The Impact of Cholesterol Information on Meat Demand: Application of an Updated Cholesterol Index

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We estimate an almost ideal-demand system (AIDS) to assess the impacts of cholesterol information on the market demand of meats in the U.S. Our study indicates a significant negative impact of cholesterol information on the market demand of beef and pork and a significant positive influence on chicken demand. The study further demonstrated that the flow of carbohydrate information lessened the magnitude of cholesterol health information elasticities.

Epidemiological research has reported the negative impact of cholesterol and high-calorie diets on human health since early 1970. PubMed, a medical database of the National Library of Medicine (NLM) with more than 15 million medical-literature citations, has recorded numerous such articles since 1967. However, between 1970 and mid-1990, medical research and the media have focused exclusively on the negative aspects of cholesterol while giving little or no attention to low-carbohydrate-related health issues. As a result, cholesterol has emerged as a serious health concern affecting consumers' preferences and, ultimately, the market demand of agricultural commodities (Yen and Chern 1992). Numerous marketing research articles published in this period show the significant impact of cholesterol information on the market demand of shell eggs (Brown and Schrader 1990), dairy products (Jensen and Kesavan 1993), butter (Chang and Kinnucan 1991), animal fats and vegetables oils (Yen and Chern 1992), and fats and oils (Chern, Loehman, and Yen 1995).

In 1990, Dr. Robert C. Atkins published *Atkins' New Diet Revolution*, which sold more than 10 million copies and stayed on the *New York Times* best-seller list for five years. Since 1995, the low-carbohydrate diet philosophy has found unexpected popularity, giving rise to a low-carbohydrate diet frenzy in the United States. Different low-carbohydrate diets such as Atkins, South Beach, Protein Power, Sugar Busters, and Stillman have been proposed to control weight, obesity, and obesity-related medical conditions. With the growing popularity of low-carbohydrate diets, medical research has shifted its focus from cholesterol concerns to low-carbohydrate diets. PubMed records show that of 1,170 research articles published on low-carbohydrate issues between 1970 and 2004, nearly 54 percent of those articles were published after 1997. Obviously, publicity about carbohydrates has overshadowed cholesterol in the public's list of diet concerns.

The main objective of this study is to revisit the impact of cholesterol on U.S. meat demand when the low-carbohydrate diet philosophy received unexpected popularity and media attention. The secondary objective of this paper is to examine the robustness of the estimated parameters in the updated sample. The question of robustness of estimated parameters is crucial because concerns have been raised about whether replication of the study with new or updated data would confirm previous research conclusions (Robison and Colyer 1994). Our study contributes to economic and empirical research by updating the cholesterol-information index of Brown and Schrader through the end of 2003 and by assessing the impact of cholesterol choices once low-carbohydrate information hit the U.S. meat markets. The article first discusses the theoretical model used. Next, data and estimation procedures are explained. Estimated own price, expenditure, and cholesterol information elasticities with updated data are then discussed. Finally, the paper concludes with major findings and implications of the results.

Model

The almost-ideal demand system (AIDS) model developed by Deaton and Muellbauer (1980) was used for the analysis. The AIDS model describes the interrelationships among meats in a separable group parsimoniously, allowing us to incorporate

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the effects of non-economic variables. Moreover, theoretical restrictions including addition, symmetry, homogeneity, and adding-up can be imposed in the AIDS model to improve estimation efficiency. The linear approximation of AIDS model, known as LA/AIDS model, was estimated to assess the impact of cholesterol information on the market demand of U.S. meats.

The minimum-expenditure function used in deriving the AIDS model is

$$(1)\ \ln c(u,p) = \alpha_0 + \sum_{k=1} \alpha_k \ln p_k + \tfrac{1}{2}\sum_{k=1}^{n}\sum_{j=1}^{n} \gamma^*_{ij} \ln p_k \ln p_j + \mu\beta_0 \prod_{k=1} p_k^{\beta_k} \ ,$$

where u is utility, p is the price of commodities, n represents the number of commodities in the demand system, and α_i, β_i, and γ^*_{ij} are parameters to be estimated.

