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Impacts of Advertising, Attitudes, Lifestyles, and Health on the Demand for U.S. Pork: A Micro-Level Analysis

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ABSTRACT

Using data from the 1994–1996 CSFII/DHKS, we identify and assess factors affecting the decision to consume pork and conditional on consuming pork, the decision of the amount of pork intake. Branded and generic advertising of pork play a prominent role in both decisions. Beef advertising, however, does not significantly affect either the probability of consuming pork or the amount of pork intake. Key health, attitudinal and lifestyle factors are smoking status, dietary status, body mass index, the importance of nutrition in buying food, and trimming visible fat from meat. These factors however impact the probability of consuming pork rather than the amount of pork consumed. Region, urbanization, race, age, income, and seasonality also affect pork demand.

Key Words: *branded advertising and promotion, CSFII/DHKS (1994–96), generic advertising and promotion, pork demand, pork checkoff.*

Previous studies have provided evidence to indicate that advertising and promotion affect consumer behavior (e.g. Forker and Ward; Ward and Lambert; Kinnucan and Forker; Kaiser et al; Capps et al; Brester and Schroeder). Further, previous studies have demonstrated the importance of health and nutrition as determinants of food demand (e.g. Putler and Frazao; Capps and Schmitz; Carlson and Gould). Kinnucan et al explored simultaneously the effects of both health information and generic promotion on U.S. demands for beef, pork, poultry, and fish.

The aforementioned studies have documented the merit of accounting for advertising and promotion as well as health and nutrition along with traditional determinants. To understand the driving forces of meat demand, these studies of meat demand have typically relied on the use of aggregate time-series data. But time-series data generally preclude focusing on demographics and other information, such as attitudes and lifestyles, that are unique to each household or individual. In fact, a major limitation in meat demand studies has been a lack of detailed data about consumer health concerns, health-related behavior, and attitudes toward food consumption.

To circumvent some of the shortcomings of the aggregate time-series approach, we explore the nature of modeling meat demand at the micro-level or individual level. To this end we center attention on pork. The source of data for this analysis is the 1994–96 Continuing Survey of Food Intakes for Individuals (CSFII) and the 1994–96 Diet Health and Knowledge Survey (DHKS). We emphasize

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assessing the impacts of advertising on the demand for pork, while controlling for lifestyles, health, nutrition, and other traditional factors. At present, U.S. pork producers, via a checkoff program under the auspices of the Pork Promotion, Research, and Consumer Information Act of 1985, invest about $12 to $15 million annually to advertise and promote pork products in generic fashion. The checkoff, currently 45 cents per $100 value, is managed by the National Pork Board (NPB) to preserve and enhance the demand for pork products. The assessment of the impacts of advertising and promotion at the micro-level may then be compared with the impacts estimated using time-series or macro-level data. Thus this analysis provides useful information to pork producers in the evaluation of their checkoff program.

The paper is organized as follows. In the next section we discuss model development. We describe data and the empirical procedures in the third section, and detail empirical results in the fourth section. Finally, we make concluding remarks.

Model Development

The theoretical framework is similar to the work of Basmann in conjunction with consumer demand with variable preferences. The utility function for individual i may be expressed as

$$(1) \qquad U_i = U(q_i; \theta(r_i); s_i), \qquad i = 1, 2, \ldots, n,$$

where $\theta(r)$ reflects individual assessments of the quality of the commodity vector q_i at a given point in time. The vector r_i represents Houthakker-Taylor state variables which correspond to stock of knowledge/information available to individual i as well as attitudes and lifestyles of individual i. The vector s_i corresponds to socio-demographic characteristics. With this framework, by assumption, the formulation of consumer preferences rests in part on information about the characteristics of q.

Maximization of U_i with respect to q_i, given r_i and s_i, under classical conditions, yields Marshallian demand functions of the form

$$(2) \qquad q_i = q_i(y_i, p, \theta(r_i); s_i)$$

Micro-level demand relationships depend not only on prices (p) and income (y_i) but also state variables and socio-demographic characteristics. This framework is not inconsistent with the concept of the information-augmented quantity vector of market goods put forward by Choi and Sosin. Importantly, this framework applies to the assessment of information in regard to advertising and promotion. The perception of the quality $\theta(r_i)$ of a good by the individual consumer affects the utility function. This perception of product quality depends on information, r_i, available to individual i. The greater the extent of advertising and promotion about a particular good (r_i) (positive information), the greater the consumption of that good, all other factors invariant.

We operationalize this theoretical framework specifically for pork and specifically tailored to questions and information available from the 1994–96 CSFII/DHKS. Schematically this framework is outlined in Figure 1. Importantly, prices are omitted from this analysis because of lack of sufficient variability over this period and because region and seasonality typically reflect price variation in cross-sectional data sets.

Two-Step Decision Models

In modeling demand using micro-level data, it is common to find zero levels of consumption. Reasons for nonconsumption include nonpreference, inventory effects, price effects, or the length of the survey period (Cheng and Capps). Because the sample in this analysis constitutes consumption over two nonconsecutive days, many individuals may have zero levels of consumption.

Double-hurdle models and traditional sample selection models facilitate zero consumption. Both models explicitly incorporate participation decisions separate from consumption decisions. Right-hand side variables may have different and even opposite effects in the two decision stages (Lin and Schmidt; Jones; Haines et al; Burton et al; Blisard and Blaylock). Since some

