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# Household Snack-Food Purchases: Does Nutrition Matter?

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Purchase patterns for two types of snack foods—pretzels and popcorn, and potato, corn, and tortilla chips—were analyzed using the data from a national survey. The study examined the effect of socio-economic and lifestyle factors including nutritional awareness and exercise habits of household respondents on snack-food purchase. A geometric-hurdle count-data model that distinguished between market-participation and purchase-frequency decisions revealed that the decision to participate in the market for snack food was separate from the purchase-level decision. Pretzels and popcorn consumers were unaffected by nutrition consideration of any kind. However, respondents who were overly concerned about desirable nutritional factors were unlikely to be buyers or potential buyers of snacks such as potato, corn, and tortilla chips.

Per-capita snack food consumption in the United States (U.S.) was 21.3 pounds in 1999. This figure translated into 5.9 billion pounds of chips (potato, corn, and tortilla), popcorn, pretzels, and nuts munched annually across the U.S. (*Snack Food and Wholesale Bakery* 1999). The dollar value of the U.S. domestic snack-food market at the retail level was estimated to be about \$19.38 billion in 1999, an increase of 6.2 percent from 1998 (*Retailing Today* 2000). Pretzels, popcorn, and chips constituted more than 75 percent of the retail value of the snack-food market. The main driving force behind the growth in the snack-food market was chips. Chips have accounted for the largest and still-increasing share of the domestic retail market for snack foods since 1992. Pretzels accounted for nearly one-third of the potato chip/pretzel market in 1995, but as a result of annual increases in sales volume for potato chips and declines for pretzels between 1995 and 1999, pretzels' market share dropped to 23 percent of the potato chip/pretzel market in 1999 (Allhouse et al. 2002).

Adverse publicity about the nutritional quality of chips has not diminished sales performance (*Retailing Today* 2000). Pretzels and popcorn, on the other hand, are considered to be relatively healthy in terms of fat content. However, this positive image has failed to translate into increased sales volume. It is quite ironic that people are consuming even more snacks with poor nutritional quality while expressing concern about their diet and

health. Many consumers express concern about food safety, yet relatively few appear to be changing their food-buying behavior in view of their concern (Lane and Bruhn 1991). For example, a survey by NPD (National Panel Diary) group evaluating the gap between consumer attitudes and behavior reported that the number of people expressing concern about health problems associated with french-fry consumption rose to 39 percent between 1985 and 1990; however, the number eating them at least once every two weeks declined just 7 percent (Bickley 1991).

A typical American diet is often associated with sources of major chronic diseases such as coronary heart disease, stroke, and diabetes (National Research Council 1989). Such association alone may not be a determinant of food choice among U.S. households. Food selection is determined by an interplay of environmental, personal, and biological factors (French et al. 1999). Some of these factors are price, taste preference, health concerns, and habits. Some individuals may decide not to purchase snack foods due to their perceived negative nutritional qualities, while others may buy them regularly.

Studies in the past—e.g., of dairy products—have related consumer health concerns and food-consumption habits (Jensen 1995; Heien and Wessells 1988). Capps and Schmitz (1991) in discussing health and nutrition factors in food analysis and Yen and Chern (1992) in investigating the impact of nutritional information on demand for dairy products have indicated that consumer health and nutritional concerns have significant effects on food demand. Many studies evaluating meat demand (Brown and Schrader 1990; Capps and

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Schmitz 1991) have concentrated on shifts in demand caused by consumers' views of the health implications of eating meat. Jensen (1995) analyzed consumer health concerns and decisions to participate in the market for whole-fat milk and found that promotion using nutritional benefits of milk can be a useful tool for the dairy industry to attract market participation.

This study examines the effects of nutritional awareness and exercise habits of 2,880 U.S. households in purchasing two types of snack foods: pretzels and popcorn, and chips such as potato chips, corn chips, or tortilla chips. We develop nutrition consideration indices (NCIs) and analyze the impact of NCIs and household socio-economic characteristics on market participation and purchase of snack foods.