The budget-share form of AIDS demand function derived from Equation (1) is

$$(2)\ s_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln \frac{Y}{P^*},\ i = 1,.....,n\ ,$$

where s_i is the share associated with ith good, α_i is the constant coefficient in the ith share equation, γ_{ij} is the slope coefficient associated with the jth good in the ith share equation $\gamma_{ij} = \tfrac{1}{2}(\gamma^*_{ij} + \gamma^*_{ji})$, Y is the expenditure on the meat group of the study, and P^* is a price index defined as

$$(3)\ P^* = \alpha_0 + \sum_k \alpha_k \ln p_k + \tfrac{1}{2}\sum_j \sum_k \gamma_{kj} \ln(p_k)\ln(p_j).$$

The AIDS does not automatically satisfy the regularity conditions associated with demand systems. However, we impose the Slutsky symmetry by setting $\gamma_{ij} = \gamma_{ji}$ in the estimation process. The theoretical demand restrictions of adding-up, price homogeneity, and symmetry were imposed as:

Adding up:

$$(4)\ \sum_{i=1}^{m} \alpha_0 = 1;\ \sum_{i=1}^{m} \lambda_{ij} = 0;\ \text{and} \sum_{i=1}^{m} \beta_i = 0;$$

Homogeneity:

$$(5)\ \sum_{j=1}^{m} \gamma_{ij} = 0;$$

Symmetry:

$$(6)\ \gamma_{ij} = \gamma_{ji},\ \text{for i} = 1,\ldots, \text{n, j} = 1,\ldots.., \text{n.}$$

To incorporate cholesterol information and seasonal dummy variables into the demand system, we used the translation procedure proposed by Pollak and Wales (1980). The translation procedure assumes that these factors can influence consumers' perceptions of basic needs. Chang and Green (1992) and Duffy (1991) proposed two different relations between α_k's and non-economic variables. Duffy suggests a set of semi-log, linear, and auxiliary relationships as in Equation (7). Chang and Green propose a linear specification and described the relationships as in Equation (8).

$$(7)\ \alpha_k = \alpha_k^0 + \sum_{j=1}^{n} \lambda_{kj} D_j + \theta_i \ln HI,\ k = 1,.....,n\ ,$$

$$(8)\ \alpha_k = \alpha_k^0 + \sum_{j=1}^{n} \lambda_{kj} D_j + \theta_i HI,\ k = 1,.....,n\ .$$

Here, D is a quarterly dummy with the fall quarter as the base and HI is the cholesterol-information index. The demand equations of the AIDS model in the budget share form derived from Duffy's specification are

$$(9)\ s_i = (\alpha_k^0 + \sum_{j=1}^{n} \lambda_{kj} D_j + \theta_i \ln HI) + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln \frac{Y}{P^*} + v_i\ ,\ i = 1,.....,n\ .$$

The demand equations of the AIDS model derived from the linear specification of Chang and Green can be specified as

$$(10)\ s_i = (\alpha_k^0 + \sum_{j=1}^{n} \lambda_{kj} D_j + \theta_i HI) + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln \frac{Y}{P^*} + v_i\ ,\ i = 1,.....,n\ .$$

The price index is estimated by approximating $\ln P^*$ using Stone's price index, defined as

$$(11)\ \ln P^* = \sum_{k=1}^{n} w_k \ln p_k\ .$$

It is our opinion that the presence of significant parameters makes Chang and Green's model superior to Duffy's model. As discussed by Green and Alston (1990), the correct elasticity formulas for LA/AIDS model of Equation (10) are given below:

(12) Own-price elasticities: $e_{ii} = -1 + \frac{\gamma_{ii}}{s_i} - \beta_i\ ;$

(13) Cross-price elasticities: $e_{ij} = \frac{\gamma_{ij}}{s_i} - \beta_i \left(\frac{\gamma_{ij}}{s_i}\right);$

(14) Expenditure elasticities: $\eta_{io} = \frac{\beta_i}{s_i} + 1$;

(15) Cholesterol-information elasticities: $\mu_i = \frac{\theta_i}{s_i} * HI_i$;

(16) Compensated-price elasticities: $e^*_{ij} = e_{ij} + \eta_i * s_j$.

