A comparison of generalized multinomial logit, random parameters logit, wtp-space and latent class models to studying consumers’ preferences for animal welfare

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1. INTRODUCTION: Background

- **ANIMAL WELFARE** is becoming a relevant **FACTOR** affecting **CONSUMER PREFERENCES**.
- Consumers are **DEMANDING** animals being reared **AS CLOSELY AS POSSIBLE** as they would be in their **NATURAL CONDITIONS**.
- Is becoming a prominent **POLITICALLY SENSITIVE** issue in EU
- Resulting in **CONTINUOUS CHANGES** in **REGULATIONS**.
- EU regulations **BAN** a number of **INTENSIVE** farming methods.
1. INTRODUCTION: Background

- **PIG WELFARE** is receiving **SPECIAL ATTENTION**.
- **BANNED** the use of **SOW STALLS** by January 2012.
1. INTRODUCTION: Background

- **BAN PIG CASTRATION** (2018), which may affect **CONSUMER PREFERENCES** as an **ANIMAL WELFARE** measure.
- However **CASTRATION**:  
  - To **AVOID** the **RISK** of obtaining meat with **BOAR TAINT**
  - **OFF-ODOUR** and **FLAVOUR** in meat
  - Can **NEGATIVELY** affect **CONSUMERS’ ACCEPTABILITY**
  - **NOT ALL** consumers are **SENSITIVE** to boar taint

There is an associated **MEAT (sensory) QUALITY** problem
1. INTRODUCTION: Background

**ANIMAL WELFARE**

Ban Castration

**MEAT QUALITY**

Avoid Boar taint

Trade-off
1. INTRODUCTION: Background

- ≈ 40% of total EU pigs are CASTRATED WITHOUT ANESTHESIA
- LEGALLY performed during the first SEVEN days after birth
- After that should only be performed under ANESTHESIA and must include a prolonged ANALGESIA by a VETERINARIAN
1. INTRODUCTION: Background

- **Alternatives to CASTRATION:**
  - Genetic **SELECTION** for ‘low-taint’ breeds
  - Different **MANAGEMENT** strategies
  - Slaughter at a **YOUNGER** age and **LOWER** weight
  - **MASKING** boar taint with different **STRATEGIES** such as spices, marinades or heat treatment.

- **We developed a** **MASKING STRATEGY** (herbs + spices + smoking)
- **FRANKFURTER SAUSAGES**
1. INTRODUCTION: Objectives

1. CONSUMERS’ EXPECTED PREFERENCE  ➔  Masking strategy.

2. CONSUMERS ACCEPTANCE  ➔  Eating test (Sensory evaluation)

3. How EXPECTATIONS are AFFECTED are affected.

4. To COMPARE results between different MODELLING approaches (RPL, GMNL, WTP-Space & LC).
2. METHODOLOGICAL FRAMEWORK

- TWO NON-HYPOTHETICAL DISCRETE CHOICE EXPERIMENTS.

- REAL SHOPPING SCENARIO

- Consumers REWARDED by €15 to participate.
We attempted to **MIMIC CONSUMER REACTION** when facing a **NEW PRODUCT** in a purchase point.

1. Questionnaire
2. Choice Experiment
3. Sensory test
4. Information
5. Repeat choice experiment
6. Shopping scenario

- **Expectation (Shelves)**
- **Eating (at home)**
- **Agreement or disagreement (repurchase)**
2. METHODOLOGICAL FRAMEWORK: Steps

1. First, SHORT QUESTIONNAIRE

   - ATTITUDES
   - OPINIONS
   - CONSUMPTION
   - SOCIOECONOMIC
   - LIFE-STYLE
2. METHODOLOGICAL FRAMEWORK: Steps

2. Second, the first DCE exercise was applied

- Participants **UNEXPECTEDLY REWARDED** by an extra €5
- Select **THEIR PREFERRED** products from different choice sets.
- **REAL MARKET** is created at the **END** of the experiment to **EXCHANGE REAL MONEY** and **REAL PRODUCTS**.
- Consumers who agreed to participate were asked to **PURCHASE** one **RANDOMLY** selected product and to **PAY** its posted price.
1. EXPECTATIONS ARE OBTAINED
3. Third, a **HEDONIC EVALUATION** test: Nine-point scale (1 ‘dislike extremely’; 2 ‘dislike very much’; 3 ‘dislike moderately’; 4 ‘dislike slightly’; 5 ‘neither like nor dislike’; 6 ‘like slightly’; 7 ‘like moderately’; 8 ‘like very much’; and 9 ‘like extremely’).

