# Nutritional food label use: A theoretical and empirical perspective

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**Abstract.** *Over the last several years, there has been an increase of several chronic diseases that are linked to dietary and lifestyle factors. Obesity, especially, is rising at an alarming rate in several countries. Due in part to increasing diet related health problems caused, among others, by obesity, nutritional labelling has been regarded as an important topic mainly because it can provide consumers with nutritional information that can be used to make informed and healthier food choices. A number of studies have focused on the empirical perspective of nutritional food label use. None of these studies, however, have focused on developing a theoretical economic model that would adequately describe nutritional food label use based on a utility theoretic framework. We attempt to fill this void by developing a simple theoretical model of nutritional label use in which we incorporate the time a consumer spends in reading food labels as part of his food choice process. The demand equations derived from the model are then empirically tested with data from a large-scale survey that was conducted in Athens, Greece from December 2005 to April 2006. Results suggest the significant role of several variables that flow directly from the theoretical model which, to our knowledge, have not been used in any previous empirical work. These results provide new insights that can be used as a segmentation tool by marketers.*

**Keywords:** label use, nutritional information, health, nutrition knowledge

## 1. Introduction

Over the last decade considerable attention has been paid to nutritional labelling of food products mainly due to the dramatic rise of food related diseases caused among others by obesity. Main causes of the obesity epidemic, that has risen three-fold or more since 1980 in some areas of North America, the UK and Eastern Europe [1], are the increased consumption of energy-dense foods high in saturated fats and sugars and reduced physical activity. Obesity has been found to be highly correlated with diseases like gallbladder disease, hypertension, stroke, certain forms of cancer, high blood pressure, coronary heart disease and Type II diabetes.

Economists (and non-economists) think of nutrition information of food products as an important issue that may help consumers make healthier food choices [2]. A number of studies have focused on the empirical perspective of nutritional label use. For example, Drichoutis *et al*.[3,4], Guthrie *et al*.[5], Kim *et al*.[6,7] and Nayga [2,8] empirically investigate the factors that affect nutritional food label use. Even though many of these applications claim to use the theoretical basis of Stigler's theory [9], i.e., the consumer will continue to acquire and process information as long as the additional costs do not outweigh the additional benefits, there has been little or no use of this theory in guiding the empirical process.

To fill this void, we attempt to develop a theoretical model of nutritional label use, which incorporates the time a consumer spends reading nutritional labels as part of his/her food choice process. Because we consider label use to be a health enhancing activity, we also use the health capital concept introduced by Grossman in his seminal paper [10]. In Grossman's model of the demand for health, health is a capital good produced via time and money and thus determines the amount of time available for market and non- market activities and the amount of income available to purchase non-health goods. Within the context of Becker's household production function framework [11], health was treated as a durable item. Thus, individuals inherit an initial stock of health capital that depreciates with age and can be increased by investment. Net investment in the stock of health equals gross investment minus depreciation. Direct investments in health include the own time of the consumer, medical care, diet, exercise, recreation etc.

While a number of theoretical and empirical extensions and applications of the framework for studying the demand for health have appeared based on Grossman's model, no other known paper has introduced nutritional food label use in it as a health enhancing activity. The next section of the paper focuses on the development of the theoretical model from which the empirical model is based. The following sections discuss the use of data from a survey conducted in the city of Athens in Greece to estimate the demand equations of interest, the measurement of the variables, the models, results, and then conclusions.

## 2. The theoretical model

We assume that there are three composite commodities in the market. The first group of commodities, which we treat as a single product, is an 'unhealthy' food product which we denote as $B$, while the other group includes 'healthy' foods that we denote as $G$. The third group denoted as $Z$ includes all other commodities. As consumption commodities, the quantities of the two foods $G$ and $B$ and the quantity of $Z$ enter the utility function directly. Consumers also get utility from the health stock $H$ they possess and from other time components. Let the utility function of a typical consumer be:

$$U = U\left(H, G, B, Z, W, E, N, R; S_1\right) \quad (1)$$

which is quasi- concave and twice differentiable. $S_1$ is a vector of demographic variables and other demand shifters, $W$ is working time, $E$ is time spent on health enhancing activities (e.g. sports or exercise time in general), $N$ is time spent on gathering nutrition information e.g. label use time and $R$ is residual time. $U$ has the following property: $U(H,0,0,Z,W,E,N,R;S_1)=0$ which suggests that food is essential for the individual. Consumption of goods is such that $U_G>0$, $U_B>0$ and $U_Z>0$. The direct positive effect of the three goods in the utility signifies that these products can provide a pleasurable consumption experience. However, $U_{GG}<0$, $U_{BB}<0$ and $U_{ZZ}<0$ because each added unit of the goods will produce less consumption pleasure. Likewise, we assume that $U_H>0$ and $U_{HH}<0$. In addition, following, Becker [11], DeSerpa [12] and Evans [13], we define time components as specific arguments in the utility function.

