

Influences of Labeling Policy and Media Coverage On the Demand for Butter and Margarine

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Abstract

The major objectives of this study are two-fold: to determine if the mandated *trans* fat information on Nutrition Fact label after 2005 had any impact on the demands for butter, margarine, and spread; and if a relationship exists between media coverage of *trans* fat and the demand for butter, margarine, and spread. The Rotterdam demand system was used to analyze the demand relationships among three fat products – butter, stick/solid margarine, and soft margarine. Study results show that the mandatory labeling *trans* fats content in the Nutrition Fact label had no significant impact on the demand for stick/solid margarine and soft margarine and the *trans* fat media coverage over the study period had a positive impact on the demand for butter and negative impacts on the demand for both stick/solid and soft margarines.

The process to partially and fully hydrogenate to harden liquid fats was developed about a hundred years ago. Animal fats that people used for cooking tended to spoil and the hydrogenation of liquid fats allowed the development of shelf-stable vegetable-based fats with neutral flavor. Hydrogenated fats was made popular during the war time when animal fats were rationed and when scientists found that saturated fatty acid intake elevate low-density lipoprotein (LDL) cholesterol levels which increased the risk for coronary heart disease. However, products made with partially hydrogenated oils are lower in saturated fats but they contain *trans*-isomer fatty acid (*trans* fat). During the 1990s, research results indicated that increased intake of *trans* fat raises LDL cholesterol levels and possibly reduces high-density cholesterol (HDL) cholesterol levels; therefore, increases the total cholesterol to HDL-cholesterol ratio. To address this public health concern, the U.S. Food and Drug Administration (FDA) proposed mandatory labeling of *trans* fat contents in 1999 and issued a final rule on nutrition labeling of *trans* fatty acids (*trans* fat) on July 11, 2003. This final rule requires manufacturers to list *trans* fat content on the Nutrition Facts label of foods and some dietary supplements on a separate line immediately under the declaration for saturated fat. The new labeling rule became effective on January 1, 2006.

Between September 2003 and June 2008, media coverage (TV/radio, newspapers, and magazines) pertaining to *trans* fat has increased from about three times per week in 2003 and 2004 to ten times per week in 2005, 19 times per week in 2006, and over 20 times per week in 2007 and 2008 (Lexis-Nexis Academic). In earlier years, media reported the potential health problems with the consumption of *trans* fat, followed by reports on food labeling requirement; fast food chains, cruise liners, Walt Disney Company, Girl Scout of America eliminating or reducing *trans* fats from their menus or products; municipalities, counties, and states campaign or passed bans on *trans* fats; and

the “*trans* fat free” claim started to appear on food labels (Unnevehr and Jagmanaitė 2008).

Moorman and Matulich (1993) indicated that consumers were more influenced by information from media sources rather than information from casual sources, such as friends and family members. According to an American Dietetic Association’s (ADA, 2002) consumer research study, media is a major contributor to nutrition and health knowledge. In this study, the ADA found that 72 percent of consumers named television as a chief source of nutrition information. Popular magazines and newspapers were also ranked as chief sources of nutrition information by 58 percent and 33 percent of respondents, respectively.

The objectives of this study are two-fold: to determine if the mandated *trans* fat information on Nutrition Fact label after 2005 had any impact on the demands for butter, margarine, and spread, and if a relationship exists between media coverage of *trans* fat and the demand for butter, margarine, and spread.

Method and Data

Following Barten (1964), the Rotterdam model which can be written as

$$(1) \quad w_i \ln q_i = \mu_i DQ + \sum_j \pi_{ij} \ln p_j + \sum_k \beta_{ik} da_k + \gamma_i d_i, \\ i = 1, 2, \dots, n.$$

