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Abstract

Research on consumers' acceptance of functional foods has relied on survey data and *ad hoc* models, describing functional foods as *credence goods* and neglecting their role as part of food manufacturers' product differentiation strategy. This paper investigates the demand for functional foods as part of a broader product category combining the distance metric (DM) method developed by Pinkse Slade and Brett (2002) with a LA/AIDS demand system. The model is applied to a scanner database of yogurt purchases in the Italian market containing data on eighteen conventional and twelve functional products. The results indicate that the Italian yogurt market is characterized by the demand for functional yogurts showing often smaller own-price elasticities than that for conventional ones, by the presence of asymmetric cross-price elasticities and by a strong component of brand loyalty which plays a major role in consumers' adoption of functional yogurts. Results also indicate that most (but not all) functional yogurts included in the analysis are able to achieve better performances then their conventional counterparts, owing a considerable part of the extra margins specifically to their functional properties.

Key words: Functional Foods, Differentiated Products, Yogurt, Distance Metric.

JEL: L15; L25; L66

Functional Foods as Differentiated Products

1. Introduction

Consumers' attention for nutraceutical food products (featuring both *nutr*itional and pharm*aceutical* properties) has been growing; among these, the increased interest for food products which "may provide a health benefit beyond the traditional nutrient it contains" (American Dietetic Association 1999) or *functional foods*, is remarkable. The market for functional foods (broadly defined) shows in fact estimated growth rates that can reach 10% (Weststrate, Poppel and Verschuren 2002).

Consumers show also higher willingness to pay for foods with health-enhancing features and/or additional health properties (West, Gendron, Laure and Lambert 2002; Larue, West, Gendron and Lambert 2004; Markosyan, Wahl and McCluskey 2007), which may attract food manufacturers trying to escape price competition typical of mature markets. However, price is still one of the major hurdles for both acceptance and buying intention regarding functional products (Childs and Poryzees 1997).

Surprisingly, to date there is no study that investigates the demand for functional products and the actual role of price in consumers substituting functional products for conventional ones. Instead, the majority of the studies on consumers' adoption of functional products have used survey-data and *ad hoc* empirical modeling, providing insights on consumers' attitude towards the acceptance of functional foods more than analyzing actual purchasing decisions. In sum, these studies find that consumers who are more favorable to functional products have a clear understanding and perception of the health related properties they have (see Urala and Lätheenmäki 2003, 2004 and 2007;

Verbeke 2005, Labrecque, Doyon, Bellavance and Kolodinsky 2006),[1] suggesting that functional foods can be considered “credence goods” sharing a collective reputation (Tirole, 1996). Despite this description being accurate in the case of products that are sold unbranded such as fruits (see the case of the anti-oxidant naturally enriched Washington apples discussed by Markosyan, Wahl, and McCluskey, 2007),[2] that may not be the case for differentiated products.

In markets characterized by differentiated products, where consumers face numerous similar alternatives among which to chose, the role of brand as guidance or trust for consumers is particularly important (Rao, Qu and Ruekert 1999), especially in those markets where consumers experience high switching cost between brands. In such markets, manufacturers will have the incentive to lengthen their product lines and develop a functional product (or more than one), providing different health benefits than those produced by other competitors.[3] In such circumstances, the successful innovators will be those providing enough information to consumers regarding the properties of their functional products, consistently with Schmalensee (1982) theory of pioneering brand advantages in differentiated product markets, especially since high R&D cost to develop

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[1] Urala and Lätheenmäki (2003; 2004 and 2007) for example found that the perceived reward and the necessity for such foods have a strong role in predicting the willingness to use functional products among the Finnish consumers. Verbeke (2005), reports that believing in the health benefits of functional foods is the main positive determinant of their acceptance in the Belgian market. Labrecque, Doyon, Bellavance and Kolodinsky (2006) found that, although cross-cultural differences were evident among MS students living in USA, Canada and France, health, health-related benefits beliefs and credibility of information are the main positive determinant of the acceptance of these products.

[2] The existing literature has neglected the fact that many functional products found in the marketplace are not unbranded, but are instead extensions of existing product lines marketed by large food manufacturers.

[3]Despite this may contradict the fact that, in presence of switching costs firms will tend to choose competing *head-to-head* matching their competitors’ strategies (Klemperer 1995), as the additional health benefits deriving from the use of functional foods are obtained from repeated consumption of the products, functional foods may increase both switching costs and brand loyalty and resulting in an increased firm’s profitability.

new functional products could play the role of barrier to entry, resulting in high profit margins for those manufacturers that venture in producing functional foods.

Another unresolved issue is therefore that of determining whether successful functional products are more profitable than conventional ones and by how much. The extra R&D cost incurred in the development of the functional component to be added to the products (which could result also in diseconomies of scope (Herath, Cranfield, Henson and Sparling 2008), and the alone the additional cost of production (and marketing) are substantial. To date there is no formal study investigating the profitability of associated with the production of functional foods.

In light of the lack of formal investigations of the “functional foods phenomenon” the goal of this analysis is threefold: 1) to analyze consumers price sensitivity for functional and conventional products; 2) to investigate the role of price in consumers’ switching decision from conventional to functional alternatives (and vice versa) and; 3) to assess whether products showing a functional attribute generate higher profitability.

To achieve these objectives, Deaton and Muellbauer’s (1980) LA/AIDS model is modified as in Rojas and Peterson (2008) and Rojas (2008) adaptation of Pinkse, Slade, and Brett (2002) Distance Metric (DM) method,[4] and applied to a two-year monthly scanner database of yogurt purchases in sixteen IRI Italian regions, provided by the Food Marketing Policy Center at the University of Connecticut and the Università Cattolica del Sacro Cuore di Piacenza, Italy, which include eighteen conventional and twelve functional products.[5]

[4] See also Pofahl and Richards (2009) analysis of new product introduction in the shelf-stable-juice market.
[5] Each product is identified as a combination of brand, flavor, fat content and the presence (or absence) of a functional attribute.

The DM-LA/AIDS follows the concept that products more distant in a characteristics space are less likely to be substitutes with one another. This method also allows for a fully flexible substitution pattern across products maintaining the analysis parsimonious (only one equation needs to be estimated, even when a large number of products/brands are considered; the size of the parameter space is heavily reduced compared to a traditional LA/AIDS). The Italian yogurt market was chosen since large yogurt manufacturers operating in this market (Danone, Parmalat, Nestle) have heavily invested in developing functional products (adding *Bifidus ActiRegularis, L. Casei Immunitatis* and/or phytosterols to their products) to escape price competition typical of mature markets.

The results show that Italian consumers of functional yogurts are on average less price sensitive that those purchasing conventional ones, and that brand loyalty plays a major role in impacting the demand for functional yogurts. Intra-brand substitution between functional and conventional yogurts appears also much more likely than inter-brand substitution. Lastly, the results suggest that, for some of the manufacturers operating in this market, functional yogurts are able to generate higher margins than their conventional counterparts, superior performances which are mostly due to the functional attributes themselves.