### Conceptual and Empirical Model

The relationship between nutrition awareness and the demand for a commodity can be positive or negative depending upon consumer knowledge of nutrition vis-a-vis the characteristics of the product. For example, if a consumer is aware of the importance of vitamins and minerals and one of the product attributes is that it is a good source of vitamins and minerals, then the awareness is expected to shift the demand for the commodity upwards. Consumer attitudes toward nutrition can have two effects. The first effect is on the probability of market participation among those consumers who were previously non-participants. The second effect is on the quantity or frequency of purchase. If nutrition is an important consideration in making purchase decisions, those who are already in the market tend to buy more or less of a product depending on how the product attributes are associated with nutritional consideration. Following the two effects of nutrition awareness, individual  $i$ 's decision to participate in the snack-food market can be expressed as

$$(1) \quad p_i = p_i(X_{s1i}, X_{n1i})$$

where  $X_{s1i}$  is the vector of socio-economic variables associated with a consumer's preference for snack food and  $X_{n1i}$  represents the vector of variables related to a consumer's perception of product attributes including nutrition attributes. Subscript  $s$  represents socioeconomic characteristics and  $n$  rep-

resents nutrition. When  $p_i = 1$  the individual is a potential participant;  $p_i = 0$  indicates nonparticipation. The frequency of purchase ( $q_i > 0$ ) is expressed as

$$(2) \quad q_i = q_i(X_{s2i}, X_{n2i})$$

where  $X_{s2i}$  and  $X_{n2i}$  are vectors of variables associated with socioeconomic characteristics and perceived attributes of products that determine the frequency of snack-food purchases. Vectors  $X_{s1i}$ ,  $X_{s2i}$  and  $X_{n1i}$ ,  $X_{n2i}$  may or may not be the same.

The decision framework in (1) and (2) can be represented by the likelihood function

$$(3) \quad L = \prod_0 P(p_i = 0 | X_{s1i}, X_{n1i}, \beta_{Xs1}, \beta_{Xn1}) \cdot \prod_+ f(q_i | X_{s2i}, X_{n2i}, \beta_{Xs2}, \beta_{Xn2}) \cdot P(p_i = 1 | X_{s1i}, X_{n1i}, \beta_{Xs1}, \beta_{Xn1})$$

where  $\mathbb{D}_0$  and  $\mathbb{D}_+$  represent products over those  $i$  for which  $p_i = 0$  and  $q_i > 0$ , respectively;  $P$  denotes the probability;  $f(q_i | \cdot)$  is the conditional (truncated) density of  $q_i$  given  $q_i > 0$ ; and  $\beta_1$  and  $\beta_2$  are vectors of parameters.

The frequency of snack-food purchases is reported as integer values. It is therefore appropriate to analyze the purchase behavior using empirical models based on count data (Cameron and Trivedi 1997; Greene 1997). A geometric-hurdle model suggested by Mullahy (1987) is used to represent the frequency of purchasing two snack-food groups. The geometric distribution of both zero and positive counts was selected to account for overdispersion in the data. Following Mullahy, the geometric distribution of a snack-food-purchase frequency ( $q_i$ ) is defined by

$$(4) \quad G(q, \gamma) = \gamma^q (1 + \gamma)^{-(q+1)}, \quad q \in \Gamma = \{0, 1, 2, 3, \dots, n\} \\ = 0, \quad \text{else}$$

where  $E(q_i) = \gamma$  and  $\text{var}(q_i) = (1 + \gamma)$ .

Parameterizing  $\gamma = \exp(X_i \beta)$ , the log-likelihood function for the single-decision geometric-hurdle model of snack-food purchase can be written as

$$(5) \quad L^{SD} = \sum_{i=1}^T q_i X_i \beta_i - (q_i + 1) \log[1 + \exp(X_i \beta)]$$

where  $X_i$  is the vector of explanatory variables including socio-demographics and product attributes.

The single-decision specification is similar to a Tobit specification which assumes that everyone is a market participant and zero purchases are simply standard corner solutions. If the consumer-decision process follows the framework as defined in (1), (2), and (3) then a hurdle geometric specification is

$$(6) \Pr(q = 0) = 1 / (1 + \gamma_1),$$

$$(7) [1 - \Pr(q = 0)] = \sum_{q \in \Gamma_+} \Pr(q) = \gamma_1 / (1 + \gamma_1),$$

$$(8) \Pr(q | q > 0) = \gamma_2^{(q-1)} / \left[ (1 + \gamma_2)^q \right], q_i \in \Gamma_+ \\ = 0, \quad \text{else}$$

