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Consumer Heterogeneity in Evaluation of Generic Food Miles Labeling

Programs: a latent class modeling approach

Abstract:

We investigated heterogeneity in consumers' preferences for food miles information using a choice experiment and latent class modeling approach. Results suggest that there are three different consumer groups with clear distinguishable behavioral patterns and perceived utility from the food attributes considered in the choice experiment. Implications of the findings are discussed.

Keywords: food miles labels, consumers heterogeneity, latent class logit model, Italy.

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1. Introduction

In recent years, globalization and expansion of international food trade has significantly increased transportation of food products around the world with negative impacts on the environment. Raw materials are grown, processed, turned into food products and transported in ever larger volumes, with ever-increasing impacts on the environment (de Boer et al., 2006; Pretty et al., 2005). Information on where the food comes from and information about the social and environmental impacts associated with production and transportation of food are also less visible to consumers.

In this context, Paxton (1994) coined the term “food miles” to indicate the distance food travels from the place it was produced until it reaches the consumers. This concept is now becoming of increasing interest to consumers, producers, retailers, and policy makers. This interest is due to the informational aspects intrinsically linked to the food miles concept, which could be brought to the attention of the consumer through food labels. The implementation of a labeling scheme showing information on food miles might be an instrument to inform consumers about the environmental characteristics of food products, meeting the growing interest on sustainable food products they express. However, consumers’ interest for food miles information might differ in relation to how they perceive the food miles concept. Specifically, consumers’ preferences for food miles information may be associated with either information on the direct and indirect impacts associated with food transportation (e.g. CO₂ emitted) or information related to the distance and time the food travelled. Thus, differences in consumers’ preferences for these different information sources might reflect the presence of heterogeneity in their preferences for food miles information. Nevertheless, while some studies have provided empirical evidence related to consumers’ preferences towards products with food miles labels and

consumers' willingness to pay for the presence of such labels (i.e., Aoki, 2009; Pirog, 2005), no other known study has examined the existence of heterogeneity in consumers' preferences when different food miles labels for the same product are proposed and simultaneously available in the market together with the unlabeled product.

The objective of this study is to examine the sources of heterogeneity among consumer groups in terms of their perceived utility of the different food miles information provided by labels, using a latent class modeling approach. To achieve our objective, we treated food miles as an attribute of a product (i.e., fresh tomato) ; then we considered the number of miles and time the food has travelled (*nmiles*), CO₂ emitted (*CO2*) and no information (*no_info*) as three mutually exclusive ways to convey (or not) food miles information to consumers. Our results generally suggest the presence of three different consumer groups.

The rest of the article is organized as follows: the following section discusses materials and methods. The next section reports data and results. In the final section we draw our conclusion.

2. Materials and methods

2.1 choice experiment designs

We designed a choice experiment (CE) to investigate consumer heterogeneity in evaluation of two types of generic food miles labeling programs: one which would provide information about the distance and time the food traveled (*nmiles*) and one which would provide information on the amount of CO₂ emission from transportation (*CO2*). Using tomato as the product of interest, other attributes were included in the design of the experiment to make it more realistic: price, production method, and type of tomato. Table 1 describes the attributes and levels we used. Considering the

number of attributes and levels, a full factorial design would have resulted in 72 possible combinations or profiles ($4 \times 2 \times 3^2$). Standard choice experimental design techniques (see Louviere et al., 2000) and SPSS Conjoint software were used to obtain an orthogonal fractional factorial design and 32 pair-wise comparisons of alternative fresh tomato profiles were obtained. These were split into four different blocks of eight choice sets, erasing one card from each block due to the repetition of some combinations. The respondents were then asked to select among three options: 2 alternative product profiles and one “none of these” option considering that some respondents might choose this option when shopping (Lusk and Schroeder 2004). Prior to the choice question, information regarding the meaning of the attributes was presented to participants. In particular, we informed subjects that the fresh tomato product presented to them differs only on price, production method, type of fresh tomato and type of generic food miles labels, while on all other respects they are to be considered identical. With regard to the food miles attribute, we informed respondents to make a choice in the CE given equal (but unknown) origin and transportation modes of the different fresh tomato products they are examining. Specifically, respondents were assured that the information on the hypothetical labels are consistent, i.e. the amount of CO₂ emissions presented on the CO₂ label equaled the emissions and the time that would occur in the course of the product transportation and otherwise, and do not vary across the levels of food miles (i.e., no information, CO₂, distance/time). Since we informed respondents that the product profiles had in fact identical environmental impact in terms of food transportation, their choice would exclusively reflect how they value the presence of either food miles label and their preference for a specific type of food miles information.

Finally, given the hypothetical nature of our CE investigation, we included a cheap talk script in the questionnaire. Our script is generic, short enough to be applied in a retail survey, and neutral with respect to the direction of hypothetical bias (Van Loo et al, 2011; Silva et al., 2011).

