Demand for Food Fats and Oils: The Role of Demographic Variables and Government Donations

Brian W. Gould, Thomas L. Cox, and Federico Perali

A systems model of U.S. food fats and oils demand is estimated using quarterly time-series data for the period 1962-87. Demographic scaling is used to incorporate demographic variables and per capita government butter donations. In addition to price, income, and demographic demand elasticities, dietary fat intake elasticities are calculated for each of the demographic characteristics included in the study. All of the five own-price elasticities are statistically significant, as are fifteen of the twenty cross-price elasticities. Fourteen of the fifteen demographic elasticities are statistically significant.

Key words: AIDS, demand system, demographic scaling, nutrient elasticities.

Increased public concern with fat consumption, especially saturated fat and blood cholesterol levels, is evidenced by the 1988 report of the Surgeon General (U.S. Department of Health and Human Services). Over the 1962-85 period, total dietary fat consumption increased from 143 grams per day to 169 grams per day, an 18% increase. Over this same period, the per capita consumption of saturated fat remained relatively constant (58-60 grams/day), while polyunsaturated fat consumption increased from 22 to 33 grams per day (i.e., a 50% increase) and monounsaturated fat consumption increased from 59 to 68 grams per day (i.e., a 15% increase, Raper and Marston).

Red meats and food fats and oils are the two major sources of dietary fat. Both total and unsaturated fat intake from food fats and oils has increased relative to the fat obtained from red meat sources. This increase reflects the increased consumption of poultry and fish in place of red meats, the increased consumption of food fats and oils, and the fat characteristics of these foods. Over the 1957-59 period, 40.9% and 54.5% of total dietary and polyunsaturated fat, respectively, were obtained from food fats and oils. These contributions increased to 47.2% and 68.2% by 1985 (Raper and Marston).

Figure 1 shows U.S. per capita disappearance of the five food fats and oils included in this study: butter, margarine, vegetable shortenings, salad and cooking oils, and lard. Steady increases in the consumption of vegetable shortenings, salad and cooking oils, lower consumption levels of animal-based fats and oils (i.e., butter and lard), and relatively constant margarine disappearance are shown.

The relative changes in the consumption of these food fats and oils raises questions about the causes. In this study a demand system is used to identify and measure the impacts of such factors. The specific objectives are threefold: (a) to incorporate a set of demographic variables into a demand systems model in a manner which avoids the shortcomings of previous efforts; (b) to examine how the per capita demand for food fats and oils is affected by a changing demographic profile (age, education, racial composition) and government butter donations; and (c) to examine how the dietary intake of total, saturated, and unsaturated fat has been affected by changes in the demographic profile of the U.S. population.

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Domestic Disappearance—Animal Based Oils

Domestic Disappearance—Vegetable Oils

Figure 1. Per capita disappearance of food fats and oils, 1962–87

Description of the Demand System

Food choices are affected by demographic, social, and economic factors. In the model developed here, we hypothesize that the U.S. consumption of food fats and oils is determined by relative prices and tastes and preferences which, in turn, are reflected by socioeconomic variables. A set of demographic variables is incorporated into a demand system in which the demand for fats and oils is separable from the demand for other foods. That is, the consumer first decides on the level of fat and oils expenditure and then allocates these expenditures between the various food fats and oils sources based on relative prices and demographic characteristics.

Demographic characteristics can be modeled in several ways. The use of equivalence scales is one method; however, with this approach demographic characteristics are virtually equivalent to changes in prices (Lewbel, p. 1). This restriction has been overcome through demographic translating, scaling, and Gorman procedures. In this study the demographic scaling procedure originally proposed by Barton is used so that the demographic variables can affect more than the “subsistence” or “necessary” parameters of the demand system (Pollak and Wales 1981).