Consumers produce health according to the health production function:

$$H = H\left(G, B, W, E, N_I; S_2, k, n\right) \quad (2)$$

We define as $N_I$ the stock of nutritional information possessed by the individual where $H_{N_I} > 0$. Similar to the health production function concept, nutritional information are produced according to the production function,

$$N_I = N_I\left(mN; N_k, S_3\right) \qquad (3)$$

The consumer can invest to his stock of nutrient information by gathering nutritional information (e.g., by reading nutritional labels of food products) and this investment is facilitated by nutrition knowledge $N_k$. Equation (3) shows that the consumer can invest in the amount of nutritional information he/she possesses by acquiring new information (or by refreshing his/her knowledge). $m$ reflects the efficiency of the consumer to derive and process information from one unit of time $N$ that he/she spends gathering information ($0 \leq m \leq 1$). For example, if $m=1$ then all the time he/she allocates reading nutritional labels is health enhancing. The $m$ variable can be considered a human capital variable that is fixed in the short run.

In the health production function (2), $G$ and $B$ are inputs in the production of health. The assumption of foods that can either increase or decrease the level of health is commonly being used when trying to model healthy and unhealthy consumption [14]. Therefore, since $G$ is a 'healthy' food, we assume that its consumption will increase the individual's stock of health: $H_G>0$. On the other hand, $B$ is an 'unhealthy' food and therefore its consumption will decrease the individual's stock of health: $H_B<0$.

$E$ and $W$ are time inputs in the health production that directly affect the level of health. We assume that the time spent in health enhancing activities, such as exercise, contributes positively to health: $H_E>0$. Working time $W$ is also assumed to affect the level of health stock either positively or negatively: positively due to healthy components of work (e.g., physical activity on job) or negatively due to unhealthy components of work (e.g., job strain). The $k$ and $n$ variables capture the healthy and unhealthy components of work (e.g., strain, physical activity or satisfaction at/from work) assuming that they affect the efficiency of the production process. Such factors are well known to affect health [15,16,17]. $S_2$ is the stock of human capital which refers to the knowledge, information, ideas, skills and health of individuals [18].

From the individual's point of view, both market goods and own time, are scarce resources. Following neoclassical consumer theory, we assume that the consumers' market wage rate is $w$ and $Y$ is unearned income. The goods budget constraint equates the value of outlays on goods to income, under the assumption that the consumer does not save:

$$P_G G + P_B B + P_z Z = wW + Y \qquad (4)$$

Here $P_G$, $P_B$ and $P_Z$ are the prices of $G$, $B$ and $Z$, respectively. Similarly, the individual faces a binding time constraint and can choose on the time he/she will spend on the different activities in order to exhaust a time endowment equal to $T$, where $T$ equals the length of the decision period (e.g., twenty four hours for a period of one day):

$$W + E + N + R = T \qquad (5)$$

The equilibrium quantities of the choice variables can now be found by maximizing the utility function given by equation (1) subject to the constraints given by equations (2), (3), (4) and (5).

The derived conditional demand function of label use time from the above optimization process is:

$$N = N^*\left(m, P_G, P_B, P_Z, w, Y, T, S_1, S_2, S_3, N_K, n, k\right) \quad (9)$$

Market prices are assumed constant. Since no data were collected on the respondent's market wage rate $w$, we will use working time as a proxy for opportunity cost of time [19]. Furthermore, instead of the unearned income $Y$, we will use household's annual income $I$ as a proxy. Equation (9) then reduces to:

$$N = N^*\left(m, W, I, S_1, S_2, S_3, N_K, n, k\right) \quad (10)$$

Substituting (10) into the nutrition information production function (3), we also get the following function:

$$N_I = N_I^*\left(mN^*; N_k, S_3\right) \quad (11)$$

Equations (10) and (11) are used to empirically test our theoretical model.

## 3. The Data

Since no available secondary data exist with respect to the variables we want to use, a consumer survey, using personal interviews, was conducted during December 2005 to April 2006. The questionnaire developed was pre-tested to a small sample of consumers during November 2005. The main survey covered the Greater Athens area in Greece. A multistage stratified sampling method was used for the survey. In total, we selected 95 areas (consisting of one or more unified blocks) covering the entire Greater Athens area. The systematic sample that was drawn from each area was then visited during the morning hours and if a contact could not be established, a letter was distributed to the household explaining the purpose of the survey and asking for their participation. If a household could not be located (e.g., if the household moved), it was replaced with another household when possible. The households were then revisited during the afternoon hours. A total of 2565 households were selected to participate in the survey corresponding to a sampling fraction of 0.8‰. Of these, 263 households were not found (e.g., moved) and 240 of them were replaced, thus reducing the initial sample to 2542 households. We were not able to establish contact with 1277 households and 899 households refused to cooperate. Hence, 366 households agreed to participate in the survey yielding response and cooperation rates of 14.40% and 28.93%, respectively [20]. Refusal rate was about 35.37% while the no-contact rate was about 50.24%[20].

When the household agreed to participate in the survey, we asked to interview the major food shopper or we randomly chose one of the household shoppers if more than one individuals did the grocery shopping. An average interview lasted for about 22 minutes while totally more than 129 hours of interviews were conducted. Individuals who failed to respond to a question or to report their socioeconomic and demographic information were dropped from the sample. Hence, the number of respondents used in the analysis was 356.