Data and Estimation Procedures

The quarterly price and consumption data (1989–2003) for poultry, beef, and pork were collected from U.S. Department of Agriculture (USDA) publications. The USDA reports fish quantities in their annual series. To estimate the quarterly model, the annual fish-quantity data was disaggregated into quarterly time series by using the SAS procedure called PROC EXPAND. Missing observations were estimated using the SAS-imputed procedure called PROC MI. There was a drastic decrease in the flow of research articles on cholesterol diets from the second quarter of 1997 (Figure 1). In our opinion, this period marks the shift of research focus from cholesterol to low-carbohydrate issues.

Therefore, the complete data set was divided into two sample periods to capture the impact of cholesterol information amidst the changing influences of low-carbohydrate-related health information. The first sample covers the period from the first quarter of 1989 to the second quarter of 1997, a period when cholesterol influence was considered to be strong. The second sample period runs from the third quarter of 1997 to the last quarter of 2003, a period of robust low-carbohydrate information flow. The updated cholesterol-information index (1989–2004) was constructed following Kinnucan et al. (1997). Mathematically,

(17) $WCII_t = \tau_t UFAV_t$,

where $WCII_t$ is the net publicity about the links between of cholesterol and heart disease. $UFAV_t$ is Brown and Schrader's (1990) negative-information index and τ_t, which represents a weighting factor, is a relative proportion of all favorable and unfavorable articles in period t such that $\tau_t = UFAV_t / (FAV_t + UFAV_t)$ where FAV_t is the cumulative sum of favor-

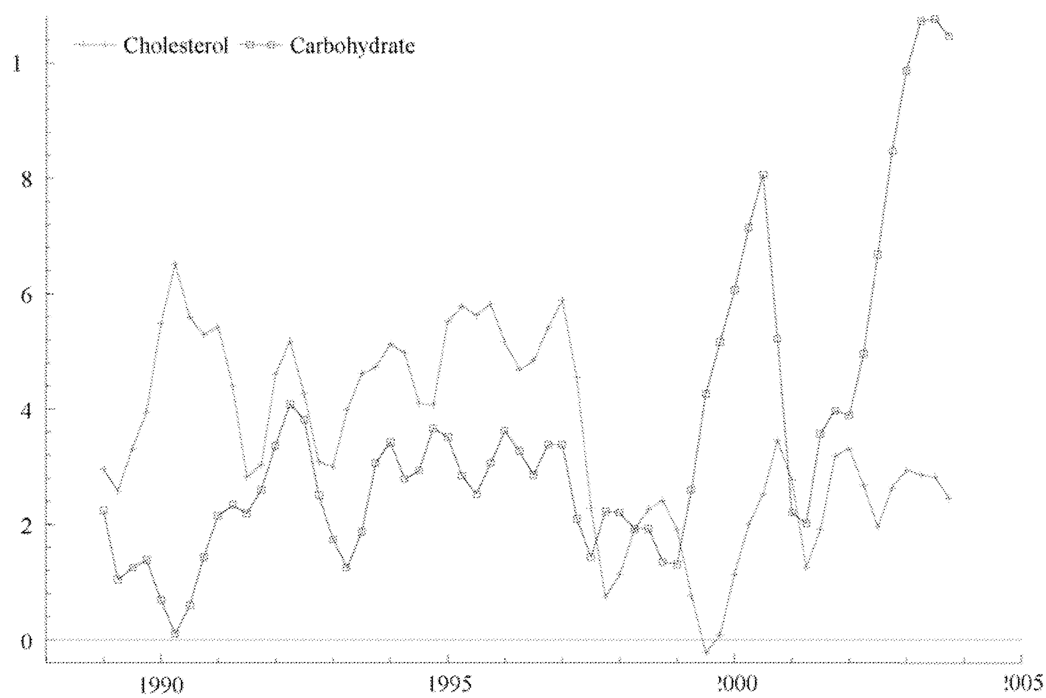

Figure 1. A Cubic Polynomial Representation of Carbohydrate and Cholesterol Information Flow (1970–2003).

