

# Organic Food Consumption Patterns in France

**Daniel Hassan (TSE, GREMAQ-INRA)**

**Sylvette Monier-Dilhan (TSE, GREMAQ-INRA)**

**Véronique Nichèle (INRA ALISS, Paris)**

**Michel Simioni (TSE, GREMAQ-INRA)**

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**Abstract:** This research addresses two important issues for the future expansion of organic consumption in France. The first one is related to knowing whether the organic choice is a permanent feature of consumer's attitude or not: Do organic buyers occasionally pick one organic product or do they choose organic for "several" categories? The second issue concerns the impact of prices on buying organics which is revisited, distinguishing between capturing new consumers and increasing the demand coming from people already involved in organic markets. This question is examined using the market basket approach; the price issue requires further estimations of demand models. The study relies on two staple food products, eggs and milk. The findings are : (i) choosing organic for one of the two items reinforces the probability of purchasing also the organic version of the second item; (ii) marginal reductions of the organic price have no impact on the decision of buying organic rather than conventional products; (iii) on the contrary, when people already purchase organic products, price elasticities are rather high; (iv) organic buyers' demographic profile is not related to income neither to age nor to family size, but to the educational level.

**Key words:** market basket approach, organic products, purchasing behavior, logit model.

**JEL:** C35, D12, Q13.

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In the recent years, in most developed countries, the demand for organic food has grown rapidly. For example, according to the Nutrition Business Journal, the U.S. demand for organic is increasing by about 20% a year, almost ten times the rate in total food. The IFOA (International Foundation for Organic Agriculture) states that, from 1999 to 2007, the world area devoted to organic food production has tripled. In 2007, the “green surfaces” were located mainly in Oceania (32%), in Europe (24%) and in Latin America (20%).<sup>1</sup> In the rest of the world, organic expansion is clearly at its very beginnings.<sup>2</sup> The French green area represents 8% of the European one, which positions France at the fifth rank on the continent, after Italy reaches (16%), Spain 14%, Germany 12% and the UK 9%. Nevertheless, in most developed countries, organic consumption remains small, representing about 2% of the global food expense.

Economic research aims at understanding the mechanisms which are likely to extend and to enforce the expansion of the demand for organics. A first concern is to measure the willingness to pay (WTP) for organic and the motivations to pay for it. In a recent paper, Griffith and Nesheim (2008) compute, over 98 food groups, a global WTP for organic in the UK. They find that looking simply at the mean differences in price between organic and non-organic goods substantially over-estimates the mean premium for organic. Indeed, in this case, it represents 56% of the non-organic average price instead of being 33% when controlling for all product characteristics. Hassan and Monier-Dilhan (2006) show the WTP for an organic label varies according to the brand it is associated with: the organic attracts more value when associated with store brands than with national brands. This can be an opportunity for retailers to develop organic food through store brands. Griffith and Nesheim also point the reasons households are willing to pay vary, with quality being the most important, health concerns coming second, and environmental concerns lagging far behind. This statement contradicts Bellows et al.’s one (2008). According to them, demand for organic relying on environmental concerns is potentially larger than the one driven by personal health considerations.

A second concern is to measure the impact of a diminution of the organic prices on the corresponding demand. Thompson and Kidwell (1998) estimate a discrete choice model to studying the impact of prices and demographic characteristics on the choice of organic produce concerning fresh vegetables in the U.S. They find marginal variations of the price difference between the organic and the conventional items have only small effects on the probability of buying organic. In a study relying on a demand model and concerning frozen vegetable, Glaser and Thompson (1999) find organic products are unit price elastic. In the same vein, Bunte et al. (2005) estimate a demand model and find the Dutch organic demand being elastic to prices.

A third concern is the impact of the socio-demographic characteristics of consumers prone to purchasing organic food. Reviewing studies concerning consumer demand for organic foods, Thompson (1998) concludes that neither age, nor income nor gender seem to influence the probability of buying organic products. Families with children under eighteen are more prone to make the organic choice and well educated consumers too.

This paper addresses two issues of first interest for the expansion of the demand for organics. The first one which, to our knowledge, has not been yet investigated for organics is whether organic purchases are complementary or not. We want to know if organic buyers occasionally pick one organic product or choose organic for “several” categories: Does an “organic consumer” potentially exist? The question has important implications for the future of organic markets: indeed, an affirmative answer means that, provided the industry and the

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<sup>1</sup> North America’s part of the organic agricultural world area is only 2.2% which is small compared to the national consumption.

