Estimating the Effect of FDA Allowed Health Claims on the Consumption of Soy-based Foods

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Abstract

The study evaluated the influence of the Food and Drug Adminstration (FDA)'s regulatory action regarding the health benefits of soy-based foods on soy consumption.. The results indicated that frequent users of soyfood products who were exposed to the FDA's decision would be more inclined to increase their consumption of soy-based foods as compared to those who were not exposed to such information. Yet the information about FDA's decision did not influence the behavioral intentions of infrequent-or non-consumers. In addition, effects of perceived attributes of soyfoods on the consumption pattern for soy-based food products were evaluated. Perceived attributes included convenience, health benefits, and taste. This study used conceptual model that highlights the role of perceived attributes in a demand model by combining Lancaster's characteristics model with Fishbein's multi-attribute model. Zero-inflated negative binomial model (ZINB) was used as an empirical specification to address the zero consumption of soyfood products. Results show convenience of preparation and consumption, and tastefulness had strong impacts on the consumption of soy-based food products.
Key words: FDA health claim, health benefit attributes of soyfood, soyfood products, zero-inflated negative binomial model

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Crushing of soybeans for animal feed and vegetable oil has been historically the dominant usage of soybean crop. Although the use for whole soybean for human food such as tofu, soymilk, and other soyfood products constitute a small part of the soybean demand, the total value of soyfood products sold has been increasing in recent years. Henkel (2000) reported that $2.5 billion worth of soyfoods were sold in 2000 at the retail level.. Soytech Inc. (2004) also estimated the sales of soy food products including tofu, soymilk, soy cheese, energy bars, and meat alternatives to be at nearly $4 billion in 2003. These trends further highlight the important role of soyfood products in increasing the demand for soybeans at the farm level.

The farm level demand for soybeans is likely to be adversely affected due to adjustments in diet as consumers start following the recommendations of food guide pyramid. According to Young and Kantor (1999), reduction in total fat intake to the recommended upper limit would sharply decrease consumption of fats and oil such as vegetable oil by 36 percent. This will require a decline of soybean production by 2 million tons to match the domestic demand decrease. Increased usage of soybean for soy food and energy purposes will be necessary to bridge the potential shortfall in the demand for soybean

Intake of soy food products has been shown to have beneficial effects on cardiovascular disease (CHD) risk factors. Zhang et al. (2002) reported a clear monotonic dose-response relationship between soyfood intake and risk of total CHD. Using published data and new research Messina et al.(2000) suggested that the consumption of even 10 gram (typical of Asian intake) of isoflavone-rich soy protein per day may be

associated with health benefits. Recognizing the health benefits from soyfoods, Food and Drug Administration (FDA) has allowed food companies to claim health benefits from soyfood products (FDA, 1999). The American Heart Association has also recommended consumption of soy protein to patients with elevated cholesterol level (Erdman, 2000). There are, however, few studies assessing whether such health benefits and health claims have translated into increased consumption of soyfood products.

The FDA undergoes stringent review of the scientific evidence before it allows health claims on food products. To date, the FDA established only seven allowable health claims, including calcium and a reduced risk of osteoporosis, and sodium and an increased risk of hypertension. In response to a petition from the Quaker Oats Company, the FDA approved in 1997 the first food specific health claim under the NLEA. This opened the door for additional product specific claims, particularly leading to the approval of a petition to link soy protein with reduced blood cholesterol. The permission of health claims for soy foods is of considerable significance to the soy industry. The permission officially authenticated the health benefits of soy-based foods as well as enabling the soy food industry to build new marketing strategies based on accepted scientific findings.

The goal of our research is to assess (1) whether perceived attributes of soy-bsed foods including convenience of preparation and consumption, health benefits, and taste. play any role in consumers' decisions to consume soy-based food products and (ii) whether FDA's decision to allow food manufacturers to use health claims influence consumers' willingness to participate in soy-based food market or willingness to increase, if they are currently consuming such foods.

Previous studies have related consumer health concern to the consumption habit of foods derived from dairy (Jenson, 1995; Heien and Wessells, 1988) and meat sources (Ward and Moon, 1996). Capps and Schmitz (1991) and Rimal et al. (2001) in discussing health and nutritional 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 concern have a significant effect on food demand. Jenson (1995) analyzed consumers' 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. Many studies evaluating meat demand (Brown and Schrader, 1990; Capps and Schmitz, 1991) have concentrated on shifts in demand caused by consumers' view of the health implications of eating meat. However, little is known about the relationship between the U.S. consumer's perceived benefits of soyfoods and soyfood product consumption patterns. Moon et al. (2005) reported positive effects of perceived health benefits of soyfood on consumption frequency of soyfood as a whole without delineating the effects across specific products. Our study extends their research by examining whether perceived health benefits impact soyfood consumption decisions differentially across six individual soyfood products. In addition to health benefits, other attributes such as convenience of preparation and consumption and tastefulness are included. We use conceptual model combining Lancaster's characteristics and Fishbein's multiattribute models in order to integrate perceived attributes of soyfood into soyfood consumption models. Zero-inflated negative bionomial models are developed to differentiate soyfood consuming from non-consuming households. It is postulated that attributes of soyfood

and socio-economic variables have varying effect on the consumption frequency across six soyfood products.

