition, the results indicate that within the Northeast, consumers respond similarly to changes in the determinants of demand.

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