Parameterizing  $\gamma_1 = \exp(X_1 \beta_1)$  and  $\gamma_2 = \exp(X_2 \beta_2)$ , the binomial probabilities (6) and (7) are identical to those of standard binomial logit model. Equation (8) is in the form of a truncated-at-zero geometric model. The complete likelihood function based on (6)–(8) is

$$(9) L = \prod_0 \left\{ 1 / [1 + \exp(X_1 \beta_1)] \right\} \\ \times \prod_+ \left\{ \exp(X_1 \beta_1) / [1 + \exp(X_1 \beta_1)] \right\} \\ \times \prod_+ \left\{ \exp[(q_i - 1) X_i \beta_2] / \left[ [1 + \exp(X_i \beta_2)]^{q_i} \right] \right\}$$

which reduces to a single-decision equation represented by (5) when  $\beta_1 = \beta_2$ .

### Survey Designs and Data Collection

In a nationwide random telephone survey of 2,880 households in 1997, respondents were asked about snack-food-purchase patterns. All survey respondents were at least 18 years of age. A multiple-call-back method was used. Up to five call-backs were made to the same telephone number in order to reduce bias in favor of those easy to reach by telephone. The survey questionnaire explored four aspects of consumer behavior: purchase frequency of snack food, nutritional consideration in making purchase decisions, respondents' exercise habits, and demographic background.

Survey respondents' market-participation decisions were determined by asking, "We are con-

ducting a study about different kinds of foods. Have you, personally, eaten any of the following within the past twelve months?" The list of the foods included pretzels and popcorns as a single item and chips as a separate item. Chips were further defined as potato chips, corn chips, or tortillas chips. A time period of twelve months was considered to be sufficient to determine whether a respondent was likely to be a market participant. Those who did not buy the listed snack food in the last twelve months were considered to be non-participants. In the second stage, only the market participants were asked the following question to determine the frequency of purchase: "How many times would you say you purchased the listed snack foods in the past six months?" Popcorn and pretzels were together grouped in a single category because they are found to be common snacks for many dieters and are considered to be relatively healthy in terms of fat content. Because pretzels are often promoted as a lower-fat alternative to potato chips (Allshouse et al. 2002), a comparison of the two categories can provide important implications for the industry.

Socioeconomic characteristics of respondents included household income, household size, number of children, age of respondents, marital status, race, and residential status (urban, suburban and rural). Four market regions (West, Midwest, Northeast, and South) were identified based on telephone area codes used for the interviews. Table 1 reports the specific variables used in the model and their description. The explanatory variables were grouped into four classes: household characteristics, geographic location of households, characteristics of the household meal planners, and nutrition consideration and lifestyle of the meal planners.

Means for the overall data, and for purchasers and non-purchasers of snack-food products are reported in Table 2. Seventy-one-point-five percent of households in the sample purchased pretzels and popcorn, while 75.2 percent purchased chips. The sample means in Table 2 reflect some differences in the composition of households purchasing the two types of snack food. For example, only 45.78 percent of the non-purchasers of pretzels and popcorn were female, while more than half of the non-purchasers of chips were female. In general, purchasing households had higher income and larger family size than did non-purchasing households.

**Table 1. Names of the Variables and Their Descriptions.**

Variable	Description
<b>Snack-food purchases:</b>	
Pretzels and popcorn	Number of times pretzels and popcorn purchased in previous six months
Chips	Number of times chips purchased in previous six months
<b>Household characteristics:</b>	
Household income	Gross household income (in 1,000 dollars)
Children	=1 if children in the household; =0 otherwise
Household size	Number of family members
Urban	=1 if living in urban area; =0 otherwise
<b>Geographic location<sup>a</sup>:</b>	
Northeast	New England and Mid-Atlantic states
Midwest	East North-Central and West North-Central states
South	South-Atlantic, East South-Atlantic, and West South-Atlantic states
<b>Household meal-planner's characteristics<sup>b</sup>:</b>	
White	=1 if household meal planner is white, 0 otherwise
Black	=1 if household meal planner is black, 0 otherwise
Education	Education level of household meal planner: 1 = less than high school, 2 = high school graduate, 3 = some college, 4 = trade/technical, 5 = college, and 6 = post graduate
Age	Mid-points in the age groups of household meal planners
Gender	=1 if household meal planner is a female, 0 otherwise
<b>Nutrition consideration in making purchase decisions and lifestyle:</b>	
Nutrition-undesirable	Index of undesirable nutrition considered in making food purchase decisions (0–1)
Nutrition-desirable	Index of desirable nutrition considered in making food purchase decisions (0–1)
Exercise	Household meal planner's sports activities per week (0 days per week to 7 days per week)

<sup>a</sup> The omitted region is West.