Conceptual and Empirical Models

Conceptual Model

The traditional demand equation derived from the utility maximization framework does not explain the role of product attributes in influencing the market demand for the products. The theory of consumer demand by Lancaster (1971) was the first attempt in explaining the role of product attributes. According to Lancaster, attributes of goods and services combined with activities give rise to characteristics that are directly related with consumers' demand (Pendleton and Shonkwiler, 2001) Therefore, Lancaster established at least an indirect relationship between attributes and consumption behavior. Ladd and Suvannunt (1976) identified two properties from Lancaster's model (Moon et al., 2005): a) the price of the product is the sum of the of the marginal implicit value of its attributes, and b) household income, and level of attributes and price of a product influence consumer demand. The second property was applied by Van Ravenswaay and Hoehn (1991) and Baker and Crosbie (1993) to analyze consumer preferences for food safety. Following them, our study specifies the demand equation for a soyfood, Y, for consumer, i:

$$Y_i = Y_i\,(P_1, \mathbf{P}, m, \mathbf{T}). \tag{1}$$

Where P_1 is the price of a soyfood, **P** is the vector of prices of related goods, m is consumer's income, and **T** is a vector of non-price attributes of a soyfood.

Moon et al (2005) indicate that two issues need to be addressed when including attributes of soyfoods in a demand model. First, whether consumers are knowledgeable about attributes of soyfood. There will not be any impact of beneficial attributes of soyfood on the demand for soyfood, if consumers are unaware of the link between soyfood consumption and positive health effects. Second, even if consumers have the knowledge of the attributes, credence attributes such as nutrition and food safety have always posed a challenge in terms of objectively measuring them. Consumers often fail to evaluate these attributes even after consuming the products. These issues are addressed by replacing objectively measured attributes by consumers' perceived attributes of soyfood. Fishbein's multiattribute model (Fishbein, 1963) represents a valuable approach in examining the relationship between consumers' product knowledge in terms of their perceived attributes of soyfood and their attitude toward consuming soyfood. Symbolically, Fishbein's multiattribute model can be written as

$$A = \sum_{t}^{n} \beta_t X_t \tag{2}$$

where A is the attitude toward a soyfood; X_t is the strength of the belief that the soyfood possesses an attribute t; β_t is the evaluation of attribute t; and n is the number of salient attributes of a soyfood. The model therefore proposes that attitudes toward a soyfood product is based on the summed set of beliefs about the soyfood product's attributes weighted by the evaluation of these attributes. The evaluations (β_t) and the belief (X_t) are obtained from survey responses, and used for the calculation of the overall attitude toward a product. Assuming that the beliefs about the existence of expected attributes of

soyfood products influence consumers' attitude about the products, hence, their consumption, we can replace T in (1) by *A* to obtain a soyfood demand model:

(3) $$Y_i = Y_i (P_1, \mathbf{P}, m, \boldsymbol{A}).$$

Consumers' perceived attributes of soyfood products can have twofold effects. The first effect is on the probability of the participation in the soyfood market. The second effect is on the intensity of consumption (e.g., quantity or frequency) among those who are already market participants. Following the two effects of soyfood attributes, a two-step empirical demand model for a soyfood product is postulated:

(4) $$\Pr(Y_i>0) = g(P_1, \mathbf{P}, m, \boldsymbol{A}, \gamma_1)$$

(5) $$(Y_i|Y_i>0) = \cdot(P_1, \mathbf{P}, m, \boldsymbol{A}, \gamma_2)$$

where Y_i is the frequency of soyfood product consumed during a specific time by consumer *i* and γ_1 and γ_2 are the disturbance terms. Equation (4) represents a probability of participation in soyfood product markets, while equation (5) represents the level of consumption given the participation.

An individual is a non-participant in the soyfood market when three is no potential consumption despite changes in relative prices, income or other constraints: i.e., the zero consumption among non-participants is due to unacceptable taste or other unfavorable attributes of soyfood products. Unfavorable attribute perception may cause temporary or permanent non-consumption (Lin and Milon, 1993.) Alternatively, a potential participant is merely consuming at zero quantity due to unfavorable prices and income, or temporarily unacceptable attribute perception. Any favorable change in prices, income and perceived attributes will increase the quantity of consumption. Largely, there

are three separate empirical specifications of the above postulated consumption problems found in the literature.