Representing the original demand system as

\[ D_i = D_i(P, S, M) \quad (i = 1, \ldots, n) \]

where \( D_i \) is the per capita demand for the \( i \)th commodity, \( P \) is a vector of commodity prices, \( S \) is a vector of demographic characteristics, \( M \) is a given level of expenditure, and \( n \) is the number of commodities. Demographic scaling modifies this system as

\[ D_i(P, S, M) = \phi_i D_i^*(p_1, p_2, \ldots, p_n, M) \]

where \( p_i = p_i \phi_i \) are scaled prices and the \( \phi_i \)'s are scaling parameters which are functions of the demographic variables, \( s_1, \ldots, s_k \).

The scaling functions represent the number of commodity-specific “profile equivalents” (Pollak and Wales 1980). With respect to the demand for food fats and oils, preferences depend on the number of pounds per profile equivalent, i.e., pounds/\( \phi_i \), and on the price per pound per profile equivalent, \( p_i \phi_i \), where \( i \) is butter, margarine, etc., and \( \phi_i \) is a profile of the consumer group, which is a function of demographic characteristics (Pollak and Wales 1981, pp. 1535–36).

Empirical analysis of the demand for food fats and oils using this model requires a functional form for (2) and (3). The almost ideal demand system (AIDS) model originally formulated by Deaton and Muellbauer is adopted because of the lack of a priori restrictions imposed on the substitution characteristics between commodities and the exact aggregation properties of this functional form (Deaton and Muellbauer). A

\[ \phi_i = \phi_i(s_1, \ldots, s_k) \]

Ray (1982) and Rossi apply the scaling function to household-level data. As noted by Rossi and by Deaton and Muellbauer, the scaling function can be interpreted as a measure of household size that takes into account age composition, other household characteristics, and economies of household size which can be used to deflate total expenditures to reflect a “needs corrected per capita level” (Deaton and Muellbauer, p. 314).
scaling function similar to the specification used by Ray (1982) and by Barnes and Gillingham is used to estimate equation (4):

\[ \phi_i = \prod s_i^{\epsilon_i}, \]

where \( \epsilon_i \) are estimated coefficients. \(^2\) Incorporating this scaling function into the AIDS model yields

\[ w_i = \alpha_i + \sum_j \delta_{ij}\ln p^*_j + \beta_i \ln (M/P^*_i) \]

\[ (i = 1, \ldots, n), \]

where \( w_i \) is the share of the \( i \)th type of food fat and oil, and

\[ \ln P^*_i = \alpha_0 + \sum_k \alpha_k \ln p^*_k \]

\[ + \frac{1}{2} \sum_k \sum_j \delta_{kj}\ln p^*_j \ln p^*_k. \]

With the incorporation of the scaling functions, the traditional homogeneity and adding up conditions still hold. \(^3\) In addition, equation (5) must be homogenous of degree zero in \( p^*_i \) as well as \( p \). In order to maintain homogeneity with respect to \( p_i \), (5) must be homogenous of degree zero with respect to the demographic variables. That is,

\[ \sum_{r} \epsilon_r = 0 \quad (r = 1, \ldots, d). \]

Similar to previous studies that have incorporated demographic variables in demand systems, a linearized index (such as Stone's index using scaled prices) is assumed to provide an acceptable approximation to \( \ln P^*_i \) (Capps, Tedford, and Havlicek). As such, equation (6) is approximated by

\[ \ln P^*_i = \sum_k w_k \ln p^*_k. \]

In order to avoid simultaneity problems, we adopt the Eales and Unnevehr approach where lagged budget shares are used in equation (8). \(^4\)

In the AIDS model, expenditure, price, and demographic elasticities change over time as the share of each commodity changes. Differentiating equation (5), the expenditure \((N_i)\), uncompensated price elasticities \((\Gamma_i)\), and compensated price elasticities \((\Gamma^*_i)\) can be calculated as

\[ N_i = 1 + \beta_i \ln w_i, \]

\[ \Gamma_i = (\delta_i - \beta_i w_i)/w_i - K_{ij}, \]

\[ \Gamma^*_i = (\delta_i - \beta_i w_i)/(1 + \beta_i w_i) - K_{ij} + w_i[1 + \beta_i/w_i], \]

where \( K_{ij} \) is equal to 1 if \( i = j \), 0 otherwise. Similarly, differentiating (2) with respect to the \( r \)th demographic characteristic and converting to elasticity format (Pollak and Wales 1980), the elasticity of the demand for the \( i \)th good with respect to the \( r \)th demographic characteristic \((E_i)\) is a function of the uncompensated own- and cross-price elasticities \((\Gamma_i)\) and the elasticity of the \( i \)th goods scaling function with respect to the \( r \)th demographic characteristic, \( \Omega_r \):

\[ E_i = \Omega_r + \sum_j \Gamma_{ij} \Omega_r. \]