2. The Model

The demand for yogurts in the Italian market is modeled following the Linear Approximated – Almost Ideal Demand System developed by Deaton and Muellbauer (1980). Let $j \in (1,\ldots,J)$ and $t \in (1,\ldots,T)$ represent product and time indexes, respectively. Indicating with q_{jt} the retail-level quantity demanded for product *j* at time *t* and with p_{jt} its price, the expenditure for yogurt at time *t* is $x_t = \sum_j q_{jt} p_{jt}$ so that

$$(1) \qquad w_{jt} = a_{jt} + \sum_{k=1}^{J} b_{jk} \log p_{kt} + \beta_j \log \frac{x_t}{P_t^L} + e_{jt}\,,$$

where $w_{jt} = \frac{q_{jt} p_{jt}}{x_t}$ is product's *j* expenditure share at time *t*, $\log P_t^L$ is Moschini's (1995) Laspeyers-type Price Index ($\log P_t^L = \sum_{j=1}^{J} w_j^0 \log p_{jt}$ where $w_j^0 = T^{-1} \sum_{t=1}^{T} w_{jt}$), the αs, bs and βs are parameters to be estimated and e_{jt} is an error term. The estimation of such a demand system can be problematic from a dimensionality standpoint. In fact, after imposing all the appropriate restrictions dictated by theory,[6] this model requires *J*-1 equations and *J**(*J*-1)/2 price parameters, so that, for large *J*s the estimation process becomes hardly manageable.

In order to circumvent the dimensionality issue, the cross price parameters b_{jk} are assumed to be function of the distance in attribute space between product *j* and *k*. This, approach, the Distance Metric (DM) method, originally developed by Pinkse, Slade and Brett (2002) to analyze spatial price competition in the wholesale gasoline market, has been applied to the estimation of the demand for differentiated product markets with a large number of products/brands. The methodology followed in this paper draws largely from Rojas (2008), Rojas and Peterson (2008) and in part from Pofahl and Richards

[6] In order for the AIDS model to be consistent with the primitive preference structure under which is derived, the following conditions need to hold: symmetry $b_{jk} = b_{kj}, \forall j, k$, homogeneity $\sum_{k=1}^{J} b_{jk} = 0$ and adding-up $\sum_{k=1}^{J} a_j = 0; \sum_{k=1}^{J} \beta_j = 0; \sum_{k=1}^{J} b_{kj} = 0$

(2009) applications of the DM method to the LA/AIDS model (which will be referred as DM-LA/AIDS).

In illustrating the DM method, let Z_j^C and Z_j^D be the sets of product's *j* attributes measured in continuous space (calories, fat content etc…), and in discrete space (brand, flavors, content of a functional attribute), respsctively. Let δ_{jk}^C and δ_{jk}^D be measures of "closeness" between products *j* and *k* function of, respectively, continuous and discrete attributes. Following Rojas (2008) and Pofahl and Richards (2009) δ_{jk}^C is specified as a function of the inverse of the Euclidean distance in characteristics space between products *j* and *k* or: [7]

(2) $$\delta_{jk}^C = \frac{1}{1+2\sqrt{\sum_l (z_{jl}^C - z_{kl}^C)^2}}$$

where z_{jl}^C (z_{kl}^C) is the *l*-th continuous characteristic of product *j* (*k*). Let z_{jl}^D be an indicator variable such that z_{jl}^D ={1 if product *j* shows characteristic *l*; 0 otherwise}, so that δ_{jk}^D will be:

(3) $$\delta_{jk}^D = \begin{cases} 1 \text{ if } \left| z_{jl}^D - z_{kl}^D \right| = 0 \\ 0 \text{ if } \left| z_{jl}^D - z_{kl}^D \right| = 1. \end{cases}$$

As a technical note, it should be pointed out that δ_{jk}^C and δ_{jk}^D play two different roles. δ_{jk}^C is a global measure of product and it will show a small, but non-zero value even for products that are very dissimilar. δ_{jk}^D is instead a "local" measure of products closeness as it takes the value of 1 if *j* and *k* have the same attribute (i.e. they are

[7] Pinkse Slade and Brett (2002) treat the distance functions as general and the model semi-parametric. However, Pinkse and Slade (2004) showed that both parametric and semi-parametric specification of the model lead to similar results.

neighboring products), 0 otherwise. If one opted for the use of discrete measures only, the substitution pattern would be restricted only to the goods that share at least one neighborhood. The use of both δ_{jk}^{C} and δ_{jk}^{D} will allow a more flexible (and complete) substitution pattern.

Using the closeness measures δ_{jk}^{C} and δ_{jk}^{D} the cross-price parameter portion of the LA/AIDS is reformulated as follows:[8]

(4) $$\sum_{k=1}^{J} b_{jk} \log p_{kt} = b_{jj} \log p_j + \lambda_j \sum_{k \neq j}^{J} \delta_{jk}^{C} \log p_{kt} + \varphi_j \sum_{k \neq j}^{J} \delta_{jk}^{D} \log p_{kt} \, ,$$

which gives $b_{j1} = \lambda_j \delta_{j1}^{C} + \varphi_j \delta_{j1}^{D}, ..., b_{jn} = \lambda_j \delta_{jn}^{C} + \varphi_j \delta_{jn}^{D}$ where φ_j and λ_j are parameters to be estimated. By using the two closeness measures δ_{jk}^{C} and δ_{jk}^{D} the number of cross-price parameters for each equation is reduced from *J*-1 to 2.

Following Rojas (2008) and Rojas and Peterson (2008), symmetry can be imposed to the cross-price parameters by assuming $\lambda_1 = \lambda_2 = ... = \lambda_J = \lambda$ and $\varphi_1 = \varphi_2 = ... = \varphi_J = \varphi$. Since $\delta_{jk}^{C} = \delta_{kj}^{C}$ and $\delta_{jk}^{D} = \delta_{kj}^{D}$, one has $\lambda \delta_{jk}^{C} + \varphi \delta_{jk}^{D} = b_{jk} = b_{kj} = \lambda \delta_{kj}^{C} + \varphi \delta_{kj}^{D}$, which results in the reduction of the total number of cross-price parameters to be estimated in the system to 2.

Following Pinkse and Slade (2004), Rojas (2008), and Rojas and Peterson (2008) a subset of product attributes are interacted with the own-price, intercept and the expenditure coefficients so that only one equation need to be estimated. Imposing $a_{jt} = a_0 + \sum_n a_n z_{jn}^{a}$, $b_{jj} = \gamma_0 + \sum_l \gamma_l z_{jl}^{b}$ and $\beta_j = \beta_0 + \sum_m \beta_m z_{jm}^{\beta}$, where z_j^{a}, z_j^{b} and z_j^{β} are

[8] Instrumentally to the purposes of this analysis, both δ_{jk}^{C} and δ_{jk}^{D} will be used additively, and not multiplicatively (as in Pofahl and Richards 2009) so to warrant that no cross-price parameters will be forced to be 0 by construction.

different subsets of product's j characteristics,[9] the final specification of the DM-LA/AIDS model is:

$$
(5)\quad \begin{aligned} w_{jt} &= a + \sum_n a_n z^a_{jn} + \log p_{jt}\left(\gamma_0 + \sum_l \gamma_l z^b_{jl}\right) \\ &\quad + \lambda \sum_{k\neq j}^{J} \delta^C_{jk} \log p_{kT} + \sum_D \varphi^D \sum_{k\neq j}^{J} \delta^D_{jk} \log p_{kt} + \log \frac{x_t}{P^L_t}\left(\beta_0 + \sum_m \beta_l z^\beta_{jm}\right) + e_{jt}. \end{aligned}
$$

where, in order to understand the role of different attributes in determining the cross-price elasticities, more that one discrete closeness measure is used, namely D={ Brand (*Br*); Flavor (*Fl*); Drinkable (*Dr*); Functional (*H*)}.

