Preliminary

Disentangling the Effects of Generic Advertisement from Health Information within a Meat Demand System[1]

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[1] Empirical results presented in this paper are preliminary and will change prior to the AAEA conference in July 2002. Additional data will be collected and statistical tests performed. Copies of the updated version of the paper will be made available in the meeting.

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Consumer demand for lard for cooking purposes was so great from the late 1880s through the late 1940s that pork producers raised relatively fat hogs in order to meet these demands. However, the end of World War II brought great changes and the market for lard and other by-products of fat from hogs started to decline and consumers began thinking more about health and diet. In response, U.S. pork producers began concentrating their efforts on developing a leaner type hog that would meet increasing consumer demands for leaner meat products, relatively low in cholesterol and fat.

In a recent Food Marketing Institute survey, 87 percent of the respondents indicated that they had either a very concerned or somewhat concerned attitude about nutrition (National Pork Producers Council). Nutrition and product safety were important factors in a consumer's product selection; only taste was more important than either attribute, and both attributes were more important than price (National Pork Producers Council). In a U.S. Department of Agriculture survey, almost two-thirds of the respondents reported that they had adjusted household diets in the previous three years for health or nutrition reasons (Capps and Schmitz). As well, organizations representing producer groups appear to be very conscious of consumer's health and nutrition concerns, as evident in their generic advertisements, which have often focused on the nutritional aspects of the product promoted. Early in the development of the National Pork Promotion Program, the registered phrase "Pork the Other White Meat" was introduced. This phrase was used to challenge the consumer's perception that pork is high in fat, calories and cholesterol and positions pork alongside traditional white meats such as poultry, turkey and fish as a nutritious, healthful food item.

A good assessment of the effects of generic advertisements and health information on consumer demand will provide insights toward the understanding of the ever-changing consumer

behavior in the consumption of pork and other meat products. Additionally, it is important from a policy perspective to discern the demand effect of the above two variables. The objective of the paper is to estimate the consumer demand for U.S. pork products within a meat demand system framework, incorporating into the model product-related health information variables and generic advertisement variables. The Rotterdam model was adopted for the meat demand system.

The Conceptual Model

The representative consumer is assumed to be a rational individual who makes decisions upon reviewing the appropriate data, analyzing the facts and determining the options based on the constraints. Thus, demand for a product is realized after the consumer has acquired enough information to judge the product, its price and the alternatives. However, acquiring the necessary information is a major task in the purchasing process and consumers do not have the time, resources or energy required to review every potential fact before making a decision. Yet, this information is important to the decision process and thus there is a need for information.

If it is assumed that information is complete and no uncertainty exists, then there is no role for advertising. In this case, preferences incorporate complete knowledge about commodity attributes, and hence advertising can play no role in shifting preferences. For meat demand this means that consumers have a total understanding of all nutritional and dietary needs, and they know the necessary mix of goods and the alternatives for fulfilling these needs. While the assumption of complete knowledge is often made in empirical work, it is obviously unrealistic. Information available to the consumer is far from complete and evolves over time. Since the

nutritional needs of consumers are never fully understood, and continually evolve along with our changing life-styles, the preferences for meat will undergo periodic changes.

Discussion of Meat Demand Systems

Previous studies have adopted various demand system specifications to estimate the demand for meat products such as pork, beef, chicken and fish. Most meat demand studies do not consider either generic advertisements or health information (e.g., Eales and Unnevehr), while those that do consider either advertising or health information look at one of the effects and do not account for the other (e.g., Capps and Schmitz, McGuirk et al). One study has examined the combined effects of generic advertising and health information on U.S. meat consumption (Kinnucan et al.).

Since information does not by itself give utility, generic advertising and health information variables must enter the utility function in some specific way. Kinnucan et al. view information as an input in the household production function, thereby allowing advertising and health information variables to enter the demand function for market goods as separate shift variables, along with prices and income.

An alternative approach to incorporating the impacts of advertising or health information in demand analysis is through the translating or scaling approaches introduced by Pollak and Wales. These approaches have been adopted in previous studies to augment the conventional Rotterdam demand system to include advertising variables (Cox, Goddard and Cozzarin). Intuitively, translating introduces an overhead or fixed cost as it requires the consumer to consume a minimum amount of the good in question. Generic advertisements are often aimed at getting the consumer to increase consumption of a product by influencing the consumer to

believe that the product is good for them. The “Got Milk” campaign emphasizes the importance of calcium in the diet. The “Pork the Other White Meat” emphasizes that pork is not as high in fats as beef and is as nutritionally good for the consumer as chicken. If these advertisements successfully convince consumers that there is a certain minimum amount of the good that should/could be consumed for good health, or if generic advertisements serve to increase (or slow the rate of decrease) of this subsistence consumption level, then the translating approach is appropriate.