Description of the Data

The demand for the five types of food fats and oils are analyzed using aggregate quarterly U.S. time-series data for 1962-87. \(^5\) Commercial butter disappearance data are obtained from various issues of Dairy Situation (USDA). Quarterly commercial disappearance for margarine, vegetable shortening, and salad and cooking oils are estimated from the following:

\[ COMMDIS_i = PROD_i + STOCK_{t-1} + IMPORT_i - EXPORT_i - STOCK_i. \]

where \( COMMDIS \) is commerical disappearance, \( PROD \) represents production levels, \( STOCK \) are ending stock levels, \( IMPORT \) are imports, and \( EXPORT \) represents exports of the commodity. Various issues of Current Industrial Reports: Fats and Oils Production, Consumption, and Stocks

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\(^2\) As noted by an anonymous reviewer, the estimated scaling coefficients are assumed to remain constant over the study period. This assumption implies that, as more health information becomes available, the role of demographic characteristics in determining per capita consumption is unaffected. Future research could develop a time-varying scaling specification similar to the dynamic AIDS models developed by Moschini and Meilke and by Ray (1984).

\(^3\) The usual symmetry and homogeneity conditions on the AIDS share equations are adopted. We conducted log-likelihood ratio tests (Judge et al., p. 758) and could not reject these restrictions.

\(^4\) \( p^* \) is used in place of \( p \) in Stone's index because the underlying cost function is now dependent on \( p^* \).

\(^5\) One problem with the use of this aggregate per capita disappearance data is that they encompass both intermediate and final commodity demand. Thus, the econometric results should be interpreted with caution.
are used to obtain monthly production and stocks (U.S. Department of Commerce). Annual import and export data are obtained from Putnam. For lard, various issues of the CRB Commodity Yearbook are used to obtain monthly commercial disappearance values (Buchman and Gaylann). Estimates of aggregate per capita disappearance values are obtained by dividing by quarterly population estimates obtained from published Department of Commerce sources.

Quarterly estimates of butter, margarine, and shortening prices are obtained from published BLS retail city average price series. Wholesale prices for salad and cooking oils and lard are converted to retail prices using data provided in various issues of the Fats and Oils Situation (USDA). These data, as well as those used for estimation, are available upon request from the authors.

The demographic variables are as follows: the median age of the population (AGE), the non-white proportion of the population (NON-WHITE), and the median years of schooling completed by those over twenty-five years of age (SCHOOL). These data are obtained from Bureau of the Census (Current Population Reports and Statistical Abstract of the United States). Quarterly values of the demographic variables are estimated by interpolating from the annual estimates of these variables. The variable DONATE, which represents per capita USDA donations of butter, is also used as an explanatory variable in each of the commodity-specific scaling functions. Estimates of quarterly government donations are obtained from Dairy Situation and other published USDA data (CCC Milk Price Support and Related Activities).6

Total expenditure for fats and oils (EXPEND) is the sum of the expenditures of each of the commodity components. Commodity-specific expenditure values and budget shares are obtained from the above estimates of prices and quantities.

**Estimation Procedure**

Given the adding-up characteristics of the AIDS share equations, only four equations in a five-equation system are independent. Thus, the lard equation is dropped from the estimation, with the parameters of this equation estimated from the symmetry and homogeneity conditions. Because the model with demographic scaling is nonlinear in the parameters, an iterative seemingly unrelated regression procedure (SYSLIN within the SAS system) is used for estimation. Price, expenditure, demographic, and donation elasticities are calculated from the estimated coefficients and corresponding share values. Approximate asymptotic standard errors are computed via the δ-method for the demographic elasticities because of the nonlinear nature of the elasticities (Rao).

