The General Nesting Logit (GNL) Model using Aggregate Data

Andre de Palma and Julien Monardo (2017)

Presented by Silvio Ravaioli

June 27, 2019

Preview of the Paper

- Demand estimation with aggregate data (representative agent)
- General equivalence between discrete choice and rational inattention model
- In the General Nesting Logit products can be independent, substitutable, or complementary
- Linear regression of market shares on product characteristics and "nesting" terms
- Pro: good parsimony/flexibility compromise to add compl.
- Con: it requires external definition of criteria (nests)
- Simple application: brand/segment substitutability for cereals (Dominick's database)

Thoughts for the Discussion

- **General equivalence between discrete choice and rational inattention model**
- What does RI represent in a traditional market (e.g. cereals)?
- **In the General Nesting Logit products can be independent, substitutable, or complementary**
- When do we need this flexibility?
- **How can we *really* connect discrete choice and rational inattention?**

Thoughts for the Discussion

- **General equivalence between discrete choice and rational inattention model**
- What does RI represent in a traditional market (e.g. cereals)?
- **In the General Nesting Logit products can be independent, substitutable, or complementary**
- When do we need this flexibility?
- **How can we *really* connect discrete choice and rational inattention?**

Thoughts for the Discussion

- **General equivalence between discrete choice and rational inattention model**
- What does RI represent in a traditional market (e.g. cereals)?
- **In the General Nesting Logit products can be independent, substitutable, or complementary**
- When do we need this flexibility?
- **How can we *really* connect discrete choice and rational inattention?**

Key References - Matejka & McKay (AER 2015)

- **Rational Inattention to Discrete Choices: A New Foundation for the Multinomial Logit Model**
- Equivalence between discrete choice model with ARUM and rational inattention (RI) model with Shannon Entropy
- Information friction: it is costly to learn true payoffs
- Choice is probabilistic, based on true payoffs, prior beliefs, and attention cost

- Representative agent
- One-shot decision (no memory, learning, or communication)
- Continuous state and signals [State-Signal-Action model]
- Shannon Entropy assumption

Key References - Matejka & McKay (AER 2015)

- **Rational Inattention to Discrete Choices: A New Foundation for the Multinomial Logit Model**
- Equivalence between discrete choice model with ARUM and rational inattention (RI) model with Shannon Entropy
- Information friction: it is costly to learn true payoffs
- Choice is probabilistic, based on true payoffs, prior beliefs, and attention cost

- Representative agent
- One-shot decision (no memory, learning, or communication)
- Continuous state and signals [State-Signal-Action model]
- Shannon Entropy assumption

Key References - Fosgerau & De Palma (WP 2016)

- **Generalized Entropy Models**
- Extension of Matejka-McKay based on a generalization of Shannon entropy
- Entropy cost component expresses *taste for variety*
  rich complementarity/substitutability pattern
- Dual representation of discrete choice ARUM (requires substitutability)
- Some generalized entropy models lead to demand systems that cannot be rationalized under any ARUM
- Demand models can be estimated by linear regressions - invert market shares to find implied mean utility as in Berry (1994)
- Theoretical backbone for this paper

Key References - Fosgerau & De Palma (WP 2016)

- **Generalized Entropy Models**
- Extension of Matejka-McKay based on a generalization of Shannon entropy
- Entropy cost component expresses *taste for variety*
  rich complementarity/substitutability pattern
- Dual representation of discrete choice ARUM (requires substitutability)
- Some generalized entropy models lead to demand systems that cannot be rationalized under any ARUM
- Demand models can be estimated by linear regressions - invert market shares to find implied mean utility as in Berry (1994)
- Theoretical backbone for this paper

Key References

- **Fosgerau, Melo, De Palma, and Shum (WP 2017) Discrete Choice and RI: A General Equivalence Result**
- *When information costs are modelled using a class of generalized entropy functions, the choice probabilities in any rational inattention model are observationally equivalent to some additive random utility discrete choice model and vice versa*
- *Any ARUM can be given an interpretation in terms of boundedly rational behavior* [...although RI is not a case of bounded rationality...]