2.2 Data collection instrument

The questionnaire is divided into four sections: (i) questions regarding sustainable and organic consumption; (ii) consumers' purchase behaviour and consumption habits of fresh tomato; (iii) CE questions designed to assess organic consumers' preference for two generic food miles labelling programs; and (iv) questions regarding socio-demographic characteristics of the respondents. The questionnaire format was pre-tested on a small sample of individuals (i.e., 40 people), with the goal of testing the appropriateness of the chosen attributes and the clarity of the questions.

2.3 Empirical model: latent class logit model

Heterogeneity in consumers' preference for food miles labels is analyzed within the choice experiment framework. Specifically, a latent class is employed to identify different consumer groups among our respondents according to their preferences for the different food miles information and the other attributes considered in the CE design. Theoretically, LCM models are suited in explaining the sources of heterogeneity, which are often related to socio-economic characteristics and taste of the respondent, since individuals are sorted into a number of latent classes (Ouma et al. 2007; Boxall and Adamowicz, 2002) where each class is characterized by homogeneous preferences, but preferences are heterogeneous across classes (Boxall and Adamowicz, 2002). Thus, since the part-worth utility varies across consumer groups or classes, the sample of surveyed consumers can be split into a discrete number of market segments (Nilsson et al. 2006). Within a given class, individual

choices from one choice situation to another are assumed to be independent and choice probabilities are assumed to be generated by the logit model (Greene, 2006). Formally, in the LCM, the utility of individual n choosing alternative j in choice situation t is:

$$[1] \quad \mathbf{U}_{njt|s} = \beta_s \mathbf{X}_{njt} + \varepsilon_{njt|s}$$

where, β_s is the parameter vector of class s associated with the vector X_{njt} of observed attributes associated with alternative j as explanatory variables, while $\varepsilon_{njt|s}$ are error terms associated to the class. Then, the probability P_n that individual n selects option j in choice situation t , given that he belongs to latent class s , is:

$$[2] \quad P_{n(njt|s)} = \prod_{t=1}^T \frac{\exp(\beta'_s x_{njt})}{\sum_{j=1}^J \exp(\beta'_s x_{njt})}$$

where T denotes the number of choice situations for person n .

3. Data and Results

3.1 Data

We conducted our CE study during spring 2009 in Naples, Italy. Adult food shoppers (at least 18 years old) were randomly selected in three different grocery stores and 200 face to face interviews were performed.

Summary statistics for the characteristics of the full sample are presented in Table 2. The majority of respondents were female (63.5%), as expected when targeting persons responsible for household food purchases in Italian households. Majority of the respondents belong to the 25 to 40 years old age group, while mean household annual income is less than € 19,000 and the majority had a high school degree. According to ISTAT 2009, the demographic characteristics of the Neapolitan

population are represented by 46.69% of male and 53.31% of female; the 25 to 40 class of respondents' age account 28.08% of the population; and 53.5% have a high school degree. Our sample profile seems to be consistent with these data.

3.2 Estimates from LCM

The optimal number of classes to be used in the analysis was selected in accordance with the Bayesian Information Criterion (BIC) proposed by Boxall and Adamowicz (2002). This criterion was also used to assess whether additional segments provide any further economic information, with the overall aim of attaining segment parsimony. In our application, this criterion is minimized in a three class model, leading to the estimates reported in table 3. In addition, models with more than three classes contain estimated class probabilities that are either smaller than 10% or statistically insignificant. Finally, incorporating demographic characteristics of the respondent (e.g. age, gender, education, income, etc) failed to improve the statistical performance of our model. This finding is consistent with other application of latent class models to consumer food preferences (Nilsson et al. 2006; Ouma et al. 2007; Tonsor et al. 2009). With this regard, Nilsson et al. (2006) argued that in case of strong separability assumption between credence certification attributes and demographic information the observable consumer characteristics could be poor indicators of food preference.

Consistently with other empirical studies that have been focused on consumer heterogeneity for food product attributes (Hu et al. 2004; Lusk, 2003; Lusk and Hudson, 2004; Nilsson et al. 2006; Ouma et al. 2007, Tonsor et al. 2009), our results indicate significant heterogeneity in preferences across latent class as revealed by the differences in magnitude and significance of the utility function parameter estimates. The associated class probabilities indicate that 59%, 20%, and 21% of the respondents

have higher fitted probability to belong to the first, second and third class, respectively. The utility coefficients for the first class (59% of the sample) indicate that these respondents positively valued all attributes considered in our CE design compared to the corresponding baseline characteristics. Hence, consumers of this class would consume either cherry or plum rather than beefsteak fresh tomato, bearing information related to time and number of food miles food travelled, CO₂ emitted and organic production method. However, these preferences appear to be dominated by significantly negative no-buy and price parameters. Specifically, compared to the other classes, members of this class enjoy as much utility from buying one the proposed product combinations showing relatively higher price sensitivity. Thus, we refer to this class as “TRADING-OFF”.