The effects of seasonality in food fats and oils consumption are accounted for by several harmonic variables in each share equation. Following Doran and Quilkey, and Kinnucan and Fearon, these harmonic variables are calculated as

\[
H_{1i} = \cos(\lambda t) \quad (k = 1, 2)
\]

\[
H_{2i} = \sin(\lambda t) \quad (t = 1, \ldots, T),
\]

where

\[
\lambda_k = 2\pi k / 4 \quad (k = 1, 2).
\]

With the incorporation of the scaling function [equation (4)] and the harmonic variables [equation (14)], the estimated AIDS share equations are

\[
w_i = \alpha_i + \sum_j \delta_i \left( \ln p_j + \sum_r \epsilon_j \ln s_r \right) + \beta_i \left( \ln M - \left( \sum_j w_{i-j} \left( \ln p_j + \sum_r \epsilon_j \ln s_r \right) \right) \right)
\]

\[
+ h_i H_{1i} + h_2 H_{2i} + h_3 H_{3i} \quad (i = 1, \ldots, 5).
\]

**Estimated Coefficients and Elasticities**

Table 1 presents the estimated demand system coefficients and associated asymptotic standard errors. All own-price coefficients are statistically significant at the 5% level except for the own price of lard. Six of the ten cross-price

6 Government donations are calculated as follows:

\[
GD_i = GOVSTOCK_{i-1} - GOVSTOCK_i + REMOVE_i - FDONATE_i
\]

where GD is government donations, GOVSTOCK is government ending stocks, REMOVE represents government net removals and FDONATE is foreign donation commitments.

7 A dummy variable specification was also evaluated to address seasonality in U.S. fats and oils consumption. Demand system parameters (price, conditional expenditure, and demographic effects) were quite robust across the dummy variable and harmonic specifications. Results for the harmonic specification are presented because it provided marginally superior explanatory power in terms of higher R² and log-likelihood values.
coefficients are also significant at this level, as is the butter and shortenings expenditure coefficients. Seven of the harmonic variable coefficients and nine of the estimated demographic coefficients are statistically significant at the 5% level. 

Table 2 shows the uncompensated price and expenditure elasticities evaluated at the means of the data. All of the own-price elasticities are statistically different from zero at the 5% level, as are fifteen of the twenty cross-price elasticities. In terms of the relationship between butter and margarine, the cross-price elasticity of the change in butter’s price on margarine demand is statistically significant at the 5% level and is negative, indicating gross complementarity. Similar results are found by Goddard and Amuah, and by Cox for the Canadian fats and oils market. Similarly, margarine price has a statistically significant (gross) effect on butter (Marshallian) demand. All significant elasticities indicated gross complementarity except for lard and butter.

Table 3 provides a comparison of price and expenditure elasticities estimated here and those of Goddard and Amuah, Cox, and Huang. Goddard and Amuah, and Cox used Canadian quarterly data. To provide as close a comparison as possible, the elasticities obtained in the present study are reestimated using means of the independent variables over the 1973-86 period, the period over which Goddard and Amuah, and Cox estimated their models. The Canadian butter and margarine price and expenditure elasticities obtained by Goddard and Amuah, and by Cox are quite similar to those obtained in the current study. The results obtained by Huang are quite different; they may reflect the use of annual time-series data and a different time period for analysis.

