

Buying Organic Food: A Multi Level Model of Consumer Behaviour

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Theoretical background

1. Economics: Effects of price and income
2. Environmental sciences: Effects of environmental consciousness
3. Health sciences: Effects of health consciousness

Hypothesis:

1. Price: substitution effect
 - Economics: effect of relative price
 - Psychology: effect of price level
2. Income effect
 - substitution to “higher” quality good
 - size of household
3. Environmental consciousness (EC): no direct measures
 - possession of durable goods like TV, Hi-Fi, dishwasher etc.
 - transportation (travel to work; possession of cars; possession of bicycles)
 - membership in environmental associations
 - education; age
4. health consciousness (HC): no direct measures
 - small children; bad health; age;

Variable	expected effect on probability of buying organic food
relative price	—
price level	—
income	+
household size (income)	—
durable goods (EC)	—
public transp. (EC)	+
automobiles (EC)	—
bicycles (EC)	+
environm. association (EC)	+
education (EC)	+
small children (HC)	+
bad health (HC)	+
age (EC/HC)	convex
sex	?

Data:

- 1998 Income and Consumption Survey (EVE 98)
- income and consumption flows over one month
- 1'500'000 food consumption actions (food/beverages; level 1) in 9000 households (level 2) (average 165 actions/household)
- additional interview on life conditions with 4500 individuals

Variables

- Price of good ik (i : consumption action, k : product category): $p_{ik} = z_{ik}/x_{ik}$
(x : amount consumed, z : money spent)
- Price estimates:

$$\text{organic: } \hat{p}_k^b = (\sum_{i=1}^{n_k} z_{ik} b_{ik}) / (\sum_{i=1}^{n_k} x_{ik} b_{ik})$$

$$\text{convent.: } \hat{p}_k^c = [\sum_{i=1}^{n_k} z_{ik} (1 - b_{ik})] / [\sum_{i=1}^{n_k} x_{ik} (1 - b_{ik})]$$

(b : indicator for organic food)

Possible improvement: $\hat{p}_{ik} = \beta_{0k} + \beta_{1k} \ln(x_{ik})$

- Relative price: $\hat{p}_k^r = \hat{p}_k^b / \hat{p}_k^c$

- Price level: $\hat{p}_k^L = \hat{p}_k^c \cdot \bar{x}_k$
($\bar{x}_k = 1/n_k \sum_{i=1}^{n_k} x_{ik}$ standardized units of product k)

- Residual price deviation:

$$p_i^d = (p_{ik}(1 - b_{ik}) + p_{ik}/\hat{p}_k^r \cdot b_{ik})/\hat{p}_k^c$$

- relative amount: $x_i^r = x_{ik}/\bar{x}_k$
- durable goods: index over dishwasher, freezer, fridge, microwave, TV, Fax, PC, Hi-Fi, mobile phone, video camera, VCR

Constant elasticity model: (j : household index)

$$\ln\left(\frac{P_{ij}}{1 - P_{ij}}\right) = \beta_0 + \beta_1 \ln \hat{p}_k^r + \beta_2 \ln \hat{p}_k^L + \beta_3 \ln p_{ij}^d + \beta_4 \ln x_{ij}^r + \beta_5 \ln(\text{inc}_j) + \gamma \mathbf{Z}$$

Multilevel modeling:

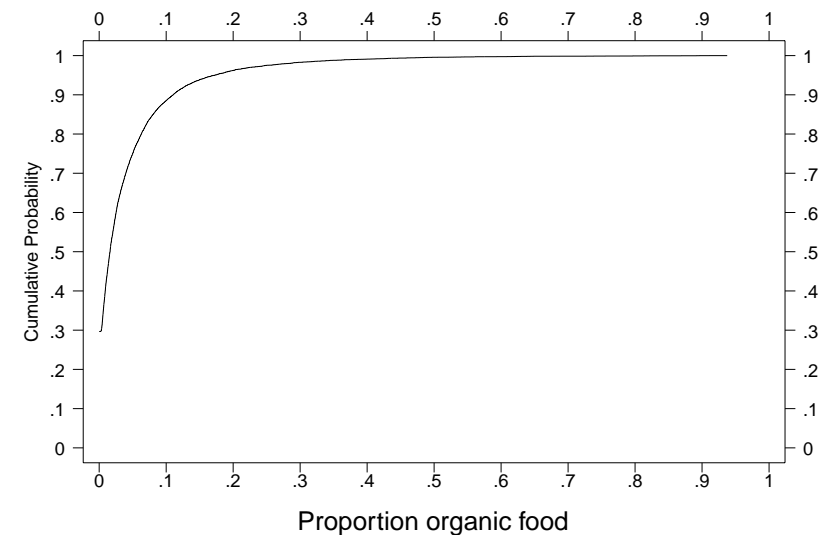
- Goal: divide within (β^w) and between (β^b) estimators