able articles on cholesterol. Effects of seasonality on the U.S. meat demand are incorporated in the LA/AIDS model by using quarterly demand-shift seasonal dummy variables for seasonality. We treated meat as a weakly separable group consisting of poultry, beef, pork, and fish. It is assumed that consumption of an individual meat product relies on the expenditure of the group, the prices of the goods within the group, seasonality, and cholesterol information. The LA/AIDS model was estimated using seemingly unrelated regressions (SUR) to maintain the theoretical parameter restrictions. The fish equation was dropped, while beef, pork, and poultry equations were estimated, due to the singular nature of the share system. The parameter estimates of the omitted equation (fish) were recaptured from the estimated models by using the classical adding-up restrictions. Theoretical restrictions of homogeneity and symmetry were imposed as a maintained hypothesis. All tests, unless indicated otherwise, are reported at 1-percent and 10-percent levels of significance. Estimated elasticities are calculated at sample mean-budget shares.

Result and Discussions

The descriptive statistics of the variables used in the regression model are presented in Table 1. Initially, the impact of cholesterol information was estimated using the data from 1989.I–1997.II (Model 1), which is the period when the influence of carbohydrate information was considered to be low. Model 2 was estimated using the data from 1997.II–2003.IV. This aggregation of data might be permissible, given the drastic decrease of research articles related to cholesterol and heart diseases and the simultaneous shift of research focus to the effects of low-carbohydrate diets on obesity and weight loss (Figure 1). A full model using a complete data set from 1989.I to 2003.IV (Model 3) was also estimated to examine the aggregate impacts of updated cholesterol information and to examine the robustness of estimated coefficients.

Autocorrelation is frequently a serious problem in demand studies using time-series data. The Durbin-Watson statistic showed no evidence of serial correlation in the unrestricted equations in all models (Tables 2, 3, and 4). The parameter estimates and t values of the demand systems with homogeneity and symmetry restrictions for all models are reported in Tables 2, 3 and 4. The relatively high R^2 value, which is at or above 0.85 in all models for all meat types, and the presence of statistically significant parameter coefficients suggest a good fit of all models to the given data. In all models, the overall impacts of seasonality were significant.

Table 1. Descriptive Statistics of Data Used in Updated Cholesterol Analysis, 1973–2003.

	Mean	Standard error	Standard deviation	Minimum	Maximum	Sum	N
PFISH	5.13	0.01	0.10	4.95	5.26	308.05	60
PPOULT	5.01	0.01	0.05	4.94	5.10	300.72	60
PPORK	5.45	0.01	0.11	5.24	5.62	326.79	60
PBEEF	5.69	0.01	0.09	5.56	6.03	341.36	60
EXPENDITURE	7.69	0.01	0.08	7.53	7.89	461.68	60
HI	142.33	8.17	63.26	23.00	230.00	8540.00	60
BC	16.68	0.07	0.57	15.00	17.55	1000.61	60
PYC	22.39	0.25	1.97	17.48	26.23	1343.60	60
PC	12.76	0.09	0.67	11.33	14.31	765.72	60
FISHC	3.72	0.02	0.12	3.52	4.22	223.20	60

PFISH is fish price ($/pound), PPOULT is chicken price ($/pound), PPORK is price of pork ($/pound), PBEEF is price of beef ($/pound), Expenditure is money spent in meat consumption, HI is health-information index, BC is beef consumption (pounds per person), PYC is poultry consumption (pounds per person), PC is pork consumption (pounds per person), and FISHC is fish consumption (pounds per person).

Table 2. SUR Estimates of the LA/AIDS Model with Homogeneity and Symmetry Restriction Imposed, 1989.I–1997.I, Cholesterol-Information index (Model 1).