The sign and magnitude of the estimated $\varphi^D s$ will reveal the structure of consumers switching motivated by a price increase. For example a large and positive estimate of φ^{Br} would suggest that brand loyalty plays a major role in this market, as consumers would tend to switch more between products sold under the same brand than otherwise. Of particular interest is the sign of φ^H, the coefficient associated with closeness in functional attribute. If $\varphi^H > 0$, consumers will be more likely to switch within the same type of yogurts (either conventional or functional) as prices change. If instead $\varphi^H < 0$ consumers will be more likely to switch from a functional to a conventional yogurt (or vice versa). The other parameters have similar interpretations.

The Marhsallian (uncompensated) own- (η_{jj}) and cross- (η_{jk}) price elasticities can be recovered as follows:

[9] Pinkse and Slade (2004) suggested the interaction of product characteristics with own-price, expenditure and intercept's coefficients, to obtain unique parameters and limit the number of equations to be estimated, however increasing the risk of collinearity in the estimated model. In light of this risk and to avoid reducing the flexibility of the model, Pofahl and Richards (2009) did not follow Pinkse and Slade but estimated instead the full set of simultaneous equations. As the interaction of the own-price parameter is instrumental to one of the goals of this paper, the approach followed here is to use sets of mutually exclusive product characteristics as shifters of the own-price, expenditure and intercept coefficients as to limit the risk of collinearity.

(6 - a) $$\eta_{jj} = -1 + \frac{\gamma_0 + \sum_l \gamma_l z_{jl}^b}{\overline{w_j}} - \left(\beta_0 + \sum_m \beta_l z_{jm}^{\beta} \right)$$ and

(6 - b) $$\eta_{jk} = \frac{\lambda \delta_{jk}^{SFP} + \sum_d \varphi^D \delta_{jk}^D}{\overline{w_j}} - \left(\beta_0 + \sum_m \beta_l z_{jm}^{\beta} \right) \frac{\overline{w_k}}{\overline{w_j}},$$

where $\overline{w_j} \left(\overline{w_k} \right)$ is product's *j* (*k*) expenditure share's measured at the sample average. [10]

Comparing own- and cross- price elasticities for functional and conventional yogurts will give an indication of consumers' loyalty and substitution across products, and help determining the role of prices on consumers' acceptance of functional products versus conventional ones.

In order to assess the profitability associated with producing functional yogurts, one needs to specify a supply-side relationship for the firms operating in the Italian yogurt market. Assume constant marginal costs, and that manufacturers maximize profits by considering each product as a separate profit center (independently on the composition of the product line). Under the assumption that the prices observed in the data are the outcome of a multi-product Bertrand game equilibrium (as in Nevo 2001), the profit maximizing FOC for product *j* will be: [11]

(7 - a) $$L_{jj} = \frac{p_j - c_j}{p_j} = -\frac{1}{\eta_{jj}} = \left[1 - \frac{\gamma_0 + \sum_l \gamma_l z_{jl}^b}{\overline{w_j}} + \left(\beta_0 + \sum_m \beta_l z_{jm}^{\beta} \right) \right]^{-1}$$

[10] A general expression for both own- ($j = k$) and cross- ($j \neq k$) price (compensated) elasticities is $\eta_{jk} = \eta_{jk} + \varepsilon_j \overline{w_k}$ where $\varepsilon_j = 1 + \left(\beta_0 + \sum_m \beta_l z_{jm}^{\beta} \right) \Big/ \overline{w_j}$ is the expenditure elasticity for product *j*.

[11] As the purpose of this paper is not that of evaluating the structure of the pricing game that bests suits the Italian yogurt market, the assumption of multi-product Bertrand pricing is instrumental to the fact that generates FOC which are easily differentiable and that the resulting equations (8 – a) and (8 – b) are easily interpretable. For analyses presenting market structures consistent with other games' see for example Pinkse and Slade (2004) or Rojas (2008).

or similarly,

$$\text{(7 - b)} \quad p_j - c_j = -\frac{p_j}{\eta_{jj}} = \overline{p_j}\left[1 - \frac{\gamma_0 + \sum_l \gamma_l z_{jl}^b}{\overline{\overline{w_j}}} + \left(\beta_0 + \sum_m \beta_l z_{jm}^\beta\right)\right]^{-1},$$

where c_j is product's j (constant) marginal cost, $\overline{p_j}$ is product's j average price, and L_{jj} stands for the Lerner Index, a classical measure of market power, while (7–b) measures the per-unit margins associated with product *j*.

As the decision of introducing a functional component is related with long-run strategic decisions, one can differentiate both (7-a) and (7-b) w.r.t. z_j^H, the indicator variable for the functional attributes, and obtain the following comparative static expressions (it is assumed that z_j^H is introduced only as own-price parameter shifter):

$$\text{(8 – a)} \qquad \frac{\partial L_j / \partial z_j^H}{L_j} = -\frac{\partial \eta_{jj} / \partial z_j^H}{\eta_{jj}} = \frac{\gamma_H}{\overline{\overline{w_j}}}\left[1 - \frac{\gamma_0 + \sum_l \gamma_l z_{jl}^b}{\overline{\overline{w_j}}} + \left(\beta_0 + \sum_m \beta_l z_{jm}^\beta\right)\right]^{-1}$$

and

$$\text{(8 – b)} \qquad \frac{\partial \% p_j}{\partial z_j^H} - \frac{\partial \% c_j}{\partial z_j^H} = \frac{\partial \eta_{jj} / \partial z_j^H}{(\eta_{jj}+1)\eta_{jj}}$$

$$= \frac{\gamma_H}{\overline{\overline{w_j}}}\left[1 - \frac{\gamma_0 + \sum_l \gamma_l z_{jl}^b}{\overline{\overline{w_j}}} + \left(\beta_0 + \sum_m \beta_l z_{jm}^\beta\right)\right]^{-1}\left[\frac{\gamma_0 + \sum_l \gamma_l z_{jl}^b}{\overline{\overline{w_j}}} - \left(\beta_0 + \sum_m \beta_l z_{jm}^\beta\right)\right]^{-1}$$

These comparative statics expressions measure (respectively) the percentage of market power (8-a) and profit margin (8-b) for a functional yogurt that can be directly attributable to the functional component. Since γ_H is expected to be positive (i.e. consumers of functional products are expected to be less price sensitive than those consuming conventional ones) the sign of (8 – a) is expected to be positive. (8 – b) is also expected to be positive with the caveat that $\left|\eta_{jj}\right| > 1$. Another way to interpret (8-a) and (8-b) is to see them as measures of the profitability that a yogurt manufacturer would give up, the functional products were stripped of the functional attributes, leaving everything else unchanged.