On the other hand, scaling assumes that the effect of advertising is to lower the consumer’s perception of the per-unit price and, thus increase the perceived product quantity for a given price. An advertisement such as 25 percent off or 20 percent more in quantity are examples of this type of advertisement. However, as explained in the previous paragraph, since most generic advertisements in meat products are to affect perceived product quality rather than perceived quantity, scaling will not be considered in this study.

The translating approach will not be used for the health information variable for two reasons. First, the complication of translating both the advertising expenditure variable and the health information variable would render the estimation of Rotterdam model unduly complicated. Second, since the translating approach can be viewed as an attempt to increase perceived product quality, this may only pertain to the generic advertisement variables and not the health index. Since, one can make no assumption as to how the health index should influence demand, the translating approach may be too specific for the health information variable.

The Rotterdam Model

The Rotterdam model, first proposed by Barten (1964) and Theil (1965), works in differentials. It is consistent with demand theory (Barten 1964, Theil, 1965) and has been shown to provide reasonable and robust functional form approximations (Mountain 1988). Further, Brown and Lee (1993) points out that the Rotterdam model is readily applicable to advertising studies and Alston and Chalfant find that the model performs better for the U.S. meat demand data when compared with its major rival, the Linearized Almost Ideal Demand System.

The Rotterdam Model with Generic Advertisements and Heath Information

The consumer is assumed to maximize utility as a function of the consumed bundle subject to a budget constraint and available information on the attributes of the goods. The information on the attributes, in turn, is assumed to depend on generic advertisements and the stock of health information. The consumer choice problem can be written as follows:

(1) Maximize $U = U(q|\, a, H)$

Subject to $p' q = Y$

where $q = (q_1, q_2 \ldots q_n)$, $p = (p_1, p_2 \ldots p_n)$ and $a = (a_1, a_2 \ldots a_n)$ are n x 1 vectors of quantities, prices and advertising expenditure levels for the n commodities included in the model, H is the health information index, and Y is total meat expenditures. Parameters of the utility function are postulated to depend on the consumer's stock of information regarding product attributes, which is a function of advertising expenditures and non-advertising related health information.

Maximization of equation (1) with respect to q yields Marshallian demand functions of the following form:

(2) $q_i = f_i(p, Y\, |a, H)$.

where demand depends not only on prices, income, but also on generic advertising expenditures and health information. This framework is consistent with the concept of the information-augmented quantity vector of market goods put forward by Choi and Sosin.

Multiplying both sides of the total differential of equation (2) by (p_i/Y) and using $w_i = p_i q_i /Y$ gives the following:

(3) $w_i \, d \log q_i = \{\partial q_i/\partial Y\} p_i \, d \log Y + \sum_{j=1}^{n} (p_i \, p_j/Y) \{\partial q_i/\partial p_j\} d \log p_j +$

$$\{\partial q_i/\partial H\}(H \, p_i /Y) \, d \log H + \sum_{j=1}^{n} p_i \, a_j/Y \{\partial q_i/\partial a_j\} d \log a_j$$

where the Slutsky equation decomposes the compensated price derivatives into

(4) $\partial q_i/\partial p_j = \partial h_i/\partial p_j - \{\partial q_i/\partial Y\} q_i$

and the link between the effects of advertising and Hicksian substitution effects is shown by Selvanthan to follow:

(5) $\partial q_i/\partial a_k = -\sum_{j=1}^{n} \{\partial h_i/\partial p_j\} \, p_j/a_k \quad \partial[\log(\partial U/\partial q_j)]/\partial (\log a_k)$

Equation (5) can be further simplified by the use of the notations of demand elasticity with respect to advertising (τ_{ij}), the elasticity of marginal utility with respect to advertising (ς_{ij}), and the compensated price elasticity of demand (η_{ij}). That is, (5) is equivalent to:

(6) $\tau_{ij} = -\sum_{k=1}^{n} \eta_{ij} \, \varsigma_{kj}$,

where

(7) $\tau_{ij} = \partial(\log q_i) / \partial(\log a_j)$

(8) $\varsigma_{ij} = \partial [\log (\partial U/\partial q_i)] / \partial(\log a_j)$

(9) $\eta_{ij} = \partial (\log h_i) / \partial (\log p_j)$

The expression in (6) indicates that advertising's effect on demand is multifaceted; in general, it may be positive or negative and, hence, has to be determined empirically.