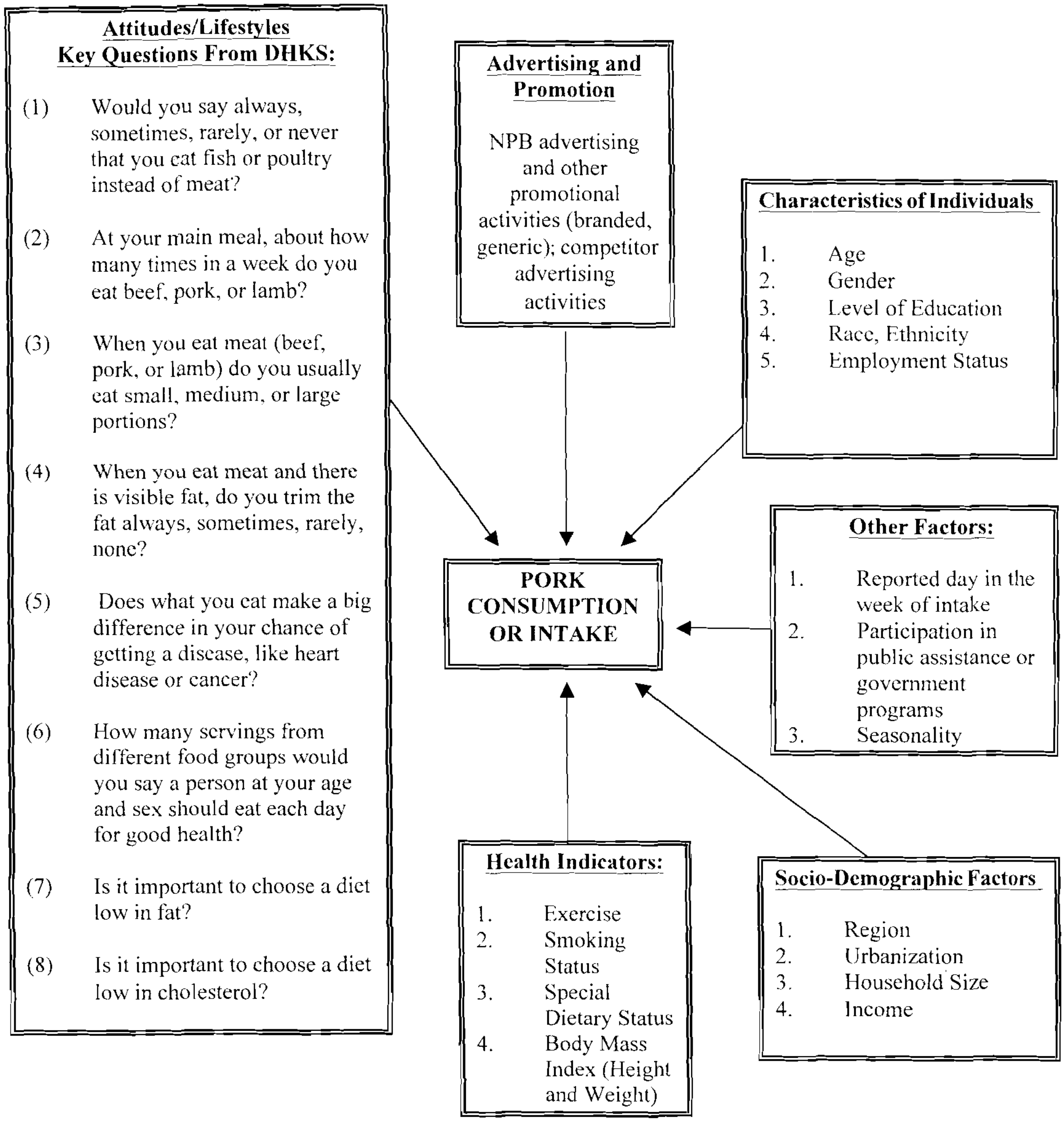

Figure 1. Framework for Analysis

U.S. consumers avoid pork purchases, it is important to capture the two-stage decision process associated with pork consumption.

Choosing among double-hurdle and sample selection models is both a theoretical and an empirical question. We adopt the double-hurdle model in this analysis. In this process the first step constitutes the participation decision—to consume or not to consume pork. The second step deals with the consumption decision; that is, given that the individual decides to consume pork, we determine the amount of pork consumption. (Heckman; Cheng and Capps; Blisard and Blaylock). The use of OLS procedures ignores the nature of the two-step process; OLS estimation is not the optimal procedure because of bias and inconsistency of parameter estimates due to censored responses. Tobit analysis also may be used, but the use of Tobit analysis restricts the directional effects to be the same for the two-stage process (Byrne, Capps, and Saha). Heckman's sample selection model implies that zero consumption is indicative of nonpreference. Given the definition of pork consumption over two nonconsecutive days, many of the respondents reporting zero consumption are likely pork consumers who decided not to consume pork during the particular survey period. We therefore consider the possibility of corner solutions.

Thus to observe positive consumption, the individual has to pass two hurdles: the participation hurdle and the consumption hurdle. Zero observations may occur in either the participation decision or the consumption decision (Lee and Maddala; Blundell and Meghir; Blaylock and Blisard). Haines et al employed the double-hurdle model in considering food consumption decision as a two-step process. Blaylock and Blisard, in considering cigarette consumption, and Yen, in considering away-from-home food consumption, also used the double-hurdle model to allow for the interaction between decisions on whether and how much to consume.

The general structure of the double-hurdle model is as follows:

$$(3)\qquad \begin{aligned} q_i &= q_i^* \quad \text{if } q_i^* > 0 \quad \text{and} \quad D_i = 1 \\ q_i &= 0 \quad \text{otherwise} \end{aligned}$$

where

$$(4a)\qquad D_i = Z_i\gamma + v, \qquad v \sim N(0, 1)$$

$$(4b)\qquad q_i^* = X_i\beta + \epsilon, \qquad \epsilon \sim N(0, \sigma^2).$$

D_i represents the zero-one discrete choice whether or not individual *i* consumes pork. q_i^* is a latent variable corresponding to the optimal quantity for individual *i* derived from utility maximization. A level of consumption (q_i) is observed only if $q_i^* > 0$ and $D_i = 1$ simultaneously. Equation (4a) is the participation equation. Equation (4b) corresponds to the consumption equation. We assume that both the participation and consumption equations are linear in parameters. The explanatory variables X_i and Z_i may or may not be the same in the respective equations. Let ρ represent the correlation between error terms ϵ and v. The double-hurdle two-step decision model then is represented by the following likelihood function (Blundell and Meghir; Blaylock and Blisard; Moon and Ward):

$$(5)\qquad \begin{aligned} L = {} & \prod_0 [1 - p(D_i = 1)p(q_i^* > 0 \mid D_i = 1)] \\ & \times \prod_+ [p(D_i = 1)p(q_i^* > 0 \mid D_i = 1) \\ & \times \phi(q_i^* \mid q_i^* > 0 \mid D_i = 1)], \end{aligned}$$