An additional note on (8-b): this equation represents the difference in relative variations of price and costs as the composition of the functional products changes. In other words (8-b) represents the variation in the ability of manufactures to charge prices above marginal cost thanks to the presence of the functional component (the derivation of (8-b) and additional clarifications are reported in the Appendix).

3. Data and Estimation

Equation (5) is estimated using primarily a custom scanner database provided by the Food Marketing Policy Center at the University of Connecticut[12] and the Univerista` Cattolica del Sacro Cuore di Piacenza, Italy, supplied originally by Information Resources Incorporated (IRI). The data include twenty four monthly observations of yogurt sales' (quantity and value of sales) for the period January 2004 – December 2005 in Iper- and Super-markets located in sixteen Italian IRI regional markets to cover most of the national territory,[13] for a total of 384 market combinations. Thirty products[14] are identified in the data from the combination of vendors, which will be referred to as

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[12] Special thanks go to Ronald W. Cotterill, director of the Food Marketing Policy Center for granting the the access to the data.

[13] IRI regions are defined consistently with the political boundaries of the Italian regions except "Piedmont and Val d'Aosta", "Basilicata and Calabria" and "Abruzzo and Molise". The Trentino-Alto-Adige region was excluded due to the strong presence of regional brands.

[14] The products chosen represent firms operating nationally with a "reasonably large" (at least 0.5%) expenditure share in the "national" market. The sub-categories are identified by combination of fat content, flavor and "health" content (functional and conventional).

brands (Danone, Granarolo, Parmalat, Nestle and Muller), flavors (white, fruit and other flavors), fat content (skim and whole), drinkable versus non-drinkable, and the presence (or absence) of a functional attribute, for a total of 11,520 usable observations. Besides volume and value of sales (used to calculate prices in €/Kg), the data contain also average volume per unit and a measure of market penetration, e.g. the average number of items per products per store.

The continuous product characteristics used are calories, proteins, carbohydrates and fat content (all referred to 100 g of product). The data for these characteristics were collected from the manufacturers' websites or, when not available, form www.ciao.it, a website where Italian consumers share opinions and information on purchase experiences, reporting at times the nutritional content of the food products they bought.[15] Table 1 presents summary statistics of the data for the thirty products considered in the analysis, including product characteristics, price and expenditure shares.

Monthly dummies are included in the estimation to capture seasonal variations in yogurt consumption, while regional dummies are added to capture unobservables across areas. Equation (5) is estimated via Generalized Method of Moments (GMM) using cost variables to account for the endogeneity of price. The variables used as instruments are: farm-level milk price (national, monthly, €/l) from the Istituto per lo Studio dei Mercati Agricoli (ISMEA); a cost index of retail activities (regional, annual) and retail workers per capita earnings (regional, annual, € .000) from the Osservatorio Italiano del Commercio; the industrial price of heating oil (national, monthly, €/hl) from the Ministero dello Sviluppo Economico, Statistiche dell'Energia; and the commercial price

[15] The accuracy of the postings was evaluated by cross-referring available nutritional information available from both www.ciao.it and manufacturers' websites which in the cases considered resulted accurate.

of electricity at the source (regional, monthly, €/Mw) from the Gestore del Mercato Elettrico Italiano. The model is estimated with Stata v. 10.

4. Results

The results discussed in this section come from the estimation of one single specification of equation (5), where average volume per unit and market penetration are used to shift the intercept (z_j^a), calories, brand (vendor) dummies and the functional indicator are interacted with own-price (z_j^b), while protein and carbohydrates are interacted with the deflated category expenditure (z_j^β).[16] Several other alternative specifications of the DM-LA/AIDS model were estimated, their results being qualitatively similar to those of the model discussed below, therefore omitted for brevity. Overall the model appears to have a satisfactory fit (R-square=0.76; all parameters are jointly significant the 0.1% level), and the orthogonality condition of the overidentifying instruments satisfied, the *p*-value of the Hansen (1982) *J*-test being 0.0989.

4.1 Estimated Parameters

The baseline own-price parameter is negative (-0.0802) and significant at the 1% level; the coefficient associated with the interaction of price and calories is positive and significant, suggesting that Italian consumers show lower price sensitivity for richer, perhaps "tastier" yogurts. The coefficient of the interaction of price with the functional indicator shows a positive sign (0.0096) to indicate that, everything else constant, Italian

[16] As mentioned previously, product characteristics are mutually exclusive as of being part of z_j^a, z_j^b and z_j^β to mitigate problems of potential collinearity of the variables in the model. The mean Variance Inflation factor was monitored across specifications. The VIF for the current specification is 4.6..

consumers show lower price sensitivity for functional yogurts than for conventional ones. The interaction of own-price with Granarolo, Parmalat and Muller dummies are negative and significant, indicating that Danone, the market leader and Nestle, the other innovator in the market, may benefit from consumers showing lower price sensitivity for their products. In particular, Granarolo's yogurts should show the most elastic demands, as the coefficient for this brand's dummy (-0.0134) is four times as large than that of Parmalat (-0.037) and twice that of Mueller (-0.0060).

The estimated parameters associated with the interactions of other products' prices with the closeness measures indicate that, as price increases, consumers tend to switch more between products with similar nutritional characteristics (protein, carbohydrates and fat), as the coefficient associated with δ_{jk}^{C} is positive and significant. The Italian yogurt consumers show also brand loyalty, the coefficient for closeness in brand being positive (0.0024) and significant. The closeness in functional property increases the likelihood of substitution as the coefficient associated with it is positive (0.0009) and significant. This result suggests that one would not expect a large amount of switching between functional and conventional as indicates that consumers tend to preferentially buy either functional or conventional yogurts.

The impact of closeness in the flavor attribute is negative but not significant indicating that in the Italian yogurt market flavor plays a marginal role in the structure of substitutability across products. The negative and statistically significant coefficient for closeness in the "drinkable" attribute (-0.0015) indicates that as the price of non-drinkable yogurts increases, consumers tend to switch to drinkable alternatives (and vice versa). The plausibility of this result lays on the fact that drinkable yogurts are priced higher than non-drinkable ones (see table 1) so, as the price gap between these products narrows, consumers may perceive them as more similar. In completing the exposition of the estimated parameters, the category expenditure's and demand intercept's shifters are all significant at the 5% level.