A basic property of demand systems incorporating factors such as advertising is that any demand increase for some product as a result of a change in the factor must be offset by demand decreases for other products, while total expenditures remain constant. Thus, advertising can cause no change other than a reallocation of budget shares, given that only good i is advertised. This property can be written as the differentiation of the budget constraint with respect to a_i .

(10a) $\sum_j p_j (\partial q_j/\partial a_i) = 0$

or

(10b) $\sum_j w_j \tau_{ji} = 0.$

Equation (10b) should serve as an additional restriction on demand parameters resulting from the presence of advertising and should be tested or imposed similarly to homogeneity and symmetry restrictions of the neoclassical theory.

To deal with the homogeneity and symmetry restrictions, define the following terms:

(11) $\alpha_i = \partial p_i q_i /\partial Y$ and

(12) $\Omega_{ij} = w_i \eta_{ij}$

where α_i is the marginal propensity to spend on good i and Ω_{ij} is the (i,j)th Slutsky coefficient. The adding up condition needs to satisfy

(13) $\sum_{i=1}^{n} \alpha_i = 1$

while the Slutsky coefficients must be symmetric ($\Omega_{ij} = \Omega_{ji}$) and satisfy the following condition for homogeneity:

(14) $\sum_{j=1}^{n} \Omega_{ij} = 0$, i=1…n.

Using equations (4) through (12) leads to a simplification of equation (3):

(15) $w_i \, d \log q_i = \alpha_i \, d \log R + \sum_{j=1}^{n} \Omega_{ij} \, d \log p_j + \sum_{j=1}^{n} \xi_{ij} \, d \log a_j + \nu_i \, d \log H$

where $d \log R = d \log Y - \sum_{j=1}^{n} \Theta_j \, d \log p_j$; and $\sum_{j=1}^{n} \Theta_j \, d \log p_j$ is the Frisch price index; $\xi_{ij} = \tau_{ij} \, w_i = - \sum_{k=1}^{n} \Omega_{ij} \, \varsigma_{kj}$ is the elasticity of the marginal utility of good j with respect to advertising good i; and $\nu_i = \{\partial q_i / \partial H\}(H \, p_i / Y)$. Equation (15) is the unconditional differential demand equation for commodity in terms of undeflated (absolute) variables. Selvanathan shows that the advertising coefficients satisfy the following condition:

(16) $\sum_{j=1}^{n} \xi_{ij} = 0, \; i = 1, \ldots, n.$

and Capps and Schmitz suggest that an additional adding-up constraint be added:

(17) $\sum_{i=1}^{n} \nu = 0.$

Incorporating Generic Advertisements using the Translating Approach

The translating approach allows the variables to be made functions of advertising in a specific way. It makes an assumption about how generic advertisements enter the utility function. As previously mentioned, it is reasonable to assume that commodity promotion strives to convince consumers that the product is of a better quality than the rest. The goal may be to make the consumer believe that there is a certain minimum amount required for good health. This minimum requirement can be viewed as a fixed cost. Through the translating approach this fixed cost can be made a function of advertising. Formally, the consumer choice problem with translating can be written as the following:

(18) Maximize $U = U(q^* \mid H)$

Subject to $p'q^* = Y^*$

where q_i^* is now defined as $q_i^* = q_i - \gamma_i$; $Y^* = Y - \sum p_j \gamma_j$; and $\gamma_i = \gamma_i(a)$, the translation for product i through which advertising is introduced. The termY^* is income available after the fixed cost $\sum p_j \gamma_j$ has been met (Brown and Lee, 1992).

The demand equation has the following form:

(19) $q_i = (\gamma_i, p_i, Y^* | H)$.

Differentiating (19) with respect to a_k, the advertising effects have the general form:

(20) $\partial q_i / \partial a_k = [\partial \gamma_i / \partial a_k] - \partial q_i / \partial Y \quad \sum_j p_j [\partial \gamma_i / \partial a_k]$

The above equation illustrates that a translating model involves an income effect. The own advertising demand effect will be positive when the marginal propensity to consume is greater than 0 but less than 1 and the cross-advertising parameter effects are negative indicating substitute type relationships (Brown and Lee, 1992). The cross-advertising effects similarly involve direct and indirect effects through the first and second terms on the right-hand side of equation (20), respectively.