where p denotes the probability of pork consumption, and ϕ denotes the standard normal density function. Π_0 and Π_+ denote a product over zero observations and positive observations, respectively. The resulting log-likelihood function then becomes

$$(6)\qquad \begin{aligned} \ln L = {} & \sum_0 \ln\left[1 - \Phi\left(Z_i\gamma, \frac{X_i\beta}{\sigma}, \rho\right)\right] \\ & + \sum_+ \ln\left[\Phi\left(\frac{1}{\sqrt{1-\rho^2}}\left(Z_i\gamma + \frac{\rho}{\sigma}X_i\beta\right)\right)\right] \\ & + \sum_+ \ln\left[\frac{1}{\sigma}\phi\left(\frac{q_i^* - X_i\beta}{\sigma}\right)\right], \end{aligned}$$

where Φ denotes the standard normal distribution function. If the correlation coefficient ρ is zero, the model reduces to Cragg's independent double-hurdle model (Cragg).

Empirically, the participation stage model is given by

$$(7)\qquad \begin{aligned} & PORKPROB_i \\ & = a_0 + a_1\ln(\text{Advertising \& Promotion Expenditure}) \\ & + a_2\ln(INCOME_i) + a_3\ln(AGE_i) \\ & + a_4 NW_i + a_5 MW_i + a_6 WEST_i \\ & + a_7 MSANCC_i + a_8 NMSA_i \\ & + a_9 HHSIZE_i + a_{10} MALE_i \\ & + a_{11} BLACK_i + a_{12} OTHER_i \\ & + a_{13} NHISP_i + a_{14} HS_i + a_{15} COL_i \\ & + a_{16} EMiP_i + a_{17} REGEX_i \\ & + a_{18} MODEX_i + a_{19} GOODH_i \\ & + a_{20} FSYES_i + a_{21} NVSMOKED_i \end{aligned}$$

$$+ a_{22}SMOKEN_i + a_{23}WICYES$$
$$+ a_{24}LCALDIET_i + a_{25}LFATDIET_i$$
$$+ a_{26}VEGEY_i + a_{27}BMI\_SP_i$$
$$+ a_{28}WINTER_i + a_{29}SPRING_i$$
$$+ a_{30}SUMMER_i + a_{31}WKDYWKDY_i$$
$$+ a_{32}WKDYWKED_i + a_{33}KQ1E_i$$
$$+ a_{34}KQ4II_i + a_{35}KQ4HI_i$$
$$+ a_{36}KQ2FA_i + a_{37}KQ15BI_i$$
$$+ a_{38}KQ26\_GA_i + a_{39}KQ26\_GS_i$$
$$+ a_{40}KQ26\_GR_i + a_{41}KQ342_i$$
$$+ a_{42}KW343_i + a_{43}KQ344_i + a_{44}KQ35S_i$$
$$+ a_{45}KQ35M_i + a_{46}KQ35L_i$$
$$+ a_{47}KQ37S_i + a_{48}KQ36R_i$$
$$+ a_{49}KQ36N_i + \epsilon_i,$$

and the consumption stage model is given by

$$\begin{aligned}
(8)\quad PORK_i &= b_0 + b_1 \ln(\text{Advertising \& Promotion Expenditure}) \\
&+ b_2\ln(INCOME_i) + b_3\ln(AGE_i) \\
&+ b_4NW_i + b_5MW_i + b_6WEST_i \\
&+ b_7MSANCC_i + b_8NMSA_i \\
&+ b_9HHSIZE_i + b_{10}MALE_i \\
&+ b_{11}BLACK_i + b_{12}OTHER_i \\
&+ b_{13}NHISP_i + b_{14}HS_i + b_{15}COL_i \\
&+ b_{16}EMiP_i + b_{17}REGEX_i \\
&+ b_{18}MODEX_i + b_{19}GOODH_i \\
&+ b_{20}FSYES_i + b_{21}NVSMOKED_i \\
&+ b_{22}SMOKEN_i + b_{23}WICYES \\
&+ b_{24}LCALDIET_i + b_{25}LFATDIET_i \\
&+ b_{26}VEGEY_i + b_{27}BMI_SP_i \\
&+ b_{28}WINTER_i + b_{29}SPRING_i \\
&+ b_{30}SUMMER_i + b_{31}WKDYWKDY_i \\
&+ b_{32}WKDYWKED_i + b_{33}KQ1E_i \\
&+ b_{34}KQ4II_i + b_{35}KQ4HI_i \\
&+ b_{36}KQ2FA_i + b_{37}KQ15BI_i \\
&+ b_{38}KQ26_GA_i + b_{39}KQ26_GS_i \\
&+ b_{40}KQ26_GR_i + b_{41}KQ342_i \\
&+ b_{42}KQ343_i + b_{43}KQ344_i \\
&+ b_{44}KQ35S_i + b_{45}KQ35M_i \\
&+ b_{46}KQ35L_i + b_{47}KQ36S_i \\
&+ b_{48}KQ36R_i + b_{49}KQ36N_i + \nu_i,
\end{aligned}$$

where $i = 1, \ldots, n$ denotes the number of individuals. Variable names and definitions are exhibited in Table 1. The socio-demographic variables pertain to age, gender, region, urbanization, race, education level, employment status, seasonality, and day of the week. Health and nutrition factors deal with health status, exercise level, smoking status, participation in government food programs, body mass index of the individual (health and weight), and whether or not individuals are on a low-calorie or low-fat diet. Attitudinal factors relate to the number of food servings a person should eat each day to insure good health; the link between diet and disease; the importance of choosing a low-fat or low-cholesterol diet; the importance of nutrition; the substitution of fish and/or poultry for meat; the number of times beef, pork, or lamb is eaten each week; the size of the beef, pork, or lamb portions eaten; and the trimming of fat from meats.

PORKPROB and PORK are the dependent variables. PORKPROB refers to whether or not individual i consumes pork, and PORK refers to the amount of pork consumption conditional on individual i choosing to consume the product. To capture potential nonlinear relationships for income and age, we employ a logarithmic transformation of these variables.