4.2 Own-Price Elasticities

Estimates of the own-price elasticties are obtained using (6-a) and reported in table 3. All the estimated elasticities are statistically significant at the 5% level and range between -1.4 (Danone's functional/drinkable/whole yogurt) and -10.52 (Nestle conventional/other flavors/skim), the average value being -4.31. The magnitudes of these estimates are comparable with those of other research using data at a similar level of disaggregation (see Pofahl and Richards 2009)[17] and appear larger than the category-level values of elasticity which Di Giacomo (2008) found in her analysis of the Italian yogurt market.[18] Overall, the results indicate that consumers are less price sensitive for functional yogurts than for conventional ones (although not for fruit flavored), that drinkable yogurts' demand show relatively low price elasticity; that the demand for the market leader (Danone) products are on average less elastic than those for the other brands and that both flavors and fat content play a role in impacting own-price elasticity. What follows is a more detailed illustration of the results in the same order as they were summarized:

[17] Pofahl and Richars (2009) found brand-level elasticity in the fruit juice market to vary between -3.15 and -14.18.
[18] Di Giacomo's (2008) estimated elasticities of the demand for yogurt in the Italian market range from −0.799 for drinkable yogurts to -2.626 for children's yogurt. It should be mentioned that those values of elasticities are calculated in an inconsistent way, since use estimates form a Nested-logit demand model with seventy-eight brand-level products with then it uses aggregate shares over brands and/or category instead of the original (smaller) ones used in the estimation.

1 – *Functional vs. Conventional*: the demand for functional yogurts shows lower values of own-price elasticity than their conventional counterparts, although with some exceptions. Functional “other flavors” and white yogurts show less elastic demand than conventional ones: in particular the elasticities of demand for Danone’s conventional/ other flavor/whole is twice as large as that for the functional alternative (-3.07 versus -1.47). For the fruit flavor, instead, the demand for conventional yogurts appears to be (on average) less elastic than that for functional ones, with the most evident example being Danone (skim) where the own-price elasticity is approximately 3.9 times larger than that of the conventional one (-5.81 versus -1.51).

2 – *Drinkable*: the demand for functional drinkable yogurts show own-price elasticities below the average value of -4.31, in particular Danone’s whole drinkable shows the lowest own-price elasticity among all the products considered (-1.4); an exception is Granarolo/drinkable/whole whose demand appears to be fairly elastic (-5.7).

3 – *Brands*: the demand for Danone’s yogurts tends to be less elastic than for others’, across flavors, fat content and functional properties. For most of Danone’s products (8 out of 11) the own-price elasticities are below the average value of -4.31. On the opposite front, most of Granarolo’s product show values of elasticity above the average, with the exception of conventional/fruit/whole (-1.61).

4 – *Flavors*: the demand for white yogurts show (on average) higher values of elasticity than that for others, both for conventional and functional yogurts alike. For example the demand for Danone’s conventional/white/skim yogurt shows an elasticity of -5.98, while that for fruit/skim is -3.51 and other flavors/whole is -3.07. The elasticity of demand for

Granarolo's conventional/white/whole is -8.34, that for the fruit flavor -2.7 and the "other flavors" -1.62.

5 – *Fat content*: across brands and flavors, the demand for whole yogurts appears to be more inelastic than for skim yogurts. For example the elasticity of demand for Parmalat's conventional/fruit/skim is -4.72 while that for whole is -1.71. Similarly for Mueller/fruit one can observe values of elasticity equal to -1.45 for the whole alternative and -6.42 for the skim. This trend is consistent also for functional products (see the values of Danone's functional/white and those of both Danone and Nestle' functional/drinkable alternatives).

4.3 Cross-Price Elasticities

This section analyzes intra-brand and inter-brand cross-price elasticities between functional and conventional yogurts in two separate moments, using Danone as an example to illustrate intra-brand substitution and fruit flavored yogurts as exemplification of the inter-brand case.[19] In the discussion that follows η_{FC} (η_{CF}) indicates the cross-price elasticity of demand for a functional (conventional) yogurt as the price of a conventional (functional) alternative changes.

The focus will be on intra-brand substitution first. All estimated marshallian cross-price elasticities of demand for Danone's yogurts are positive (values are reported in Table 4); for white yogurts η_{FC}s and η_{CF}s are similar in magnitude, while for fruit flavored the η_{CF}s are larger than the η_{FC}s; the opposite is observed for the "other

[19] Discussion of other brands and flavors is omitted since the findings are qualitatively similar to those discussed in the main text. A full set of tables for the other brands and flavor combinations is available upon request to the author.

flavors" yogurts. In substance, it appears that Danone's white yogurts' consumers do not see conventional and functional alternatives as different enough to justify an asymmetric pattern of cross-price elasticities (and different own-price elasticity). For fruit flavored yogurts instead differentiation is weak resulting in consumes, being more likely to switch from functional to conventional yogurts (if motivated by a price increase) than vice versa. The opposite is observed for "other flavors" yogurts, although the magnitudes of the cross-price elasticities are small. An interesting result is that there is also asymmetry in the cross-price elasticities between functional products, in particular for those between drinkable and non-drinkable yogurts. The results suggest that consumers are more likely to switch from non-drinkable to drinkable yogurts than vice versa, with the exception of fruit/whole.

The values of inter-brand elasticites for fruit flavored yogurts are reported in Table 5. As some of the values of Marshallian η_{FC} s and η_{CF} s (top panel) are negative, compensated elasticites are also calculated (bottom panel). Most of the negative uncompensated cross-price elasticities do not revert when the Hicksian are calculated. The result of the η_{FC} s and η_{CF} s being negative, suggests that consumers may perceive a functional yogurt offered by one manufacturer distant enough to a conventional one offered by another manufacturer. In this case those products will not be seen as substitutes, as suggested by Kadiyali, Vilcassim and Chintagunta (1996). An alternative explanation is that, as Betancourt (2006) points out, since purchases are often executed to satisfy different individuals in the same households, different types of yogurts may act as complements instead of substitutes.

In sum, the pattern of cross-price elasticities indicates that brand-loyalty plays a major role in this market, and that major competition for functional yogurts arises mainly from other functional ones and for only a few conventional ones being similar, in terms of fat content and flavor to the functional. As substitution between functional and conventional product is unlikely, the scenario that emerges is that that in the Italian yogurt market manufacturers' may aim to attract new consumers in order to expand the consumers' base and avoid sales cannibalization for the other existing conventional products, instead of convincing existing consumers to switch to the functional alternatives.

4.4 Estimated Margins and Contribution of the Functional Component

The estimated Lerner indexes and profit margins are presented in table 6. As the behavior of the estimated Lerner indexes parallels that of the own-price elasticities it emerges that, on average, Danone shows large market power for most of its products, with the exception of conventional/white and functional/skim products (as low as 0.16 for white/skim). The highest value is observed for the drinkable/whole (0.71 which is closely followed by the 0.7 of functional/other flavors/whole). Among conventional yogurts, whole, fruit flavored yogurts seem to show considerable market power across brands (0.69, Muller; 0.62, Granarolo and 0.58, Parmalat).