## 4. Measurement of variables and econometric modelling

To estimate equations (10) and (11) we employed the specifications below:

$$LABUSE = \begin{pmatrix} b_0 + b_1 WWEEKH + b_2 STRAIN + b_3 NFLX + b_4 PHDEM + b_5 WALK + b_6 NKNOW \\ +b_7 EFFIC + b_8 PLANNER + b_9 INVOLV + b_{10} HCLAIMTR + b_{11} ISMEDIC \\ +b_{12} ISFRIEN + b_{13} ISELSE + b_{14} ISNO + b_{15} EXER + b_{16} OBESE + b_{17} OVWEIGHT \\ +b_{18} UNWEIGHT + b_{19} NOSMOKE + b_{20} SMSTOP + b_{21} HHEAD + b_{22} GEND \\ +b_{23} AGE + b_{24} HSIZE + b_{25} EDUC_2 + b_{26} INC_2 + b_{27} INC_3 + b_{28} INC_4 \end{pmatrix} + u \quad (12)$$

$$NI = \begin{pmatrix} b_0 + b_1 LABEFFIC + b_2 ISMEDIC + b_3 ISFRIEN + b_4 ISELSE \\ +b_5 ISNO + b_6 NKNOW + b_7 GEND + b_8 AGE + b_9 EDUC_2 \\ +b_{10} INC_2 + b_{11} INC_3 + b_{12} INC_4 \end{pmatrix} + v \quad (13)$$

Equations (12) and (13) above empirically represent equation (10) and (11) discussed earlier. The description of the variables used in these last two equations and their descriptive statistics are presented in Table 1. Table 2 presents the correspondence between the variables of the theoretical model based on equations (10) and (11) and the variables from the empirical forms represented by equations (12) and (13).

The $S_1$ and $S_2$ variables introduce into the model several demographic variables and demand shifters that have been found to affect label use. For example, Celsi and Olson [21] found that consumers will spend more time attending to information as their involvement increases. The *PLANNER* and *INVOLV* variables are thought to capture this effect. The role of claims has also been explored with respect to label use [22,23,24] and therefore the variable *HCLAIMTR* is introduced to test if the perceived believability of health and nutrition claims influences label use. Drichoutis *et al*.[3,4] showed the effect of several attitudinal and behavioural factors on label use and therefore we introduce some lifestyle factors to explain label use (i.e. *EXER*, *OBESE*, *OVWEIGHT*, *UNWEIGHT*, *NOSMOKE*, *SMSTOP*). Other typical demographic factors (e.g., education, income) are used in equation (12) as possible determinants of label use.

Similarly the $S_3$ variable includes demographic variables plus the information sources regarding nutrition that has been found to affect nutrition knowledge [3,4] (or stock of nutrition information in our case). For clarity we should note that similar to Blaylock *et al*.[25], we distinguish between two types of knowledge about nutrition. The first type is knowledge of nutritional principles, which we call nutrition knowledge and the second type is knowledge of the specific nutrient content of foods, which for this paper is identical with the concept of nutrition information stock.

To measure label use (*N*) we first asked consumers to think about many food products that carry nutritional labels. To avoid confusion each respondent was then showed a 11(cm)x7(cm) nutritional label indicating that this is how a typical nutritional label looks like (details on the format of the label are described later). Following Drichoutis *et al*.[3,4], Guthrie *et al*.[5] and Nayga [8], label use was measured by asking respondents how often they use nutritional labels when grocery shopping. Possible answers were *never*, *not often*, *medium*, *often* and *always*. Only 11% of the sample (39 cases) indicated that they always use nutritional food labels when grocery shopping while 24.7% (88 cases) indicated they often use food labels. Medium and not often use was reported by the 11.24% (40 cases) and 19.1% (68 cases) of the sample, respectively. The majority of the sample (34% or 121 cases) reported that they never use nutritional food labels while grocery shopping.

The healthy and unhealthy components of work (*n*, *k*) were proxied by job strain, work flexibility, physical demands of work and the requirement of working or standing while at work. The type of occupational stress having a negative impact on workers' health is defined as job strain [26,27,28]. Job strain occurs when job demands are high and job decision latitude is low. High job demands can be associated with intense pressure of work provoked by performing tasks at high speed and by being subjected to tight deadlines. Job latitude can be measured by job decision at work on the individual level. Therefore, working respondents were asked how often they face tight deadlines, how often they have to work at fast pace and how often they can change their pace of work or the order of their tasks [26,29] on a five likert scale ranging from *never* to *very often*. Respondents who stated that they *often* or *very often* work at fast pace and/or face tight deadlines while simultaneously not being able to change the pace of the work or the order of the tasks were qualified as having job strain. Therefore, the corresponding variable (*STRAIN*) takes the value of 1 and 0 otherwise. Non-working respondents were assumed to have no job strain.