<sup>2</sup> The African share of the area devoted to organic crops in the world is only 0.03%.

retailers insure regular and easy supplying, the demand for organics could extend to a large number of products.

If the organic choice is a permanent feature of consumers' attitude, buying the organic model in one category product should increase the probability of buying also organic when purchasing some other product. This hypothesis can be tested relying on discrete choice models. Indeed, during the last fifteen years, an increasing body of researches aims at adapting choice models to capture correlations between choices among different product categories (Russell et al., 1997). Interdependence between goods is often related to some common factors (brand name, price) as in Singh, Ansari and Gupta (2005)'s multicategory choice model, applied to the demand for snacks. Interdependence can also rely on some product class complementarity as shown in Manchanda, Ansari and Gupta (1999) who assess complementarity within two pairs of goods (laundry detergent/fabric softener and cake mix/cake frosting). It can also depend simply on the store traffic patterns, as shown by Russell and Petersen (2000) who study the purchasing behavior for four grocery paper goods located in the same shop department and propose an original and easy to implement approach to seeking for correlations between items in the same consumers' basket. We apply this method to investigating for possible interdependence among organic purchases.

The second issue addressed in this paper concerns the impact of prices. We measure the price impact on the global demand using a standard demand model. But a major concern for organics is whether price changes influence the decision to buy organic rather than conventional and are likely to enlarge the organic markets. This dimension can be explored through choice models: probability-price elasticities measure how far a variation of the organic price affects the probability to buy the organic version.

We analyse the households' purchasing behaviour for two staple products, eggs and milk. The first section provides an overview of the organic market expansion for these products. The second section studies the correlation between organic choices. The third section addresses the question of the price impacts on the purchasing decisions in terms of probability of purchase as well as in terms of quantity purchased. The last section concludes.

## 1. Organic food demand for eggs and milk

We choose to study two staple food products, eggs and milk, whose organic share is significant, equivalent or greater than the French organic mean share: in 2005, 2.2 % for milk and 3.2 % for eggs. Each one accounts for 6% of the total organic expense in France.<sup>3</sup> Table 1 presents the main features of the evolution the French consumption for these two products, between 1998 and 2005. Figures are computed from the French TNS Worldpanel data. For each product, the total annual consumption per household remains stable but the organic demand is multiplied by more than two. At the same time, the number of consumers also increases. Indeed, in 1998, people buying organic at least once a year represent 3.3% of the total number of buyers for milk and 7.3% for eggs; in 2005, these ratios are respectively 8.6% and 13.3%. Similarly, the percentage of "organic consumers" (organic purchases > 90%) increases significantly.

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<sup>3</sup> Within the organic expense, the first products group is fruits and vegetables (16%), but micro-level data on organic purchases of fruits and vegetables are difficult to obtain.

Table 1: Evolution of French organic milk consumption from 1998 to 2005

Year	Quantity per household			Consumers (% of total buyers)		Prices	
	Total	Organic	Organic	At least one organic purchase	Organic purchases $\geq$ 90% of total	Organic (€)	Organic/ non- organic
	liter for milk, unit for egg		%				
	Milk						
1998	129.24	0.87	0.67	3.33	0.32	0.98	1,69
1999	104.77	1.01	0.96	4.73	0.46	1.15	1,92
2000	117.04	1.43	1.22	5.45	0.68	1.16	1,90
2001	121.03	1.62	1.34	6.47	0.67	1.22	1,91
2002	127.48	2.07	1.62	7.15	0.87	1.11	1,66
2003	117.63	1.96	1.66	7.01	1.03	1.21	1,73
2004	108.12	2.01	1.86	8.08	1.25	1.22	1,69
2005	105.17	2.26	2.15	8.60	1.50	1.21	1,63
Eggs							
1998	181.27	2.58	1.42	7.3	1.93	0.28	1.93
1999	145.62	3.44	2.36	9.2	2.61	0.29	1.87
2000	161.94	4.96	3.06	11.3	3.78	0.29	1.81
2001	165.57	4.86	2.96	11.2	3.78	0.31	1.94
2002	165.30	4.65	2.81	11.8	3.98	0.31	1.82
2003	186.14	5.12	2.75	12.6	4.50	0.35	2.06
2004	178.58	4.94	2.77	12.4	4.61	0.35	2.06
2005	181.18	5.82	3.21	13.3	4.91	0.34	2.00

During the period, for the two products, prices (organic and conventional) raise regularly, at a rate equivalent at the inflation one for milk (15%) and greater for eggs (21%).<sup>4</sup> The ratio between organic and non-organic prices remains stable, at a high level: about 1.63 for milk and 2.00 for eggs (2005). Contrary to Griffith and Nesheim's finding (2008), these ratios provide a good measure of the organic premium. We check for it running hedonic price function estimations (see appendix 1) which allow controlling for the all characteristics.