The first is the tobit model which assumes that everyone is a market participant. In this model, zero purchases are simply standard corner solutions. The second is the Heckman type specification which does not allow for corner solutions (Blaylock and Blisard, 1993; Jensen, 1995). (comment: CD model arises when we assume zero correlation between the first and second stages) Hence, the decision is either to participate or not to participate. Once a household participates in the soyfood product market, it will have positive purchase levels. The third and most flexible model is also known as Cragg's "double hurdle" model (Jensen, 1995; Blaylock and Blisard, 1993; Haines, Guilkey, and Popkin, 1988). This model makes a distinction between market participation and zero purchases. According to this model, a zero purchase level may mean either nonparticipation in the market or non purchase due to relative price, income, and product attributes. Double hurdle model is the most general and can accommodate tobit and Heckman models as special cases (Jensen, 1995). There are two hurdles in this model a consumer must pass before a positive consumption of soyfood products takes place: be a potential consumer and actually consume soyfood products. The two-step decision making framework is incorporated in the empirical model specification that uses count data for the dependent variables.

Empirical Model Specification

Variables that count the number of times something happens are often modeled using count data models such Poisson and Negative Binomial models. For example, factors affecting how frequently a person visited the doctor (Cameron and Trivedi, 1986),

how frequently members of the House of Representatives switch parties (King, 1988) and the number of police arrests in a fixed period (Land, 1992.). In our study, Zero-Inflated Negative Binomial (ZINB) Model (Mullahey, 1986; Greene, 1997; Long, 1997) is used as an empirical model to analyze above discussed soyfood consumption behavior. This model is selected based on two merits: (i) it incorporates the framework of double-hurdle process discussed above, and (ii) it takes into account the potential over-dispersion of the consumption frequency.

Let Y_i represent the consumption of a soyfood product by an individual *i* in terms of number of times in a month. Thus, Y_i takes on integer values ranging from 0 to any positive value. Following Folz et al. (2000), let z represent a binary indicator of regime 1 (z=0) and regime 2 (z=1), and let P* represent the outcome of the generalized Poisson (negative binomial) process in regime 2. The observed consumption frequency of soyfood products, Y_i, is zXP*. A ZINB model for soyfood consumption, therefore, is:

(6) $\Pr (zi = 0) = F(wi, \gamma)$

(7) $\Pr (Y_i=j \mid z_i=1) = e^{-\mu_K} \frac{\mu_i^j}{j!}$,

Where F (.) is a cumulative probability distribution function with a logistic distribution, the parameter μ_i is determined by a linear combination of perceived attributes of soyfood products and socio-economic characteristics of consumers($\ln \mu_i = \beta' x_i \quad \varepsilon_i = \ln \lambda i + \text{in } u_i$), β and γ are parameter vectors to be estimated, w and x are covariates representing the explanatory variables in the soyfood consumption models. The exponential of disturbance term ε_i (i.e., u_i) is assumed to have a gamma distribution. The probability density function for the observed random variable (Y_i) is

(8) $\Pr (Y_i=j) = \Pr(z_i=0) + (1 - \Pr(z_i=0)) \cdot f(Y_i = j)$,

Where the distribution of Y_i conditional on x_i and u_i, $f(Y_i = j \mid x_i \text{ and } u_i) =$

$e^{-\lambda u_i}(\lambda_i u_i)^j / j!$. The log-likelihood is[1]

$$\ln L = \sum \ln(\Pr(Yi = j)).$$

Survey Design and Data Collection

Survey Instrument A survey instrument was designed to measure various conceptual variables pertinent to accomplishing the objective of this research. The survey instrument consist principally of two sections. The first section measures health status, motivation and knowledge in general along with perceived knowledge of health benefits specific to soy-based foods. Question items measuring general health knowledge are drawn from Mooreman and Maulitch (1993) while measures of health status and motivation are constructed from previous surveys related to food consumption. There have been no published studies measuring consumer attitudes or perceptions specifically related to soy-based foods. Therefore, knowledge/awareness of the health benefits of soy foods and perceptions about other attributes including taste, price, or convenience are measured using question items generated for this project. In addition, frequency measures of the consumption of various soy-based foods (i.e. Tofu, Soy veggie burgers, Soy milk, Soy Protein bars, Soy supplements, Soy cheese, and Meat Substitutes) are elicited from respondents. Finally, the survey instrument elicits information on demographic characteristics including education, age, gender, income, place of residence, and ethnic background. Such demographic profiles may impact the consumption of soy-

[1] For more detail on the model specification see Folz et al., 2000.

based foods directly as well as indirectly *via* their effects on general health knowledge or knowledge/awareness of the health benefits of soy protein.