To measure work flexibility we asked respondents if the working days and the working hours are inflexible, somewhat flexible or very flexible. Respondents that stated that either working days or working hours are inflexible were classified as having no job flexibility (*NFLX*). Respondents not working were seen as having flexibility and were aggregated with those having flexibility. Respondents were also asked to evaluate the physical demands of their work on a seven likert scale from *very, very light* to *very, very exerting* [30]. When respondents stated that the physical demands of their work are exerting or more, the variable (*PHDEM*) was given a score of 1 and 0 otherwise. Similarly, respondents were asked how often they have to stand or walk while at work on a seven likert scale ranging from *never* to *always*. When respondents stated that they have to walk or stand while at work *often* or more, the variable (*WWALK*) was given a score of 1 and 0 otherwise.

Following Byrd-Bredbenner *et al*.[31] each consumer was shown a typical EU nutritional food label in order to test consumer's efficiency (*EFFIC*) in deriving information from nutritional food labels. The labels were printed on a 11(cm)x7(cm) white paperboard and were formatted using the "Big 8" format (i.e., showing the amount of 8 key nutrients energy, protein, carbohydrates, fat, sugar, saturated fat, fibre and sodium). The consumers were then asked a series of six questions. The first three questions tested their ability to locate quantitative information from the label. In each of the three questions, respondents were therefore asked: how much total carbohydrates, proteins and saturated fat, respectively, are in 100 grams of this food. The next two questions tested consumers' ability to manipulate quantitative information evaluating their diet planning computations ability. Participants were asked: if you ate 500 grams of this food, how much calories would you get? If you ate 200 grams of this food, how much fat would you get? The last question tested consumers' ability to choose between foods. A new label was shown to them using the same format with the previous label and consumers were then asked to indicate the healthiest food choice. For each correct answer, consumers were assigned a score of 1 and for each wrong answer they were assigned a score of 0, thus yielding a score between 0 and 6 for each consumer. The scale was then divided by six to rescale the variable and make it consistent with the theoretical model presented in the previous section. About 80.9%, 84% and 71.9% of the respondents were able to correctly locate the requested quantitative information from the label with regards to carbohydrates, proteins and saturated fat, respectively. The percentages dropped to 47.2% and 44.7% when consumers were asked to manipulate quantitative information in the next two questions, respectively. Finally, about 84.3% of the respondents were able to choose correctly between the two food alternatives based on the nutritional information showed to them.

To measure nutrition knowledge (*NKNOW*), we asked a series of questions derived from the Nutrition Knowledge questionnaire [32]. The questions examined consumers' knowledge on four sections: dietary recommendations, sources of nutrients, choosing everyday foods and diet-disease relationships. These four sections were composed of nine questions. Correct answers were assigned a score of 1 while incorrect answers were assigned a score of 0 thus yielding a score between 0 and 9 for each respondent.

Nutrition information stock (*NI*) is measured as the knowledge of the specific nutrient content of foods. We used 7 questions of pairwise comparison of foods regarding the nutrient content of foods [3,25,32]. Consumers were asked to compare certain foods (e.g., butter vs. margarine, whole milk vs. skim milk, white bread vs. whole wheat bread etc) and were asked to indicate which has more cholesterol, fat, fibre, calories etc (see Table 1). For each correct answer the respondents were assigned a score of 1 and a score of 0 for an incorrect answer, thus yielding a score between 0 and 7 for each respondent.

To construct a measure of involvement with food, we followed Drichoutis *et al*.[33]. Respondents were asked how important was to them, while grocery shopping, each of five food attributes i.e. brand name, taste, nutrition value, ease of preparation and price. Possible answers ranged from *not important at all* to *very important*. For each food attribute that respondents rated as *important* or *very important*, a score of 1 was assigned, otherwise a score of 0 was assigned, thus yielding a total score between 0 and 5 for each individual.

Respondents were also asked to report their body weight and height. We used these to calculate the Body Mass Index (BMI) which is calculated according to the formula: BMI=weight/height $^2$. Individuals with a BMI over 30 are classified as obese. Individuals with a BMI between 25 and 30 are overweight, those with a BMI between 20 and 25 are considered to have normal weight and those with a BMI under 20 are underweight. The rest of the variables are described in Table 1.

The outcome variable in equation (12) is a discrete choice variable which calls for the use of what is known as Qualitative Response models [34]. For ranking (ordinal) dependent variables, an ordered logit model is considered appropriate. The fitted (predicted) values from this estimation are used in equation (13) multiplied with efficiency (*EFFIC*) and thus forming a new variable (*LABEFFIC*), which is consistent with the theoretical model variable ($mN$)[1]. The latter equation was estimated via ordinary least squares.

## 5. Results and findings

Table 3 presents the results for equation (12). Our discussion of the results for equations (12) is based on the statistical significance of the marginal effects and discrete changes, which were calculated at the means of all other variables [2]. Discrete changes were calculated for the dummy variables only. The parameter estimates for equation (13) are presented in Table 4.

Table 3 shows that label use is affected by several socio-economic factors but most importantly by factors that flow directly from the theoretical model and thus amplifying its usefulness. Respondents with strain (STRAIN) are 9.79% more likely to use nutritional labels often than those with no strain. Similarly respondents with no flexibility (NFLX) are more likely to medium and often use nutritional labels. This is an indication of the importance of work related factors on label use. It may show that consumers try to compensate the negative effect of work on their health with a more healthful diet, which could be achieved through increased label use.

