Assessing the Impacts of Low Carbohydrate Related Health Information on the Market Demand for Vegetables

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Abstract

An Almost Ideal Demand System was estimated to examine the impacts of low carbohydrate information on the market demand of US vegetables. Analysis was extended to examine the performance of alternative carbohydrate information indexes. Study shows significant robust impacts of low carbohydrate information across all included vegetables. Results favor the general and weighted carbohydrate information index.

Key Words: Carbohydrate Information Index, Vegetable Demand, Structural Change, Carbohydrate Information

The relationship between health concerns, consumers' preferences, and market demand has received increasing attention in marketing research in recent years. Numerous research efforts have been made to examine the impacts of health information, especially cholesterol or fat information, on the consumption of shell eggs (Brown and Schrader, 1990), beef, pork, poultry, and fish (Capps and Schmitz, 1991), fats and oils (Chang and Kinnucan (1991), animal fats and vegetables oils (Yen and Chern, 1992), saturated fat (Chern *et al.*,1995), red meats, dairy products, animal fats and vegetables (1995), poultry meat (Kinnucan et al., 1997), beef and chicken (Wilson and Marsh, 2000), and beef (Nivens and Schroeder, 2000). Most of these studies confirm the significant role of health information on the market demand of food group.

Unfortunately, previous demand studies on health information effects completely ignore the role of low carbohydrate information on the market demand of foods. Increasing concerns and awareness about low carbohydrate diets have been shown significantly alter the landscape of food demand patterns in United States (US) in recent years (Gregori, 2004). Likewise, the growing problems of obesity and aggressive media focus on low carbohydrate diet issues likely to further affect the future course of US agricultural production, marketing, and trade, an issue crucial for US farmers, agricultural industries, policy makers, and consumer groups.

In this study, we examine the impacts of low carbohydrate-related health information on the market demand of US vegetables. This issue is of special interest in the midst of an ongoing low-carbohydrate craze in the US. Previous past health information studies excessively focus on shell egg and red meats, so we shift our focus to vegetables (tomato, potato, broccoli, lettuce, and mushroom), an area neglected in empirical demand analysis. A secondary objective of this study is to evaluate and compare the performance of alternative carbohydrate information indexes on the market demand of vegetables. We begin our study with model specifications, development of alternative forms of carbohydrate information indexes, data, and estimation procedures. Then, we discuss the effects of carbohydrate information and different forms of carbohydrate information indexes on the market demand of vegetables. Finally, we present a discussion of the major findings and conclusions.

Model

We select an Almost Idea Demand System (AIDS) model proposed by Deaton and Muellbauer (1980) to assess the impacts of low carbohydrate information on the market demand of vegetables. The AIDS model was selected due to its ease in model estimation procedure, flexible functional forms, and maintenance of theoretical restrictions.

The minimum expenditure function used in deriving the AIDS model is specified as:

$$\ln c(u,P) = \alpha_0 + \sum_{k=1} \alpha_k \ln P_k + \frac{1}{2}\sum_{k=1}^{n}\sum_{k=1}^{n} \gamma_{kj}^{*} \ln P_k \ln P_j + \mu\beta_0 \prod_{k=1}^{n} P_k^{\beta_k} \qquad (1.1)$$

where u is utility, P is the price of commodities, n represents the number of commodities in the demand system, and $\alpha_{0,}$ $\beta_{k,}$ and γ_{kj} are parameters to be estimated.

Though intrinsically non-linear in its parameters, the linear approximation of AIDS model, known as LA/AIDS model, has been widely used in demand analysis studies. We estimate the linear approximate AIDS (LA/AIDS) as:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln \frac{Y}{P^*} \qquad i = 1,\ldots,n$$

(1.2)

where,

$$\mathrm{P}^* = \alpha_0 + \sum_i \alpha_i \ln p_i + \frac{1}{2}\sum_i \sum_j \gamma_{ij}^{*} \ln(p_i)\ln(p_j) \qquad (1.3)$$

P* is the weighted price based on Stone’s price index and defined as:

$$\log(p^*) = \sum_{i=1}^{n} w_i \log(p_i) \qquad (1.4)$$

The theoretical restrictions of adding up and homogeneity were imposed as:

Adding up:

$$\sum_{i=1}^{m}\alpha_i = 1; \sum_{i=1}^{m}\lambda_{ij} = 0; and \sum_{i=1}^{m}\beta_i = 0; \qquad (1.5)$$

Homogeneity:

$$\sum_{j=1}^{m}\gamma_{ij} = 0; \qquad (1.6)$$

Symmetry:

$$\gamma_{ij} = \gamma_{ji}, \text{ for i= 1,…,n, j=1,….., n.} \qquad (1.7)$$

Following Deaton and Muellbauer (1980) suggestions, the price parameters, α_k's, in the AIDS model's minimum expenditure function (1.1) are specified as a function of cholesterol information and seasonal dummy variables. We assume a semi-log relationship (1.8) between α_k's, and non-economic variables, as proposed by Duffy (1991), as:

$$\alpha_k = \alpha_k^0 + \theta_i \ln HI, k = 1,....., n \qquad \textit{(1.8)}$$

Next, the demand equations of the AIDS model derived from Duffy's specification (1.9) is specified as:

$$w_i = \alpha_k^0 + \theta_i \ln HI + \sum_{j=1}^{n}\gamma_{ij}\ln p_j + \beta_i \ln\frac{Y}{P^*} + v_i, i = 1,....., n \qquad (1.9)$$

The estimated model (1.9) is Linear Approximate Almost Ideal Demand System (LA/ AIDS). The γ_{ij} shows the change in the ith vegetable's budget share with respect to change in the jth price with real vegetable expenditure (Y/P), holding remaining prices constant. The β_i shows the change in the ith vegetable's budget share with respect to a change in real expenditure on the vegetables, holding prices constant. The AIDS does not satisfy the regularity conditions of a demand system automatically. However, Slutsky symmetry was imposed by setting $\gamma_{ij} = \gamma_{ji}$ in estimation process. The elasticities for the LA/AIDS model of (1.9) are calculated using the following formulas:

Own-price elasticities: $e_{ii} = -1 + \frac{\gamma_{ii}}{w_1} - \beta_i$ (1.10)

Cross-price elasticities: $e_{ij} = \frac{\gamma_{ij}}{w_i} - \beta_i \left(\frac{w_j}{w_i} \right)$ (1.11)

Expenditure elasticities: $\eta_i = 1 + \frac{\beta}{\omega_i}$ (1.12)

Carbohydrate information elasticities: $\mu_i = \frac{\theta_i}{w_i} * H_i$ (1.13)

Compensated price elasticities $e^*_{ij} = e_{ij} + \eta_i * w_j$ (1.14)

As a general rule, own- price elasticities are expected to be negative and expenditure elasticities positive. No *priori* assumptions are made for cross-price elasticities. Most of the vegetables are considered as favorable healthy substitutes of high carbohydrate diets. Therefore, carbohydrate information elasticities are expected to positive for tomato, lettuce, broccoli, and mushroom. However, negative carbohydrate information elasticity was expected for the potato, due to its high calorie content.

Data and Estimation Procedures

Annual data for the period of 1980 through 2003 were used for the analysis. Price and quantity data of tomato, potato, broccoli, lettuce, and mushroom were collected from the USDA. A general carbohydrate information index (GCII)(here-after known as Model1) is constructed following the idea of Brown and Schrader (1990). The general carbohydrate information index was created by scanning 1170 abstracts, which were showed up, when we use two key word groups "low carbohydrate diets and weight loss" and "low carbohydrate diets and obesity" placing restrictions on key words, language, date, and category in the PubMed database, a service of the National Library of Medicine (NLM), which includes over 15 million citations for biomedical articles back to the 1950's.

Mathematically,

$$GCII_t = \sum_{i=1}^{t}(NS_i - NA_i) \qquad (1.15)$$

where GCII represents the general carbohydrate information index. NS_i and NA_i are the sum of articles showing favorable and unfavorable effects of low carbohydrate diets on weight loss, obesity, and obesity-related medical conditions, respectively. The actual data, along with detailed procedures for constructing a General Carbohydrate Information Index is available upon request.