The Rotterdam model with translating on advertising can be written as follows:

(21) $w_i \, d \log q_i = \alpha_i \, d \log R + \sum_{j=1}^{n} \Omega_{ij} \, d \log p_j + \sum_{j=1}^{n} \kappa_{ij} \, d \log a_j + \nu_i \, d \log H$

where $\kappa_{ij} = (a_j p_j / Y)(\partial \gamma_i / \partial a_k)[1-(\partial q_i / Y)(\sum_j p_j)]$. An additional adding-up constraint is needed,

(22) $\sum_{i=1}^{n} \kappa_{ij} = 0$, i=1,…n.

The previous restrictions continue to hold, with the exception of the prior advertising coefficient adding-up constraint, $\sum_{j=1}^{n} \xi_{ij} = 0$, i =1,…,n, as ξ is no longer in this model.

Data and Estimation Procedure

The Rotterdam meat demand system includes demand equations for beef, pork, poultry and fish products. The price and quantity data for beef, pork, and poultry are monthly data from Putman and Allhouse and USDA's *Livestock and Poultry Situation and Outlook Report.*[3] Price data for fish were obtained from Henry Kinnucan. He divided per capita expenditure data from a

[3] The average of the three months was used as the quarterly data in the regression.

1982-1984 USDA survey by per capita fish consumption to get a base price, which, in turn, was multiplied by the quarterly CPI for fish to get a time series. Fish consumption data through 1991 were obtained by following a procedure outlined in Schmitz and Capps (p.10) (Kinnucan, et al); regression analysis was then used to update the fish consumption series through 2000.

Advertising data were obtained from quarterly issues of AD $ *Summary* published by the Leading National Advertisers (LNA), Inc.[4] The beef, pork and fish advertising data are those reported by LNA for the Beef Industry Council, the National Pork Producers Council, and the National Fish and Seafood Council, respectively.[5] As the Rotterdam model has logarithmic specifications, the problem of zero advertising expenditures in some periods was addressed by adding a small positive number (0.001) to each observation (zero and positive values alike)

A health information index was constructed using Brown and Schrader's cholesterol information index. Brown and Schrader developed two data series, one that indicated the cumulative sum of articles appearing in medical journals that support the link between blood serum cholesterol and heart disease (negative information) and another that indicated the cumulative number of articles that attacked or questioned the line (positive information). This data set was partially updated by conducting a search on Medline for articles that dealt with the adverse effects of cholesterol. These articles were examined and added to Brown and Schrader's data series that supports the link between serum cholesterol and heart disease. The data series comprised of the cumulative number of articles questioning the link is currently being updated and this series was not included in the health information index for this project.

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[4] Advertising data from 1994 – 2000 is annual data. It was made quarterly by examining the pattern of spending from 1976-1993 and emulating this pattern.

[5] LNA changed the classification system in 1997. Prior to 1997 the numerical classification for this data was F150 and after 1997 the numerical classification is F332. No adjustments were made for this data classification problem.

The Rotterdam meat demand system was estimated using seemingly unrelated regressions (SUR) in order to impose the parametric restrictions from consumer theory. Due to the adding-up constraint only three equations in the system are independent, thus the poultry equation was dropped and the parameters for the omitted equation were estimated using the neoclassical restrictions from consumer theory.

Empirical Results[6]

The desired price coefficients in the empirical estimation do not exactly represent those discussed in the conceptual model. The empirical model estimated is as follows:

(23) $w_i \, d \log q_i = \alpha_i \, d \log Y + \sum_{j=1}^{n} (\Omega_{ij} - \alpha_i \Theta_j) \, d \log p_j + \sum_{j=1}^{n} \kappa_{ij} \, d \log a_j + \nu_i \, d \log H.$

Regression results are presented in Table 1. Price homogeneity and symmetry have been imposed.

The price coefficients cannot be estimated directly as d log R is a function of price and income. However in the empirical estimation enough information is obtained where each price coefficient can be calculated as a linear combination of the estimated parameters. The standard errors for the calculated price coefficients will need to be determined by a bootstrapping method, as one needs to determine the covariance terms of the estimated parameters. This work is currently underway and the results will be included in the presentation at the AAEA conference in Long Beach, CA.

[6] These results are preliminary and will change prior to the AAEA conference in July 2002.