Using split-sample technique, the second section evaluates the value of the FDA's regulatory action regarding the health benefits of soy-based foods. The survey instrument is designed in such a way that half of the sample is exposed to the following information:

The Food and Drug Administration (FDA) officially confirmed the health benefits of soy-based foods with a 1999 ruling that food manufacturers can claim "25 grams of soy protein a day as a part of a diet low in saturated fat and cholesterol may reduce the risk of heart disease". This ruling is based on the scientific finding that this soy protein dosage reduced blood cholesterol levels by 9.3% and the risk of coronary heart disease by 18.6 %.

Given such information, consumers' behavioral intentions are measured with questions asking (i) willingness-to-try soy-based foods for non-consumers, (ii) willingness-to-include soy-based foods regularly in their diets for infrequent consumers, and (iii) willingness-to-increase soy-based foods for current consumers. In contrast, the remaining half of the sample answers the same questions given their current preferences and knowledge of soy-based foods (i.e., without being exposed to the FDA decision about the health benefits of soy-based foods).

Data Collection: This paper uses data collected from a pilot study (convenience sample) drawn from a Midwest college town (Moon and Balasubramanian, 2002). Two questionnaires (i.e., one with information about the FDA's decision and the other without it) were given to students taking introductory Marketing courses. They were asked to administer the surveys to adult, non-student subjects and to verify that respondents have answered all survey items. At the conclusion of the survey, the students were instructed to obtain the first name and phone number of the respondent so that we can verify that they actually participated in the survey. Upon verification, the students receive extra

credit that contributes to their total course scores. Total 200 students participated in this project (i.e., 400 questionnaires were distributed) and 315 respondents returned completed questionnaires. Table 1 presents the description of variables included in the study.

Results and Discussion

Consumption Frequency of Soyfood Products

Sample households reported consumption frequency of six soyfood products per month. Table 2 presents the proportion of households reporting non-zero consumption, mean frequency of consumption per month among all households and among the subset of households reporting non-zero consumption. As shown in the table, 45 percent of the households in the sample consumed at least one type of soyfood product per month. Meat substitutes, tufu, and vegetable burgers were the popular type of soyfood products. Average consumption frequency across all types of soyfood products was nearly four times in a month among all households, and over nine times among the subset of the households with only positive (greater than zero) consumption frequency. Soy supplements, soy milk and soy cheese were the most frequently consumed soyfood products among those households who were already in the soyfood market.

Perceived attributes of soyfood

General negative attributes, positive health benefits, positive convenience attributes, tastefulness, and inexpensiveness were the five major perceived attributes of soyfood considered in the study (Table 1). These attributes were measured using a seven-point rating scale (1=strongly disagree, 7= strongly agree). Tests were conducted to

evaluate the internal consistency of statements under each category. In addition, mean tests were conducted to evaluate the difference in the perceived attributes between those who were consuming soyfood products and those who were not.

General negative attributes were measured using four independent statements: a) Only vegetarians eat soy-bsed foods; b) Soy-based foods are not available at the grocery stores; c) Soy-based foods are unnatural; and d) Soy-based foods are not good for you. A test was conducted to evaluate the internal consistency of the four statements. The computed test statistic showed that the four statements had a high level of consistency (Cronbach's $\alpha = 0.60$) in measuring the health benefits of soyfood (Table 3). A composite negative attribute index was created by summing up the reported scores for each statement and dividing by four. The difference between the households who consume soyfood products and those who do not was statistically insignificant in terms of their reported negative attributes of soy-based food.

Beneficial health attributes were measured using six independent statements relating to soyfood's ability to a) reduce cholesterol level in blood; b) act as an antioxidant; c) retain bone mass; d) help women during menopause; e) soy-based foods may replace meat products; and f) soy-based foods may replace milk products. A test was conducted The computed test statistic to evaluate the internal consistency of the four statements showed that the four statements had a high level of consistency (Cronbach's $\alpha = 0.79$) in measuring the health benefits of soyfood (Table 3). A composite health benefits index was created by summing up the reported scores for each statement and dividing by six. Despite significant differences between households who consume soyfood products and those who did not in terms of their perception regarding selected

health benefits of soy-foods (e.g., soyfoods act as an antioxidant and help retain bone mass), overall there were no differences.