$$y_{ij}^* = \beta_0 + \beta_1^w (\ln \hat{p}_k^r - \overline{\ln \hat{p}_k^r}) + \beta_1^b \overline{\ln \hat{p}_k^r} + \dots + \varepsilon_{ij}$$

- Estimation:
 - Fixed-effects model (β^w): household-dummies
 - Between-effects m. (β^b): reg. with aggregates
 - Random-effects m. (β^w and β^b): $\beta_{0j} = \beta_0 + u_j$

- Std. logistic regression (clustered Huber/White sandwich estimator):
 - * consistent (in large samples: same point estimates as in fixed-effects/between-effects models) but less efficient
 - * Problem: unbalanced Panels \Rightarrow households with many consumption actions (n_j) have more influence on point estimates
 - * Possible solution: apply (p)weights $1/n_j$
 - between estimator: consistent
 - within estimator: unclear
 - loss of efficiency

Results:



Mean proportion of organic food: 4.2%

	M1		M2		M3	
w.rel.price	-0.337	-16.52	-0.590	-24.59	-0.573	-24.11
w.level			-0.622	-31.22	-0.638	-31.95
w.rel.dev					-0.228	-18.78
w.rel.amount					-0.170	-14.99
constant	-3.104	-149.52	-3.135	-148.20	-3.141	-147.34

dependent: organic food; estimation: Logit (sandwich/cluster), unweighted,
n = 1426881

	M4		M5		M6	
w.rel.price	-0.588	-24.47			-0.588	-24.47
b.rel.price	-0.567	-1.00			-0.580	-1.03
w.level	-0.692	-32.08			-0.692	-32.09
b.level	-6.063	-17.47			-6.060	-17.59
w.rel.dev	-0.232	-18.85			-0.232	-18.87
b.rel.dev	2.911	14.01			2.901	12.94
w.rel.amount	-0.180	-15.19			-0.180	-15.20
b.rel.amount	-0.995	-8.88			-0.934	-7.45
ln(income)			0.192	4.34	-0.004	-0.08
hh_size			-0.162	-9.49	-0.018	-0.98
constant	4.631	9.07	-4.380	-11.43	4.728	7.03

dependent: organic food; estimation: Logit (sandwich/cluster), unweighted,
n = 1426881

	M7		M8		M9	
z.rel.price	-0.592	-24.50	-0.573	-13.15	-0.559	-11.02
m.rel.price	-0.354	-0.63	0.655	0.71	1.418	1.27
z.level	-0.698	-32.23	-0.691	-17.35	-0.715	-14.50
m.level	-5.130	-15.66	-5.353	-9.69	-4.599	-6.93
z.rel.dev	-0.233	-18.84	-0.251	-10.60	-0.251	-9.23
m.rel.dev	2.829	13.00	2.496	7.06	2.521	5.85
z.rel.amount	-0.183	-15.35	-0.207	-8.87	-0.209	-7.83
m.rel.amount	-0.524	-4.32	-0.758	-3.77	-0.548	-2.23
ln(income)	0.103	2.24	0.060	0.72	-0.004	-0.05
hh_size	-0.137	-6.13	-0.145	-3.41	-0.171	-3.73
goods	-0.104	-9.10	-0.076	-3.94	-0.079	-3.43
cars	-0.242	-7.07	-0.265	-4.59	-0.262	-3.69
bicycles	0.116	8.69	0.116	4.53	0.127	4.58
age	0.051	5.46	0.058	3.42	0.083	3.36
age ² /10	-0.005	-5.29	-0.005	-3.20	-0.008	-2.86
env.ass			0.996	3.88	1.066	3.59
pub.transp.					0.137	1.57
education	0.054	7.49	0.057	4.12	0.051	3.58
child < 4	0.422	6.58	0.557	4.40	0.606	4.39
bad health			-0.085	-0.85	-0.300	-2.46
women	-0.039	-0.90	-0.062	-0.81	0.004	0.05
constant	1.674	2.61	1.654	1.42	0.642	0.50