- **Joo (JMP 2019) RI as an Empirical Framework** with an application to the welfare effects of nex product introduction and endogenous promotion
- Welfare calculation differs between RI and RUM
- Role of information shifters (promotion and consumer inertia)

Key References

- **Fosgerau, Melo, De Palma, and Shum (WP 2017) Discrete Choice and RI: A General Equivalence Result**
- *When information costs are modelled using a class of generalized entropy functions, the choice probabilities in any rational inattention model are observationally equivalent to some additive random utility discrete choice model and vice versa*
- *Any ARUM can be given an interpretation in terms of boundedly rational behavior* [...although RI is not a case of bounded rationality...]

- **Joo (JMP 2019) RI as an Empirical Framework** with an application to the welfare effects of nex product introduction and endogenous promotion
- Welfare calculation differs between RI and RUM
- Role of information shifters (promotion and consumer inertia)

Example: Market Segmentation for Cereals

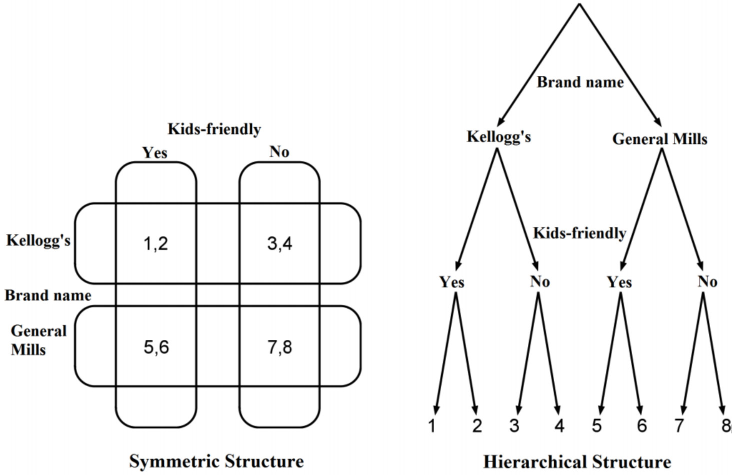

Figure 1: Cereals: symmetric vs. hierarchical structure

Introduction

- Benchmark: the **nested logit model** accounts for multiple discrete characteristics (criteria) used to partition the choice set into groups (nests).
- Product choice follows a two (or more)-steps process: choose a group (e.g. cereal segment), then a product from the group
- **Concerns**: arbitrary hierarchy, restrictive substitution constraints, independence from irrelevant alternatives
- **Solution**: General Nesting Logit: product differentiation + segmentation (discrete criteria) + no hierarchy + no generalized extreme value
- Possible applications: incentive to introduce a new product on the market, incentive to bundle products

Introduction

- Benchmark: the **nested logit model** accounts for multiple discrete characteristics (criteria) used to partition the choice set into groups (nests).
- Product choice follows a two (or more)-steps process: choose a group (e.g. cereal segment), then a product from the group
- **Concerns**: arbitrary hierarchy, restrictive substitution constraints, independence from irrelevant alternatives
- **Solution**: General Nesting Logit: product differentiation + segmentation (discrete criteria) + no hierarchy + no generalized extreme value
- Possible applications: incentive to introduce a new product on the market, incentive to bundle products

Generalized Entropy Model

- Representative consumer with income y
- Choice set of differentiated products $\mathcal{J} = \{0, 1, \ldots, J\}$
- Maximization of consumer's utility function: sum of expected utility and a generalized entropy function [deterministic function of the choice vector $q = (q_0, \ldots, q_J)$]

$$\max_{q \in \Delta} u(q, y) = \alpha z + \sum_j v_j q_j + \Omega(q)$$

$$\text{subject to budget constraint } y \geq \sum_j p_j q_j + z$$

- z consumption of the numeraire good
- α marginal utility of income
- v_j and p_j are the quality and price of product j
- $\Omega(q)$ is a generalized entropy function