## 2. Cross-category dependence among organic choices

The present section is devoted to the analysis of the correlation between organic choices. We address this issue conducting a market basket analysis that concentrates on the composition of the basket of products purchased by a household during each single shopping trip. The first sub-section presents Russell and Petersen's approach based on a global utility model which takes into account cross-category demand relationships (complementarity, independence or substitutability). The data are presented in the second sub-section and the results in the third one.

### 2.1. A market basket choice model

This approach, implemented by Russell and Petersen (2000), allows calculating the probability of each possible basket, without any *a-priori* knowledge on the order in which choices are made in building the baskets. The global basket model (the choice for all the items

<sup>4</sup> During this period the inflation rate is 12%.

in the basket) is constructed by specifying a series of local models (the choice for each item in the basket). Assuming that the conditional probability of choice in one category, given the actual choices in all other categories, can be expressed in the form of the logit model, we are able, using Besag's theorem, to give to any global basket model the form of a multivariate logistic model.

Assume that consumer  $k$  has  $i = 1, \dots, N$  categories available for purchase. Then, a market basket is the vector of category choices  $B(k) = \{I(1,k), \dots, I(i,k), \dots, I(N,k)\}$  where  $I(i,k) = 1$  if consumer  $k$  buys category  $i$  (and 0 otherwise). Facing the choice between two products, and for each one, between the organic and the conventional versions, we have 4 categories and  $16 (2^4)$  alternative baskets.

It is assumed that the conditional utility of consumer  $k$  for product category  $i$  is given by:

$$U(i,k) = \alpha_i + \beta_i \text{Price}_{ik} + \sum_{j \neq i} \theta_{ij} I(j,k) + \sum_{j \neq i} \gamma_{ij} \text{SD}_k I(j,k) + \zeta(i,k) \quad (1)$$

$\text{Price}_{ik}$  is the price at which the consumer  $k$  buys the product  $i$ . The term  $\sum_{j \neq i} \theta_{ij} I(j,k)$  links the choice of the category  $i$  to the actual choice decisions in all other product categories in the basket. Logical consistency requires that the cross-effects be symmetric ( $\theta_{ij} = \theta_{ji}$ ).  $\theta_{ij} > 0$  (resp.  $< 0$ ) implies a positive (resp. negative) association.

$\text{SD}_k$  denotes variables defining household characteristics,  $\zeta(i,k)$  is a random error with mean zero. Assuming that the random error has an extreme value distribution, the conditional probability of selecting category  $i$  can be expressed as the logit model

$$\Pr(I(i,k)) = 1 / [1 + \exp\{-Z(i,k)\}]^{-1} \quad (2)$$

$$Z(i,k) = \alpha_i + \beta_i \text{Price}_{ik} + \sum_{j \neq i} \theta_{ij} I(j,k) + \sum_{j \neq i} \gamma_{ij} \text{SD}_k I(j,k) \quad (3)$$

$Z(i,k)$  is the deterministic portion of equation (1). Intuitively, it means that the consumer's choice of the final category in the basket (category  $i$ ) is affected by the bundle of categories already selected. In this way, the probability of choice in one category is dependent upon the context created by previous choices.