Perceived convenience attributes were measured using three different statements relating to convenience in preparation and consumption of soyfood. These statements also showed a high level of consistency (Cronbach's $\alpha = 0.65$) in measuring perceived convenience of soyfood. A composite convenience index was created by summing up the reported scores for each of the statements and dividing by three. The results showed that soyfoods were generally perceived to be inconvenient (mean value of composite index = 2.57 compared to 3 = neither agree nor disagree that soyfoods are convenient.) There were statistically significant difference (P-value <0.05) in perceived convenience attributes of soyfoods between households who consume soyfood products and those who do not. Households who do not consume soyfood products clearly disagree that soyfoods are convenient to prepare and consume.

Perceived taste of soyfood was measured using a statement, "I like the taste of soy-base foods." Households generally disagreed that soyfoods were tasteful. Those who consumed soyfoods were statistically different (P-value <0.05) from those who did not in terms of their reported perception of tastefulness of soyfoods.

Finally, the price effects on the consumption frequency for soyfood products were measured using a statement, "Soyfood are inexpensive." Although households disagreed that soyfoods were inexpensive (mean = 2.58), those who did not consume soyfoods were likely to disagree more than those who consumed. Dahr and Foltz (2004) reported that the mean price of soy milk per gallon was more than $8 compared to the $3 for skim/low

fat milk. Prices of soyfood products may have been an obstacle in increasing participation in soyfood market.

Socio-economic characteristics and soyfood consumption

Socio-economic characteristics included respondent's gender, age, ethnic background of the household, education, household income. The average age of a respondent was 38 years. The difference in age between soyfood consumers and non consumers was not significant. An average soyfood consumer was more educated and had more household income than the non-consumer. The percentage of white respondent in the soyfood consuming subgroup was 92% compared to 79% in the non-consuming subgroup.

Regression Results

Tables 4 report the results of the zero-inflated negative binomial count data model. The dispersion parameter (Alpha) and zero-inflation model parameter (Tau) are statistically significant at P-value of less than 0.05. Therefore, the choice of ZINB models was consistent with the consumption behavior for soy-based food products.

Perceived negative attributes of soy-based foods had negative impact on the consumption frequency of soyfoods. Consumers who considered soyfood as unnatural and only for the vegetarians were generally did not want to be part of the soyfood market. This result is consistent with the results discussed above that non-consumers of soyfood products were statistically different from consumers based on their perceived negative attributes (Table 3.)

Perceived health benefit index had a statistically significant effect con consumption of soyfood products. That is, consumers who perceived beneficial health

attributes in soyfood products were more likely to participate in the soyfood market as well as increase consumption frequency. This result is consistent with previous studies addressing the impact of health information on food choices (Jensen, 1995; Ippolito and Mathios, 1993; Capps and Schmitz, 1991;Brown and Schrader, 1990.)

Consumers who agreed that soyfood products were convenient and tasteful were likely to consume more frequently than those who disagreed Attributes such as convenience and tastefulness had greater effects on consumption frequency than the health attributes. This finding confirms the finding by Kilcast et al. (1996) that convenience in preparation consumption can increase the consumption of fruits and vegetables among the low vegetable consumers. Soyfood products that incorporate convenience in preparation and consumption (e.g., frozen products) were likely to be better accepted by non-participant or low frequency consumers.

Tastefulness was essential to increase consumption frequency for soyfood products. Other studies have shown importance of taste in selecting food items. Acceptance of soy yogurt was found to be significantly lower than traditional milk yogurt primarily due to taste factor among college students in northern Louisiana (Wu et al., 2005). Rimal and Fletcher (2000) reported that attitudes toward in-shell peanuts was influenced by attributes such as fat, taste, and healthiness and that taste were the only attribute influencing consumer purchase decisions. According to Glanz, et al. (1998), taste and costs are of more importance to American consumers while selecting food than nutritional concerns. It is, therefore, important to promote soyfood products as being tasty and convenient in addition to being nutritious.

Figure 1 simulated the impact of perceived negative attributes, positive health attributes, tastefulness, and convenience of soyfood products on consumption frequency. It clearly shows that tastefulness was the single most important attribute followed by convenience in preparation and consumption, and beneficial health attributes. For example, those who strongly disagreed that soy-based food products were tasteful were likely to consume soyfoods less than 2 times a month compared to 8 times a month among those who strongly agreed. Those who perceived soyfoods to have negative attributes including unnatural food, only for vegetarian, and general a bad food, were likely to consume barely one time a month. The perceived health attributes had least impact on tofu consumption. The average frequency of tofu consumption was nearly 6 times a year among those who strongly disagreed that soyfood had health benefits compared to 8 times a year among those who strongly agreed. This result indicates that consumers do not select tofu because of the health benefits of soy proteins, but likely because of other reasons such as eating habits and customs.