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[1] To test the validity of using a variable as a product of two other variables we also tried estimating equation (13) using $m$ and $N$ as separate variables. This estimation produced the same results.

[2] The parameter estimates are available upon request.

In addition, respondents with physically demanding (PHDEM) jobs are more likely to medium use nutritional labels and less likely to not use labels. This result makes more sense if we think that those doing heavy work may need a more nutritious diet that will allow them to deal with the increased physical demands of their job. In a similar fashion, those with non- sedentary jobs (WALK) are 13.16% more likely not to use nutritional labels and 3.85% less likely to always use nutritional labels than those with sedentary jobs. This result may suggest that those with non- sedentary jobs perceive their jobs as contributing to their everyday exercise and health and thus may find unnecessary the use of nutritional labels as a means to a healthier diet. In contrast, those that stated that they exercise for half an hour at least once a week (*EXER*) are more likely to use nutritional labels.

The statistical significance of nutrition knowledge (*NKNOW*) and efficiency of reading nutritional labels (*EFFIC*) reinforces the theoretical model. According to the results people with higher nutrition knowledge are more likely to use nutritional labels. For example, an increase of one point in the nutrition knowledge score increases the probability of using often and always, nutritional labels by 2.34% and 1.24% respectively. This finding is indicative of the fact that respondents who are nutritionally knowledgeable are more likely to be able to evaluate and understand the information on food labels. Furthermore, respondents that are more able to derive information from nutritional labels are more likely to use them. This finding has important implications for policy makers and marketers since it shows that increased label use can be realized by better comprehension of nutritional information. This also calls for the use of consumer friendly and easy to use label formats.

As expected males (*GEND*) and older respondents (*AGE*) are less likely to use nutritional labels. The former finding has been verified by several studies [3,4,5,6,7,35] and once more confirms that men are less interested in nutrition perhaps because they are less likely to agree that nutritional labels are useful [36]. The latter result regarding age, can be associated with the lower processing capacity accompanying older people and the fact that older people tend to perceive labels to be less understandable [37]. Furthermore, household heads (*HHEAD*) are more likely to use nutritional labels, which is probably driven by the responsibility sentiment toward the other members of the household regarding their nutrition and health.

Finally and not surprisingly, respondents that stated that very few products carry trustful nutrition and health claims (*CLAIMTR*) are less likely to use nutritional labels. This finding reconfirms the strong link between nutrition panels and claims and points out that the use of labels is also part of how much one can trust the product he/she buys. We should also note that to our surprise, education or income effects are not significant.

Results for equation (13) are also very interesting. Most importantly, the product of the fitted values of label use with efficiency (*LABEFFIC*), which flows directly from the theoretical model, is statistically significant and positive. This variable can be interpreted as the proportion of label use time that is useful for the consumer in terms of deriving information from the labels, and it shows that as this increases so is nutrition information stock. The result for this variable indicates the importance of efficiency and label use together on building the stock of nutrition information.

Furthermore, it is interesting that nutrition knowledge (*NKNOW*) positively affects nutrition information stock and thus showing that increased knowledge of principles about nutrition may facilitate acquisition of specific nutrition knowledge.

As expected consumers with a university degree or higher ($EDUC_2$) have higher nutrition information stock than consumers with a high school degree or less, which emphasizes the role of schooling on knowledge. Similarly, higher income respondents (*$INC_4$*) have higher nutrition information stock, which relates with the previous finding if we assume that income and education are correlated. There is also a positive effect of age (*AGE*) on nutrition information stock. This result may indicate the role of previous experience if combined with the result from the label use equation that older people are less likely to use nutritional labels. This may also indicate that a possible reason why older individuals do not pay attention to nutritional information is that they have a higher stock of nutrition information knowledge.

In addition, males (*GEND*) have a lower stock of nutrition information knowledge, which can be explained by the fact that as we stated before they are typically less interested in nutrition issues. Surprisingly, there is no effect of the information source regarding nutrition issues, which may show that building on the stock of nutrition information can only be achieved by reading nutrition labels.

## 6. Conclusion

In this paper we attempted to fill a void in the nutritional labelling literature by developing a theoretical model that hopefully will provide a standard approach in empirically exploring consumer label use. In order to test the demand equations derived from the model, we collected data from personal interviews of primary grocery shoppers in Athens, Greece. No other known study has based their estimation from a utility theoretic model specific to label use. Our results suggest the significant role of several variables that flow from the theoretical model and are used for the first time, to our knowledge, as possible determinants of label use. The results can be used as a guide by marketers in segmenting the market between laber users and non-users since we identified the profile of consumers more likely to engage in label usage behaviour. According to the results, the profile of consumers more likely to read nutritional labels while shopping is: a younger female with higher nutrition knowledge and higher efficiency in deriving information from the label, a consumer who is head of the household and exercises at least once a week, under job strain, with no flexibility in changing workdays-hours, having a physically demanding job and being trustful toward nutrition and health claims. In addition, label use was shown to affect the level of nutrition information stock along with efficiency and certain other demographic factors.