<sup>b</sup> The respondent is assumed to be a household meal planner who makes food-purchase decisions including snack food for the entire household.

The sample means compared well with the population averages. The 1999–2000 average household income for the U.S. was \$41,484 (U.S. Department of Commerce 2003) compared to the sample average of \$40,584. Similarly, while 85 percent of the U.S. population is white, 86 percent of the sample households were white. The gender composition of the U.S. was approximately 51 percent female, and 55 percent of the meal planners in the sample were

female. The regional distribution in the sample is nearly identical to the regional distribution of the U.S. population.

Since consumers' attitudes and concerns about nutrition and health are observed indirectly, the responses to several nutrition and health-related questions were combined to construct an index measure of the consumer's consideration of nutrition in making purchase decisions. Two categories of

**Table 2. Sample Means of Explanatory Variables Used in the Model.**

Variable	Pretzels and popcorn <sup>1</sup>			Chips <sup>2</sup>	
	All households	Purchasers	Non-purchasers	Purchasers	Non-purchasers
Purchase (number of times in six months)					
Pretzels and popcorn	5.90	8.26	-	-	-
Chips	9.92	-	-	13.20	-
Household characteristics:					
Household income	\$40.584	\$41.476	\$35.940	\$41.168	\$36.421
Children	0.7951	0.8339	0.5777	0.8390	0.4702
Household size	2.6389	2.7032	2.2943	2.7070	2.1509
Urban	0.1780	0.1797	0.1826	0.1783	0.1930
Geographic location:					
Northeast	0.1882	0.1934	0.1635	0.1846	0.2140
Midwest	0.2619	0.2598	0.2561	0.2539	0.2947
South	0.3333	0.3295	0.3542	0.3420	0.2772
Household meal-planner's characteristics:					
White	0.8637	0.8704	0.8283	0.8676	0.8351
Black	0.0737	0.0713	0.0844	0.0693	0.1018
Education	3.4706	3.5267	3.3289	3.5209	3.1825
Age	44.3811	43.4205	48.4196	43.2273	51.1579
Gender	0.5498	0.5714	0.4578	0.5557	0.5298
Nutrition consideration in making purchase decisions and lifestyle:					
Nutrition-undesirable	0.4960	0.5003	0.4848	0.4956	0.5123
Nutrition-desirable <sup>1</sup>	0.4204	0.4200	0.4374	0.4141	0.4823
Exercise <sup>2</sup>	3.0839	3.0659	3.1935	3.0370	3.4245
Number of observations	2880	2058	822	2166	714
	(100%)	(71.5%)	(28.5%)	(75.2%)	(24.8%)

<sup>1</sup> Household income, children, household size, Northeast, education, age, gender, and exercise were significantly different between participant and non-participant at less than 5%.

<sup>2</sup> Household income, white, children, household size, education, age, gender, and exercise were significantly different between participant and non-participant at less than 5%.

questions formed the basis for developing the health-consideration indices. The first category related to the consideration of desirable nutritional components such as vitamins and minerals, contribution of food to overall recommended daily allowance, amount of fiber, and amount of protein. The second category was consideration of undesirable nutritional factors such as cholesterol level, sodium content, fat, additives, calories, and sugar in making purchase decisions. Nutrition consideration in making purchase decisions was recorded on a scale of 1 to 10, 1 being almost never (AN)

considered while making food purchase decision and 10 being nearly all the time (NAT) considered. Table 3 reports the mean and the coefficient of variation (CV) for the households' responses to the nutritional issues. As expected, mean responses were generally neutral—that is, on an average, households tended to consider both desirable and undesirable nutrition factors “sometimes” in making food-purchase decisions. However, reported coefficients of variation suggest that there was considerable variation in the responses.