Socio-economic characteristics of households including gender, age and education had effects on soyfood consumption frequency. Older respondents were likely to consume soy-based food products less frequently than younger respondents. Similarly, female respondents were likely to consume soy-based foods less frequently than men. Respondents' education level had positive effect on soyfood consumption. Previous studies have reported the role of education on food choices. Grossman and Kaestner (1997) reported a positive relationship between education and health. A person with more education is better able to maintain a healthy life than a person with less education. Better education enhances the access to nutrition information, thus increase

the likelihood of nutritional considerations while making food selections. Nayga (1997) also found a significant positive relationship between education and a main meal planner's perceived importance of nutrition in food shopping. Race may be another individual characteristic associated with the variation in soyfood consumption. White respondents were likely to consume soy-based foods more frequently than non-white respondents. This result is not consistent with expected behavior nationwide. In general, Asians are likely to account for a dominant share of soyfood consumption. The results in this study are likely to be an artifact of the characteristics of sample respondents. Sample respondents are highly educated (more than eighty-five percent have college education) and are mainly white.

The Role of FDA Allowed Health Claims: As stated earlier, the survey instrument exposes half of the sample to the FDA's decision allowing food manufacturers to use health claims on soy foods and asks whether they would be willing to increase the consumption of soy-based foods if the respondents are regular consumers.[2] If they are non or infrequent user of soy-based foods, such respondents are asked whether they would be willing to include soy-based foods more regularly in their diets. The rest of the sample is asked the same questions without being exposed to the information about the FDA's decision. This split sample technique allows us to determine whether the FDA's regulatory action influences behavioral intentions as measured with willingness-to-increase or willingness-to-include. The two measures were coded with a five-point scale ranging from 'Definitely would' to Definitely would not'.

[2] Prior to the information on the FDA's decision is introduced, a screening question was asked to determine whether or not the respondents are regular consumers of soy-based foods.

The results were analyzed using a simple cross tabulation and chi-squared statistics reported in table 5. Among the total respondents 30% were regular users of soyfood products while 70% were irregular or non-users. Among the regular users, five respondents reported that they would definitely include soyfood in their diet before the exposure to FDA claim. The number increased to 43 after the FDA exposure. Similarly, those who reported that they would probably include soyfood in their diet increased from 13 to 26. Interestingly, none of the respondents reported that they would definitely not include soyfood in their diet after they were exposed to FDA claims. These results were statistically significant at 5% level. Among the irregular or non-users, however, FDA claim did not seem to have any effect. Although there were few numeric changes in the positive direction, they were not statistically significant. These results indicate that respondents (regular users of soy-based foods) who were exposed to the FDA's decision would be more inclined to increase their consumption of soy-based foods as compared to those who were not exposed to such information. Yet the information about FDA's decision did not influence the behavioral intentions of infrequent- or non-consumers.

Summary and Implications

Impact of FDA's 1999 official confirmation of the health benefits of soy foods on consumers' consumption pattern for soyfood products such as tofu, vegetable burgers, soy milk, soy supplements, meat substitutes, and soy cheese was examined. In addition, the study evaluated the effects of perceived attributes of soyfoods on the consumption.

Survey results showed that respondents (regular users of soy-based foods) who were exposed to the FDA's decision would be more inclined to increase their

consumption of soy-based foods as compared to those who were not exposed to such information. Yet the information about FDA's decision did not influence the behavioral intentions of infrequent- or non-consumers.

Lancaster's characteristics model was combined with Fishbein's multi-attribute model to develop a soybean demand function that included perceived attributes of soyfood. Zero-inflated negative binomial model (ZINB) was used as an empirical specification to address zero consumption of soyfood products

Perceived negative attributes of soy-based foods had negative impact on the consumption frequency of soyfoods. Perceived health benefit index had a statistically significant effect con consumption of soyfood products. That is, consumers who perceived beneficial health attributes in soyfood products were more likely to participate in the soyfood market as well as increase consumption frequency. Consumers who agreed that soyfood products were convenient and tasteful were likely to consume more frequently than those who disagreed Attributes such as convenience and tastefulness had greater effects on consumption frequency than the health attributes. Tastefulness was essential to increase consumption frequency for soyfood products.

Socio-economic characteristics of households including gender, age and education had effects on soyfood consumption frequency. The study demonstrated that soyfood market can be segmented based on consumers' socio-economic characteristics including age, gender, education and ethnic background. Instead of promoting all soyfood products as a generic product group, they need to be treated as unique products able to meet the needs of specific segment of the food market.