Generalized Entropy Model

- Representative consumer with income y
- Choice set of differentiated products $\mathcal{J} = \{0, 1, \ldots, J\}$
- Maximization of consumer's utility function: sum of expected utility and a generalized entropy function [deterministic function of the choice vector $q = (q_0, \ldots, q_J)$]

$$\max_{q \in \Delta} u(q, y) = \alpha z + \sum_j v_j q_j + \Omega(q)$$

$$\text{subject to budget constraint } y \geq \sum_j p_j q_j + z$$

- z consumption of the numeraire good
- α marginal utility of income
- v_j and p_j are the quality and price of product j
- $\Omega(q)$ is a generalized entropy function

Entropy Function

- $\Omega(q)$ is a generalized entropy function
- $\Omega : [0, \infty)^{J+1} \rightarrow \mathbb{R} \cup \{-\infty\}$
- $\Omega(q) = -\sum_j q_j \; ln \; S^{(j)}(q)$ if $q \in \Delta$
- $\Omega(q) = -\infty$ if $q \notin \Delta$ (feasibility)
- $S(\cdot) = (S^{(0)}(\cdot), ..., S^{(J)}(\cdot))$ is a flexible generator which satisfies four conditions [Axiom 1, page 8]
- $S(q)$ is twice continuously differentiable, homogeneous of degree 1, and globally invertible, the Jacobian of $ln \; S$ is positive semi-definite and symmetric, and $-\frac{\partial \Omega(q)}{\partial q_k} = ln \; S^{(k)}(q) + 1$
- The last assumption is crucial to derive a tractable demand

Entropy Function

- $\Omega(q)$ is a generalized entropy function
- $\Omega : [0, \infty)^{J+1} \to \mathbb{R} \cup \{-\infty\}$
- $\Omega(q) = -\sum_j q_j \; ln \; S^{(j)}(q)$ if $q \in \Delta$
- $\Omega(q) = -\infty$ if $q \notin \Delta$ (feasibility)
- $S(\cdot) = (S^{(0)}(\cdot), ..., S^{(J)}(\cdot))$ is a flexible generator which satisfies four conditions [Axiom 1, page 8]
- $S(q)$ is twice continuously differentiable, homogeneous of degree 1, and globally invertible, the Jacobian of $ln \; S$ is positive semi-definite and symmetric, and $-\frac{\partial \Omega(q)}{\partial q_k} = ln \; S^{(k)}(q) + 1$
- The last assumption is crucial to derive a tractable demand

Main Result: Theorem 1

- We can define the net utility $\delta_j = v_j - \alpha p_j$ and rewrite the problem as maximization of the utility

$$u(q, y) = \alpha y + \sum_j \delta_j q_j - \sum_j q_j \; ln \; S^{(j)}(q)$$

- **Theorem 1.** [page 9] Let $S(q)$ be a flexible generator satisfying the conditions above. *Maximization of utility leads to a demand system with interior solution*

$$q_i(\delta) = \frac{H^{(i)}(e^{\delta})}{\sum_j H^{(j)}(e^{\delta})} \qquad \text{where} H^{(i)} = S^{-1(i)}$$

- When $S(q) = q$ we get Shannon entropy and we are back to logit demand [end of page 9]

Main Result: Theorem 1

- We can define the net utility $\delta_j = v_j - \alpha p_j$ and rewrite the problem as maximization of the utility

$$u(q, y) = \alpha y + \sum_j \delta_j q_j - \sum_j q_j \; ln \; S^{(j)}(q)$$

- **Theorem 1.** [page 9] Let $S(q)$ be a flexible generator satisfying the conditions above. Maximization of utility leads to a demand system with interior solution

$$q_i(\delta) = \frac{H^{(i)}(e^{\delta})}{\Sigma_j H^{(j)}(e^{\delta})} \qquad \text{where} H^{(i)} = S^{-1(i)}$$