A logarithmic transformation of advertising and promotion expenditure also is used to ensure diminishing marginal returns. Pork checkoff funds are used only for generic advertising and promotion, not branded advertising and promotion. We separate Leading National Advertisers (LNA) branded advertising and promotion expenditures from the National Pork Producers Council (NPPC) generic advertising and promotion expenditures. In this

Table 1. Variable Definitions

Variable	Definition
PORKPROB	Individual consumes pork? (1 = yes, 0 = no)
PORK	Amount of pork consumption (grams)
Advertising & Promotion	
LNA-BRANDED	LNA branded advertising expenditures (thousand dollars)
NPPC-GENERIC	NPPC generic advertising expenditures (thousand dollars)
LNA-BEEF	LNA advertising expenditures for beef (thousand dollars)
Socio-Demographic Factors & Characteristics of Individuals	
INCOME	Income (dollars)
AGE	Age
NE	Region is Northeast? (1 = yes, 0 = no)
MW	Region is Midwest? (1 = yes, 0 = no)
WEST	Region is West? (1 = yes, 0 = no)
MSANCC	Outside central city? (1 = yes, 0 = no)
NMSA	Non-metropolitan statistical Area? (1 = yes, 0 = no)
HHSIZE	Household size
MALE	Male respondent? (1 = yes, 0 = no)
BLACK	Race is black? (1 = yes, 0 = no)
OTHER	Race is other? (1 = yes, 0 = no)
NHISP	Origin is non-hispanic? (1 = yes, 0 = no)
HS	High school completed? (1 = yes, 0 = no)
COL	College completed? (1 = yes, 0 = no)
EMP	Employed? (1 = yes, 0 = no)
Seasonality	
WINTER	Season is winter? (1 = yes, 0 = no)
SPRING	Season is spring? (1 = yes, 0 = no)
SUMMER	Season is summer? (1 = yes, 0 = no)
WKDYWKDY	Survey in weekday and weekday? (1 = yes, 0 = no)
WKDYWKED	Survey in weekday and weekend? (1 = yes, 0 = no)
Government Program Participation	
FSYES	Receiving food stamps? (1 = yes, 0 = no)
WICYES	Receiving WIC coupons? (1 = yes, 0 = no)
Health & Nutrition	
REGEX	Exercise more than twice in a week? (1 = yes, 0 = no)
MODEX	Exercise at least once in a week? (1 = yes, 0 = no)
GOODH	Health is good? (1 = yes, 0 = no)
NVSMOKED	Never smoked? (1 = yes, 0 = no)
SMOKEN	No smoking now? (1 = yes, 0 = no)
PREGLAC	Pregnant/lactating status? (1 = yes, 0 = no)
LCALDIET	Low calorie diet? (1 = yes, 0 = no)
LFATDIET	Low fat diet? (1 = yes, 0 = no)
VEGEY	Vegetarian? (1 = yes, 0 = no)
BMLSP	Body-mass index
Attitudinal/Lifestyle Factors	
KQ1E	How many servings from different food groups would you say a person your age and sex should eat each day for good health?
KQ2FA	Do you agree what you eat makes a difference in your chance of getting a disease? (1 = yes, 0 = no)
KQ4HI	Is it important to choose a diet low in fat? (1 = yes, 0 = no)

Table 1. (Continued)

Variable	Definition
KQ4HII	Is it important to choose a diet low in cholesterol? (1 = yes, 0 = no)
KQ15BI	When you buy food is nutrition important? (1 = yes, 0 = no)
KQ26 GA	Do you always eat fish or poultry instead of meat? (1 = yes, 0 = no)
KQ26_GS	Do you sometimes eat fish or poultry instead of meat? (1 = yes, 0 = no)
KQ26_GR	Do you rarely eat fish or poultry instead of meat? (1 = yes, 0 = no)
KQ342	Do you eat beef, pork, or lamb 1–2 times in a week? (1 = yes, 0 = no)
KQ343	Do you eat beef, pork, or lamb 3–4 times in a week? (1 = yes, 0 = no)
KQ344	Do you eat beef, pork, or lamb 5–6 times in a week? (1 = yes, 0 = no)
KQ35S	When you eat meat do you usually eat small portions? (1 = yes, 0 = no)
KQ35M	When you eat meat do you usually eat medium portions? (1 = yes, 0 = no)
KQ35L	When you eat meat do you usually eat large portions? (1 = yes, 0 = no)
KQ36S	When you eat meat do you sometimes trim the visual fat? (1 = yes, 0 = no)
KQ36R	When you eat meat do you rarely trim the visual fat? (1 = yes, 0 = no)
KQ36N	When you eat meat do you never trim the visual fat? (1 = yes, 0 = no)

way we are able to identify and assess the impacts of branded and generic advertising and promotion expenditures on the probability of consuming pork and on the amount of pork consumed given the decision to eat pork. Finally we consider as well the impact of beef advertising on the decision to consume pork and on the decision of how much pork to consume. Because beef and pork are considered red meats, poultry advertising is excluded from the analysis. We use the LNA expenditures on beef in this assessment, and we employ a logarithmic transformation of these expenditures as well. In equations (7) and (8) the variables for income; age; household size ($HHSIZE_i$); body mass index (BMI_SP_i); and the number of servings from the meat, poultry, fish, dry beans, and egg group necessary to ensure good health (KQIE) correspond to the right-hand-side variables which correspond to zero-one or dummy variables.

Data

The source of the data for this analysis is the 1994–96 Continuing Survey of Food Intake of Individuals (CSFII) and the Diet and Health Knowledge Survey (DHKS) available from ARS, USDA. The CSFII and DHKS are designed to measure food intakes and nutrients consumed by Americans as well as their attitudes about diet and knowledge about diet-health relationships. The data include the actual amount of food consumption (in grams) for individuals over 20 years of age over two nonconsecutive days.

The sample consists of only DHKS respondents who provided two days of intake data from the CSFII, 1836 observations in 1994; 1936 in 1995; and 1877 observations in 1996. Thus the total number of observations in this study is 5649 for 1994–96. However, observations which have zero income values or have missing values for other pertinent variables are eliminated, leaving 4691 observations for use in this study.