Due to the nature of the survey we conducted (i.e., representativeness of our sample), our results can be generalized to the population of Athens, which accounts for half the population of Greece. Ideally, however, future research should test the robustness of our results on semi-urban and rural population and see if there are urbanization effects, as other researches have suggested [38,39]. Replicating our study in other parts of Europe would also be beneficial especially since marketers are anxious to know how to target consumers with the new mandatory nutritional labelling regulations that the EU is contemplating to implement.

**Table 1**. Names and Description of variables

| Variable | Variable Description | Scale | N | % | Mean | S.D. |
|---|---|---|---|---|---|---|
| *LABUSE* | Label use while shopping (1-5 scale) | 1-5 | | | 1.596 | 1.442 |
| | *Always* | | 39 | 10.96 | | |
| | *Often* | | 88 | 24.72 | | |
| | *Neither Often nor Rarely* | | 40 | 11.24 | | |
| | *Rarely* | | 68 | 19.10 | | |
| | *Never* | | 121 | 33.99 | | |
| *LABEFFIC* | The product of the predicted values for label use with efficiency in reading nutritional labels (EFFIC) | 0-5 | | | 0.983 | 1.269 |
| *INVOLV* | Degree of involvement with food | 1-5 | | | 3.649 | 0.912 |
| *PLANNER* | Respondent is the major meal planner=1, Otherwise=0 | 0, 1 | 264 | 74.16 | 0.742 | 0.438 |
| *WWEEKH* | Work hours of a typical week | | | | 18.465 | 21.735 |
| *CLAIMTR* | Respondent believes that very few or no products carry trustful nutrition or health claims=1, Otherwise=0 | 0, 1 | 133 | 37.36 | 0.374 | 0.484 |
| *STRAIN* | Respondent is suffers from strain=1, Otherwise=0 | 0, 1 | 26 | 7.30 | 0.073 | 0.261 |
| *NFLX* | Respondent has no workday or work hour flexibility=1, Otherwise=0 | 0, 1 | 71 | 19.94 | 0.199 | 0.400 |
| *PHDEM* | Respondent's job is physical demanding=1, Otherwise=0 | 0, 1 | 43 | 12.07 | 0.121 | 0.326 |
| *WALK* | Respondent has to walk or stand often while working=1, Otherwise=0 | 0, 1 | 77 | 21.63 | 0.216 | 0.412 |
| *ISMEDIC* | Primary source of nutrition information is nutritionists, physicians etc.=1, Otherwise=0 | 0, 1 | 30 | 8.43 | 0.084 | 0.278 |
| *ISMEDIA** | Primary source of nutrition information is TV, radio, newspapers, books etc.=1, Otherwise=0 | 0, 1 | 184 | 51.68 | 0.517 | 0.500 |
| *ISFRIEN* | Primary source of nutrition information is friends, relatives etc.=1, Otherwise=0 | 0, 1 | 68 | 19.10 | 0.191 | 0.394 |
| *ISELSE* | Primary source of nutrition information is something else from the above=1, Otherwise=0 | 0, 1 | 12 | 3.37 | 0.034 | 0.181 |
| *ISNO* | Respondent does not get informed at all regarding nutrition information=1, Otherwise=0 | 0, 1 | 62 | 17.42 | 0.174 | 0.380 |
| *EXER* | Respondent exercises for at least half an hour at least once a week=1, Otherwise=0 | 0, 1 | 106 | 29.77 | 0.298 | 0.458 |
| *OBESE* | Respondent is obese (BMI≥30)=1, Otherwise=0 | 0, 1 | 50 | 14.04 | 0.140 | 0.348 |
| *OVWEIGHT* | Respondent is overweight (25≤BMI<30)=1, Otherwise=0 | 0, 1 | 140 | 39.33 | 0.393 | 0.489 |
| *NWEIGHT** | Respondent has normal weight (20≤BMI<25)=1, Otherwise=0 | 0, 1 | 149 | 41.85 | 0.419 | 0.494 |