- When $S(q) = q$ we get Shannon entropy and we are back to logit demand [end of page 9]

Implications of Theorem 1

- The demand system generalizes the logit demand
- RUM may differ in the RU distribution assumptions
- GEM may differ in the specifications of S
- For any ARUM there exists a GEM that leads to the same demand
- Some GEM are not consistent with any ARUM
- Properties of the GEM [pp 10-12]

General Nesting Logit

- Use product segmentation to add structure to the entropy function
- Market for differentiated products with segmentation in C criteria (dimensions) that generate nests. Products of the same type (i.e. grouped in all the dimensions) are in the same group
- Dimensions capture *similarity*: products of the same type are closer substitutes
- $\sigma_c(j)$ is the set of products grouped together with j on dimension c

$$S^j(q) = \begin{cases} q_0, & \text{if } q \in \Delta, j = 0 \\ q_j^{\mu_0} \prod_c q_{\sigma_c(j)}^{\mu_c}, & \text{if } q \in \Delta, j > 0 \\ -\infty & \text{if } q \notin \Delta \end{cases}$$

By imposing $\mu_c > 0$ and $\mu_0 + \sum_c \mu_c = 1$, $S(\cdot)$ satisfies axiom 1

General Nesting Logit

- Use product segmentation to add structure to the entropy function
- Market for differentiated products with segmentation in C criteria (dimensions) that generate nests. Products of the same type (i.e. grouped in all the dimensions) are in the same group
- Dimensions capture *similarity*: products of the same type are closer substitutes
- $\sigma_c(j)$ is the set of products grouped together with j on dimension c

$$S^j(q) = \begin{cases} q_0, & \text{if } q \in \Delta, j = 0 \\ q_j^{\mu_0} \prod_c q_{\sigma_c(j)}^{\mu_c}, & \text{if } q \in \Delta, j > 0 \\ -\infty & \text{if } q \notin \Delta \end{cases}$$

By imposing $\mu_c > 0$ and $\mu_0 + \sum_c \mu_c = 1$, $S(\cdot)$ satisfies axiom 1

Issues with GNL model

- There is an analytic formula for the **inverse** market shares only. Recovering the market shares requires inverting a system of nonlinear equations (it cannot be performed analytically)
- A priori symmetric restrictions on the substitution patterns (at the market level) that may hold only at the individual level [same problem as in the family of generalized extreme value models]

Market for Cereals

- Two dimensions: brand name (Kellogg's or General Mills) and segment (familry or kids)
- The 3-levels NL assumes a hierarchical structure, requires the a priori assumption between two cases, and its generator becomes $S^{(j)}(q) = q_j^{\mu_0} q_{\sigma_1(j)}^{\mu_1} q_{\sigma_2(j)}^{\mu_2}$
- Note that $\sigma_2(j)$ is a subset of $\sigma_1(j)$

- GNL model removes the hierarchy assumption and treats the dimensions symmetrically and independently
- Key difference: $\sigma_2(j)$ is not necessarily a subset of $\sigma_1(j)$
- GNL is observationally equivalent to the 3-lv NL with nested parameters (γ_1, γ_2) when $\gamma_1 = \mu_1$ and $\gamma_2 = \mu_1 + \mu_2$

Market for Cereals

- Two dimensions: brand name (Kellogg's or General Mills) and segment (familry or kids)
- The 3-levels NL assumes a hierarchical structure, requires the a priori assumption between two cases, and its generator becomes $S^{(j)}(q) = q_j^{\mu_0} q_{\sigma_1(j)}^{\mu_1} q_{\sigma_2(j)}^{\mu_2}$
- Note that $\sigma_2(j)$ is a subset of $\sigma_1(j)$

- GNL model removes the hierarchy assumption and treats the dimensions symmetrically and independently
- Key difference: $\sigma_2(j)$ is not necessarily a subset of $\sigma_1(j)$
- GNL is observationally equivalent to the 3-lv NL with nested parameters (γ_1, γ_2) when $\gamma_1 = \mu_1$ and $\gamma_2 = \mu_1 + \mu_2$