Descriptive statistics of the variables are reported in Table 2. On average, roughly 31 percent of individuals ate pork over a two-nonconsecutive-day period; the average quantity consumed over two nonconsecutive days was about 13 grams. The average household income of the individuals in this sample was $36,150, and the average age was about 50. Means of the zero-one variables depict the proportion of individuals that fall into particular categories. For example, 51 percent of respondents were male, nearly 90 percent believed that what you eat makes a difference in the chances of getting a disease, 9 percent were on a low-fat diet, and 47 percent had never smoked. As exhibited in Table 3, the eight questions associated with attitudes or lifestyles are not highly correlated on a pair-

Table 2. Descriptive Statistics of Variables in the Models

Variable	All Individuals	Individuals with Pork Intake	Individuals with No Pork
PORKPROB	0.314	1	0
PORK[a]	13.117	41.745	0
LNA-BRANDED[b]	9767.9	9700	9831.4
NPPC-GENERIC[b]	2160.6	2172.4	2152.4
LNA-BEEF[b]	4072.8	4089.3	4025.5
INCOME[c]	36153.00	34424.00	35455.00
AGE	50.36	52.65	50.13
NE	0.190	0.158	0.204
MW	0.263	0.299	0.237
WEST	0.191	0.161	0.213
MSANCC	0.442	0.401	0.454
NMSA	0.266	0.309	0.250
HHSIZE	2.596	2.552	2.588
MALE	0.508	0.531	0.501
BLACK	0.119	0.175	0.096
OTHER	0.054	0.047	0.067
NHISP	0.931	0.940	0.918
HS	0.350	0.363	0.335
COL	0.452	0.384	0.469
EMP	0.599	0.566	0.591
REGEX	0.488	0.474	0.491
MODEX	0.127	0.133	0.125
GOODH	0.839	0.822	0.832
FSYES	0.101	0.110	0.103
NVSMOKED	0.470	0.432	0.485
SMOKEN	0.269	0.284	0.266
WICYES	0.003	0.003	0.003
LCALDIET	0.062	0.054	0.064
LFATDIET	0.090	0.065	0.101
VEGEY	0.019	0.016	0.035
BMI_SP	26.592	27.045	26.321
WINTER	0.227	0.235	0.221
SPRING	0.256	0.255	0.256
SUMMER	0.282	0.294	0.274
WKDYWKDY	0.487	0.462	0.499
WKDYWKED	0.482	0.507	0.471
KQ1E	2.004	2.046	1.861
KQ4HI	0.878	0.856	0.858
KQ4HII	0.892	0.875	0.885
KQ2FA	0.900	0.888	0.893
KQ15BI	0.945	0.948	0.926
KQ26_GA	0.169	0.132	0.192
KQ26_GS	0.694	0.704	0.664
KQ26_GR	0.091	0.115	0.085
KQ342	0.369	0.353	0.368
KQ343	0.330	0.360	0.297
KQ344	0.155	0.189	0.141
KQ35S	0.333	0.304	0.346
KQ35M	0.540	0.565	0.510
KQ35L	0.112	0.122	0.102

Table 2. (Continued)

Variable	All Individuals	Individuals with Pork Intake	Individuals with No Pork
KQ36S	0.213	0.244	0.191
KQ36R	0.041	0.047	0.038
KQ36N	0.068	0.073	0.092

[a] grams
[b] 000 dollars
[c] dollars

wise basis. Thus we are in position to disentangle the separate effects of this set of attitudinal/lifestyle variables.

Advertising and promotion efforts are not included in the 1994–96 CSFII/DHKS. Data pertaining to advertising and promotion are branded expenditures from Leading National Advertisers (LNA) and generic expenditures from the National Pork Producers Council (NPPC). The respective data on advertising and promotion are available quarterly. Quarterly advertising and promotion expenditures were matched with the 1994–96 CSFII/DHKS data by appropriate time periods since it was not possible to measure the exposure of each individual directly. Generally, pork promotional efforts were national in scope and directed to all demographic groups. Within a quarter, all individuals are presumed to have equal potential for exposure to the promotions since advertising programs typically are targeted at a broad national audience. Theoretically, all other things constant, promotions are designed to increase the probability of consuming pork and the absolute amount of pork consumption. About $250 million was spent on branded promotion and roughly $50 million was spent on generic promotion over the 1994–96 period.[1] On average, over this period about $23 million was directed to branded promotion per quarter and about $4.5 million was directed to generic programs per quarter.

Empirical Results

Estimates of the parameters and their statistical significance for the participation and consumption decisions obtained from double-hurdle procedure with disaggregate LNA branded and NPPC generic advertising expenditures in the model are exhibited in Table 4. The χ^2 test statistic is statistically significant, indicating that the double-hurdle model contains at least one statistically significant coefficient. Also, the correlation between the participation stage and the consumption stage in the double-hurdle model is 0.6458, statistically different from zero. We considered both contemporaneous and lagged effects of advertising and promotion in both stages. We do not allow the length of the lags to be greater than four quarters. Based on five choices of lags (0 to 4) for branded and generic pork advertising promotion expenditures as well as beef advertising and promotion expenditures, 125 double-hurdle models were considered. The criterion for choosing the appropriate model and hence the appropriate lag lengths rested on the maximum value of the respective log-likelihood functions.

[1] There were three data sources for generic expenditures: NPPC, LNA, and Bozell Inc. Bozell, Inc. is the advertising firm used by NPPC. The advertising and promotion expenditures from three data sources were not the same. Kinnucan and Belleza reported that LNA data generally understate actual expenditures or misrepresent turning points. The correlation matrix of the respective advertising and promotion variables revealed notable differences. The correlations range from −0.023 between generic NPPC expenditures and generic LNA expenditures to 0.475 between Bozell expenditures and generic NPPC expenditures. To check on the robustness of the impacts of advertising and promotion on the probability of consuming pork and on the amount of pork consumption, we considered all sources of generic expenditures related to promotional efforts. Although we report only the generic expenditures from NPPC in this paper, empirical results related to LNA and Bozell expenditures are available from the authors upon request.