Alternative Forms of Carbohydrate Information Indexes

Despite its popularity, Brown and Schrader's cholesterol information index has been criticized for its high correlation with a trend variable and its failure to reflect the consumers' changing patterns of health information over time (Kim and Chern 1997). Concepts of weighted factor (Kinnucan *et al.* 1997), geometrically declining weight, and cubic function (Kim and Chern 1997) have been proposed to create alternative health information indexes and improve upon the Brown and Schrader Index. Although the concerns of how health information passes from medical articles to general consumers remains an issue of empirical discussion, we further extend our analysis to examine performance of three additional alternative forms of carbohydrate information indexes as:

- Weighted Carbohydrate Information Index (WCII): Model 2
- Cubic Carbohydrate Information Index (CCII): Model 3

- Geometrically Declining Carbohydrate Information Index (GDCII): Model 4

Weighted Carbohydrate Information Index (WCII)

The weighted carbohydrate information index was developed following the model proposed by Kinnucan *et al.* (1997). Mathematically:

$$WCII_t = \tau_t FAV_t \tag{1.16}$$

Where $WCII_t$ is the net positive publicity of low carbohydrate diets on weight loss, obesity, and obesity related medical conditions. The FAV_t is the sum of favorable articles supporting low carbohydrate diets, and τ_t, a weighting factor, is a relative proportion of all favorable and unfavorable articles in period 't'. Specifically, $\tau_t = FAV_t / (FAV_t + UNFAV_t)$ where $UNFAV_t$ is the cumulative sum of unfavorable articles on low carbohydrate diets.

Cubic Carbohydrate Information Index (CCII)

Cubic carbohydrate information index assumes carry-over and decay effects of an article published in a specific time period. Mathematically:

$$CCII_t = \sum_{i=t-1}^{t} W_{si} NS_i - \sum_{i=t-n}^{t} W_{ai} NA_i) \tag{1.17}$$

where NS and NA are the number of favorable and unfavorable articles on low carbohydrate diets at period t, respectively. W_{SI} and W_{AI} represent the corresponding carryover weights and n is the number of carryover periods. A third degree polynomial weight function of cubic carbohydrate information index (CCHI) was estimated as:

$$w_i = \alpha_0 + \alpha_1 i + \alpha_2 i^2 + \alpha_3 i^3 \tag{1.18}$$

where α, a vector of coefficients, characterizes the third degree polynomial weight function. The values of the coefficients (α_i) were determined following the restrictions proposed by Kim and Chern (1999). We propose n = 4 and m = 1, assuming that an article as a source of consumer health information lasts for 4 quarters and generates the maximum influence during the first quarter of publication.

Geometrically Declining Carbohydrate Information Index

Geometrically Declining Carbohydrate Information Index (GDCII) assumes a gradual decay of low carbohydrate health information once it is published in medical journals. Although, the actual rate of decay of health information is unknown, we assume that a per quarter health information decay rate (d) of 20% for our analysis purposes. Kim (1998) proposed decaying rates of 10% and 20% for cholesterol and fat health information, respectively. The geometrically declining weighted function for carbohydrate information was calculated as:

$$w_i = \alpha(\frac{1}{1+d})^i$$

$$GDCII = \sum_{i=t-n}^{n} w_i NM_{t-i}$$

$$= \sum_{i=0}^{n} \alpha(\frac{1}{1+d})^i NM_{t-i} \qquad \text{(set i=0 at period)} \qquad (1.19)$$

where d is decaying rate with 0<d<1 and α is a scalar and setting equal to one.

Result and Discussions

The LA/AIDS model was estimated using seemingly unrelated regressions (SUR) to accommodate the parameter restrictions. In estimation, one equation was dropped from the system to avoid the singularity condition in the variance and covariance matrix (Barten 1969). As the adding up constraint allows only four independent equations in the system, the parameter estimates of the omitted equation are recaptured from the estimated models using the symmetry and homogeneity restrictions. To ensure the robustness of the estimated parameters of the model, we estimate the model twice, first by removing the mushroom equation, and secondly by excluding the tomato equation.

All theoretical restrictions of the model tested and imposed successfully using the Wald criteria. Based on the results of the Wald tests, an appropriately restricted model was developed to examine the impacts of low carbohydrate-related health information and to estimate the elasticities of economic and non-economic variables in the model. The sample mean of budget share was used to estimate the elasticities of the exogenous variables.