Elasticities [Page 17, Appendix B.2]

- We can compute the analytic formula for the matrix of own- and cross-price elasticities (not market shares, thought)
- Each criteria has a nesting structure matrix Θ_c
- Build a market structure matrix

$$\rho(\mu, \Theta) = \left[\mu_0 I_J + \sum_c \mu_c \frac{q_j}{q_{\sigma_c(j)}} \Theta_c\right]^{-1}$$

- Obtain the matrix of own- and cross- price elasticities

$$\Sigma = \left[\frac{\partial q_j}{\partial p_i} \frac{p_i}{q_j}\right] = -\alpha \operatorname{diag}(pq)\rho(\mu, \Theta)(\operatorname{diag}(1/q) - J_J)$$

Elasticities [Page 17, Appendix B.2]

- We can compute the analytic formula for the matrix of own- and cross-price elasticities (not market shares, thought)
- Each criteria has a nesting structure matrix Θ_c
- Build a market structure matrix

$$\rho(\mu, \Theta) = \left[\mu_0 I_J + \sum_c \mu_c \frac{q_j}{q_{\sigma_c(j)}} \Theta_c\right]^{-1}$$

- Obtain the matrix of own- and cross- price elasticities

$$\Sigma = \left[\frac{\partial q_j}{\partial p_i} \frac{p_i}{q_j}\right] = -\alpha \text{ diag } (pq)\rho(\mu, \Theta)(\text{diag } (1/q) - J_J)$$

Elasticities [Page 17, Appendix B.2]

- We can compute the analytic formula for the matrix of own- and cross-price elasticities (not market shares, thought)
- Each criteria has a nesting structure matrix Θ_c
- Build a market structure matrix

$$\rho(\mu, \Theta) = \left[\mu_0 I_J + \sum_c \mu_c \frac{q_j}{q_{\sigma_c(j)}} \Theta_c\right]^{-1}$$

- Obtain the matrix of own- and cross- price elasticities

$$\Sigma = \left[\frac{\partial q_j}{\partial p_i} \frac{p_i}{q_j}\right] = -\alpha \text{ diag } (pq)\rho(\mu, \Theta)(\text{diag } (1/q) - J_J)$$

Econometric Setting

- Net utility for product j

$$\delta_{jt}(\cdot) = \beta_0 + \mathbf{X}_{jt}\beta - \alpha p_{jt} + \xi_{jt}$$

- Some confusion about ξ_{jt} (unobserved product characteristic): consider $\xi_{jt} = \xi_j + \xi_t + u_{jt}$

- Relation between utility and market shares

$$ln\ S^{jt}(q;\theta_2) = \delta_{jt}(X, p, \xi; \theta_1) + c_t$$

- It follows that

$$ln\ S^{jt}(q;\theta_2) - ln\ S^{0t}(q;\theta_2) = \delta_{jt}(X, p, \xi; \theta_1)$$

- And finally the system of demand equations

$$ln\ (q_{jt}) - ln\ (q_{0t}) = \delta_{jt}(X, p, \xi; \theta_1) + \sum_c \mu_c ln\ \left(q_{jt}/q_{\sigma_c(jt)}\right)$$

Econometric Setting

- Net utility for product j

$$\delta_{jt}(\cdot) = \beta_0 + \mathbf{X}_{jt}\beta - \alpha p_{jt} + \xi_{jt}$$

- Some confusion about ξ_{jt} (unobserved product characteristic): consider $\xi_{jt} = \xi_j + \xi_t + u_{jt}$

- Relation between utility and market shares

$$ln\ S^{jt}(q;\theta_2) = \delta_{jt}(X,p,\xi;\theta_1) + c_t$$

- It follows that

$$ln\ S^{jt}(q;\theta_2) - ln\ S^{0t}(q;\theta_2) = \delta_{jt}(X,p,\xi;\theta_1)$$