From equation (12) we calculate the elasticity
Table 2. Uncompensated Price, Demographic, and Donation Elasticities Evaluated at the Sample Means (1962-87)

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Price Elasticity</th>
<th>Demographic Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Butter</td>
<td>Margarine</td>
</tr>
<tr>
<td>Butter</td>
<td>-.662</td>
<td>-1.14</td>
</tr>
<tr>
<td></td>
<td>(.057)</td>
<td>(.029)</td>
</tr>
<tr>
<td>Margarine</td>
<td>-.130</td>
<td>-1.27</td>
</tr>
<tr>
<td></td>
<td>(.037)</td>
<td>(.112)</td>
</tr>
<tr>
<td>Shortening</td>
<td>-.079</td>
<td>-1.07</td>
</tr>
<tr>
<td></td>
<td>(.038)</td>
<td>(.060)</td>
</tr>
<tr>
<td>Salad and cooking oils</td>
<td>-.083</td>
<td>-.204</td>
</tr>
<tr>
<td>Lard</td>
<td>-.146</td>
<td>-.285</td>
</tr>
<tr>
<td></td>
<td>(.069)</td>
<td>(.061)</td>
</tr>
</tbody>
</table>

Source: Computations by the authors.
Note: Because of the nonlinear nature of the elasticities, approximate asymptotic standard errors computed via the delta method are provided in parentheses.

of commodity demand with respect to changes in the three demographic characteristics (table 2). Fourteen of the fifteen demographic elasticities are statistically different from zero at the 5% level or better (i.e., all but AGE/Lard). AGE has elastic and positive effects on butter, shortening, and lard demand and a negative impact on margarine and cooking oils. These results suggest the aging of the U.S. population increases (decreases) butter (margarine) demand.

Table 3. Comparison of Alternative Fats and Oils Price Elasticity Estimates for the U.S. and Canada Evaluated at the 1973-86 Data Means

<table>
<thead>
<tr>
<th>Previous Study</th>
<th>Dependent Variable</th>
<th>Price Elasticity</th>
<th>Cooking Oils</th>
<th>Expenditure Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Butter</td>
<td>Margarine</td>
<td>Shortening</td>
<td>Cooking Oils</td>
</tr>
<tr>
<td>U.S. Current</td>
<td>-.62</td>
<td>-.13</td>
<td>-.15</td>
<td>-.17</td>
</tr>
<tr>
<td>Huang'</td>
<td>-.17</td>
<td>.05</td>
<td>-.12</td>
<td>.17</td>
</tr>
<tr>
<td>Canada</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goddard and Amuah</td>
<td>-.72</td>
<td>-.29</td>
<td>-.09</td>
<td>-.08</td>
</tr>
<tr>
<td>Cox</td>
<td>-.79</td>
<td>-.12</td>
<td>-.16</td>
<td>-.08</td>
</tr>
<tr>
<td>U.S. Current</td>
<td>-.13</td>
<td>-.23</td>
<td>-.17</td>
<td>-.37</td>
</tr>
<tr>
<td>Huang</td>
<td>.07</td>
<td>-.27</td>
<td>.19</td>
<td>.84</td>
</tr>
<tr>
<td>Canada</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goddard and Amuah</td>
<td>-.26</td>
<td>-.60</td>
<td>-.04</td>
<td>-.07</td>
</tr>
<tr>
<td>Cox</td>
<td>-.14</td>
<td>-.47</td>
<td>-.31</td>
<td>-.07</td>
</tr>
<tr>
<td>U.S. Current</td>
<td>-.08</td>
<td>-.10</td>
<td>-.45</td>
<td>-.24</td>
</tr>
<tr>
<td>Huang</td>
<td>-.03</td>
<td>.03</td>
<td>-.22</td>
<td>.37</td>
</tr>
<tr>
<td>Canada</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goddard and Amuah</td>
<td>-.119</td>
<td>-.57</td>
<td>.72</td>
<td>-.74</td>
</tr>
<tr>
<td>Cox</td>
<td>-.15</td>
<td>-.24</td>
<td>-.26</td>
<td>-.21</td>
</tr>
</tbody>
</table>

U.S. Current   | -.08              | -.19            | -.20         | -.48                  | .98                   |
| Goddard and Amuah | 0.03        | .62             | -.52         | -.14                  | .01                   |
| Canada         | -.31              | -.24            | .02          | -.57                  | .93                   |