Nutrition-consideration indices were designed

**Table 3. Nutritional Issues Considered by Household Meal Planners While Making Food Purchase Decisions.**

Nutritional issues	Mean	Coefficient of variation
<b>Undesirable nutritional components:</b>		
Cholesterol level in the food	5.56	60.23
Sodium (salt) content in the food	5.21	62.75
Amount of fat in the food	6.70	47.59
Amount of additives in the food	4.61	69.42
Number of calories in the food	5.82	54.67
Amount of sugar in the food	5.07	61.33
<b>Desirable nutritional components:</b>		
Number of vitamins and minerals in the food	5.02	60.58
Overall contribution of the food to the recommended daily allowance	4.68	64.86
Amount of fiber in the food	4.65	65.46
Amount of protein in the food	4.90	62.35

**Table 4. Estimated Parameters for Geometric-Hurdle and Single-Decision Models, Pretzels and Popcorn.**

Variables	Geometric Hurdle		Single Decision
	Participation	Purchase	
Intercept	0.6542*	1.4669***	1.3548***
Household income	0.0109***	0.0050***	0.0063***
Children	0.2304	-0.0096	0.0255
Household size	0.0629	0.0647**	0.0630***
Urban	0.0517	-0.0080	0.0045
Northeast	0.1291	0.3519***	0.3209***
Midwest	0.0998	0.2203***	0.1990***
South	-0.0259	0.2913***	0.2495***
White	0.6624***	0.0788	0.1779
Black	0.3602	0.1773	0.2166
Education	0.0657	-0.0239	-0.0107
Age	-0.0184***	-0.0024	-0.0058***
Gender	0.6349***	-0.0749	0.0325
Nutrition-undesirable	0.3062	-0.0680	0.0013
Nutrition-desirable	-0.3349	0.0120	-0.0570
Exercise	-0.0173	0.0259***	0.0173*
Likelihood (unrestricted)		-6143.45	-6559.33
Likelihood (restricted)		-7174.12	-8224.92
Chi-square		2059.96***	3331.18***
Vuong statistics			2.32***

\* Indicates significance at  $\alpha=0.10$ .\*\* Indicates significance at  $\alpha=0.05$ .\*\*\* Indicates significance at  $\alpha=0.01$ .

following Misra et al. (1995). The item scores for each respondent were first summed up to get a total score in each of the two nutrition categories. The total scores were then divided by the maximum possible total and expressed as an index ranging from 0.0 to 1. An index value of 1 corresponds to the highest possible score.

### Empirical Findings

The parameter estimates for the Tobit-type single-decision model (Equation 5) and the geometric-hurdle model (Equation 9) for the two snack food categories are reported in Tables 4 and 5. Chi-square tests rejected the null hypothesis, at the 0.01-significance level, that all parameters were equal to zero. The geometric-hurdle model was tested against the single-decision model using Vuong's statistic test (Vuong 1989). Vuong's statistic ( $V$ ) tests the null hypotheses that two competing mod-

els are equally close to the true data-generating process against the alternative hypothesis that one of the models is closer.  $V$  is asymptotically distributed as a normal distribution. The calculated  $V$  is 2.32 for pretzels and popcorn, and 4.69 for chips. The critical value at 0.05-significance level is 1.96. Hence, the null hypothesis that the single-decision model and the geometric-hurdle models are equally close to the true data-generating process is rejected in favor of the geometric-hurdle model. Thus the geometric-hurdle model appears to explain purchase behavior of households in the samples for pretzels and popcorn and for chips.

### Participation Decisions

The geometric-hurdle model results suggest that gross household income had a significant and positive impact on the participation decision for pretzels and popcorn. That is, households with higher

**Table 5. Estimated Parameters for Geometric Hurdle and Single Decision Models, Chips.**

Variables	Geometric Hurdle		Single Decision
	Participation	Purchase	
Intercept	2.1730***	2.8883***	2.8402***
Household income	0.0043	0.0006	0.0014
Children	0.2287	0.1692***	0.1779***
Household size	0.1272	0.0504***	0.0602***
Urban	-0.0124	-0.0109	-0.0183
Northeast	-0.2307	0.0309	0.0030
Midwest	-0.0885	0.0653	0.0495
South	0.2492	0.1904***	0.2129***
White	0.2722	-0.0229	0.0141
Black	-0.3605	-0.0427	-0.0967
Education	0.1114***	-0.0474***	-0.0296**
Age	-0.0253***	-0.0090***	-0.0125***
Gender	0.3073**	-0.1383***	-0.0889**
Nutrition-undesirable	0.4505	0.0435	0.1064
Nutrition-desirable	-0.9079***	-0.2264**	-0.3241***
Exercise	-0.0605**	0.0018	-0.0050
Likelihood (unrestricted)		-7268.19	-7611.57
Likelihood (restricted)		-8568.57	-9629.83
Chi-square		2600.72***	4036.52***
Vuong Statistics			4.69***

\* Indicates significance at  $\alpha=0.10$ .