	Dependent variables			
Independent variables	Beef	Pork	Poultry	Fish
PBEEF	0.095**	-	-	-
	(4.06)			
PPORK	−0.020	0.109**	-	-
	(-0.84)	(6.48)		
PPOULT	−0.040**	−0.086	0.147**	-
	(−2.11)	(−5.86)	(5.83)	
PFISH	−0.034**	−0.002	−0.021**	0.057**
	(−7.63)	(−1.83)	(−2.93)	(5.15)
EXPENDITURE	−0.250**	0.005*	0.247**	−0.002
	(−3.09)	(1.10)	(3.17)	(−0.89)
HI	−0.00014 *	−0.0001**	0.0002**	0.00004
	(−0.80)	−2.47)	(3.99)	(−1.57)
D1	0.009**	−0.007**	−0.003	0.001**
	(1.66)	(−1.73)	(−0.60)	(2.93)
D2	0.025**	−0.02**	−0.007**	0.002
	(7.02)	(−7.04)	(−2.31)	(1.28)
D3	0.025**	−0.016**	−0.010**	0.001
	(9.10)	(−7.57)	(−4.27)	(0.46)
INTERCEPT	2.32**	0.28	−1.710**	0.110*
	(3.98)	(0.59)	(−3.09)	(2.01)
R-SQUARE	0.91	0.95	0.88	0.85

* significant at $\alpha = 0.10$
** significant at $\alpha = 0.01$

Price Effects

Our *a priori* expectation is that the own-price elasticities should be negative for all meat types. As expected, the own-price elasticities were negative and inelastic (Tables 5, 6 and 7). Piggott and Marsh (2004) recently reported own-price elasticities of −0.924 for beef, −0.701 for pork, and −0.328 for poultry. Own-price elasticities reported by Fraser and Moosa (2002) were −0.96 for beef, −0.57 for chicken, and −0.54 for pork. Results of our analysis of Model 1 suggest own-price elasticities of −0.523 for beef, −0.605 for pork, −0.711 for poultry, and 0.140 for fish. In Model 2, the own-price elasticities are −0.603 for beef, −0.916 for pork, −0.299 for poultry, and −0.315 for fish. The magnitudes of estimated elasticities in Models 1 and 2 compare favorably with those in Model 3. The corresponding own-price elasticities of model 3 were −0.63 for beef, −0.59 for pork, −0.46 for poultry, and −0.22 for fish. The USDA/ERS summarized own-price elasticities of U.S. meat demand to range from −2.59 to −0.15 for beef, −1.23 to −0.07 for pork, and −1.25 to −0.10 for broilers. Our estimated own-price elasticity estimates fall within the ERS reported ranges. In our case, compensated elasticities for two separate periods are shown in Table 8. These values are calculated using the formula shown in equation (16). The magnitudes of elasticities are consistent with the range obtained in literature.

Expenditure Effects

As per our *a priori* expectation, the signs for expenditure elasticities were positive in all models (Tables 5, 6, and 7). The total meat expenditure emerged

Table 3. SUR Estimates of the AIDS Model with Homogeneity and Symmetry Restriction Imposed 1997.II–2003. IV, Cholesterol-Information index (Model 2).

	Dependent variables			
Independent variables	Beef	Pork	Poultry	Fish
PBEEF	0.143**	-	-	-
	(6.38)			
PPORK	−0.014	0.031	-	-
	(−0.64)	(0.86)		
PPOULT	−0.148**	−0.013**	0.210**	-
	(−8.27)	(−2.46)	(7.72)	
PFISH	0.019**	−0.004	−0.049**	0.034**
	(3.92)	(−0.69)	(−5.62)	(3.43)
EXPENDITURE	−0.039	0.040	0.024	−0.025**
	(−0.88)	(0.79)	(0.49)	(−2.39)
HI	0.0002	0.0005**	0.0004**	−0.0001
	(0.69)	(−2.18)	(2.14)	(−1.56)
D1	0.015**	−0.004*	−0.010**	−0.001
	(4.76)	(1.87)	(−2.91)	(−0.27)
D2	0.027**	−0.021**	−0.005*	−0.001
	(12.69)	(−9.09)	(−1.88)	(−1.61)
D3	0.024**	−0.016**	−0.007**	0.001
	(11.74)	(−7.18)	(−3.29)	(0.18)
INTERCEPT	0.593*	−0.038	0.210	0.235**
	(1.75)	(−0.10)	(0.56)	(2.91)
R-SQUARE	0.85	0.92	0.98	0.89