Table 1: Estimated SUR Coefficients from the Rotterdam Model				
Independent Variable	Notation in equation 22	Dependent Variable		
		Pork Quantity	Beef Quantity	Fish Quantity
Meat Expenditure	α_i	-.0248443 (.0593489)	.3062345 (.0364915)	.4255809 (.0510457)
Pork Price	$(\Omega_{ij} - \alpha_i \Theta_j)$	-.0543218 (.0502266)	-.030016 (.0308825)	-.0867032 (.0431996)
Beef Price		-.0664936 (.0718062)	-.3090282 (.044151	-.2252082 (.0617601)
Fish Price		-.2539712 (.1360031)	.074608 (.0836233)	.1665427 (.1169754)
Generic Beef Advertising Expenditure	κ_{ij}	-.0005736 (.0006702)	.000924 (.0004121)	.0007248 (.0005764)
Generic Pork Advertising Expenditure		.0005057 (.000497)	-.0000697 (.0003056)	-.0007289 (.0004274)
Generic Fish Advertising Expenditure		-.0009958 (.000461)	.0002526 (.0002835)	.0008479 (.0003965)
Health Index	ν_i	-.0368932 (.2146803)	.1136804 (.131999)	-.0254433 (.1846453)
Intercept		.0046359 (.0041767)	-.0043294 (.0025681)	-.0000289 (.0035924)
R^2		.4337	.5266	.4753
Numbers in the parentheses represent the standard errors.				

From the estimated marginal propensity to spend on good i and the estimated coefficient for prices, we can calculate the coefficients for prices discussed in the conceptual model. These coefficients are presented in table 2.[7]

[7] The standard errors are currently being estimated via a bootstrapping procedure and the results will be presented at the AAEA conference in Long Beach.

Table 2: Calculated Coefficients for Prices				
Independent Variable	Notation	Dependent Variables		
		Pork Quantity	Beef Quantity	Fish Quantity
Pork Price	Ω_{ij}	-.05264	-.05065	-.11543
Beef Price		-.18242	1.11885	2.2110
Fish Price		-.39100	1.61448	2.18082

The high number of insignificant coefficients (shown in Table 1), along with the low R^2, suggests that the model is not a good fit for the data. It appears that beef quantity is positively influenced by a link between cholesterol and adverse health effects, while pork and fish are adversely affected by the link. None of these health index coefficients are statistically significant. Only two of the advertising coefficients are statistically significant. Generic fish and seafood advertisements have a significant positive effect on the quantity of fish/seafood demanded, while it has a significant negative effect on the quantity of pork demanded. What is interesting to note is that neither beef nor pork advertisements have a significant effect on either beef or pork consumption. This implies that either the effect is lagged and a lagged variable needs to be added to the model or it may simply be that the effects are too small to be noted in this model.

The model will be revised and additional regressions will have to be performed before the presentation in Long Beach, California. The advertising expenditure data will be reevaluated as the last 4 years are annual rather than quarterly data. Additionally, Medline will be examined to see how many additional articles questioning the link between blood serum cholesterol and heart disease have been written since 1987, and alternative measures of health information will be explored.

Outline of Future Empirical Application

This paper attempted to disentangle the effect of generic advertisements on the consumption of meat products in the United States from that of non-advertising induced health information related preference changes. We plan to run additional regressions after the data is updated and alternative health indexes are explored. We plan to perform a bootstrapping technique to obtain standard errors for the calculated price coefficients, and we will determine more precisely the own-advertising and cross-advertising effects of generic promotion programs by major meat producer groups. In so doing, we expect to gain insight into how structural changes in consumer preferences from increased health information affect the consumption of meat products over time. Presently this additional empirical work is being completed and the results will be presented at the AAEA meeting.

Citations:

Alston, J.M., and J.A.Chalfant. "The Silence of the Lambdas: A Test of the Almost Ideal and Rotterdam Models." *American Journal of Agricultural Economics.* 75(1993):304-313.

Alston, J.M., J.A. Chalfant, and N.E. Piggott. "The Incidence of the Costs and Benefits of Generic Advertising." *American Journal of Agricultural Economics*., 82(2000): 665-671.

Barten. A.P. "Consumer Demand Functions Under Conditions of Almost Additive Preferences." *Econometrica.* 32(January-April 1964): 1-38.

_____. *"*The System of Consumer Demand Functions Approach: A Review*."* *Econometrica.* 45(1977): 23-52.

Brewster, G.W., and T.C. Schroeder. "The Impacts of Brand and Generic Advertising on Meat Demand." *American Journal of Agricultural Economics.,* 77(1995):969-79.