| *UNWEIGHT* | Respondent is underweight (BMI<20)=1, Otherwise=0 | 0, 1 | 17 | 4.77 | 0.048 | 0.214 |
| *NOSMOKE* | Respondent has never smoked=1, Otherwise=0 | 0, 1 | 155 | 43.54 | 0.435 | 0.497 |
| *SMSTOP* | Respondent has smoked in the past but does not smokes now=1, Otherwise=0 | 0, 1 | 59 | 16.57 | 0.166 | 0.372 |
| *SMOKE** | Respondent smokes=1, Otherwise=0 | 0, 1 | 142 | 39.89 | 0.399 | 0.490 |
| *HHEAD* | Respondent is household's head=1, Otherwise=0 | 0-1 | 273 | 76.69 | 0.767 | 0.423 |
| *GEND* | Respondent is male=1, Otherwise=0 | 0, 1 | 130 | 36.52 | 0.365 | 0.482 |
| *AGE* | Respondent's age | | | | 49.770 | 14.866 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *HSIZE* | Household size | | | | 2.933 | 1.161 |
| *$EDUC_1$** | Respondent has up to high school education=1, Otherwise=0 | 0, 1 | 240 | 67.42 | 0.674 | 0.469 |
| *$EDUC_2$* | Respondent has university education or higher=1, Otherwise=0 | 0, 1 | 116 | 32.58 | 0.326 | 0.469 |
| *$INC_1$** | Annual household income is <€10.000 =1, Otherwise=0 | 0, 1 | 72 | 20.22 | 0.202 | 0.402 |
| *$INC_2$* | Annual household income is €10.000- 20.000 =1, Otherwise=0 | 0, 1 | 126 | 35.39 | 0.354 | 0.479 |
| *$INC_3$* | Annual household income is €20.000- 40.000 =1, Otherwise=0 | 0, 1 | 123 | 34.55 | 0.346 | 0.476 |
| *$INC_4$* | Annual household income is >€40.000= 1, Otherwise=0 | 0, 1 | 35 | 9.83 | 0.098 | 0.298 |
| *NKNOW* | Nutrition knowledge | 0- 9 | | | 5.503 | 1.310 |
| | *Experts advice* | 0, 1 | 170 | 47.75 | 0.478 | 0.500 |
| | *Food source $_1$* | 0, 1 | 159 | 44.66 | 0.447 | 0.498 |
| | *Food source $_2$* | 0, 1 | 69 | 19.38 | 0.194 | 0.396 |
| | *Food source $_3$* | 0, 1 | 13 | 3.65 | 0.037 | 0.188 |
| | *Food choice $_1$* | 0, 1 | 272 | 76.40 | 0.764 | 0.425 |
| | *Food choice $_2$* | 0, 1 | 260 | 73.03 | 0.730 | 0.444 |
| | *Dietary recommendation $_1$* | 0, 1 | 318 | 89.33 | 0.893 | 0.309 |
| | *Dietary recommendation $_2$* | 0, 1 | 344 | 96.63 | 0.966 | 0.181 |
| | *Dietary recommendation $_3$* | 0, 1 | 354 | 99.44 | 0.994 | 0.075 |
| *NI* | Nutrition information stock | 0- 7 | | | 4.567 | 1.226 |
| | *Proteins/ Whole milk vs skimmed milk* | 0, 1 | 126 | 35.39 | 0.354 | 0.479 |
| | *Calories/Butter vs margarine* | 0, 1 | 36 | 10.11 | 0.101 | 0.302 |
| | *Vitamins/White vs whole wheat bread* | 0, 1 | 294 | 82.58 | 0.826 | 0.380 |
| | *Fat/Yoghurt vs whipping cream* | 0, 1 | 331 | 92.98 | 0.930 | 0.256 |
| | *Cholesterol/ Whole milk vs skimmed milk* | 0, 1 | 283 | 79.49 | 0.795 | 0.404 |
| | *Fibre/White vs whole wheat bread* | 0, 1 | 304 | 85.39 | 0.854 | 0.354 |
| | *Cholesterol/Butter vs margarine* | 0, 1 | 252 | 70.79 | 0.708 | 0.455 |
| *EFFIC* | Efficiency reading nutritional labels | 0- 1 | | | 0.688 | 0.308 |
| | *Locate information $_1$* | 0, 1 | 288 | 80.90 | 0.809 | 0.394 |
| | *Locate information $_2$* | 0, 1 | 299 | 83.98 | 0.840 | 0.367 |
| | *Locate information $_3$* | 0, 1 | 256 | 71.91 | 0.719 | 0.450 |
| | *Manipulate information $_1$* | 0, 1 | 168 | 47.19 | 0.472 | 0.500 |
| | *Manipulate information $_2$* | 0, 1 | 159 | 44.66 | 0.447 | 0.498 |
| | *Choose between foods* | 0, 1 | 300 | 84.27 | 0.843 | 0.365 |