The behavior of the estimated profit margins resembles in part that of the Lerner Indexes. Not surprisingly, all the functional/drinkable yogurts have relatively high profit margins (the lowest is \$0.93 of Granarolo/whole, the highest \$3.96 for Danone/whole). Looking at the manufacturers, it emerges that Parmalat and Nestle (with the exception of whole/drinkable showing profit margins of $2.51) fare much worse than their competitors and that Danone shows the largest profitability for skim yogurts across all categories and Muller does for conventional/whole.

Table 7 presents estimates of the contribution of the functional attribute to a product's performance measured via the variation of the Lerner Index as in (8 – a) and the difference between the variations of price and marginal cost as in (8 – b). The contribution of the functional attributes to the Lerner index varies substantially across brands and sub-categories of functional yogurts. For Danone's products, this is relatively small for white yogurts (6.51% for skim and 5.49% for whole) and large for the others (the largest for other flavors/whole, approximately 35.5%). Some considerably large contributions are also obtained for Parmalat/other flavors/whole (26.14 %) and Nestle/drinkable/whole (25.6 %). The yogurt for which the functional component contributed to the Lerner index the least is Granarolo/drinkable/whole (5.13%).

The difference of relative variation in price and marginal cost due to the presence of the functional attribute (i.e. the increase of the ability to transmit variation in cost to price), shows Danone's/non-drinkable/whole (excluding white) and all the drinkable alternatives benefiting largely from the presence of the functional attribute. The functional component allows for a large increase in the ability to charge prices above marginal cost respectively be 20.21% for other flavors/whole; 15.42% for fruit/whole; and 15.19% for drinkable/whole. The only other functional yogurt for which the ability of raising prices above cost increases with the functional attribute is Nestle drinkable/whole (10.89%).

In sum, some yogurt manufacturers operating in the Italian yogurt market are able to largely improve their performances thanks to the presence of a functional element to some of their products. Danone, the market leader, is able to capitalize on it more than its competitors due to the strong brand loyalty that consumers' show toward its products.

5. Conclusions

As consumers' interest for nutraceutical food products is increasing, food manufacturers see the development of new, functional products, as an opportunity to revitalize existing mature markets. Although functional foods may offer opportunities to gain higher margins, the higher prices associated with them and the lack of trust in the additional health benefits that they provide, may jeopardize the success of using functional foods as differentiating tools. As stated preference studies have found, trust and credence are strong determinants of consumers' acceptance of functional foods. However, these studies have disregarded the fact that functional products are present in the marketplace as parts of broader pre-existing product lines.

This study has analyzed the demand for functional and conventional products in the Italian yogurt market and the performances associated with the presence of functional attributes for some of the products via a relatively novel, flexible and parsimonious methodology (the Distance Metric method).

Results show that brand loyalty plays an important role in the Italian yogurt market and that the success of the functional products in this market is heavily influenced by it. Danone, the market leader is able to exert high margins for its functional products;

it appears that consumer's show trust for the products of this manufacturer who is therefore rewarded by larger profitability.

Results also show that consumers of functional yogurts tend to be less price sensitive than those that shop for conventional ones, superior performances are (in some cases) associated with the presence of a functional attribute. Inter-brand substitution across functional and conventional yogurts being weak, manufacturers aim to expand their consumer base avoiding functional products to cannibalizing the sales of their conventional products. Intra-brand substitution between non-drinkable (both conventional and functional) and drinkable (which in this market show functional properties) is asymmetric and indicates that consumers may be attracted more to these alternatives than to non-drinkable functional ones, which points to functional drinkable yogurts as the products with the highest likelihood to succeed in the Italian market for functional yogurts.

There are several possible paths that can be taken into expanding this research. Two of them are: 1) as the European Union has recently regulated health claims in food labels, with the Regulation (EC) No 1924/2006 20, December 2006 (active in July 2007) this provides a "natural experiment" setting to evaluate the changes in both consumers' and manufacturers' behavior as the new regulation should mitigate the "credence" component of functional products; and 2) explicitly modeling the strategic long-run investment decision of developing a functional product to infer on both the short- and long-run performances associated with this specific type of product innovation.

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Table 1 – Product Characteristics, Average Price and Expenditure Shares by Brand and Product Type.

Brand	*Flavor*	*Type*	*Calories (Kcal)*	*Proteins (gr)*	*Sugar (gr)*	*Fat (g)*	*Price (€/kg)*	*w*
Conventional								
Danone	White	Skim	49	6.1	5	0.1	4.41	1.15
Danone	White	Whole	99	3.3	12.5	3.7	4.37	1.35
Danone	Fruit	Skim	52	4.1	7.9	0.1	4.4	12.11
Danone	Others	Skim	58	4.4	8.9	0.1	5.24	2.87
Granarolo	White	Skim	39	4.7	4	0.1	3.81	0.84
Granarolo	White	Whole	68	3.5	3.5	4	3.5	0.94
Granarolo	Fruit	Skim	75	3.9	13.7	0.1	4.02	1.49
Granarolo	Fruit	Whole	103	3.2	12.5	4.1	4.17	9.15
Granarolo	Others	Whole	117	3.7	15.1	4.3	4.38	3.02
Mueller	White	Whole	109	5.1	11.3	4.5	2.91	4.08
Mueller	Fruit	Skim	76	4.6	13.4	0.1	3.94	1.08
Mueller	Fruit	Whole	111	2.9	16.1	3.6	3.37	10.1
Mueller	Others	Whole	118	4.4	15.8	4.4	3.45	2.62
Nestle	Fruit	Skim	40	4.2	5.6	0.1	4.05	1.63
Nestle	Others	Skim	73	4.3	13.4	0.2	4.86	0.57
Parmalat	Fruit	Skim	59	5.2	9.4	0.12	3.47	1.68
Parmalat	Fruit	Whole	109	3.4	15.5	3.7	3.19	6.24
Parmalat	Others	Whole	119.2	3.28	15.36	4.72	3.45	0.85
Functional								
Danone	White	Skim	48	4.9	6.1	0.1	4.98	1.07
Danone	White	Whole	72	4.2	5.1	3.5	4.96	1.4
Danone	Fruit	Skim	52	4.4	7.5	0.1	5.32	1.08
Danone	Fruit	Whole	104	3.7	13.6	3.4	5.32	3.7
Danone	Others	Whole	103	3.8	13.5	3.3	5.31	7.67
Parmalat	Fruit	Whole	103.2	3.12	14	3.84	4.91	0.77
Parmalat	Others	Whole	106	3.1	14	4.2	5.01	1.02
Functional/drinkable								
Danone	Drinkable	Skim	29	2.7	3.7	0.1	5.55	3.79
Danone	Drinkable	Whole	73	2.7	11.8	1.2	5.54	11
Granarolo	Drinkable	Whole	77	3	12	1.9	5.3	1.2
Nestle	Drinkable	Skim	62	2.7	12.7	0.08	5.29	1.55
Nestle	Drinkable	Whole	77	2.6	14.5	0.9	5.21	3.98