' Huang delineated only three categories: butter, margarine, and other oils. The other oils category is presented in the shortening rows and columns. The elasticities estimated by Huang were obtained from an annual time-series model of the years 1953-81.
ceteris paribus. That is, older Americans have stronger preferences for butter relative to margarine, perhaps reflecting preferences acquired prior to the recent negative health concerns for cholesterol and saturated fat in the diet.\footnote{As the U.S. population ages, the proportional impact of this older cohort increases. Hence, the AGE variable likely reflects cohort rather than pure age effects.}

The highly elastic, statistically significant and negative (positive) SCHOOL elasticity in the butter and lard (shortening) equations indicates that increases in the average U.S. level of education have reduced (increased) butter and lard (shortening and cooking oils) demand, ceteris paribus. These results are intuitively appealing under the hypothesis that higher education levels increase dietary/health awareness and concern. The result is a ceteris paribus substitution away from lard (and butter) to vegetable shortenings. The sign and magnitude of the NON-WHITE elasticities indicate that increases in the proportion of the nonwhite population have decreased (increased) the demand for butter, shortening, and lard (margarine and cooking oils), ceteris paribus.

The estimated coefficients of the government donations variable (DONATE) can be used to analyze the impacts of government butter donations on the demand for the five commodities in the study. While government butter donations are found to have small negative elasticity impacts on commercial disappearance of butter (−0.003), these impacts are not statistically different from zero. The associated shortening elasticity is statistically significant and positive, although relatively small (table 2). One explanation of the magnitude and significance of the DONATE/Shortening elasticity (0.004) may be that the income gained from government donations is reallocated to the consumption of shortenings, a net substitute for butter (table 4). Hence, as butter prices decrease for the (relatively small) recipient portion of the population (i.e., it is free to those who receive the donations, but they are a small part of the total population), the complementary price effect of butter on shortenings (−0.079, table 2) and the positive conditional expenditure elasticity (0.891, table 2) combine to yield a small but statistically significant positive impact on shortening demand. However, given the conditional nature of these second-stage estimates, caution in their interpretation is advised.

### Table 4. Fat Composition of Food Fats and Oils

<table>
<thead>
<tr>
<th>Type of Food</th>
<th>Total Fat</th>
<th>Saturated Fat</th>
<th>Mono Fat</th>
<th>Poly Fat</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butter</td>
<td>370</td>
<td>229</td>
<td>106</td>
<td>14</td>
<td>120</td>
</tr>
<tr>
<td>Margarine</td>
<td>366</td>
<td>74</td>
<td>163</td>
<td>115</td>
<td>278</td>
</tr>
<tr>
<td>Shortenings</td>
<td>454</td>
<td>114</td>
<td>202</td>
<td>118</td>
<td>320</td>
</tr>
<tr>
<td>Salad and cooking</td>
<td>454</td>
<td>68</td>
<td>195</td>
<td>171</td>
<td>366</td>
</tr>
<tr>
<td>Lard</td>
<td>454</td>
<td>178</td>
<td>205</td>
<td>51</td>
<td>256</td>
</tr>
</tbody>
</table>

Source: Gehlert, appendix A.

Note: The salad and cooking oil coefficients pertain to soybean oil (partially hydrogenated). The shortening coefficients pertain to vegetable shortenings. The figures in parentheses correspond to the percent of total fat. They do not sum to 100 due to the inability to correctly identify and measure all fatty acids.

### Changing Demographic Characteristics and Fat Consumption

Given the assumed separability of the consumption of food fats and oils from other commodities and following Pitt and Sahn, the elasticity response of the intake of the $m$th-type of dietary fat (i.e., total, saturated, and unsaturated fat) obtained from food fats and oils to a change in the $r$th demographic characteristic ($D_{mr}$) can be calculated:

\[
D_{mr} = \left( \frac{\sum a_{mr}E_{ir}Q_i}{\sum a_{mr}Q_i} \right)
\]

where $a_{mr}$ is the quantity of the $m$th-type of dietary fat per unit of the $i$th-type of food, $E_{ir}$ is the demographic quantity elasticity calculated via (12), and $Q_i$ the predicted quantity of the $i$th food. The values of $a_{mr}$ are obtained from table 4. The "fat intake" elasticities estimated via equation (17) are conditional because of the separability assumption, i.e., the fat intake associated with meat or other dairy products is not covered by this analysis.