where p_i and q_i being the price and quantity of good i , respectively; a is a vector of factors other than quantity, such as the news pertaining to *trans* fat; $\ln x_i = \log(x_{it} - x_{it-52})$, $x_i = p_i, q_i$; $da_j = da_{jt} - da_{jt-52}$ (the time subscribe was omitted for brevity); $w_i = p_i q_i / m$ is the budget share for good i ; $\mu_i = p_i (\partial q_i / \partial m)$ is the marginal propensity to consume; $DQ = \sum_i w_i \ln q_i$ is the Divisia volume index; $\pi_{ij} = (p_i p_j / m) s_{ij}$ is the Slutsky coefficient, with $s_{ij} = (\partial q_i / \partial p_j + q_j \partial q_i / \partial m)$ or the element in the i th row and j th column of the substitution matrix; $\beta_{ik} = w_i (\partial \ln q_i / \partial a_k)$ is a media coverage coefficient indicating the impact of the k th type of medium coverage relating to *trans* fat during period t ; d_i is a dummy variable that has a value of 1 for time periods after 2005; otherwise it has a value of 0; d_i is a time trend variable for the weeks after labeling rule became effective and γ_i is the coefficient of d_i which measures the impact of the mandatory *trans* fat labeling on the demand for product i . The general restrictions on demand are

$$(2) \quad \text{adding up: } \sum_i \mu_i = 1 \text{ and } \sum_i \pi_{ij} = 0; \sum_i \beta_{ik} = 0; \sum_i \gamma_i = 0; \\ \text{homogeneity: } \sum_j \pi_{ij} = 0; \text{ and} \\ \text{symmetry: } \pi_{ij} = \pi_{ji}.$$

Trans fat media coverage variables are the number of reports pertaining to *trans* fats by TV/radio and newspapers/magazines (printed media), respectively. There are two types of media coverage: the ones pertain to general *trans* fats discussion and the ones with butter/margarines mentioned. These media coverage variables were treated as psychological stocks and specified as

$$(3) \quad a_{m,k,t} = \sum_{j=1 \text{ to } t-1} (1 - \lambda_m)^j f_{m,k,j} + f_{m,k,t}$$

where superscript k denotes the content of media coverage (general *trans* fat or butter/margarine specific), m denotes the type of media (TV/radio or printed media), $f_{m,k,j}$ is the number of reports during week j for either TV/radio or printed media (k) and λ_k is an erosion or depreciation parameter for medium k which has a value between zero and one. Because the frequencies of TV/radio and printed media are highly correlated, the number of TV/radio and printed media coverage were combined into those for general *trans* fat and those for butter/margarine specific,

$$(4) \quad a_{k,t} = \sum_m (\sum_{j=1 \text{ to } t-1} (1 - \lambda_m)^j f_{m,k,j} + f_{m,k,t});$$

a grid search method was used to estimate λ_m , i.e., using the values between 0 and 1 with steps of 0.05 for TV/radio and printed media; the values of λ_m that provided the best fit were chosen (Maddala 1992). The demand elasticity of media coverage is

$$(5) \quad \partial \ln q_i / \partial \ln a_k = \beta_{ik} a_k / w_i.$$

Three types of fats were used in the study: butter (Butter), stick/solid margarine (Hard M), and soft margarine (Soft M; includes soft, soft stick, pattie, and liquid). The raw data, weekly national sales data, were reported at the universal product code (UPC) level and include unit and dollar sales; the UPC level data were aggregated into the three types of fats described above. In this study, quantity demanded was measured in pounds, prices were obtained by dividing dollar sales by pound sales.

Table 1 shows the sample statistics. As shown in Table 1, butter accounted for 53% of the dollar sales and 31% of the quantity sales, followed by stick/solid margarine (37% dollar sales and 49% of quantity sales) and soft margarine (11% dollar sales and 20% of quantity sales). The average price for butter, stick/solid margarine, and soft margarine are \$2.94, \$1.30, and \$0.91 per pound, respectively.

Note that seasonality could be eliminated using 52nd differences in the Rotterdam model. Pound sales and the dollar shares were used as the dependent variables q_i and w_i , respectively; the average prices were used as explanatory variables p_j . Average budget share values underlying the differencing were used in constructing the model variables – w_{it} was replaced by $(w_{it} + w_{it-52})/2$. Iterative seemingly unrelated regression method was used to estimate parameters μ and π . Results are presented in Table 2.