\*\* Indicates significance at  $\alpha=0.05$ .

\*\*\* Indicates significance at  $\alpha=0.01$ .



incomes were more likely to be pretzel and popcorn buyers than were those with lower incomes. However, income had no effect on the decision to participate in the chips market. Household size had no impact on the decision to participate in either snack-food market. A white household meal planner was more likely to be a pretzel and popcorn buyer than were meal planners of other ethnic groups, but ethnic background of the meal planner had no impact on the decision to participate in the chips market. Among the sample households there was a positive relationship between education level of a household meal planner and the decision to participate in the chips market. The results, however, did not indicate a significant relationship between education and the decision to participate in the pretzel and popcorn market. The older a household meal planner was, the less likely he or she was to be a snack-food consumer. A female household meal planner was more likely to be a snack-food buyer than was her male counterpart. Nutrition consideration and lifestyle had a statistically insignificant impact on the decision to participate in the pretzel and popcorn market but a significant impact on the decision to participate in the chips market. Those meal planners who considered desirable nutrition factors such as vitamins and minerals while making food-purchase decisions were not likely to be a participant in the chips market. Similarly, those who exercised regularly were not likely to be buyers or potential buyers of chips.

#### *Purchase Frequency*

Household income, household size, geographic location, and lifestyle (exercise habits) of household meal planners had statistically significant impacts on the purchase frequency of pretzels and popcorn. It is interesting to note that many of these variables had no impact on the participation decisions for pretzels and popcorn. Such disparity further reinforces the hypothesis that participation and purchase-frequency decisions for pretzels and popcorn were made separately among the sample households. Among the participant households, those with larger households were likely to buy pretzels and popcorn more frequently than were those with smaller households. Geographic location of households made a considerable difference in the magnitude of the impact on purchase frequency of pret-

zels and popcorns. Households located in the Northeast were likely to purchase pretzels and popcorn most frequently, followed by those located in the South and the Midwest. Contrary to the results for pretzels and popcorn, many of the variables affecting the decision to participate in the chips market also affected the frequency of purchase. Among the participant households, those with children and larger households were likely to buy chips more frequently than were those without children and with smaller households. Households located in the South were likely to buy chips more frequently than were those located in other regions. Although an educated meal planner was likely to be a buyer or a potential buyer of chips, the higher the level of education the lower the frequency of chips purchases. Similarly, older meal planners were likely to buy chips less frequently than were younger meal planners. Among those households already participating in the chips market, the more a meal planner considered desirable nutrition factors while making food-purchase decisions, the less frequently he or she purchased chips.

#### *Effects of Nutrition Consideration and Exercise Habits*

The effects of nutrition considerations and exercise habits were further examined using a profile of a typical snack-food consumer. Due to the presence of discrete explanatory variables in the model, it was inappropriate to calculate predicted probabilities at the sample means of the explanatory variables. For example, a mean of 0.57 for the gender variable does not have a meaningful interpretation; obviously, a household meal planner had to be either male or female. An alternative to using sample means was to calculate probabilities for specific household profiles. A typical snack-food consuming household was located in the rural or suburban South and had a white female household meal planner in her 40s with some college education. Annual household income was forty thousand dollars. Household size was three, with one child. The household meal planner exercised three times a week. The effects of nutrition consideration in food-purchase decisions on the market participation and on the purchase of snack foods were shown at two levels. First was the effects of undesirable nutrition factors such as fat and cholesterol. The effect

was shown when a household meal planner “almost never” considered them and when she “almost always” considered them while she considered desirable nutrition factors such as vitamins and minerals “sometimes” (0.5 index value). In the second level, the effects of desirable nutrition factors were calculated keeping the consideration of undesirable nutrition factors at the 0.5 index value.