The key result is obtained by applying Besag's theorem (1974). Suppose that basket  $b$  contains  $I(1,b), \dots, I(i,b), \dots, I(N,b)$ , where  $I(i,b)$  is the dummy variable equals to 1 if category  $i$  is included in basket  $b$ , 0 otherwise. Then, given Equations (2) and (3) and the assumption that cross effect coefficients are symmetric  $\theta_{ij} = \theta_{ji}$ , the probability of selecting basket  $b$  is given by:

$$\Pr(B(k) = b) = \frac{\exp\{\mu(b,k)\}}{\sum_{b^*} \exp\{\mu(b^*,k)\}} \quad (4)$$

Where  $b^*$  denotes all possible baskets, and  $\mu(b,k)$  is the utility of basket  $b$ :

$$\mu(b,k) = \sum_i \alpha_i I(i,b) + \sum_i \beta_i \text{Price}_{ik} I(i,b) + \sum_{i < j} \theta_{ij} I(i,b) I(j,b) + \sum_{i < j} \gamma_{ij} \text{SD}_k I(i,b) I(j,b) \quad (5)$$

## 2.2 Data

Data concerning eggs and milk purchases are drawn from the French TNS Worldpanel over a one-year period (2005), which is a micro-level database. In 2005, one can list 108,804 baskets containing eggs and /or milk. These purchases, 95% of which are made in mass distribution, were conducted by 12,890 households. Households' socio-demographic characteristics are shown in the table 4.

Table 4: Household Data Summary

	Mean	Std. Dev.	Min	Max
Household's size	2.7	1.3	1	5
Number of consumption units <sup>5</sup>	2.1	0.8	1	3.6
Monthly income (€)	2263	1124	153	6555
Monthly income per consumer unit (€)	1203	653	90	5031
Age (year)	48,4	15.5	18	98
Educational level	Bachelor	–	Primary	> Bachelor +4

The market basket distribution is shown in table 5, where each of the 108,795 baskets is identified in terms of its contents: CE: Conventional egg, OE: Organic egg, SM: Conventional milk, OM: Organic milk.

Table 5: Basket Market Distribution

Baskets with	Number of baskets
CE	9768
OE	415
CM	24102
OM	310
CE & OE	433
OE & OM	77
OE & CM	1497
CE & OM	427
CE & CM	63193
CM & OM	959
CE & OE & OM	94
CE & OE & CM	3638

<sup>5</sup> We consider the OCDE scale of consumption which is defined as following: the first adult with a weight of 1, the second of 0.7 and 0.5 for each child.

OE & CM & OM	242
CE & CM & OM	3052
CE & OE & CM & OM	597
	108804

As might be expected, baskets with organic products occur much less often than baskets with conventional products. Nevertheless, the number of baskets is never zero, whatever the combination of goods taken into account. Table 6 gives some information about the baskets.

Table 6: Percentage and Price of Each Product

Baskets with	Percentage	Price
Standard egg	74.43	0.17 (0.05)
Organic egg	6.40	0.33 (0.05)
Standard milk	90.02	0.67 (0.14)
Organic milk	7.65	1.10 (0.21)

Standard errors of parameters are shown in brackets

The heterogeneity in prices is due to the factors pointed by the hedonic analysis (kind of shop, quantity purchased, brand...). Since we observe only the basket selected by the household but not the 15 potential baskets (i.e. the non chosen alternative), the conditional logit model estimation requires to building them in terms of prices. So we draw randomly in a log normal distribution the unknown prices. The average and standard deviations are those of the sample. As we need the largest range of prices, we use two samples, according to the purchase place, hard discount or not. Given the large number of alternatives, we deal with 1631925 (15\*106795) “observations”.

### 2.3. Market basket analysis

First of all we deal with a simple model without demographic shifters. Demographic variables are introduced in a second step. In this section we comment the results concerning the correlation between organic choices.

#### 2.3.1 Benchmark model

The basic model, used as a benchmark, is the one where equation (5) becomes:

$$\mu(b,k) = \sum_i \alpha_i I(i,b) + \sum_i \beta_i \text{Price}_{ik} I(i,b) + \sum_{i < j} \theta_{ij} I(i,b) I(j,b) \quad (5.1)$$

To estimate this model we deal with 1570440 observations (instead of 1631925). Indeed, we only keep the observations for which all demographic variables to be taken into account by the following are filled in. So the sample is the same whatever the model, with or without demographic variable.

Table 7: Parameter Estimates for Benchmark Model

	Standard eggs	Organic eggs	Standard milk	Organic milk
Intercept	.23** (.06)	-2.94** (.10)	1.04** (.05)	-3.25 ** (.05)
Price	.02 (.02)	0.01 (.07)	-0.08* (.05)	.03 (.07)
Standard eggs $\theta_{1j}$	–	-.11** (.03)	.78** (.05)	.17** (.03)
Organic eggs $\theta_{2j}$	-.11** (.03)	–	.18** (.04)	1.33** (.04)
Standard milk $\theta_{3j}$	.78** (.05)	.18** (.04)	–	.04 (.04)
Organic milk $\theta_{4j}$	.17** (.03)	1.33** (.04)	.04 (.04)	–

Standard errors of parameters are shown into brackets

Statistical significance is denoted as \*\* if .05 level or better, and as \* if .10 level or better.