Brown, M.G. and J.Y Lee. "Alternative Specifications of Advertising in the Rotterdam Model." *European Review Agricultural Economics.* 20(1993):419-436.

_____. "Theoretical Overview of Demand Systems Incorporating Advertising Effects." *Commodity Advertising and Promotion.* H.W. Kinnucan, S.R. Thompson and H.S. Chang, eds. Ames, Iowa State University Press, 1992.

Brown, D.J., and L.F. Schrader. "Cholesterol Information and Shell Egg Consumption." *American Journal of Agricultural Economics.* 72 (1990) 548-555.

Capps, O. and Schmitz, J. "A recognition of health and nutrition factors in Food Demand Analysis." *Western Journal of Agricultural Economics.* 16 (1991): 21-35.

Chalfant, J.A., and J.M. Alston, "Accounting for Changes in Tastes." *Journal of Political Economy.* 96(1988):391-410.

Chavas, J.P, "Structural Change in the Demand for Meat." *American Journal of Agricultural Economics*, 65(1983): 148-53.

Choi, S., and K. Sosin, "Testing for Structural Change: The Demand for Meat. *American Journal of Agricultural Economics.,* (1990): 228-236.

Cox, T. "A Rotterdam Model Incorporating Advertising Effects: The Case of Canadian Fats and Oils." *Commodity Advertising and Promotion.* H.W. Kinnucan, S.R. Thompson and H.S. Chang, eds. Ames, Iowa State University Press, 1992.

Eales, J.S., and L.J. Unnevehr. "Simultaneity and Structural Change in U.S. Meat Demand." *American Journal of Agricultural Economics.* 75(May 1993): 259-268.

Green, W.H. *Econometric Analysis.* 4th edition. New York. Macmillan Publishing Company, 1998.

Goddard E., and B. Cozzarin. "A Preliminary Look at Advertising Beef, Pork, Chicken, Turkey, Eggs, Milk, Butter, Cheese and Margarine in Canada." *Commodity Advertising and Promotion.* H.W. Kinnucan, S.R. Thompson and H.S. Chang, eds. Ames, Iowa State University Press, 1992.

Kinnucan, Henry, H. Xiao, C. Hsia, and J. Jackson. "Effects of Health Information and Generic Advertising on U.S. Meat Demand." *American Journal of Agricultural Economics.* 79(1997):13-23.

Leading National Advertisers. Ad $ *Summary*. New York: Leading National Advertiser,s Inc., all issues 1975 – 2001.

McGuirk. A., P. Discoll, J. Alwang, and H. Huang. "System Misspecification Testing and Structural Change in the Demand for Meats. " *Journal of Agricultural and Resource Economics.* 20(July 1995): 1-21.

Martin, W., and D. Porter. "Testing for Changes in the Structure of the Demand for Meat in Australia." *Aust. J. Agricultural Economics*. 29(1985): 16-31.

Minnesota Pork Producers Association.
http://www.apec.umn.edu/faculty/bbuhr/apec3421/apechome.htm

Moschini, G. and K. Meilke, "Modeling the Pattern of Structural Change in U.S. Meat Demand." *American Journal of Agricultural Economics,* (1989): 253-261.

Mountain, D.C. "The Rotterdam Model: An Approximation in Variable Space." *Econometrica.* 56(March 1988): 477-484.

National Pork Producers Council. Http://www.nppc.org/NEWS/pricereportbackground.html and Http://www.nppc.org/NEWS/testimony990526b.html

Pollak, R. and T.J.Wales. "Demographic Variables in Demand Analysis" *Econometrica* 49:6(1981):1533-1551.

Putman, J.J. and J.E. Allshouse. *Food Consumption, Price and Expenditure, 1970-1990*. Washington DC: U.S. Department of Agriculture, ERS Statistical Bulletin Number 840.

Schmitz, J.D., and O. Capps, Jr. *A Complete Systems Analysis of Nutritional Awareness and Food Demand.* Texas A&M Agriculture Experiment Station Bulletin 1712, March 1993.

Selvanathan, E.A. "Advertising and Consumer Demand: A Differential Approach." *Economics Letters*. 31(November 1989):215-219.

Theil. H. “The Information Approach to Demand Analysis.” *Econometrica.* 33(January 1965): 67-87.

U.S. Department of Agriculture. Economic Research Service (USDA, ERS), *Livestock and Poultry Situation and Outlook Report.*