Price Effects

Autocorrelation is frequently a serious problem is demand studies, when time series data are used. The Durbin-Watson statistic showed no evidence of serial correlation in the unrestricted equations. Table 1.1 reports the estimated vegetable demand equations using general health information index. The R^2 values of tomato, lettuce, broccoli, mushroom, and potato were 0.90, 0.95, 0.89, and o.95, respectively. The high R^2 values and presence of significant coefficients reveal a good fitness of the estimated models. Own price is expected to yield a negative effect on per capita vegetable demand. Except broccoli, the estimated own -price effects are negative and consistent with a *priori* expectations. The analysis suggests own- price elasticities of -0.40 for tomato, -0.61 for lettuce, and 0.33 for broccoli, -0.79 for mushroom, and -0.33 for potatoes. These magnitudes suggest that one percent increase in own price of the tomatoes, lettuce, broccoli, mushroom, and potatoes decreases the consumption of tomatoes, lettuce, broccoli, mushroom and potatoes by 0.40 percent, 0.61 percent, 0.33 percent, 0.79 percent and 0.33 percent, respectively.

Expenditure Effects

As expected, the signs of expenditure elasticities were positive for all included vegetables (Table 1.2). However, study suggests total vegetable expenditure as significant determinant of demand only for lettuce, broccoli, and mushroom. Estimated expenditure elasticities are 0.98 for tomato (insignificant), 1.34 for lettuce, 2.16 for broccoli, 0.57 for mushroom, and 0.88 for potato (insignificant). The magnitudes of the expenditure elasticities show that lettuce and broccoli are luxury goods. However, with the expenditure elasticities less than one, tomatoes mushroom and potatoes are necessity goods. The estimated expenditure elasticities of lettuce (0.98) and tomato (1.04) compare favorably with the finding of Acharya and Molia (2004).

Carbohydrate Information Effects

The coefficients associated with the general carbohydrate information index were significant and robust across all included vegetables (Table 1.1). Analysis suggests positive and significant effects of carbohydrate information on the market demand of tomato and lettuce. Analysis shows the favorable impacts of low carbohydrate information dissemination for tomato and lettuce demand. Estimated general carbohydrate information elasticities for tomato and lettuce were 0.06 and 0.07, respectively. Low Carbohydrate information elasticity measures the percentage change of US vegetable demand to a percentage change in the low carbohydrate information variable. Carbohydrate information elasticities of 0.06 for tomatoes and 0.07 for lettuce indicates that there would be a 0.6 percent and 0.7 percent increase in the quantity of tomatoes and lettuce in response to a 10 percent increase in the low carbohydrate information.

Based on the annual US average tomatoes consumption of 16.1 pounds per person, the elasticity of 0.6 implies an increase of 0.097 pounds per person of tomatoes as a result of 10 percent increase of low carbohydrate information. This implies that the total revenue of tomatoes sector will be increased by 26.76 millions dollars as a result of 10 percent increase of low carbohydrate information.

Given the annual US average lettuce consumption of 28.9 pounds per person, the elasticity of 0.7 implies an increase of 0.202 pounds per person of lettuce as a result of 10 percent increase of low carbohydrate information. An increase of 10 percent of low carbohydrate information will increase the total revenue of 31.17 million dollars in lettuce sector.

Analysis yields carbohydrate information elasticities of -0.09 for potato, -0.17 for mushroom, and -0.26 for broccoli. Carbohydrate information elasticities of -0.09 for potatoes, -0.17 for mushroom, and -0.26 for broccoli indicates that there would be a 0.9

percent, 1.7 percent and 2.6 percent decrease in the quantity of potatoes, mushroom and broccoli in response to a 10 percent increase in the low carbohydrate information. Given the average US potatoes consumption 45.7 pounds per person, the elasticity of -0.9 shows that there will be decrease of 0.412 pounds per person of potato demand resulting into the total revenue loss of 33.49 million dollar in potato sector.

Annual US average mushroom consumption is 3.7 pounds per person. The elasticity of 1.7 implies that decrease of 0.063 pounds per person would occur as a result of 10 percent increase of low carbohydrate information index. This implies that the total revenue of mushroom sector is decreased by 16.64 million dollars as a result of 10 percent increase of health dissemination. Based on the average consumption of broccoli of 3.9 pounds per person, the elasticity of 2.6 implies that decrease of 0.102 pounds per person would occur as a result of 10 percent increase of carbohydrate information index. This implies that the total revenue of broccoli sector is decreased by 10.02 million dollars as a result of 10 percent increase of carbohydrate related health information.