*The variables with an asterisk where omitted for estimation purposes

**Table 2**. Correspondence between theoretical and empirical variables

| Variables in theoretical model | Variables in empirical model |
|---|---|
| N | LABUSE |
| $N_I$ | NI |
| m | EFFIC |
| W | WWEEKH |
| I | $INC_2$, $INC_3$, $INC_4$ |
| $N_K$ | NKNOW |
| n, k | STRAIN, NFLX, PHDEM, WALK |
| $S_1$, $S_2$ | INVOLV, PLANNER, CLAIMTR, EXER. OBESE, OVWEIGHT, UNWEIGHT, NOSMOKE, SMSTOP,HHEAD, GEND, AGE, HSIZE, $EDUC_2$, $INC_2$, $INC_3$, $INC_4$ |
| $S_3$ | ISMEDIC, ISFRIEN, ISELSE, ISNO, $EDUC_2$, $INC_2$, $INC_3$, $INC_4$, AGE, GEND |

**Table 3**. Marginal effects and discrete changes for label use equation

| **Variables** | **Label use=never** | **Label use=rarely** | **Label use=medium** | **Label use=often** | **Label use=always** |
|---|---|---|---|---|---|
| *INVOLV* | 0.0411 | 0.0054 | -0.0052 | -0.0269 | -0.0143 |
| *ISMEDIC* | 0.0745 | 0.0047 | -0.0112 | -0.0458 | -0.0223 |
| *ISFRIEN* | 0.0141 | 0.0017 | -0.0018 | -0.0091 | -0.0048 |
| *ISELSE* | -0.0822 | -0.0187 | **0.0069*** | 0.0579 | 0.0362 |
| *ISNO* | 0.0286 | 0.0031 | -0.0039 | -0.0184 | -0.0095 |
| *PLANNER* | -0.0423 | -0.0046 | 0.0058 | 0.0271 | 0.0140 |
| *CLAIMTR* | **0.1351**** | **0.0123*** | **-0.0187**** | **-0.0850**** | **-0.0436**** |
| *WWEEKH* | 0.0008 | 0.0001 | -0.0001 | -0.0005 | -0.0003 |
| *STRAIN* | **-0.1359**** | -0.0383 | 0.0069 | **0.0979**** | 0.0693 |
| *NFLX* | **-0.1043*** | -0.0216 | **0.0096**** | **0.0723*** | 0.0440 |
| *PHDEM* | **-0.1115*** | -0.0264 | **0.0086**** | 0.0787 | 0.0506 |
| *WALK* | **0.1316*** | 0.0065 | -0.0201 | **-0.0796**** | **-0.0385**** |
| *EXER* | **-0.1463**** | **-0.0291**** | **0.0136**** | **0.1003**** | **0.0615**** |
| *OBESE* | 0.0429 | 0.0041 | -0.0060 | -0.0272 | -0.0138 |
| *OVWEIGHT* | -0.0769 | -0.0115 | 0.0091 | 0.0511 | 0.0281 |
| *UNWEIGHT* | -0.0717 | -0.0152 | 0.0066 | 0.0499 | 0.0303 |
| *NOSMOKE* | 0.0125 | 0.0016 | -0.0016 | -0.0082 | -0.0043 |
| *SMSTOP* | -0.0610 | -0.0110 | 0.0065 | 0.0415 | 0.0239 |
| *HHEAD* | **-0.1644**** | -0.0060 | **0.0255**** | **0.0980**** | **0.0469**** |
| *GEND* | **0.1320*** | **0.0118*** | -0.0184 | **-0.0829*** | **-0.0424*** |
| *AGE* | **0.0051**** | **0.0007**** | **-0.0007**** | **-0.0034**** | **-0.0018**** |
| *HSIZE* | -0.0226 | -0.0030 | 0.0029 | 0.0148 | 0.0079 |
| $EDUC_2$ | -0.0275 | -0.0039 | 0.0034 | 0.0182 | 0.0098 |
| $INC_2$ | -0.0088 | -0.0012 | 0.0011 | 0.0058 | 0.0031 |
| $INC_3$ | -0.0035 | -0.0005 | 0.0004 | 0.0023 | 0.0012 |
| $INC_4$ | 0.1399 | 0.0019 | -0.0228 | -0.0816 | -0.0376 |

| | | | | | |
|---|---|---|---|---|---|
| *NKNOW* | **-0.0357**** | -0.0047 | **0.0046*** | **0.0234**** | **0.0124**** |
| *EFFIC* | **-0.1558*** | -0.0204 | **0.0199*** | **0.1021*** | **0.0543*** |

| Thresholds parameters [a] | Coefficient | Std. error | t-statistic |
|---|---|---|---|
| $MU_1$ | 0.930 | 0.0899 | 10.338 |
| $MU_2$ | 1.462 | 0.1042 | 14.030 |
| $MU_3$ | 3.135 | 0.1787 | 17.541 |

*Fit measures for ordered logit model*

| | |
|---|---|
| %correct predictions | 42.42 |
| Log likelihood | -501.1158 |
| Restricted log likelihood | -539.8184 |
| McFadden $R^2$ [b] | 0.071696 |
| $x^2$ (p-value) | 77.40 (1.61E-06) |

*(**) Significant at the 10%(5%) significance level.

[a] These are threshold parameters that separate the adjacent categories, estimated with the other model parameters. The first threshold parameter MU(0) is typically normalised to zero.

[b] $1-(\log L_{unrestricted}/\text{Log}L_{restricted})$.

**Table 4**. Estimated coefficients for nutrition information stock equation.

| Variables | Coefficient | p-values |
|---|---|---|
| *Constant* | **2.4725**** | **0.000** |
| *ISMEDIC* | -0.2737 | 0.214 |
| *ISFRIEN* | -0.0981 | 0.540 |
| *ISELSE* | 0.0009 | 0.998 |
| *ISNO* | -0.1887 | 0.271 |
| *LABEFFIC* | **0.2227**** | **0.000** |
| $EDUC_2$ | **0.2708*** | **0.066** |
| $INC_2$ | 0.0352 | 0.832 |
| $INC_3$ | 0.1894 | 0.273 |
| $INC_4$ | **0.5175**** | **0.035** |
| *AGE* | **0.0105**** | **0.016** |
| *GEND* | **-0.2245*** | **0.092** |
| *NKNOW* | **0.2351**** | **0.000** |
| $R^2$ | 0.214 | |
| Adjusted $R^2$ | 0.186 | |
| F-value | 7.78 | 0.000 |

*(**) Significant at the 10%(5%) significance level.

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