Table 5 presents these elasticity estimates (with associated standard errors) for the mean values of the independent variables over the entire study period as well as point estimates for three quarters. Approximate standard errors obtained by the $\delta$-method are also computed to facilitate interpretation. The predicted quantities for each type of fat or oil are obtained by using the estimated shares and actual prices for the three pe-

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AGE</strong></td>
<td>Total fat</td>
<td>-.355</td>
<td>-.220</td>
<td>-.224</td>
<td>-.688</td>
</tr>
<tr>
<td></td>
<td>(0.068)</td>
<td>(0.065)</td>
<td>(0.074)</td>
<td>(0.094)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saturated fat</td>
<td>4.23</td>
<td>5.22</td>
<td>5.68</td>
<td>.074</td>
</tr>
<tr>
<td></td>
<td>(0.064)</td>
<td>(0.085)</td>
<td>(0.060)</td>
<td>(0.058)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total unsaturated fat</td>
<td>-6.37</td>
<td>-4.95</td>
<td>-4.78</td>
<td>-9.20</td>
</tr>
<tr>
<td></td>
<td>(1.03)</td>
<td>(1.04)</td>
<td>(1.02)</td>
<td>(1.121)</td>
<td></td>
</tr>
<tr>
<td><strong>SCHOOL</strong></td>
<td>Total fat</td>
<td>.461</td>
<td>.403</td>
<td>.474</td>
<td>.580</td>
</tr>
<tr>
<td></td>
<td>(0.078)</td>
<td>(0.084)</td>
<td>(0.082)</td>
<td>(0.120)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saturated fat</td>
<td>-0.90</td>
<td>-1.27</td>
<td>-0.60</td>
<td>.077</td>
</tr>
<tr>
<td></td>
<td>(0.088)</td>
<td>(1.20)</td>
<td>(0.088)</td>
<td>(0.085)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total unsaturated fat</td>
<td>.661</td>
<td>.601</td>
<td>.646</td>
<td>.734</td>
</tr>
<tr>
<td></td>
<td>(1.05)</td>
<td>(1.03)</td>
<td>(1.07)</td>
<td>(1.148)</td>
<td></td>
</tr>
<tr>
<td><strong>NONWHITE</strong></td>
<td>Total fat</td>
<td>.170</td>
<td>.001</td>
<td>.091</td>
<td>.482</td>
</tr>
<tr>
<td></td>
<td>(0.039)</td>
<td>(0.038)</td>
<td>(0.042)</td>
<td>(0.054)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saturated fat</td>
<td>-4.46</td>
<td>-5.93</td>
<td>-5.11</td>
<td>-1.72</td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td>(0.049)</td>
<td>(0.036)</td>
<td>(0.036)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total unsaturated fat</td>
<td>.391</td>
<td>.220</td>
<td>.282</td>
<td>.679</td>
</tr>
<tr>
<td></td>
<td>(0.058)</td>
<td>(0.055)</td>
<td>(0.058)</td>
<td>(0.069)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Computations by the authors.

Note: Because of the nonlinear nature of the elasticities, approximate asymptotic standard errors computed via the δ-method are provided in parenthesis. These elasticities are conditional on total expenditures for food fats and oils. These elasticities refer to the dietary intake of fat from these commodities. Hence, these elasticities do not include the fat intake from meat and other dairy products.

Periods covered by this table. When viewing table 5, it should be noted that the coefficients for margarine, vegetable shortening, and salad and cooking oils presented in table 4 are aggregates of several different types of oils with varying fat compositions. The results may differ with a finer definition of food fats and oils.