Results

Table 2 shows the iterative seemingly unrelated regression estimates of equation (1) with homogeneity and symmetry (2) imposed. The data for model (1) add up by construction and the equation for spread was deleted (Barten 1969). The estimates are invariant to the equation deleted, and the parameters of the deleted equation can be recovered by using the adding up demand restrictions in equation (2) or by simply re-running the model deleting a different equation.

Results show that the *trans* fat labeling beginning 2006 (coefficient γ_i) had an insignificant impact on the demand for these products. The lack of impact may be explained by the actions of food industry before 2006; i.e., some of food manufacturers had already added *trans*-fat information on the Nutrition Facts label, reformulated margarine products, or both prior to the effective date of the rule. The lack of relationship between the policy and demand may also suggest any market impact

produced by the policy was overwhelmed by an ongoing and stronger trend in the demand of these products. Unfortunately, we had data only for the 2003-08 period, which could be too short to capture any long-term changes in demand between these products.

TV/radio has a $\lambda=0.75$ and newspaper/magazines has a $\lambda=0.85$; indicating media coverage impacts decayed relatively quickly. General media coverage had a negative impact on the demand for butter but its impact on margarine (hard and soft) was insignificant. Specific *trans*-fat-butter-margarine coverage had a positive impact on the demand for butter but a negative impact on hard and soft margarine.

The marginal propensities to consume (MPC, μ_i) for all three products are positive and statistically different from zero. All own-price Slutsky coefficients are negative and statistically different from zero. All cross-price Slutsky coefficients are positive, indicating that butter, stick/solid margarine, and soft margarine are (net) substitutes (Green 1978, based on substitution effect only or compensated for real income changes).

The coefficient estimates for general *trans*-fat coverage indicate that *trans* fat coverage had a negative impact on the demand for butter and positive impacts on the demand for stick/solid and soft margarines; however the latter are not statistically different from zero. The butter/margarine specific media coverage had a positive impact on the demand for butter and a negative impact on the demand for stick/solid margarines and soft margarines. In addition, the coefficient estimates for butter/margarine specific coverage are larger for stick/solid margarines than the one for soft margarines; an indication of that butter/margarine specific media coverage had a larger negative impact on the demand for stick/solid margarines than for soft margarines. The coefficient estimates for the time trend variable for *trans* fats' mandatory labeling are all statistically not different from zero, an indication of the new labeling requirement had no impact on the demand for the three fat products during the study period.

Demand elasticity estimates based on the demand parameter estimates (μ_i and π_{ij}) and calculated at the sample means are shown in the bottom half of Table 2. The estimated income elasticities ($\epsilon_{im} = \mu_i/w_i$) show the impacts of a one percent increase in the total expenditure of fats on the sales of the individual fats. Results show that if the total expenditure on fats is increased by one percent, the sales of butter, stick/solid margarine, and soft margarine would increase by 1.39%, 0.43%, and 1.04%, respectively.

The uncompensated own-price elasticity estimates ($\epsilon_{ii} = \pi_{ii}/w_i - w_i\epsilon_{im}$) show the demands for butter ($\epsilon_{ii} = -1.30$) and stick/solid margarine ($\epsilon_{ii} = -1.67$) is price elastic; and the demand for soft margarine ($\epsilon_{ii} = -0.75$) is price inelastic. The uncompensated cross-price elasticity estimates ($\epsilon_{ij} = \pi_{ij}/w_i - w_j\epsilon_{im}$) are small relative to their own-price elasticities. A positive cross-price elasticity estimate shows that the products are (gross) substitutes and a negative cross-price elasticity estimate shows that the products are (gross) complements. The cross-price elasticity estimates presented in Table 2 show that butter is a substitute for stick/solid margarine and soft margarine; however, stick/solid margarine is a complement to butter.

Elasticity estimates for media coverage variables are estimated using equation (9). In general, these elasticity estimates are small. Results show a one percent increase in general *trans* fat media coverage would decrease the demand for butter by .0016% and a one percent increase in butte/margarine specific media coverage would increase the demand for butter by 0.0049% and decrease the demand for stick/solid margarine and soft margarine by 0.0062% and 0.0030%, respectively.