Table 3. Correlation Matrix of Attitudinal/Lifestyle Variables

KQ1E	1																
KQ2FA	—	1															
KQ4HI	—	0.159	1														
KQ4HI	—	0.159	0.64	1													
KQ15B	—	0.112	0.25	0.253	1												
KQ26_	—	0.044	0.09	0.089	0.058	1											
KQ26_	0.00	0.021	0.02	0.025	0.033	−0.6794	1										
KQ26_	0.03	—	—	—	—	−0.1427	—	1									
KQ342	—	0.031	0.09	0.074	0.073	0.0254	0.0549	−0.0806	1								
KQ343	0.02	—	—	—	0.005	−0.1534	0.1006	0.0365	—	1							
KQ344	0.10	—	—	—	—	−0.1661	0.0202	0.1230	—	—	1						
KQ35S	—	0.022	0.09	0.101	0.062	0.1090	—	−0.0425	0.07	—	—	1					
KQ35	0.04	—	0.00	—	0.007	−0.1029	0.0788	0.0066	—	0.06	0.05	—	1				
KQ25L	0.04	—	—	—	—	−0.0810	0.0043	0.0614	—	0.02	0.13	—	—	1			
KQ36S	0.02	—	—	—	—	−0.1302	0.0512	0.0745	—	0.06	0.09	—	0.087	0.09	1		
KQ36R	0.00	—	—	—	—	−0.0436	—	0.0778	—	0.02	0.02	—	0.046	0.04	—	1	
KQ36N	0.03	—	—	—	—	0.0612	—	0.0264	—	—	0.06	—	—	0.12	—	—	1
	KQ1	KQ2	KQ4	KQ4	KQ15	KQ26_	KQ26	KQ26_	KQ3	KQ3	KQ3	KQ3	KQ35	KQ3	KQ3	KQ3	KQ36

We discuss the empirical results focusing on (1) the profile of pork consumers obtained based on the results of the participation equation and (2) the drivers of the absolute level of pork intake based on the results of the consumption equation. For all statistical analyses the level of significance chosen was 0.10.

Participation Stage Results—Profile of Individuals Likely to Eat Pork

With this specification, branded advertising for pork enters the participation decision stage contemporaneously, NPPC generic advertising for pork enters the equation with a four-quarter lag, while advertising expenditures for beef enter the model with a two-quarter lag. In this model specification, branded advertising expenditures for pork and generic advertising expenditures for pork significantly impact the probability of consuming pork. The impact of beef advertising is not statistically different from zero in this stage.

The effects of income and age on the probability of consuming pork are positive and statistically significant. Individuals located in the Northeast and West are less likely to eat pork than individuals located in the South and the Midwest. Individuals located in non-metro areas are more likely to eat pork than individuals located in central cities or suburban areas. Blacks are more likely to eat pork than whites or other races. The probability of consuming pork also is inversely related to the level of education. Those individuals either completing high school or college are less likely to eat pork than those individuals not completing high school. Neither household size, gender, nor employment status significantly impacts the probability of eating pork.

Key health factors impacting the probability of consuming pork are smoking status, special diet, and body mass index (height and weight). Those individuals who have never smoked or are not smoking now have a lower probability of consuming pork than those individuals who are currently smoking. Individuals who are on a low-fat diet are less likely to eat pork than other individuals. Body mass index and the probability of consuming pork are positively correlated. The amount of exercise, participation in the Food Stamp Program or the WIC Program, self-perception of degree of healthiness, and being on a low-calorie diet are not significant determinants of the probability of consuming pork.

Seasonality plays a role in the probability of eating pork. The consumption of pork is more likely in the summer, winter, and spring relative to the fall. However, day of the week is not a key factor associated with the probability of eating pork.

Attitudinal or lifestyle factors affect the probability of pork consumption. Eating red meat (beef, pork, or lamb) on a regular basis, either 1–2, 3–4, or 5–6 times a week is positively linked to the probability of pork consumption. In addition, those individuals who always trim the visual fat from meat are less likely to eat pork than those individuals who sometimes, rarely, or never trim the visual fat from meat. Those individuals who think that what you eat can make a difference in the chances of getting a disease are less likely to eat pork than those individuals who do not think so. The greater the importance of nutrition in food-buying decisions, the greater the probability of pork consumption. The greater the number of servings from different food groups a person should eat each day for good health, the greater the probability of pork consumption. The probability of eating pork is not significantly different among those individuals who always, sometimes, or rarely eat fish or poultry instead of meat versus those individuals who never eat fish or poultry instead of meat.

Nayga and Capps, using data from the 1987–88 Nationwide Food Consumption Survey, examined the decision to purchase pork in the away-from-home and at-home markets. However, they did not consider health or attitudinal variables in their study. Our results concerning region, urbanization, race, age, and income generally correspond with those of Nayga and Capps.

Consumption Stage Results

LNA branded and NPPC generic advertising expenditures are positively associated with

Table 4. Double-Hurdle Model Results for the Probability of Consuming Pork and the Absolute Amount of Pork Consumption Using Data Pertaining to LNA Branded and NPPC (Generic) Advertising and Promotion Expenditures for Pork and Data Pertaining to LNA Advertising and Promotion Expenditures for Beef