The PseudoR<sup>2</sup> reaches 0.51. The intercepts for the standard products are positive. They are negative for the organic products. This result simply reflects that the probability of purchasing a standard product is higher than the probability of buying an organic product. Otherwise, all price effects are non significant.

The only cross-effect to be negative is the one linking organic eggs and conventional eggs, which indicates that these products act as substitutes. On the same shopping trip, consumers do not buy both organic and conventional eggs. This result can be linked to the fact that this product is not dedicated to individual consumption but it is a “collective purchase”. This is less true for milk where different consumption patterns may coexist inside the same family. This can explain the nil value of the cross effect between organic and conventional milk.

All other groups of two products act, more or less, as demand complements. We can distinguish three degrees of complementarity. Between a conventional product and the other product in the organic variety, complementarity is weak ( $0.18 = \theta_{23} = \theta_{32} \square \theta_{14} = \theta_{41} = 0.17$ ). Between conventional eggs and conventional milk the medium complementarity expresses their usual association in most shopping baskets ( $\theta_{31} = \theta_{13} \square 0.78$ ). The highest complementarity is between organic products ( $\theta_{24} = \theta_{42} = 1.33$ ). So a consumer buying an organic product increases more his/her utility when buying the other organic product rather than the conventional one.

### 2.3.2 Models with Demographic variables

To take into account demographic variables, we use equation 5 where  $SD_k$  denotes one of the four following variables: income per unit consumption, family head’s age, household size, family head’s education. We estimate thus four models, one for each demographic effect. For example, the equation considering the income per unit consumption effect is written as:

$$\mu(b,k) = \sum_i \alpha_i I(i,b) + \sum_i \beta_i Price_{ik} I(i,b) + \sum_{i<j} \theta_{ij} I(i,b) I(j,b) + \sum_{i<j} \gamma_{ij} (Inc/U.C.)_k I(i,b) I(j,b) \quad (5.2)$$

Table 8 displays for each of the four estimated equations (5) only the results for the cross effects  $\theta_{ij}$  and  $\gamma_{ij}$ . Indeed, constants and price coefficients do not change. The results are given at appendix 2.

Table 8: Results on cross effects and demographic shifters parameters

Effects	Income/ U.C.	Age	Family size	Educational Level
<b><i>Cross effects</i></b>				
CE & OE $\theta_{12} = \theta_{21}$	-0.27** (0.05)	-0.23** (0.08)	-0.009 (0.06)	-0.21** (0.06)
CE & CM $\theta_{13} = \theta_{31}$	0.96** (0.05)	1.10** (0.05)	0.51** (0.05)	0.84** (0.05)
CE & OM $\theta_{14} = \theta_{41}$	-0.14** (0.06)	0.04 (0.1)	0.31** (0.07)	-0.28** (0.07)
OE & CM $\theta_{32} = \theta_{23}$	0.30** (0.06)	0.16* (0.08)	0.14** (0.06)	0.27** (0.06)
OE & OM $\theta_{42} = \theta_{24}$	1.30** (0.07)	1.49** (0.12)	1.23** (0.09)	1.14** (0.09)
CM & OM $\theta_{34} = \theta_{34}$	-0.20 (0.06)	-0.12 (0.09)	0.10 (0.07)	0.06 (0.07)
<b><i>Demographic*cross effects</i></b>				
CE & OE $\gamma_{12} = \gamma_{21}$	0.02** (0.005)	0.02** (0.005)	-0.03* (0.02)	0.025** (0.01)
CE & CM $\gamma_{13} = \gamma_{31}$	-0.02** (0.001)	-0.006** (0.004)	0.10** (0.005)	-0.014** (0.004)
CE & OM $\gamma_{14} = \gamma_{41}$	0.04** (0.006)	-0.002 (0.002)	-0.05 (0.02)	0.11 (0.01)
OE & CM $\gamma_{32} = \gamma_{23}$	-0.01** (0.005)	0.0006 (0.001)	0.02 (0.02)	-0.02* (0.01)
OE & OM $\gamma_{42} = \gamma_{24}$	0.002 (0.007)	-0.003 (0.002)	0.03 (0.03)	0.044** (0.019)
CM & OM $\gamma_{34} = \gamma_{34}$	0.01* (0.05)	0.003** (0.02)	-0.016 (0.02)	-0.002** (0.01)
Pseudo R <sup>2</sup>	0.5137	0.5136	0.5139	0.5135
Observations	1570440			

Standard errors of parameters are shown into brackets

Statistical significance is denoted as \*\* if .05 level or better, and as \*if .10 level or better.