- And finally the system of demand equations

$$ln\ (q_{jt}) - ln\ (q_{0t}) = \delta_{jt}(X,p,\xi;\theta_1) + \sum_c \mu_c ln\ \left(q_{jt}/q_{\sigma_c(jt)}\right)$$

Empirical Application: Demand for Cereals

- Data
  - Dominick's Database: ready-to-eat cereals, Chicago, 1991-92
  - Segmentation as in Nevo 2001
  - Nutrient content from USDA Nutrient Database for Standard Reference
  - Price of sugar (instrument)
  - Restriction on top 50 brands (73% of sales)
  - Market shares calculated based on number of servings
- Descriptive statistics
  - Four segments (family, kids, health, taste enhanced)
  - Six brand names (General Mills, Kellogg's, Quakers, Post, Nabisco, Ralston)
  - 17 types of products

Empirical Application: Demand for Cereals

- Data
  - Dominick's Database: ready-to-eat cereals, Chicago, 1991-92
  - Segmentation as in Nevo 2001
  - Nutrient content from USDA Nutrient Database for Standard Reference
  - Price of sugar (instrument)
  - Restriction on top 50 brands (73% of sales)
  - Market shares calculated based on number of servings
- Descriptive statistics
  - Four segments (family, kids, health, taste enhanced)
  - Six brand names (General Mills, Kellogg's, Quakers, Post, Nabisco, Ralston)
  - 17 types of products

Identification [pp. 23-25]

- Unobserved product characteristic $\xi_{jt} = \xi_j + \xi_t + u_{jt}$
- u_{jt} (residual term) includes advertising, shelf-space, positioning,...
- Endogeneity: prices and nesting terms
- Instruments z_t
- **Characteristics-based instruments**: promotional activity (heterogeneous across stores and time)
- Number of promoted products in the same segment (NL and GNL) and same type (GNL only)
- **Cost-based instrument**: input prices. Sugar $\times$ sugar content
- Instruments are not weak

Results: GNL vs 3-levels NL models

	(1) GNL	(2) 3NL1	(3) 3NL2
Price ($-\alpha$)	-1.114***	-2.499***	-2.642***
	(0.0896)	(0.118)	(0.130)
Segment/nest (μ_1)	0.608***	0.778***	0.768***
	(0.0102)	(0.00882)	(0.00996)
Company/subnest (μ_2)	0.293***	0.818***	0.807***
	(0.0103)	(0.00715)	(0.00802)
Promotion (β)	0.0704***	0.0924***	0.107***
	(0.00272)	(0.00326)	(0.00348)
Fixed Effects Segments (γ)			
Health/nutrition (γ_H)	-0.647***	-0.876***	-0.0569***
	(0.0110)	(0.00752)	(0.00567)
Kids (γ_K)	-0.435***	-0.554***	0.0336***
	(0.00886)	(0.00868)	(0.00443)
Taste enhanced (γ_T)	-0.683***	-0.926***	-0.0682***
	(0.0114)	(0.00753)	(0.00586)
Fixed Effects Brand Names (θ)			
Kellogg's (θ_K)	0.0541***	-0.0429***	0.160***
	(0.00422)	(0.00340)	(0.00536)
Nabisco (θ_N)	-0.867***	-0.207***	-2.277***
	(0.0275)	(0.0118)	(0.0191)
Post (θ_P)	-0.545***	-0.185***	-1.451***
	(0.0165)	(0.00946)	(0.00858)
Quaker (θ_Q)	-0.573***	-0.308***	-1.511***
	(0.0166)	(0.0150)	(0.00669)
Ralston (θ_R)	-0.871***	-0.228***	-2.382***
	(0.0277)	(0.0131)	(0.0175)
Constant (β_0)	-0.141*	0.221***	-0.102
	(0.0570)	(0.0668)	(0.0678)
Observations	99281	99281	99281
RMSE	0.237	0.267	0.274
F-test for price	464.47	514.32	471.42
F-test for segment/nest	359.01	468.09	467.46
F-test for brand/subnest	326.60	488.31	464.10

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: The dependent variable is $\ln(q_{jt}) - \ln(q_{0t})$. Regressions include fixed effects for brand names and segments, months, and stores. Robust standard errors are reported in parentheses. The Sanderson-Windmeijer F statistics are reported for the weak identification test.