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Table 1. Description of variables included in the study

Variable	Description
Soy-based food	Consumption of frequency of soy-based food products per month
Perceived Attributes of Soy Products	
Negative Attributes	
Vegetarians	Only vegetarians eat soy-based foods
Not Available	Soy-based foods are not available at the grocery store
Unnatural	Soy-based foods are unnatural
Not Good	Soy-based foods are not good for me
Positive Health Benefits	
Lowering Cholesterol	Soy-based foods lower cholesterol level in blood
Antioxidant	Soy-based foods act as an antioxidant
Bone mass (Osteoporosis)	Soy-based foods retain bone mass
Menopause	Soy-based foods are good for women during menopause
Meat Replacement	Soy-based foods may replace meat products
Milk Replacement	Soy-based foods may replace milk products
Positive Convenience	
Convenient	Soy-based foods are convenient
Recipes	Recipes that use soy-based foods are readily available
Preparation	I know how to prepare soy-based food items
Taste	I like the taste of soy-based foods
Inexpensive	Soy-based foods are inexpensive
Sociodemographics	
Female	1 = female; 0 = male
Age	Respondents' age in years
Ethnic background	1 if white; 0 otherwise
College	1=college or more than college education; 0 otherwise
Household Income*	1=less than $20,000, 2=$20,000-$34,999, 3=$35,000-$49,999, 4=$50,000-$64,999, 5=$65,000-79,999, 6=more than $80,000

*Mid points in the income range are used to obtain household income in $

Table 2. Soy Food Consumption Behavior of Surveyed Households

Soy Food Products	Respondents Reporting Non-Zero Consumption (%)	Mean Consumption Frequency, All Observations ± MSE (Times/month)	Mean Consumption Frequency, Non-Zero Consumption ± MSE (Times/month)
Tofu	30	0.64 ± 0.096	3.16 ± 0.312
Veggie Burger	18	0.76 ± 0.101	2.71 ± 0.260
Soy Milk	16	0.59 ± 0.105	3.87 ± 0.449
Soy Bar	16	0.43 ± 0.086	3.07 ± 0.436
Soy Supplements	14	0.62 ± 0.108	4.42 ± 0.454
Meat Substitutes	45	0.75 ± 0.106	3.00 ± 0.303
Soy Cheese	28	0.44 ± 0.091	3.83 ± 0.516
All	45	4.09 ± 0.552	9.15 ± 1.094

Note: MSE = Mean Standard Error

Table 3. Summary statistics of variables representing soyfood attributes and socio-economic characteristics of respondents.

Variables	All Observation		Non-Zero Observation		Zero Observation	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Perceived attributes of soy products:						
Vegetarians	1.72	1.077	1.51 [B]	.907	1.89 [A]	1.176
Not Available	2.21	1.232	2.06 [A]	1.235	2.33 [A]	1.220
Unnatural	1.64	1.078	1.51 [B]	.946	1.74 [A]	1.168
Not Good	1.76	1.141	1.58 [B]	1.077	1.91 [A]	1.174
Index of Negative Attributes (α=0.60)*:*	1.831	.7599	1.665 [A]	.7114	1.970 [A]	.7732
Lower cholesterol	3.60	.896	3.75 [A]	.938	3.47 [A]	.842
Antioxidant	3.36	.817	3.46 [A]	.906	3.27 [B]	.726
Osteoporosis	3.26	.971	3.33 [A]	1.052	3.20 [B]	.898
Menopause	3.28	.996	3.48 [A]	1.138	3.11 [B]	.826
Meat Replacement	3.36	1.298	3.65 [A]	1.226	3.13 [A]	1.313
Milk Replacement	3.25	1.314	3.43 [A]	1.294	3.11 [A]	1.317
Index of Positive Health Benefits(α=0.79):	3.35	.742	3.51 [A]	.764	3.21 [A]	.698
Convenient	2.79	1.039	3.01 [A]	1.112	2.61 [A]	.941
Recipes	2.74	1.079	2.95 [A]	1.155	2.57 [A]	.982
Preparation	2.19	1.246	2.55 [A]	1.344	1.89 [B]	1.076
Index of Positive Convenience Attributes(α=0.65):	2.57	.864	2.83 [A]	.917	2.36 [B]	.755
Taste	2.52	1.148	2.99 [A]	1.118	2.13 [B]	1.023
Inexpensive	2.58	1.030	2.69 [A]	1.135	2.49 [A]	.929
Sociodemographics						
Female	.51	.501	.51 [A]	.502	.51 [A]	.501
Age	38.01	13.850	37.32 [A]	14.191	38.58 [A]	13.582
White	.78	.412	.87 [A]	.337	.71 [B]	.454
College	.85	.360	.92 [A]	.270	.79 [B]	.411
Household Income	48.41	30.431	49.77 [A]	30.844	47.30 [A]	30.137

Mean tests were conducted using Tukey process. Means with the same letters are not significantly different at 5%.