Signs and values of simple cross-effects coefficients are similar to the benchmark model and the global fitness is always the same as the benchmark model one. Some demographic effects are significant. Specifically, introducing income or educational level provides a more accurate measure of the linkage between products. For example, well-off consumers are less prone to buy only conventional products ( $\gamma_{13} = \gamma_{31} = -0.02$ ) than consumers with low income ( $\theta_{13} = \theta_{31} = 0.96$ ).

Our main concern is the cross-effect between organic products. An important feature is that the only demographic variable which affects the strong positive cross-effect between the two organic products is the educational level. Loyalty to organics is not sensitive to income, though organic products are more expensive than conventional products, neither to age nor to

household size. In other words, the “organic belief” is not linked to any particular socio-demographic profile but education.

### 3. Price effects (*in progress*)

We present successively the demand price elasticities and the probability price elasticities.

#### 3.1. Demand price elasticities

Demand model price elasticities are calculated using the parameters estimated from an AIDS demand system (Almost Ideal Demand System, Deaton and Muelbauer, 1980). This model has been widely used in research studies on the demand for food products (see among others Moschini, Moro and Green, 1994; Moschini and Mielke, 1989; Eales and Henderson, 2001; Eales and Unnevehr, 1988). For each product, we suppose that the decision to purchase or not to purchase the product is made before (and independently of) the choice between the conventional or the organic version. Since only a minority of households use to buy organic, we consider a representative consumer and observe his behavior for a monthly basis (four weeks). For each product and each retailer, there are 52 observations (4 years, 2003-2005), including in particular the total expense spent on the product considered, its distribution between the two versions and retail prices.

The demand model takes the form of a system of equations written in the following way for each product:

$$w_{it} = \alpha_i + \sum_{j=1}^5 \gamma_{ij} \log p_{it} + \beta_i \log(Y_t / P_t) + \rho_{it} \quad (7)$$

The dependent variables ( $w_{it}$ ) are the monthly market share of each brand in the budget of the representative household ( $w_{it}$  with  $i=1,2$  and  $t=1,\dots,52$ ). The independent variables are the monthly prices of the 2 versions ( $p_{it}$ ), the total expense for the product considered in the retail store studied ( $Y_t$ ), corrected by an index of average prices ( $P_t$ ) and  $\rho_{it}$  is the error term.<sup>6</sup> Resulting from the additivity constraint, only one budget share equation is estimated. The direct price elasticities, calculated at the mean value (see Table 10), are computed using the following formulas tested by Green and Alston (1990) :

$$\varepsilon_i = -1 + \frac{1}{\bar{w}_i} (\gamma_{ii} - \beta_i) \quad (8)$$

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<sup>6</sup> The translog price index  $P_t$  (where  $\log P_t = \alpha_0 + \sum_i \alpha_i \log p_{it} + \sum_i \sum_j \gamma_{ij} \log p_{it} \log p_{jt}$ ) is replaced by the linear Stone index approximation ( $\log P_t = \sum_i w_i \log p_i$ ). To overcome the simultaneity problem related

to the presence of  $w_{it}$  in both terms of equation (1),  $w_{it}$  in the Stone index, is substituted by the  $w_i$  mean. Furthermore, the prices and expenses are normalized by their means (Ashe and Wessells, 1997). We impose the theoretical restrictions of additivity of budget shares ( $\sum_i \alpha_i = 1$ ), of homogeneity and of symmetry

$$\left( \sum_i \gamma_{ij} = \sum_j \gamma_{ji} = \sum_i \beta_i = 0 \right).$$

Table 10: Own price elasticities (AIDS)

Eggs		Milk	
Conventional	Organic	Conventional	Organic
-0.88** (0.04)	-2.38** (0.47)	-1.00** (0.03)	-1.52** (0.76)

Standard errors of parameters are shown into brackets

The demand price elasticities are all statistically different from zero and have the expected negative sign. Moreover, the organic products are more price elastic than the conventional ones: in absolute terms, the ratio between the organic and the conventional elasticities is 1.5 for milk and about 2.7 for eggs. These figures confirm previous results encountered in the literature and mean that people used to buy organics, who are mostly part-organic consumers, should buy more organic products if prices were lowered.