The effects of two types of nutrition considerations at two levels on the predicted probabilities of participating in the two snack-food markets and purchasing them are presented in Table 6. In general, if the household meal planner “almost always” considered undesirable nutrition factors such as fat and cholesterol, her likelihood of participating in both types of snack-food markets increased more than when she “almost never” considered them. However, the conditional and unconditional mean frequency of purchasing both types of snack foods did not change substantially. When desirable nutrition factors were considered “almost always” while making food-purchase decisions, the probability of market participation decreased by about six percentage points for chips and by about three-and-one-half percentage points for pretzels and popcorn. There was a change in conditional and unconditional mean frequency of purchase for chips, while

the mean frequency of purchase for pretzels and popcorn changed very little. For example, a typical participant household meal planner was likely to purchase chips about 15–16 times in six months when he or she “almost never” considered desirable nutrition factors. The purchase frequency decreased to about 12–14 times when she “almost always” considered them. Thus the net effect was a loss of about two to three purchases in six months. Relative to the mean purchases (Table 2), it is a loss of 15–22 percent among participant households and 20–30 percent among all households.

The effects of a household meal planner’s exercise habits on the probability of market participation and purchase frequency are reported in Table 7. In calculating the effects it is assumed that the household meal planner considered desirable and undesirable nutrition factors “sometimes.” That is, both nutrition indices were set at 0.5. The exercise habits of the household meal planner had very little impact on the probabilities of market participation for pretzels. However, as the number of days of exercise each week increased, the probability of participation in the chips market decreased. A similar effect was found on the conditional mean frequency of purchase of snack foods. Those household meal planners who were participants in the

**Table 6. Effects of Nutrition Consideration in Household Food Purchase Decisions on Predicted Probabilities of Participation in Snack-food Market and Frequency of Purchase.**

Undesirable and desirable nutritional factors	Purchase frequencies and probabilities			
	Almost never consider		Almost always consider	
	Pretzels/ popcorn	Chips	Pretzels/ popcorn	Chips
<b>Undesirable Nutrition Factors</b>				
Probability of market participation	0.8750	0.9145	0.9048	0.9438
Conditional mean frequency of purchase (# of times in six months)	8.90	14.97	8.04	15.15
Unconditional mean frequency of purchase (# of times in six months)	7.79	13.69	7.27	14.30
<b>Desirable Nutrition Factors</b>				
Probability of market participation	0.9061	0.9548	0.8734	0.8949
Conditional mean frequency of purchase (# of times in six months)	8.26	16.41	8.67	13.96
Unconditional mean frequency of purchase (# of times in six months)	7.48	15.67	7.57	12.49

**Table 7. Effects of Exercise Habits on Predicted Probabilities of Participation in Snack-food Market and Frequency of Purchase.**

Measure	Pretzels and popcorn			Chips		
	0 days/ week	3 days/ week	7 days/ week	0 days/ week	3 days/ week	7 days/ week
Probability of market participation	0.8956	0.8908	0.8839	0.9415	0.9306	0.9133
Conditional mean frequency of purchase (number of times in six months)	7.78	8.45	9.45	14.78	15.04	15.43
Unconditional mean frequency of purchase (number of times in six months)	6.97	7.53	8.35	13.91	13.99	14.09

pretzel and popcorn market and exercised every day tended to purchase pretzels and popcorn two times more in six months than those who did not exercise regularly—a 24-percent increase among participant households and a 34-percent increase among all households. The impact of exercise on conditional and unconditional mean purchase frequency of chips was very little.

### Concluding Remarks

The results presented in this study show the usefulness of using a geometric-hurdle framework in analyzing food-purchasing patterns. The decision to participate in the market for snack food was separate from the purchase-level decision by participating households. The pretzels and popcorn consumers were unaffected by nutrition considerations of any kind. However, a pretzel and popcorn buyer with a regular exercise habit was likely to increase purchase frequency by 24–34 percent. Therefore, a promotion campaign that focuses on the positive image of pretzels and popcorn is likely to increase sales among consumers with healthy lifestyles. The results suggest that those household meal planners who were overly concerned about desirable nutrition components were unlikely to be buyers or potential buyers of chips, and that those who did participate in the chips market were likely to decrease their purchase frequency by 15–30 percent. Such a finding is consistent with the “unhealthy” image associated with chips, but only among those who insist on desirable nutritional factors in food. Those

who are concerned about fat and cholesterol seem to still be eating chips, as evident from the model results and growing industry sales. This further highlights the inconsistency between consumer’s reported behavior and actual behavior.

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