	Participation		Consumption	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
ln(LNA-BRANDED)[a]	0.1649*	2.34	9.1101*	1.89
ln(NPPC-GENERIC)[a]	0.0712*	1.61	4.2963*	1.54
ln(LNA-BEEF)[a]	−0.0560	−0.75	−5.3314	−0.86
ln(INCOME)	0.0644*	2.04	−0.9256	−0.40
ln(AGE)	0.3701*	5.00	−0.5511	−0.06
NE	−0.1432*	−2.36	11.4319*	2.60
MW	0.0634	1.22	10.3533*	3.16
WEST	−0.0778*	−1.31	−1.0148	−0.23
MSANCC	0.0047	0.09	−3.9520	−1.16
NMSA	0.1284*	2.23	2.5791	0.63
HHSIZE	−0.0204	−1.23	0.3048	0.27
MALE	0.0212	0.46	10.6600*	3.76
BLACK	0.4876*	7.31	5.4437	0.57
OTHER	0.0748	0.76	9.3608	1.36
NHISP	−0.0021	−0.02	−0.4824	−0.08
HS	0.1488*	−2.51	2.7344	0.65
COL	−0.2420*	−3.82	2.0001	0.34
EMP	−0.0110	−0.22	3.5653	1.11
REGEX	0.2215	0.47	−1.4557	−0.54
MODEX	−0.0143	−0.21	−3.0051	−0.65
GOODH	0.0278	0.48	−0.1909	−0.05
FSYES	0.0104	0.13	4.0481	0.94
NVSMOKED	−0.0860*	−1.70	−1.6301	−0.47
SMOKEN	−0.0024	−0.04	−2.1210	−0.63
WICYES	−0.0269	−0.07	−4.5770	−0.14
LCALDIET	−0.0287	−0.33	−1.9600	−0.30
LFATDIET	−0.2372*	−3.06	4.7067	0.66
VEGEY	−0.0996	−0.62	−3.6763	−0.29
BMI_SP	0.0063*	1.65	0.0216	0.08
WINTER	0.1579*	2.33	−16.0545*	−2.11
SPRING	0.0847	1.17	−7.3012*	−1.47
SUMMER	0.2849*	2.94	−13.0520*	−2.64
WKDYWKDY	−0.0309	−0.26	1.2433	0.18
WKDYWKED	0.0750	0.64	0.2534	0.04
KQ1E	0.0314*	1.51	1.1915	0.89
KQ2FA	−0.1650*	−2.07	−3.4816	−0.62
KQ4HI	0.0284	0.33	−0.1377	−0.03
KQ4HII	0.0320	0.46	2.2599	0.52
KQ15BI	0.1878*	1.99	−4.9379	−0.79
KQ26_GA	−0.1154	−1.06	2.5371	0.36
KQ26_GS	−0.0316	−0.33	3.1805	0.56
KQ26_GR	0.0771	0.69	−4.0341	−0.60
KQ342	0.2076*	2.93	1.2844	0.19
KQ343	0.2802*	3.83	0.9369	0.12
KQ344	0.3462*	4.08	3.6465	0.41
KQ35S	0.1144	0.55	20.9436	0.70

Table 4. (Continued)

	Participation			Consumption	
Variable	Coefficient	t-ratio		Coefficient	t-ratio
KQ35M	0.1894		0.91	22.3641	0.75
KQ35L	0.1667		0.79	30.4410	1.01
KQ36S	0.0919*		1.81	6.4251*	1.99
KQ36R	0.1242		1.25	−0.0661	−0.01
KQ36N	0.1257*		1.32	5.4650	1.13
σ				51.8367*	31.42
ρ				0.6458*	7.23
Constant	−4.8439*	−5.23		−44.4599	−0.39
χ^2			445.4*		
Log-likelihood			−10,297.8		

* Significant at 0.10-level.

[a] Contemporaneous branded advertising and promotion expenditures for pork, 4-lag of generic advertising and promotion expenditures for pork, and 2-lag of advertising expenditures for beef in the participation equation; 1-quarter lag of branded advertising and 3-quarter lag of generic advertising expenditures for pork and 1-quarter lag of advertising expenditures for beef in the consumption equation.

amounts of pork intake. The impact of beef advertising expenditures on pork intake is not statistically different from zero. Branded advertising expenditures for pork enter the model with one-quarter lag, generic advertising expenditures enter the model with a three-quarter lag, and advertising expenditures for beef enter the model with a one-quarter lag. Using the results exhibited in Table 4, the branded advertising elasticity at the sample means is 0.2182. The NPPC generic advertising elasticity for pork at the sample means is 0.1029. Yen provides the detailed calculations to derive the marginal impacts and the elasticities associated with double-hurdle models.

Key drivers of the absolute amount of pork intake, besides advertising and promotion, are region, gender, and seasonality. For those deciding to eat pork, intake on average was about 42 grams in the sample. Conditional on eating pork, individuals residing in the Northeast and Midwest consume 10 to 11 grams more pork than individuals residing in the South. Males consume about 10 grams more pork than females, all other factors invariant. Further, when pork consumption occurs, it is higher in the fall by 7 to 16 grams than in the winter, spring, and summer.

Income, age, urbanization, household size, education, and employment status are not significant determinants of absolute levels of pork intake. While health, nutrition, and attitudinal factors affect the decision to consume pork, once the decision is made, these factors are not significant drivers of the **level** of pork consumed.

Concluding Remarks

Using data from the 1994–96 CSFII/DHKS, we identify and assess factors affecting two issues indigenous to pork demand: (1) the decision to consume pork or not; and (2) conditional on consuming pork, the absolute level of pork intake. The data pertain to two nonconsecutive days of intake for 4691 individuals. We consider advertising and promotion, health issues, and attitudes and lifestyles of individuals along with socio-demographic characteristics of individuals as potential determinants of pork demand.

Branded and generic advertising of pork play a prominent role in the probability of consuming pork and the absolute amount of pork intake. Beef advertising, *ceteris paribus*, does not significantly affect either the probability of consuming pork or the amount of pork intake. Brester and Schroeder as well as Kinnucan et al found that generic advertising had no effect on the demand for pork. Brester and Schroeder's analysis included branded and generic advertising but excluded health information. Kinnucan et al's analysis included generic advertising and health information but not branded advertising. Our analysis includes branded and generic advertising for pork, competitor (beef) advertising, health information, and attitudinal information.

The branded advertising elasticity for pork in our analysis is estimated to be 0.2182 while the generic advertising elasticity for pork is estimated to be 0.1029. These elasticities, derived using a micro-level analysis, are higher than those reported using more conventional time-series analysis. Estimates from cross-sectional data generally conform to long-run patterns, while estimates from time-series data typically conform to short-run patterns. Consequently, the advertising elasticities derived from cross-sectional data are likely to be greater than those derived from time-series data.

The micro-level analysis also supports the contention that health issues and attitudes of individuals are important drivers of pork demand. Key health, attitudinal, and lifestyle factors are smoking status, dietary status, body mass index, the importance of nutrition in buying food, and trimming visible fat from meat. These factors, however, impact the probability of consuming pork rather than the amount of pork consumed. Region, urbanization, race, age, income, and seasonality also affect pork demand.