### 3.2. Discrete choice elasticities

One interesting aspect of choice models is to allow computing price elasticities to measure the percentage change in the probability of choosing product  $i$  with respect to a change in the price of product  $j$ . These elasticities measure the price influence on the *decision* of buying each product (eggs or milk, organic or conventional).

The formulas of price elasticities are the following:

$$e(i, j)_k = \partial \log P(i)_k / \partial \log Price_{jk} = \begin{cases} \beta_i [1 - P(i)_k] & \text{if } i = j \\ \beta_j P(j)_k \left[ \frac{P(i, j)_k}{P(i)_k P(j)_k} - 1 \right] & \text{if } i \neq j \end{cases} \quad (6)$$

$P(i)_k$  is the probability that basket  $k$  contains the product  $i$  :  $P(i)_k = \frac{\sum_i \exp\{\mu(b, k)\}}{\sum_{b^*} \exp\{\mu(b^*, k)\}}$ , at the

numerator, the sum is over all baskets with product of category  $I$ , at the denominator, the sum is over all possible baskets.

$P(i, j)_k$  is the probability that basket  $k$  contains at the same time the product  $i$  and product  $j$ :

$P(i, j)_k = \frac{\sum_{ij} \exp\{\mu(b, k)\}}{\sum_{b^*} \exp\{\mu(b^*, k)\}}$ , at the numerator, the sum is over all baskets with both product

of category  $i$  and product of category  $j$ .

The market basket own-price elasticities computed from the benchmark model are presented at table 9. They are statistically non significant. This feature does not change when introducing demographic variables in the model. Clearly, it means that marginal variations of the organic price have no effect on the probability of purchase, whatever the good.

Table 9: Own price elasticities (Market basket model)

Eggs		Milk	
Conventional	Organic	Conventional	Organic
0.001	0.056	-0.042	-0.63
(0.005)	(-0.070)	(0.036)	(0.75)

Standard errors of parameters are shown into brackets

## 5. Conclusion

In this research, we have firstly shown that consumers interested in one organic good are likely to extend their organic purchases to other products. The French organic demand could thus apply to a wide range of goods, provided that the industry and the retailers insure regular and easy supplying. The second result confirms that organic demands are more price elastic than conventional ones. On the other hand, marginal price decreases do not lead people to choose organic. The third aspect is that the organic choice is mainly a matter of personal conviction. Well-off consumers are not more prone to buy organic neither the elderly nor the households with children. As a consequence, business cannot target potential consumers relying one simple demographic characteristic, excepted that organic buyers are likely to have a high level of education.

A limit of the basket choice analysis is that too few products can be involved in the same framework. Indeed, the number of potential baskets grows exponentially with the number of categories and all possible baskets are not really available. Thus, basket choice models do not provide a realistic picture of the market: their contribution is first qualitative. Otherwise, assessing the inter-categories linkage does not inform about its impact on quantities, which is the other axis of market expansion. Further researches are thus necessary to go deeper into the quantitative aspects of the organic demand expansions.

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## Appendix 1: Hedonic Prices

To determine the consumers' WTP for the organic label, we estimate thus an hedonic price function. This method allows computing the organic premium while controlling for the average characteristics of the organic products. The endogenous variable is the selling price of a unit of product (in logarithm). All exogenous variables are dichotomous. To implement the hedonic price method, we use the Rosen's formulation (1974). So, we write the following function:

$$\log(p) = \beta_0 + \sum_{i=1}^n \beta_i Z_i + \varepsilon \quad (1)$$

The  $\beta$ s are the parameters to estimate and the  $Z_i$  are the characteristics and  $\varepsilon$  an error term. Besides the dummy variable Organic (Org), several variables describing the kinds of brands are taken into account:

- Leading National Brands (LNB)
- Secondary National Brands (SNB)
- Private Label (PL)
- Hard Discount brands (HD)
- Lowest Price Products (LPP)

The other variables  $Z_i$  depend on the product studied. For milk, we deal with: content of milk fat (whole (W), skimmed (S) or semi skimmed milk), packaging (box=1 if the packaging is a cardboard box, 0 otherwise), cap or not. For eggs, the variables taken into account are: standard or Red Label (RL), breeding process (battery, outdoor (OUT) or farm), egg size (small, medium (ME), big (BE)), size of pack (small (SP), medium (MP), large), and laying date.