These significant and negative elasticities suggest detectable unfavorable effects of low carbohydrate information on potato, mushroom, and broccoli. Except mushroom, market demand of potato and broccoli has decreased gradually over the last few years. The results might be useful to explain the decreasing demand trend of potato and broccoli.

Alternative carbohydrate information indexes effect

After assessing the impacts of low carbohydrate information using the general carbohydrate information index (Model 1), we re-estimate using WCII (Model 2), CCII

(Model 3), and GDCII (Model 4). Table 1.3, Table 1.4, and Table 1.5 present the estimated results of model 2, model 3, and model 4, respectively. Estimated demand equations are given in the appendix. As the carbohydrate information effects are the main focus of study, the price and expenditure effects of the re-estimated models are not discussed. Table 1.6 presents the relative performance of alternative carbohydrate information indexes in the model in terms of associated elasticities.

The carbohydrate information elasticities measure the impacts of different forms of carbohydrate information flows. The estimated health information coefficients of model 2 were significant across all vegetables. In model 2, estimated health information elasticities were 0.06 for tomato, 0.06 for lettuce, -0.27 for broccoli, -0.18 for mushroom, and -0.093 for potato. The estimated carbohydrate information of model 2 compare favorably with model 1. Results also suggests a similar magnitude of carbohydrate information elasticities between model 3 and model 4, showing no substantive different between cubic and geometrically decaying health information indexes.

Carbohydrate information elasticities of model 3 and model 4 demonstrate impacts of low carbohydrate information that are not significant influences on the demand of lettuce, broccoli, and mushroom. These results contradict the findings of model 1 and 2. Estimated carbohydrate information elasticities range from -0.002 (broccoli) to 0.04 (tomato). Except, mushroom, all models yield consistent results in term of expected signs. In our analysis, model 1 and model 2 yield robust, consistent, and significant results in comparison to model 3 and model 4, not supporting the concept of cubic and geometrically decaying health information indices. Study does confirm the significant impacts of low carbohydrate information on the market demand for selected vegetables.

Conclusions

The main focus of this paper was to empirically examine whether the ongoing low carbohydrate mania in the US has had any detectable impacts on the market demand of US vegetables. In our analysis, the own-price elasticities, expenditure elasticities, and carbohydrate information elasticities yield expected and significant results. So far, no research to our knowledge has addressed the issue of using a low carbohydrate information index. But, the results were in consistent with other researchers who report significant impacts of health information on the market demand of shell egg and red meats.

How health information flows from journal articles to general consumers remains empirical issue. Different ideas have been proposed to construct the health information index. As no method was perfect, we examine the relative performance of four alternatives carbohydrate information indices. In our analysis, estimated models with general and weighted health information indices show robust results outperforming the results of cubic and geometrically decaying index. Although, carbohydrate information emerges as a significant factor of vegetable demand, the magnitude of carbohydrate information elasticities are smaller than own -price and expenditure elasticities.

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Table 1.1. SUR Estimates of the AIDS Model with Homogeneity, Symmetry Restrictions Imposed, with GCII Index, 1980- 2004.

Independent	Dependent Variables				
Variables	Broccoli	Lettuce	Mushroom	Potatoes	Tomatoes
TPR	-0.012	-0.070	-0.020	-0.083	0.190
	(-1.70)	(-2.86)	(-1.78)	(-3.35)	(7.04)
LPR	-0.013	0.160	-0.001	-0.075	-0.070
	(-2.18)	(4.13)	(-0.12)	(-2.51)	(-2.86)
BPR	0.041	-0.013	0.004	-0.020	-0.010
	(8.25)	(-2.18)	(.59)	(-2.86)	(-1.70)
MPR	0.004	-0.001	0.007	0.011	-0.020
	(.59)	(-0.12)	(2.45)	(1.15)	(-1.85)
PPR	-0.020	-0.075	0.011	0.166	-0.080
	(-2.86)	(-2.51)	(1.05)	(4.49)	(-3.35)
GCII	-0.0001	0.0002	-0.0001	-0.0002	0.0002
	(-2.46)	(2.30)	(-2.86)	(-2.84)	(3.03)
Expenditure	0.035	0.110	-0.110	-0.030	-0.005
	(2.13)	(2.26)	(-4.19)	(.76)	(-0.16)
INTERCEPT	-0.230	-0.460	0.860	0.650	0.176
	(-1.97)	(-1.28)	(4.41)	(2.12)	(0.79)
R-SQUARE	0.89	0.95	0.85	0.95	0.90