Table 2 – Selected estimated parameters and related statistics

	Coeff	Std. error	T-ratio
Log p_j	-0.0802	0.0248	-3.2300
Log p_j *Calories	0.0004	0.0001	6.9300
Log p_j *Functional	0.0096	0.0018	5.3700
Log p_j *Granarolo	-0.0134	0.0011	-12.1700
Log p_j *Parmalat	-0.0037	0.0018	-2.0500
Log p_j *Muller	-0.0060	0.0027	-2.2200
Log (x_t/P^L_t)	-0.0035	0.0006	-6.0400
Log (x_t/P^L_t)*Carb	-0.0002	0.0000	-4.0400
Log (x_t/P^L_t)*Prot	0.0006	0.0001	5.8000
Closeness Fat/Carbs/Prot	0.0062	0.0019	3.2500
Closeness Brand	0.0024	0.0001	27.4400
Closeness Flavors	-0.0002	0.0003	-0.6200
Closeness Drinkable	-0.0015	0.0004	-4.0500
Closeness Functional	0.0009	0.0004	2.2900
Average Vol. Unit	0.0329	0.0115	2.8700
Coverage	0.0081	0.0001	67.4800
Constant	0.0365	0.0315	1.1600
Region Dummies		yes	
Month Dummies		yes	

Number of obs = 11520
Wald test $[\chi^2_{(37)}]$ = 18,919.13 P-val=0.0000
R-squared=0.7444
J-stat $[\chi^2_{(4)}]$ =7.80815 P-val=0.0989

Table 3 – Estimated Own-Price Elasticites

Brand	Flavor	Type	Elasticity	Std. Err.	T-ratio
Conventional					
Danone	White	Skim	-6.44	1.94	-3.32
Danone	White	Whole	-4.30	1.47	-2.93
Danone	Fruit	Skim	-1.51	0.18	-8.23
Danone	Others	Skim	-3.07	0.76	-4.02
Granarolo	White	Skim	-10.51	2.85	-3.68
Granarolo	White	Whole	-8.34	2.38	-3.50
Granarolo	Fruit	Skim	-5.47	1.48	-3.69
Granarolo	Fruit	Whole	-1.61	0.23	-7.17
Granarolo	Others	Whole	-2.70	0.66	-4.09
Mueller	White	Whole	-2.15	0.54	-3.99
Mueller	Fruit	Skim	-6.42	2.18	-2.95
Mueller	Fruit	Whole	-1.45	0.22	-6.74
Mueller	Others	Whole	-3.68	1.32	-2.79
Nestle	Fruit	Skim	-3.51	0.87	-4.04
Nestle	Others	Skim	-10.52	3.73	-2.82
Parmalat	Fruit	Skim	-4.72	1.40	-3.37
Parmalat	Fruit	Whole	-1.71	0.34	-5.08
Parmalat	Others	Whole	-5.82	2.42	-2.41
Functional					
Danone	White	Skim	-5.98	1.97	-3.03
Danone	White	Whole	-4.18	1.42	-2.94
Danone	Fruit	Skim	-5.81	1.94	-2.99
Danone	Fruit	Whole	-1.89	0.49	-3.82
Danone	Others	Whole	-1.43	0.24	-6.00
Parmalat	Fruit	Whole	-5.80	2.60	-2.23
Parmalat	Others	Whole	-4.54	1.96	-2.32
Functional/drinkable					
Danone	Drinkable	Skim	-2.58	0.58	-4.44
Danone	Drinkable	Whole	-1.40	0.18	-7.77
Granarolo	Drinkable	Whole	-5.70	1.73	-3.29
Nestle	Drinkable	Skim	-4.11	1.32	-3.12
Nestle	Drinkable	Whole	-2.07	0.49	-4.20

Table 4 – Selected Own- and Cross- Price Elasticites: Danone

			Conventional				Functional						
			White Skim	White Whole	Fruit Skim	Flavors Skim	White Skim	White Whole	Fruit Skim	Fruit Whole	Flavors Whole	Drink Skim	Drink Whole
Conventional	White	Skim	-6.44	0.21	0.05	0.12	0.24	0.15	0.23	0.07	0.05	0.10	0.07
	White	Whole	0.25	-4.30	0.05	0.12	0.20	0.17	0.22	0.10	0.06	0.11	0.07
	Fruit	Skim	0.29	0.24	-1.51	0.16	0.27	0.18	0.33	0.06	0.03	0.11	0.04
	Flavors	Skim	0.29	0.24	0.05	-3.07	0.28	0.18	0.35	0.07	0.04	0.11	0.05
Functional	White	Skim	0.22	0.16	0.05	0.11	-5.98	0.23	0.38	0.10	0.06	0.13	0.08
	White	Whole	0.19	0.17	0.04	0.09	0.30	-4.18	0.32	0.10	0.06	0.13	0.07
	Fruit	Skim	0.22	0.18	0.05	0.14	0.39	0.25	-5.81	0.10	0.07	0.14	0.08
	Fruit	Whole	0.19	0.25	0.03	0.09	0.30	0.24	0.29	-1.89	0.08	0.13	0.06
	Flavors	Whole	0.19	0.24	0.02	0.08	0.30	0.24	0.31	0.15	-1.43	0.12	0.05
	Drink	Skim	0.32	0.28	0.04	0.14	0.45	0.34	0.45	0.13	0.07	-2.58	0.04
	Drink	Whole	0.32	0.31	0.04	0.14	0.44	0.34	0.45	0.14	0.07	0.09	-1.40

Table 5– Selected Own- and Cross- Price Elasticites: Fruit Yogurt

Uncompensated			Conventional								Functional		
			Dan Skim	Gran Skim	Gran Whole	Mue Skim	Mue Whole	Nest Skim	Parm Skim	Parm Whole	Dan Skim	Dan Whole	Parm Whole
Conventional	Dan	Skim	-1.51	0.07	0.01	0.09	0.01	0.10	0.06	0.01	0.33	0.06	-0.03
	Gran	Skim	0.03	-5.47	0.06	0.13	0.04	0.05	0.05	0.03	0.00	0.01	-0.02
	Gran	Whole	0.01	0.21	-1.61	0.06	0.02	0.04	0.03	0.03	-0.03	0.02	0.13
	Mue	Skim	0.03	0.10	0.04	-6.42	0.07	0.05	0.07	0.03	0.01	0.01	-0.03
	Mue	Whole	0.01	0.05	0.02	0.28	-1.45	0.03	0.03	0.03	-0.03	0.01	0.10
	Nest	Skim	0.03	0.06	0.03	0.08	0.03	-5.03	0.06	0.02	0.08	0.00	-0.04
	Parm	Skim	0.02	0.06	0.02	0.11	0.03	0.06	-4.72	0.06	0.03	0.00	0.27
	Parm	Whole	0.01	0.05	0.02	0.06	0.02	0.03	0.18	-1.71	-0.03	0.02	0.43
Funct ional	Dan	Skim	0.05	0.01	0.03	0.01	0.04	0.05	0.02	0.02	-5.81	0.10	0.08
	Dan	Whole	0.03	0.00	0.01	-0.01	0.01	-0.02	-0.01	0.02	0.29	-1.89	0.19
	Parm	Whole	0.03	0.00	0.05	-0.02	0.06	-0.02	0.13	0.08	0.06	0.06	-5.80