For milk, the reference product, which price is estimated from the constant, is a lowest price product, semi skimmed milk, sold in a cardboard box. The estimated equation is the following:

$$\log(p) = \beta_0 + \beta_1 Org + \beta_2 LNB + \beta_3 SNB + \beta_4 PL + \beta_5 HD + \beta_6 W + \beta_7 S + \beta_8 Box + \beta_9 Cap + \varepsilon \quad (2.1)$$

For eggs, the reference product is a battery lowest price product, of small size, sold in bulk without red label. So the estimated equation is the following:

$$\log(p) = \beta_0 + \beta_1 Org + \beta_2 LNB + \beta_3 SNB + \beta_4 PL + \beta_5 HD + \beta_6 RL + \beta_7 Out + \beta_8 Farm + \beta_9 ME + \beta_{10} BE + \beta_{11} SP + \beta_{12} MP + \beta_{13} Date + \varepsilon \quad (2.2)$$

The estimated values of the parameters of equation (2.1) and (2.2) are displayed in table I.1. and I.2.

Table I. 1 Milk

Variables	Coefficients
Constant	-0.54** (0.001)
Organic	.28** (0.001)
Leading NB	0.28**

	(0.001)
Secondary NB	.26** (0.003)
PL	.05** (0.001)
HD	-0.06** (0.001)
U.H.T.	-0.06** (0.000)
Skimmed	-0.023** (0.001)
Whole	.13** (0.001)
Box	0.19** (0.001)
Cap	0.04** (0.001)
Adj R-squared	.65
Number of observations	223955

Standard errors of parameters are shown in parentheses.  
All coefficients are statistically significant at .05 level or better.

Hedonic regression for egg price:

Table I.2 Egg

Variables	Coefficients
Constant	-2.52** (0.003)
Organic	.778** (0.003)
Leading NB	.30** (0.002)
Secondary NB	.35** (0.002)
PL	.05** (0.002)
HD	-0.06** (0.003)
Box	-.07** (0.002)
Red Label	.15** (0.003)
Outdoor	.50** (0.002)
Farm	.47** (0.004)
Medium Egg	.09** (0.003)
Big Egg	.14** (0.003)
Small Pack	.44** (0.003)
Medium Pack	.14** (0.003)
Date	.25** (0.001)
Adj R-squared	.79
Number of observations	146155

Standard errors of parameters are shown in parentheses.  
All coefficients are statistically significant at .05 level or better.

The value of the organic premium is computed considering the estimated prices for conventional product on the one hand and organic ones on the other hand. The results are the following ones.

Table 3: Price and Value of the Label

Product	Estimated value (€)	Ratio between the organic product and the “organic benchmark”
Non Organic egg	0.15	2.20
Organic egg	0.33	
Non Organic milk	0.66	1.76
Organic milk	1.09	

We can notice that the ratio between the organic and conventional prices resulting from hedonic computations are very similar to the ones simply observed in the data: for eggs 2.20 instead of 2.04 (mean value for 2003 to 2005) and for milk 1.76 instead of 1.68.

Appendix 2:  
Parameter Estimates for model with cross effects and demographic shifters parameters

	Conventional eggs	Organic eggs	Conventional milk	Organic milk
“Income Model”				
Intercept	.24** (.06)	-2.95** (.10)	1.05** (.06)	-3.27** (.05)
Price	.024* (.02)	0.01 (.07)	-0.03* (.05)	.02 (.08)
“Age Model”				
Intercept	.24** (.06)	-2.94** (.10)	1.05** (.06)	-3.26** (.05)
Price	.037 (.02)	0.01 (.07)	-0.03* (.05)	.03 (.08)
“Family Size Model”				
Intercept	.26** (.06)	-2.94** (.10)	1.06** (.06)	-3.26** (.05)
Price	.05* (.02)	0.01 (.07)	-0.01* (.05)	.03 (.08)
“Educational Level Model”				
Intercept	.22** (.06)	-2.94** (.10)	1.04** (.06)	-3.26** (.05)
Price	.025 (.02)	0.01 (.07)	-0.08* (.05)	.02 (.08)