Parameter estimates from the main specifications

Results: Substitution Patterns

Type	Brand	Segment	Own	Cross							
				General Mills				Kellogg's			
				Family 1	Health 2	Kids 3	Taste 4	Family 5	Health 6	Kids 7	Taste 8
1	General Mills	Family	-2.7524	0.2396	0.1179	0.0896	0.0990	0.0792	-0.0425	-0.0708	-0.0613
2	General Mills	Health/nutrition	-2.7123	0.0775	0.3844	0.0760	0.0815	-0.0455	0.2615	-0.0469	-0.0414
3	General Mills	Kids	-2.9885	0.0664	0.0858	0.2999	0.0799	-0.0286	-0.0092	0.2049	-0.0150
4	General Mills	Taste enhanced	-2.5691	0.0688	0.0864	0.0749	0.3592	-0.0375	-0.0199	-0.0313	0.2529
5	Kelloggs	Family	-2.2305	0.0810	-0.0717	-0.0396	-0.0554	0.2035	0.0509	0.0829	0.0671
6	Kelloggs	Health/nutrition	-2.3392	-0.0312	0.2917	-0.0091	-0.0207	0.0365	0.3594	0.0586	0.0470
7	Kelloggs	Kids	-2.9261	-0.0411	-0.0416	0.1615	-0.0267	0.0475	0.0469	0.2500	0.0618
8	Kelloggs	Taste enhanced	-2.1892	-0.0454	-0.0468	-0.0156	0.2704	0.0488	0.0474	0.0786	0.3643
9	Nabisco	Health/nutrition	-1.5646	0.0011	0.0469	0.0007	0.0013	-0.0022	0.0436	-0.0025	-0.0020
10	Post	Health/nutrition	-1.2850	0.0085	0.1959	-0.0528	-0.0300	-0.0104	0.1770	-0.0718	-0.0489
11	Post	Kids	-2.7172	-0.0054	-0.0516	0.0824	-0.0310	0.0054	-0.0407	0.0932	-0.0201
12	Post	Taste enhanced	-1.6185	-0.0019	-0.0532	-0.0503	0.1695	-0.0012	-0.0525	-0.0496	0.1701
13	Quaker	Family	-1.9753	0.0486	-0.0024	-0.0566	-0.0314	0.0426	-0.0084	-0.0626	-0.0374
14	Quaker	Kids	-1.9466	-0.0111	-0.0033	0.0750	-0.0320	-0.0041	0.0037	0.0820	-0.0249
15	Quaker	Taste enhanced	-1.5042	-0.0073	0.0009	-0.0609	0.1574	-0.0118	-0.0035	-0.0653	0.1529
16	Ralston	Family	-2.1511	0.0211	-0.0016	-0.0209	-0.0018	0.0188	-0.0039	-0.0232	-0.0041
17	Ralston	Kids	-2.8539	-0.0224	-0.0018	0.0649	0.0008	-0.0158	0.0048	0.0715	0.0075

Average price elasticities for the GNL models

Summary

- Very preliminary version of the paper (no Conclusions)
- Model (GNL): additional flexibility wrt classic NL allows to generate complementarity, accommodates for more violations of IIA, and requires less a priori assumptions
- Application (cereals): estimated parameters are highly sensitive to the order of nesting. Top nesting is always estimated as less important (higher substitutability)
- Relevant implications for counterfactual analysis, product introduction, and bundling

The General Nesting Logit (GNL) Model using Aggregate Data

Andre de Palma and Julien Monardo (2017)

Presented by Silvio Ravaioli

June 27, 2019