* significant at $\alpha = 0.10$
** significant at $\alpha = 0.01$

as a significant determinant of the demand for beef, pork, and poultry in Model 1 and Model 3. In Model 2, beef, pork, and poultry show insignificant expenditure impacts, a result inconsistent with other research. For Model 1, results suggest expenditure elasticities of 0.404 for beef, 1.02 for pork, 1.880 for poultry, and 0.96 for fish (insignificant). In Model 3, expenditure elasticities were 0.857 for beef, 1.310 for pork, 0.857 for poultry, and 0.721 for fish. The results are somewhat consistent with Kinnucan et al. (1997), who report significant positive expenditure elasticities of 0.72, 0.73, 0.05 and 5.17 for beef, pork, poultry, and fish, respectively. Capps and Schmitz (1991) reported expenditure elasticities of 0.90, 1.889, 0.227, and 0.609 for beef, pork, poultry, and fish, respectively.

Cholesterol-Information Effects

The impact of estimated cholesterol information was robust across all three model specifications and all meat types (Table 9). Except for beef in Model 2, cholesterol information demonstrates a negative impact on the market demand of beef and pork in all models. The impact of cholesterol information was significant and positive across all models for poultry. Though positive, cholesterol information has not shown a significant impact on the market demand of fish; these results are consistent with Kinnucan et al. (1997). Our analysis of Model 1 yields cholesterol-information elasticities of −0.01 for beef, −0.05 (significant) for pork, 0.07 (significant) for poultry, and 0.072 for fish. For Model 2, analysis suggests cholesterol-information elastici-

Table 4. SUR Estimates of the AIDS Model with Homogeneity and Symmetry Restriction Imposed, 1989.I–2003.IV, Cholesterol-Information index (Model 3).

Independent variables	Dependent variables			
	Beef	Pork	Poultry	Fish
PBEEF	0.130**	-	-	-
PPORK	−0.063**	0.120**	-	-
PPOULT	−0.062**	−0.048**	0.144**	-
PFISH	−0.005 *	−0.001*	−0.026**	0.04**
EXPENDITURE	0.060**	0.075	−0.040*	−0.095**
HI	−0.0002 **	−0.001*	0.0002**	0.001
D1	0.024**	−0.007**	−0.016**	−0.0002
D2	0.031**	−0.020**	−0.010**	−0.001
D3	0.027**	−0.017**	−0.010**	0.0002
INTERCEPT	0.110	0.290*	0.430**	0.170**
R-SQUARE	0.88	0.92	0.82	0.89

* significant at α = 0.10
** significant at α = 0.01

Table 5. Estimated Price and Expenditure Elasticities for U.S. Meat Demand, 1989.I–1997.I (Model 1).

	Price of				
Equation	Beef	Pork	Poultry	Fish	Meat expenditure
Beef	−0.523**	0.10	0.071**	−0.050**	0.404**
Pork	−0.09	−0.57**	−0.349**	−0.009*	1.020
Poultry	−0.513	−0.527	−0.711**	−0.12**	1.880**
Fish	−0. 66**	−0.0381*	−0.417**	0.140	0.96

* significant at α = 0.10
** significant at α = 0.01

Table 6. Estimated Price and Expenditure Elasticities for U.S. Meat Demand, 1997.II–2003.IV (Model 2).

	Price of				
Equation	Beef	Pork	Poultry	Fish	Meat expenditure
Beef	−0.612**	−0.011	−0.331**	0.052**	0.902
Pork	−0.094	−0.916	0.094**	−0.024	1.161
Poultry	−0.543**	−0.062	−0.299**	−0.169**	1.082
Fish	0.59**	0.05	−0.835**	−0.30**	0.501**

* significant at α = 0.10
** significant at α = 0.01

Table 7. Estimated Price and Expenditure Elasticities for U.S. Meat Demand, 1989.I–2003.IV (Model 3).