Compensated			Conventional								Functional		
			Dan Skim	Gran Skim	Gran Whole	Mue Skim	Mue Whole	Nest Skim	Parm Skim	Parm Whole	Dan Skim	Dan Whole	Parm Whole
Conventional	Dan	Skim	-1.39	0.08	0.10	0.10	0.11	0.12	0.08	0.07	0.34	0.10	-0.03
	Gran	Skim	0.12	-5.45	0.13	0.14	0.12	0.06	0.07	0.08	0.01	0.04	0.01
	Gran	Whole	0.12	0.23	-1.53	0.07	0.11	0.05	0.05	0.09	-0.02	0.05	0.14
	Mue	Skim	0.12	0.11	0.10	-6.41	0.15	0.06	0.08	0.08	0.02	0.04	-0.02
	Mue	Whole	0.12	0.06	0.10	0.29	-1.36	0.05	0.04	0.09	-0.02	0.04	0.10
	Nest	Skim	0.14	0.07	0.11	0.09	0.12	-5.01	0.08	0.08	0.09	0.03	-0.04
	Parm	Skim	0.13	0.07	0.11	0.12	0.12	0.08	-4.71	0.12	0.04	0.03	0.27
	Parm	Whole	0.12	0.07	0.11	0.07	0.12	0.05	0.19	-1.65	-0.02	0.06	0.43
Funct ional	Dan	Skim	0.15	0.02	0.10	0.02	0.12	0.07	0.04	0.07	-5.80	0.13	0.08
	Dan	Whole	0.14	0.01	0.10	0.00	0.11	0.00	0.00	0.07	0.30	-1.86	0.20
	Parm	Whole	0.09	0.00	0.10	-0.01	0.11	-0.01	0.13	0.12	0.06	0.08	-5.80

Table 6 – Estimated Lerner Indexes and Profit Margins

Brand	***Flavor***	***Type***	***Lerner Index***	$p_j - c_j$
Conventional				
Danone	White	Skim	0.16	0.69
Danone	White	Whole	0.23	1.02
Danone	Fruit	Skim	0.66	2.92
Danone	Others	Skim	0.33	1.71
Granarolo	White	Skim	0.10	0.36
Granarolo	White	Whole	0.12	0.42
Granarolo	Fruit	Skim	0.18	0.73
Granarolo	Fruit	Whole	0.62	2.58
Granarolo	Others	Whole	0.37	1.62
Mueller	White	Whole	0.47	1.35
Mueller	Fruit	Skim	0.16	0.61
Mueller	Fruit	Whole	0.69	2.32
Mueller	Others	Whole	0.38	1.29
Nestle	Fruit	Skim	0.20	0.80
Nestle	Others	Skim	0.10	0.46
Parmalat	Fruit	Skim	0.21	0.73
Parmalat	Fruit	Whole	0.58	1.87
Parmalat	Others	Whole	0.17	0.59
Functional				
Danone	White	Skim	0.17	0.83
Danone	White	Whole	0.24	1.19
Danone	Fruit	Skim	0.17	0.92
Danone	Fruit	Whole	0.53	2.81
Danone	Others	Whole	0.70	3.70
Parmalat	Fruit	Whole	0.17	0.85
Parmalat	Others	Whole	0.22	1.10
Functional/drinkable				
Danone	Drinkable	Skim	0.39	2.15
Danone	Drinkable	Whole	0.71	3.96
Granarolo	Drinkable	Whole	0.18	0.93
Nestle	Drinkable	Skim	0.24	1.29
Nestle	Drinkable	Whole	0.48	2.51

Table 7– Contribution of the Functional Component to Lerner Index and Profit Margins

Brand	***Flavor***	***Type***	$\frac{\partial \% L_j}{\partial z_j^H}$	$\frac{\partial \% p_j}{\partial z_j^H} - \frac{\partial \% c_j}{\partial z_j^H}$
Danone	White	Skim	6.51	3.03
Danone	White	Whole	5.49	5.16
Danone	Fruit	Skim	15.84	3.20
Danone	Fruit	Whole	30.43	15.42
Danone	Flavor	Whole	35.49	20.21
Parmalat	Fruit	Whole	7.01	4.48
Parmalat	Flavor	Whole	26.14	5.88
Drinkable				
Danone	Drink	Skim	22.09	6.22
Danone	Drink	Whole	18.40	15.69
Granarolo	Drink	Whole	5.13	3.00
Nestle	Drink	Skim	5.28	4.87
Nestle	Drink	Whole	25.60	10.89

Appendix – Derivation and interpretation of equation (8 - b)

Under the multiproduct Bertrand equilibrium assumption, the margin for product *j* is determined as $p_j - c_j = -p_j \frac{1}{\eta_{jj}}$. For *j* being a functional product, the portion of profit margin depending on its functional attribute is:

(A-1) $$\frac{\partial(p_j - c_j)}{\partial z_j^H} = \frac{\partial p_j}{\partial z_j^H} - \frac{\partial c_j}{\partial z_j^H} = -\frac{\eta_{jj}\frac{\partial p_j}{\partial z_j^H} - p_j \frac{\partial \eta_{jj}}{\partial z_j^H}}{\eta_{jj}^2} = -\frac{\partial p_j}{\partial z_j^H}\frac{1}{\eta_{jj}} + \frac{p_j}{\eta_{jj}^2}\frac{\partial \eta_{jj}}{\partial z_j^H}.$$

Moving the first term of the RHS of (A-1) to the LHS, recalling that, by definition $-\frac{p_j - c_j}{p_j} = \frac{1}{\eta_{jj}}$, and reorganizing one obtains

(A-2) $$\frac{\partial p_j}{\partial z_j^H}\frac{c_j}{p_j} - \frac{\partial c_j}{\partial z_j^H} = -\frac{p_j}{\eta_{jj}^2}\frac{\partial \eta_{jj}}{\partial z_j^H}.$$

Substituting $\frac{c_j}{1+\eta_{jj}} = \frac{p_j}{\eta_{jj}}$ and rearranging, it gives equation (8 - b)

Assume that any variation in marginal cost will be transferred to the price via a proportionality factor defined as $\tilde{b} = \eta_{jj} / (1+\eta_{jj})$ so that $p_j = \tilde{b} c_j$. Since the contribution of the functional component to the price of j is:

(A-3) $$\frac{\partial p_j}{\partial z_j^H} = \frac{\partial \tilde{b}}{\partial z_j^H} c_j + \frac{\partial c_j}{\partial z_j^H}\tilde{b}$$

dividing both sides by p_j and rearranging gives:

(A-4) $$\frac{\partial p_j}{\partial z_j^H}\frac{1}{p_j} - \frac{\partial c_j}{\partial z_j^H}\frac{1}{c_j} = \frac{\partial \tilde{b}}{\partial z_j^H}\frac{1}{\tilde{b}}$$

indicating that (8-b) measures the additional ability of pricing above cost due to the presence of the functional attribute.

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