The total fat elasticity for **AGE** is negative and statistically significant when evaluated over the 1962–87 period and for the three quarters evaluated. This implies that the aging of the U.S. population is associated with a statistically significant, *ceteris paribus* reduction of total fat intake from the commodities included in the model. In terms of the composition of this total fat consumption, a positive (negative) and statistically significant relationship between **AGE** and saturated (unsaturated) fat intake is obtained. These results primarily reflect the elastic impacts of **AGE** on butter (+), margarine (−), shortening (+), cooking oils (−), and lard (+) from table 3 and the associated fat compositions of these commodities (table 1).

Total fat consumption from the fat and oil commodities is positively affected by increased education (**SCHOOL** elasticities, table 5). These results suggest that increasing education levels have increased consumption of unsaturated fats more than the associated decrease in saturated fats. These results are appealing under the hypothesis that, with higher education levels, the population has a greater ability to obtain information on, and understand the health impacts of, the consumption of certain types of fats. Conversely, one might expect better educated consumers to decrease their total fat intake (i.e., following dietary guidelines), not just saturated fat intake. The positive unsaturated fat **SCHOOL** elasticities may also reflect increased purchases of food away from home (**FAFH**) for those individuals with higher income levels. Much of these **FAFH** purchases occur in fast food establishments that use a large amount of vegetable-based fats.

The changing ethnic composition of the U.S. population appeared to have little impact on the intake of total fat except for the latter part of the 1980s. In contrast, the saturated fat elasticities were negative and statistically different from zero (5% level) for the late 1960s and 1970s. The unsaturated fat elasticities are positive and significant at all points evaluated.
Concluding Comments

This research analyzes the impacts of prices, fats and oils expenditures, seasonality, government butter donations, and demographic factors on quarterly U.S. fats and oils consumption over the 1962–87 period. The demand systems approach using an AIDS with demographic scaling specification performs quite well statistically and in terms of the implied elasticity results. In particular, the butter and margarine Marshallian price elasticities are similar (in signs and magnitudes) to the results of Goddard and Amuah, and Cox. The estimated impacts of the changing U.S. demographic profile (in particular, the aging of the population (AGE), increased average levels of schooling (SCHOOL), and increased proportion of the population that is nonwhite (NONWHITE)) on fats and oils consumption are generally statistically significant and appear intuitively reasonable.

The nutrient/demographic elasticities indicate that the aging of the population (AGE) is associated with statistically significant decreases in total fat intake, but with increases in the amount of saturated fats and decreases in the amounts of unsaturated fats. One interpretation of these AGE results is that older consumers acquired strong (positive) preferences for butter (and vegetable shortening) prior to current concerns for cholesterol and saturated fat in the U.S. diet.

Increasing average education level (SCHOOL) is associated with statistically significant increases in total fat intake, but with negative (positive) impacts on the amount of saturated (unsaturated) fat from the commodities modeled. Increases in the proportion of the nonwhite population (NONWHITE) have little impact on the total intake of fats but to increase (decrease) the intake of unsaturated (saturated) fats. These results are conditional in so far as the fat consumption from sources other than those modeled here (e.g., meats and other dairy products) are not reflected in these results.

Government donations (DONATE) of butter have statistically insignificant and small negative impacts on commercial disappearance of butter. The results suggest that the potential reallocation of the “income transfer” generated by these donations is spent on shortenings; but, given the conditional (second stage) nature of the specification estimated, this result should be interpreted cautiously.

The inclusion of demographic information in the estimation of conditional demand systems from aggregate disappearance data is strongly supported by this research. These procedures explicitly model changes in tastes and preferences associated with changes in the demographic profile, allow estimation of profile specific response parameters, and provide a natural basis for projecting demand based on demographic projections.

The success obtained here with respect to the use of demographic characteristics in demand systems estimation supports the continuation of research first initiated by Barton. Three areas of research that could extend the model developed here are (a) development of a model where the demographic coefficients are allowed to vary over time, (b) application of the model to household level cross-sectional data, and (c) extension of the Pollack and Wales (1981) demand systems model where the “appropriate” method (i.e., translating, scaling, Gorman) for incorporating demographic effects is parametrically tested when multiple demographic characteristics are included in the model.

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