	Price of				
Equation	Beef	Pork	Poultry	Fish	Meat expenditure
Beef	−0.630**	−0.114**	−0.102**	−0.004*	0.857**
Pork	−0.378**	−0.595**	−0.276**	−0.035*	1.310
Poultry	−0.154**	−0.135**	−0.461**	−0.093**	0.857*
Fish	0.017*	−0.031*	−0.441**	−0.226**	0.721**

* significant at α = 0.10
** significant at α = 0.01

Table 8. Compensated Price Elasticities.

	Price of			
Equation	Beef	Pork	Poultry	Fish
MODEL I(1989.I–1997.I)				
Beef	−0.35**	0.20	0.18**	−0.03**
Pork	0.34	−0.32**	−0.06**	0.04*
Poultry	0.28	−0.06	−0.20**	−0.03**
Fish	−0.26**	0.21**	−0.14**	−0.19
MODEL II (1997.II–2003.IV)				
Beef	−0.24**	0.22	−0.07**	0.10**
Pork	0.35	−0.63	0.24**	0.03
Poultry	−0.10**	0.21	0.01**	−0.12**
Fish	0.79**	0.17	−0.69**	−0.27**

* significant at α = 0.10
** significant at α = 0.01

Table 9. Cholesterol Health-Information Elasticities in Different Model Specifications of U.S. Meat Demand.

	Cholesterol-information elasticities		
Equation	Model 1 (1989.I–1997.I)	Model 2 (1997.II–2003.IV)	Model 3 (1989.I–2003.IV)
Beef	−0.01	−0.01	−0.07**
Pork	−0.05*	−0.04*	−0.03*
Poultry	0.07**	0.04*	0.14**
Fish	0.072	0.042	0.008

* significant at α = 0.10
** significant at α = 0.01

ties of −0.01 for beef, −0.04 (significant) for pork, 0.04 (significant) for poultry, and 0.042 for fish.

The estimated cholesterol-information elasticities of Model 1 are greater in absolute magnitude than corresponding elasticities of Model 2. The reduction in the magnitude of cholesterol-information elasticities in Model 2 suggests that carbohydrate information as a potential source of health information may be at work after 1997, lessening the impact of cholesterol information. When the complete data set (Model 3) was used, cholesterol-information elasticities were −0.07 (significant) for beef, −0.03 (significant) for pork, 0.14 (significant) for poultry, and 0.008 for fish. Results suggest that cholesterol information remains a significant determinant of beef, pork, and chicken demand in U.S. markets. Kinnucan et al. (1997) reported compensated cholesterol-information elasticities of −0.681 for beef, −0.195 for pork, 1.659 for poultry, and 1.768 for fish. Recently, Rickertsen, Kristofersson, and Lothe (2003) reported corresponding health-information elasticities for Nordic meat markets ranging from −0.05 to 0.11 for beef, −0.01 to 0.04 for pork, −0.02 to 0.30 for chicken, and −0.07 to 0.20 for fish.

Conclusions

The main objective of our paper is to estimate the impact of cholesterol information using an updated cholesterol-information index, especially when consumer consumption and meat demand are supposedly affected by the dissemination of low-carbohydrate information in the U.S. To accurately examine the impact of cholesterol information, we disaggregated the whole data set into two sample periods, where 1997.II—a period of extensive low-carbohydrate information flow—serves as a cut-off point. A separate model with the complete data was also analyzed to examine the robustness of estimated parameters.

After examining all model specifications we found that the impact of price, expenditure, and cholesterol information are robust in all sample periods. Analysis suggests that cholesterol information does affect the market demand of U.S. meat (beef, pork, and poultry). In our analysis, the magnitude of cholesterol-information elasticities was less pronounced when low-carbohydrate information reached U.S. meat consumers. Analysis suggests that carbohydrate information does lessen the magnitude of cholesterol-information elasticities.

The implication of research findings for meat industries is that negative information about carbohydrates should increase the demand for meat products, although cholesterol information is supposed to decrease the demand for meat products especially for beef and pork. The magnitude of the joint effect of negative carbohydrate and negative cholesterol information will determine the future demand and supply of meat products in the US. However, additional studies are needed to confirm the combined effects of cholesterol and carbohydrate information.

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