Note: Number of parenthesis is the t-value. TPR, LPR, BPR, MPR, PPR and CCII represent the tomatoes price, lettuce price, broccoli price, mushroom price, potatoes price, and General Carbohydrate information index respectively.

Table 1.2. Estimated Price and Expenditure Elasticities for US Vegetables, AIDS Model, GCII Index, 1980-2004

	Expenditure			**Price Elasticity**		
	Elasticity	**Broccoli**	**Lettuce**	**Mushroom**	**Tomatoes**	**Potatoes**
Tomatoes	0.98	-0.43*	-0.33*	-0.18*	-0.40*	-0.29*
Lettuce	1.34*	-0.47*	-0.61*	0.08	-0.21*	-0.25*
Broccoli	2.16*	0.33*	-0.15*	0.17	-0.03*	-0.28*
Mushroom	0.57*	0.09	-0.11	-0.79*	-0.06*	0.07
Potatoes	0.88	-0.70*	-0.34*	0.26	-0.25*	-0.33*

Note: * indicate the corresponding elasticities are significant the 10 percent level or less.

Table 1.3. SUR Estimates of the AIDS Model with Homogeneity, Symmetry Restriction Imposed, With WCII Index 1980- 2004 (Model 2)

Independent Variables	**Dependent Variables**				
	Broccoli	**Lettuce**	**Mushroom**	**Tomatoes**	**Potatoes**
TPR	-0.012	-0.072	-0.021	0.192	-0.083
	(-1.70)	(-2.86)	(-1.78)	(7.02)	(-3.353)
LPR	-0.013	0.162	-0.001	-0.072	-0.075
	(-2.18)	(4.10)	(-0.12)	(-2.87)	(-2.51)
BPR	0.041	-0.013	0.004	-0.010	-0.022
	(8.25)	(-2.18)	(.59)	(-1.67)	(-2.91)
MPR	0.004	-0.001	0.007	-0.021	0.011
	(.59)	(-0.12)	(2.45)	(-1.85)	(1.15)
PPR	-0.022	-0.075	0.011	-0.083	0.166
	(-2.86)	(-2.51)	(1.05)	(-3.33)	(4.49)
WCII	-0.0001	0.0002	-0.0001	0.0002	-0.0002
	(-2.46)	(2.25)	(-2.86)	(3.04)	(-2.84)
Expenditure	0.036	0.121	-0.111	-0.004	-0.030
	(2.13)	(2.28)	(-4.19)	(-0.13)	(.76)
INTERCEPT	-0.240	-0.470	0.860	0.169	0.650
	(-1.97)	(-1.30)	(4.41)	(0.74)	(2.12)
R-SQUARE	0.89	0.95		0.90	0.95

Note: Number of parenthesis is the t-value. TPR, LPR, BPR, MPR, PPR and WCII represent the tomatoes price, lettuce price, broccoli price, mushroom price, potatoes price, and Weighted Carbohydrate information index respectively.

Table 1.4. SUR Estimates of the AIDS Model with Homogeneity, Symmetry Restriction Imposed, with CCII Index, 1980- 2004 (Model 3)