Table 4. Soy Food Consumption: Results from Zero Inflated Negative Binomial Count Data Models

Variables	ZINB Model		Marginal Effects	
	Param. Estimates	Standard Error	Param. Estimates	Standard Error
Constant	-1.4337*	0.6380	-7.2899	5.0139
ATTITUDE	-0.3187*	0.1194	-1.6204**	0.9390
KNOWSOY	0.2762*	0.1101	1.4042**	0.8661
TASTE	0.3864*	0.1011	1.9649*	0.7954
PRICE	-0.0332	0.0876	-0.1689	0.6890
CONVIN	0.2727*	0.1094	1.3868**	0.8610
FEMALE	-0.5801*	0.1776	-2.9497*	1.3957
AGE	-0.0158*	0.0074	-0.0804	0.0668
WHITE	0.7680*	0.2268	3.9052*	1.7831
COLLEGE	1.2186*	0.2546	6.1962*	2.0014
INCOME	-0.0029	0.0040	-0.0147	0.0465
Dispersion parameters				
Alpha	3.3433*	0.2018		
Zero inflation model				
Tau	-2.3702*	0.6246		

Note: * = Significance at a<0.10; and **=Significance at a<0.05

Table 5: The effects of FDA allowed health claims on the consumption intentions for soy-based foods.

	High Frequency Consumers (30% of the respondents)		Low Frequency Consumers (70% of the respondents)	
	With FDA	Without FDA	With FDA	Without FDA
Definitely would	43	5	3	2
Probably would	26	13	13	12
Might or might not	12	30	17	19
Probably would not	5	20	28	21
Definitely would not	0	7	7	5
Chi-square (d.f.=4)	57.65*		1.05	

*significant at $a<0.05$

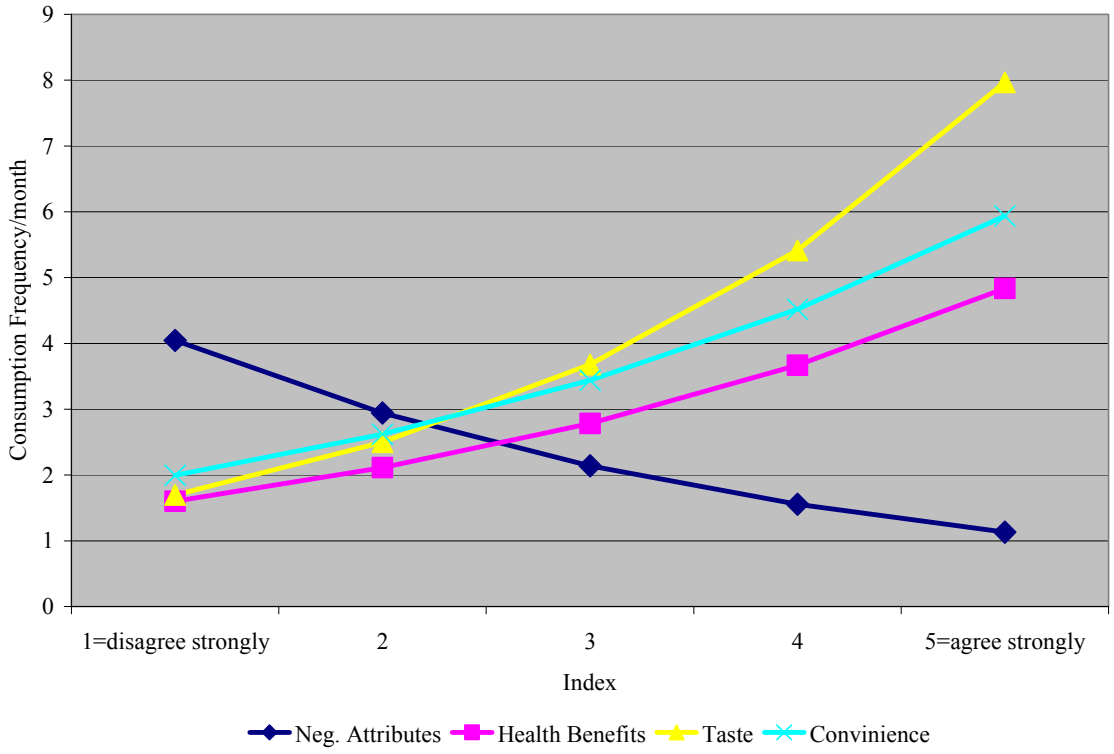

Figure 1: Simulated impact of selected attributes of soyfood on consumption frequency