Similarly, the second class (20% of the population) is characterized by a preference for both plum and cherry fresh tomato displaying information on food miles in terms of number and time food traveled, although lower utilities are associated with each of these as compared to the first segment. On the other hand, differently from the first class members of this group appear to be indifferent to CO₂ and organic production method food product attributes as well as to price. Thus, this group is referred to as the “LOCAL SPECIALTIES” group.

Finally, in the third class (21% of the population) the no-buy option parameter is negative and statistically significant indicating that members of such class prefer to consume the presented combinations of fresh tomato products to none at all. Also, the price coefficient is relatively small, suggesting a relatively price insensitive segment. Members of this class enjoy receiving information related either to organic production method or time and number of food miles food traveled. In fact, in this class both the “organic” and “nmiles” coefficients account for the highest magnitude as compared

with others across classes. Collectively, this leads us to refer to this group as the “ENVIRONMENT CONSCIOUS” class.

4. Conclusion and Discussion

In this study, we investigated heterogeneity in consumers preferences for food miles information using a latent class modeling approach. To our knowledge, this is the first study that evaluates this issue. Using data from a survey conducted in Naples, Italy, our results basically suggest that heterogeneity among the respondents exists. Specifically, we identified three different consumer groups with clear distinguishable behavioral patterns and perceived utility of the attributes. Specifically, in the first segment, consumers positively valued all types of information provided about the products such as information on number of miles, organic production method, and information on CO₂. Similarly, consumers in the second segment positively valued the three analyzed information sources, except for CO₂, although lower utilities are associated with each of these compared to the first segment, paying more attention to the type of fresh tomato. Finally, consumers in the third segment are just interested in knowing information related to either organic production method or time and number of miles food travels. Our findings can have important implications for both consumers and policy makers, since it may be necessary to design specific strategies for the different target segments. Thus, based on the characteristics of consumers identified in each group, recommendations can be made as to how retailers and policy makers can move forward with the development of food miles labeling guidelines or policies.

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5. Tables

Table 1. Attributes and levels considered

Attributes	Levels considered
Price	\$1.1/lb
	\$2.1/lb
	\$3.1/lb
	\$4.1/lb
Food miles information	No information
	Information on the number of miles and time that food travelled
	Information on the amount of CO ₂ emitted
Type of tomato	Cherry
	Plum
	Beefsteak
Production Method	Organic
	Conventional

Table 2. Socio - demographic characteristics of the sample (N = 200).

Socio-demographic characteristic (% of total)			
Gender		Educational level	
Male	36.5%	No formal education	16.0%
Female	63.5%	High school degree (1-12 years)	48.5%
Age Group%		More than 12 years and less than 16 years	16.0%
18 -24	20.5%	Graduate from college (16 years)	18.5%
25 - 40	28.5%	More than 16 years (PhD, Masters)	1.0%
41 - 54	26.0%	Annual Income%	
55-64	15.5%	\$/Euro 19,999 or less	37.5%
Over 64	9.5%	\$/Euro 20,000 - 39,999	36.0%
Marital status		\$/Euro 40,000 - 59,999	18.0%
Single	36.5	\$/Euro 60,000 - 79,999	7.0%
Married	46.5	\$/Euro 80,000 - 99,999	0.5%
Divorced	6.5	More than \$/Euro 100,000	1.0%
Widowed	4.0		
Other	6.5		

Table 3. Latent class model estimates

<i>Utility parameters</i>	<i>LCl</i>		
	<i>Class_1</i>	<i>Class_2</i>	<i>Class_3</i>
<i>No_buy</i>	-5.64*** (0.56) ^a	-0.99* (0.54)	-1.31** (0.67)
<i>Price</i>	-2.11*** (0.21)	-0.13 (0.16)	-0.46*** (0.18)
<i>CO2</i>	1.01*** (0.25)	1.00 (0.67)	1.25 (1.01)
<i>Nmiles</i>	1.05*** (0.25)	0.63** (0.29)	1.53*** (0.37)
<i>Organic</i>	0.75*** (0.18)	-0.15 (0.29)	1.95*** (0.54)
<i>Cherry</i>	0.66** (0.28)	1.22*** (0.41)	-1.01* (0.55)
<i>Plum</i>	0.88*** (0.28)	1.40*** (0.48)	-0.84 (0.53)
<i>Estimated latent class probabilities</i>	59%	20%	21%
<i>N</i>	1400		
<i>Log likelihood</i>	-985.92257		
<i>Bayes IC</i>	1.52747		

Note: *** Significance at 1% level, ** Significance at 5%, * Significance at 10% level.

^aNumbers in parentheses are standard errors.