Concluding Remarks

The Rotterdam demand system was used to analyze the demand relationships among three fat products – butter, stick/solid margarine, and soft margarine. The emphasis of this study was placed on if and how the market of butter, stick/solid margarine, and soft margarine, might have changed before and after the effective date of the final rule of labeling *trans* fats. Study results show that the general *trans* fat media coverage over the study period had a negative impact on the demand for butter and butter/margarine specific media coverage had a positive impact on the demand for butter and negative impacts on the demand for stick/solid and soft margarines. Additionally, study results also show that labeling *trans* fats in the Nutrition Fact label had no significant impact on the demand for butter, stick/solid margarine, and soft margarine.

The FDA issued the final rule on *trans* fat on July 11, 2003 and the final rule became effective on January 1, 2006. Between July 2003 and January 2006, there were publicity and news reports pertained to the *trans* fat issues. In addition, many manufacturers already listed *trans* fat content on their Nutrition Facts label before January 2006. Therefore, consumers had almost three years to hear, to find *trans* fat information on food labels, and to act upon it. As a result of consumers' familiarity with *trans* fats issues, this study found that there was no significant impact of the new labeling requirement on the demand for the three fats products.

The sales data do not have information on *trans* fat contents in the products studied. If and when the *trans* fat content information becomes available, the products can be redefined according to the *trans* fat content level in the product and the results from redefined fats products may provide better insight about consumers' reactions to *trans* fat labeling requirements.

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Table 1. Sample statistics - Weeks ending 09/20/2003 thru 06/14/2008

	Butter	Stick/Solid Margarine	Soft Margarine
Price (\$/lb)			
Mean	2.94	1.30	0.91
Std	0.31	0.11	0.06
Quantity (lbs)			
Mean	8,648,508	13,049,100	5,569,862
Std	3,269,563	1,409,061	1,903,293
\$ share (%)			
Mean	52.56%	36.86%	10.58%
Std	3.94%	4.27%	1.31%
Quantity Share (%)			
Mean	31.11%	48.84%	20.05%
Std	4.59%	5.34%	2.49%
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Media (times/week)	TV/Radio*	Printed Materials	
General			
Mean	5.48	7.89	
Std	14.54	12.42	
Butter/Margarine			
Mean	1.68	0.48	
Std	4.00	0.89	

Table 2. Demand parameter estimates

	π_{ij}			μ_i	Media Coverage		Labeling Dummy
	Butter	Hard M.	Soft M.		General	Butter/Marg	
Butter	-0.2988* (0.0214)	0.1760* (0.0201)	0.1228* (0.0070)	0.7311* (0.0076)	-0.0051** (0.0036)	0.0926* (0.0214)	-0.0025 (0.0025)
Hard M.		-0.2188* (0.0214)	0.0428* (0.0088)	0.1591* (0.0074)	0.0045 (0.0035)	-0.0812* (0.0211)	-0.0024 (0.0020)
Soft M.			-0.1656* (0.0090)	0.1099* (0.0021)	0.0006 (0.0009)	-0.0113* (0.0054)	0.0049 (0.0044)
Demand Elasticity							
	Price (Uncompensated)			Income	Media Coverage		
Butter	-1.2995* (0.0369)	-0.1779* (0.0415)	0.0864* (0.0138)	1.3910* (0.0145)	-0.0016** (0.0011)	0.0049* (0.0011)	
Hard M.	0.2507* (0.0496)	-0.7527* (0.0623)	0.0704* (0.0240)	0.4316* (0.0201)	0.0020 (0.0016)	-0.0062* (0.0016)	
Soft M.	0.6145* (0.0603)	0.0218 (0.0864)	-1.6744* (0.0853)	1.0382* (0.0196)	0.0010 (0.0014)	-0.0030* (0.0014)	
R Matrix^a							
	Butter	Hard M.					
Butter	0.9047* (0.0850)	0.1508** (0.1127)					
Hard M.	0.0179 (0.0823)	0.7202* (0.1091)					

The numbers in parentheses are standard errors of the estimates.

^aResults are corrected for first-order autocorrelation using the full **R** matrix (Berndt and Savin 1975).

*Statistically different at $\alpha = 0.05$ level.

**Statistically different at $\alpha = 0.10$ level.