Our study demonstrates that opportunities to gain a greater understanding of the demand for pork are possible using micro-level data for individuals. Additional studies using a micro-level analysis, focusing on more detailed health, nutrition, and attitudinal or behavioral questions, are worthwhile. Also, as Telser notes, demand depends not only on advertising outlays (expenditures) but also on the number of messages received by individuals. Consequently, in future studies it is desirable to better link advertising with individual behavior in micro-level analyses. The impact of advertising copy, target audience, and media mix is not necessarily reflected by using advertising expenditures as a measure of media exposure. The combination of conventional time-series (macro-level) analysis with the micro-level analysis reported in this study will provide useful information to producers in the evaluation of checkoff programs.

References

Basmann, R.L. "A Theory of Demand with Variable Consumer Preferences." *Econometrica* 24(1956):47–58.

Blaylock, J.R. and W.N. Blisard. "U.S. Cigarette Consumption: The Case of Low-Income Women." *American Journal of Agricultural Economics* 74(1992):698–705.

Blisard, W.N. and J.R. Blaylock. "Distinguishing Between Market Participation and Infrequency of Purchase Models of Butter Demand." *American Journal of Agricultural Economics* 75(1993):314–20.

Blundell, R.W. and C. Meghir. "Bivariate Alternatives to the Univariate Tobit Model." *Journal of Econometrics* 34(1987):314–20.

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

Burton, M., M. Tomlinson, and T. Young. "Consumers' Decisions Whether or Not to Purchase Meat: A Double-Hurdle Analysis of Single Adult Households." *Journal of Agricultural Economics* 45(1994):202–212.

Byrne, P., O. Capps, Jr., and A. Saha. "Calculating Marginal Effects in Models for Zero Expenditures in Household Budgets Using a Heckman-type Correction." *Applied Economics* 29(1997): 1311–16.

Capps, O. Jr. and J.D. Schmitz. "A Recognition of Health and the Nutrition Factors in Food Demand Analysis." *Western Journal of Agricultural Economics* 16(1991):21–35.

Capps, O. Jr., D. Bessler, G.C. Davis, C. Anderson and E. Smith. "Economic Evaluation of the Cotton Checkoff Program." *Departmental Technical Report 97-2*. Department of Agricultural Economics, Texas A&M University, August 1997.

Carlson, K.A. and B.W. Gould. "The Role of Health Knowledge in Determining Dietary Intake." *Review of Agricultural Economics* 16(1994):373–86.

Cheng, H.T. and O. Capps, Jr. "Demand Analysis of Fresh and Frozen Finfish and Shellfish in the United States." *American Journal of Agricultural Economics* 70(1988):533–42.

Choi, S. and K. Sosin. "Testing for Structural Change: The Demand for Meat." *American*

Journal of Agricultural Economics 72(1990): 227–236.

Cragg, J.G. "Some Statistical Models for Limited Dependent Variables with Applications to the Demand for Durable Goods." *Econometrica* 39,5(19871):829–44.

Forker, O. and R.W. Ward. *Commodity Promotions: The Econometrics and Measurement of Generic Programs*. Lexington Books. New York, NY, 1993.

Haines, P.S., K.K. Guilkey and B.M. Popkin. "Modeling Food Consumption Decisions as a Two-Step Process." *American Journal of Agricultural Economics* 70(1988):543–52.

Heckman, J.J. "Sample Selection Bias as a Specification Error." *Econometrica* 47(1979):153–61.

Jones, A.M. "A Double-Hurdle Model of Cigarette Consumption." *Journal of Applied Econometrics* 4(1989):23–39.

Kaiser, H.M., O.D. Forker, J.E. Lenz and C.H. Sun. "Evaluating Generic Dairy Advertising Impacts on Retail." *Journal of Agricultural Economics Research* 44(1988):3–18.

Kinnucan, H. and E. Belleza. "Advertising Evaluation and Measurement Error: The Case of Fluid Milk in Ontario." *Canadian Journal of Agricultural Economics* 39(July 1991):283–97.

Kinnucan, H.W. and O.D. Forker. "Allocation of Generic Advertising Funds Among Products: A Sales Maximization Approach." *Northeastern Journal of Agricultural and Resource Economics* 17(1988):64–71.

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

Lee, L.F. and G.S. Maddala. "The Common Structure of Tests for Selectivity Bias, Serial Correlation, Heterosckedasticity and Non-normality in the Tobit Model." *International Economic Review* 26(1985):1–20.

Lin, T.F. and P. Schmidt. "A Test of the Tobit Specification Against an Alternative Suggested by Cragg." *Review of Economics and Statistics* 65(1983):174–77.

Moon, W. and R.W. Ward. "Two-Stage Household Demand for U.S. Beef: Implications for Promotions, Health, and Attitudes." Unpublished manuscript, University of Florida, 1998.

National Pork Board. "About the Pork Checkoff," http://www.porkboard.org/checkoff.html

Nayga, R.M. Jr. and O. Capps, Jr. "The Decision to Purchase Pork in the Away From Home and At Home Markets: The Case of the United States." *Journal of International Food and Agribusiness Marketing* 7,4(1995):1–14.

Putler, D.S. and E. Frazao. "Consumer Awareness of Diet-Disease Relationships and Dietary Behavior: The Case of Dietary Fat." *Journal of Agricultural Economics Research* 45(1994):3–17.

Telser, L.G. "Advertising and Cigarettes." *Journal of Political Economy* 70(1962):471–99.

U.S. Department of Agriculture, Agricultural Research Service, *Design and Operation: The Continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey, 1994–96*. Washington, D.C., 1997.

Ward, R.W. and C. Lambert. "Generic Promotion of Beef: Measuring the Impact of the U.S. Beef Checkoff." *Journal of Agricultural Economics* 44(1993):456–66.

Yen, S.T. "Working Wives and Food Away From Home: The Box-Cox Double Hurdle Model." *American Journal of Agricultural Economics* 75,4(November 1993):884–895.