cases 1418803 366540 267051

dependent: organic food; estimation: Logit (sandwich/cluster), unweighted

	M1		M2		M3	
w.rel.price	-0.340	-8.30	-0.591	-12.10	-0.578	-11.89
w.level			-0.601	-14.97	-0.622	-15.57
w.rel.dev					-0.253	-10.67
w.rel.amount					-0.210	-9.07
constant	-3.093	-139.76	-3.123	-136.53	-3.131	-135.85

dependent: organic food; estimation: Logit (sandwich/cluster), weighted,
n = 1426881

	M4		M5		M6	
w.rel.price	-0.594	-11.90			-0.594	-11.89
b.rel.price	-0.503	-0.83			-0.496	-0.82
w.level	-0.675	-15.44			-0.675	-15.44
b.level	-5.022	-13.81			-5.019	-13.84
w.rel.dev	-0.263	-10.93			-0.263	-10.93
b.rel.dev	2.595	12.21			2.587	11.47
w.rel.amount	-0.223	-9.34			-0.223	-9.34
b.rel.amount	-0.905	-7.26			-0.866	-6.15
ln(income)			0.156	3.28	0.000	0.01
hh_size			-0.155	-8.22	-0.013	-0.64
constant	3.295	6.23	-4.099	-9.96	3.329	4.72

dependent: organic food; estimation: Logit (sandwich/cluster), weighted,
n = 1426881

	M7		M8		M9	
z.rel.price	-0.601	-12.03	-0.678	-8.02	-0.692	-6.94
m.rel.price	-0.318	-0.53	-0.171	-0.17	0.112	0.10
z.level	-0.685	-15.61	-0.835	-10.38	-0.838	-8.13
m.level	-4.299	-12.19	-4.554	-7.69	-3.975	-6.21
z.rel.dev	-0.264	-10.91	-0.288	-6.35	-0.314	-5.87
m.rel.dev	2.515	10.98	2.079	5.69	1.819	4.18
z.rel.amount	-0.224	-9.38	-0.227	-5.59	-0.238	-4.97
m.rel.amount	-0.503	-3.56	-0.746	-2.89	-0.523	-1.63
ln(income)	0.103	1.91	0.057	0.65	0.006	0.06
hh_size	-0.120	-4.71	-0.168	-3.31	-0.177	-3.27
goods	-0.109	-8.32	-0.083	-3.67	-0.096	-3.62
cars	-0.256	-6.74	-0.275	-3.98	-0.251	-2.92
bicycles	0.114	7.17	0.118	3.58	0.117	3.19
age	0.051	4.54	0.059	2.83	0.070	2.63
age ² /10	-0.005	-4.39	-0.006	-2.74	-0.006	-2.25
env.ass			0.842	3.55	0.766	2.80
pub.transp.					0.158	1.58
education	0.052	6.45	0.037	2.31	0.032	1.82
child < 4	0.420	5.81	0.588	3.75	0.617	3.57
bad health			-0.048	-0.44	-0.180	-1.24
women	-0.112	-2.35	-0.169	-1.96	-0.096	-0.98
constant	0.669	0.94	1.211	1.04	0.692	0.54

cases 1418803 366540 267051

dependent: organic food; estimation: Logit (sandwich/cluster), weighted

A look ahead

- Formalized theory (economic part)
- Improved price estimation
- Refined model
- Theory of life cycles; family composition
- Estimation: advanced models (random-coefficient)?
sampling?
- EVE 2000?