Independent Variables	Dependent Variables				
	Broccoli	**Lettuce**	**Mushroom**	**Tomatoes**	**Potatoes**
TPR	-0.003	-0.093	0.0003	0.197	-0.102
	(-0.44)	(-3.53)	(-0.03)	(7.15)	(-4.12)
LPR	-0.014	0.169	-0.008	-0.090	-0.054
	(-2.06)	(4.20)	(-0. 57)	(-3.53)	(-2.51)
BPR	0.041	-0.014	0.002	-0.003	-0.025
	(8.25)	(-2.06)	(0.27)	(0.44)	(-3.81)
MPR	0.002	-0.008	0.012	0.0003	-0.006
	(0.27)	(-0. 57)	(1.52)	(-0.03)	(-0.61)
PPR	-0.025	-0.054	-0.006	-0.102	0.188
	(-3.81)	(-1.89)	(-0.61)	(-4.12)	(5.27)
CCII	-0.00003	0.002	0.0002	0.004	-0.005
	(-1.25)	(0.90)	(1.23)	(3.03)	(-3.30)
Expenditure	0.070	-0.015	-0.030	0.053	-0.070
	(5.50)	(-0.47)	(-1.47)	(2.06)	(-2.49)
INTERCEPT	-0.470	0.440	0.270	0.260	1.020
	(-5.10)	(-1.85)	(1.82)	(-1.34)	(4.17)
R-SQUARE	0.84	0.92		0.93	0.86

Note: Number of parenthesis is the t-value. TPR, LPR, BPR, MPR, PPR and CCII represent the tomatoes price, lettuce price, broccoli price, mushroom price, potatoes price, and Cubic Carbohydrate information index respectively.

Table 1.5. SUR Estimates of the AIDS Model with Homogeneity, Symmetry Restriction Imposed, with GDCII Index 1980- 2004 (Model 4)

Independent Variables	Dependent Variables Broccoli	Lettuce	Mushroom	Potatoes	Tomatoes
TPR	-0.003	-0.093	0.0006	-0.101	0.197
	(-0.37)	(-3.55)	(-0.06)	(-4.07)	(7.06)
LPR	-0.014	0.169	-0.008	-0.054	-0.09
	(-2.01)	(4.21)	(-0. 56)	(-1.89)	(-3.55)
BPR	0.041	-0.014	0.002	-0.025	-0.003
	(7.75)	(-2.01)	(0.27)	(-3.81)	(-0.37)
MPR	0.002	-0.008	0.012	-0.006	0.0006
	(0.27)	(-0. 56)	(1.52)	(-0.61)	(-0.06)
PPR	-0.025	-0.054	-0.006	0.187	-0.101
	(-3.81)	(-1.89)	(-0.61)	(5.27)	(-4.07)
GDCII	-.000005	0.0005	0.00006	-0.002	0.0012
	(-1.25)	(0.97)	(1.23)	(-3.30)	(2.78)
Expenditure	0.070	-0.015	-0.03	-0.07	0.053
	(5.39)	(-0.50)	(-1.50)	(-2.43)	(2.07)
INTERCEPT	-0.47	0.445	0.27	1.01	-0.26
	(-4.99)	(1.89)	(1.84)	(4.12)	(-1.34)
R-SQUARE	0.80	0.90		0.85	0.94

Note: Number of parenthesis is the t-value. TPR, LPR, BPR, MPR, PPR and GDCII represent the tomatoes price, lettuce price, broccoli price, mushroom price, potatoes price, and Geometrically Declining Carbohydrate information index respectively.

Table 1.6: Health Information Elasticity for US Vegetables, AIDS Model, KHI Index, 1980-2004

Elasticity	Broccoli	Lettuce	Mushroom	Potatoes	Tomatoes
GCII	-0.26*	0.07*	-0.17*	-0.09*	0.06*
WCII	-0.27*	0.06*	-0.18*	-0.09*	0.06*
CCII	-0.004	0.02	0.01	-0.07*	0.04*
GDCII	-0.002	0.02	0.01	-0.07*	0.04*

Note: * indicate the corresponding elasticities are significant at 10 percent level or less. GCII, WCII, CCII, and GDCII represent the general carbohydrate information index, weighted carbohydrate information index, cubic carbohydrate information index, and geometrically declining carbohydrate information index respectively.

Table 1.7: The Average Annual Change of Consumption of Vegetables (in Pounds) with the 10 Percent Increase in Low Carbohydrate Information

	Broccoli	Lettuce	Mushroom	Potatoes	Tomatoes
Carbo- Info	-0.102	0.202	-0.063	-0.412	0.097

Table 1.8: The Average Change of Total Revenue of Vegetables (in Million dollars) with 10 Percent Increase in Low Carbohydrate Information

	Broccoli	Lettuce	Mushroom	Potatoes	Tomatoes
Revenue	10.022	31.165	16.637	33.490	26.756