- **CREATE EATING EXPERIENCE**
- **4 FRANKFURTER SAUSAGES**
  i. CASTRATED + ORIGINAL FLAVOUR
  ii. CASTRATED + MASKING FLAVOUR
  iii. NON-CASTRATED + ORIGINAL FLAVOUR
  iv. NON-CASTRATED + MASKING FLAVOUR
2. METHODOLOGICAL FRAMEWORK: Steps

4. Fourth, participants were INFORMED what they TASTED
   - Given 5 minutes to check their LIKING SCORES
   - Asked to ASSOCIATE their sensory EXPERIENCE with the SPECIFIC products and characteristics.
2. INFORMED EATING EXPERIENCE IS OBTAINED
2. METHODOLOGICAL FRAMEWORK: Steps

4. Fifth, the SAME CHOICE EXPERIMENT was REPEATED

- Participants turned to RESELECT their PREFERRED PRODUCTS from the same choice sets.
- REVIEW the FIRST DCE to CONTROL for RANDOM CHANGES.
- Take into CONSIDERATION their SENSORY EXPERIENCE and considering the product the LIKE the MOST and the product the LIKE the LEAST and the products BETWEEN.
2. METHODOLOGICAL FRAMEWORK: Steps

5. SIXTH, a REAL SHOPPING SCENARIO was created to exchange real product and money.
   - RANDOMLY selected Choice set and product
   - Consumers who accepted to participate SHOULD PURCHASE their CHOSEN product.
   - PAY its posted price
   - TAKE a real product
   - If the “NO-PURCHASE” was selected, then NO REAL exchange was realized
3. AGREEMENT OR DESAGREEMENT WITH EXPECTATIONS IS OBTAINED
2. METHODOLOGICAL FRAMEWORK: Sample

- 150 consumers selected from Madrid

**RECRUITMENT** criteria

- Regularly **PURCHASE** food
- Having **PURCHASED AND CONSUMED** FRANKFURTER sausage at least **ONE TIME** in the last **MONTH**
- **Stratified** by gender, age and postal code
3. EMPIRICAL APPLICATION: The DCE: Attributes and levels

- Literature and discussion groups
  - FLAVOUR: original, masking strategy
  - CASTRATION: meat from castrated or non-castrated
  - BRAND TYPE: manufacturer and private brands.
  - PRICE: €1.79, €1.39, €0.99, €0.59

- One relevant LIMITATION in NON-HYPOTHETICAL Choice experiment is to avoid “consumers’ DECEPTION”
3. EMPIRICAL APPLICATION: The DCE: Attributes and levels

- “Deception is defined as an act or statement _INTENDED_ to make _PEOPLE BELIEVE_ something that is _NOT TRUE_.”

- Were _FORCED_ to _DELIVER_ consumers the “_EXACT_” product presented in the _CHOICE SETS_.

- Select only the _ATTRIBUTES_ that we were able to “_CONTROL_” and “_PRODUCE_”.

- _BEHAVIORAL ECONOMIC_ is in general _STRICT_ about using _DECEPTION_ in economic experiments, while other disciplines (e.g. psychology) _ALLOW IT_.

3. EMPIRICAL APPLICATION: The DCE: Design

- Orthogonal fractional factorial design with only 8 CHOICE SETS.
  D-efficient 100%.

- Participants were also asked to perform:
  - WARMING-UP choice set
  - Final additional task: HOLD-OUT TASK.
3. EMPIRICAL APPLICATION: The DCE: Design

**CHOICE SET 4**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat of boar</td>
<td>1.79 €</td>
</tr>
<tr>
<td>Meats with spices and naturally smoked</td>
<td>Manufacturer brand</td>
</tr>
<tr>
<td>Meat of castrated pig</td>
<td>Original flavour</td>
</tr>
<tr>
<td>Meats with spices and naturally smoked</td>
<td>Manufacturer brand</td>
</tr>
<tr>
<td>Meat of boar</td>
<td>Original flavour</td>
</tr>
</tbody>
</table>

Which product would you prefer if there were only these 4 products in their usual place of purchase?

A | B | C | D

Would you buy the product you have chosen above?

Yes | No
3. EMPIRICAL APPLICATION: The DCE: Design

Special choice set – The hold out task

Which product would you prefer if there were only these 8 products in their usual place of purchase?

Would you buy the product you have chosen above? Yes No
3. EMPIRICAL APPLICATION: The DCE: Real market

3. EMPIRICAL APPLICATION: The DCE: Real market

- FOLLOW-UP questions
  - CERTAINTY
  - COMPLEXITY
  - NON-ATTENDANCEES (yes/no)
  - RELATIVE IMPORTANCE of attributes (0-10)

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
</table>

3. EMPIRICAL APPLICATION: The DCE: Econometric model

- The Mixed Logit Model (MIXL)

\[ U_{njt} = \beta_n x_{njt} + \varepsilon_{njt} / \sigma_n \quad n = 1, \ldots, N \quad j = 1, \ldots, J \quad t = 1, \ldots, T \]

- Extend the MNL introducing for unobserved heterogeneity

- Recent studies argued that much of the PREFERENCE HETEROGENEITY captured by random parameters in MIXL can be better captured by the scale term (SCALE HETEROGENEITY).

- The MIXL turns to be likely a POOR APPROXIMATION if scale heterogeneity is not accounted for.
3. EMPIRICAL APPLICATION: The DCE: Econometric model

The Generalized Multinomial Logit Model (GMNL)

\[ U_{njt} = \left[ \sigma_n \beta + \gamma \eta_n + (1 - \gamma) \sigma_n \eta_n \right] X_{njt} + \varepsilon_{njt} \]

- \( \sigma_n \) is a SCALING FACTOR that proportionately scales the \( \beta \) UP or DOWN.
- \( \delta \) is a MIXING PARAMETER that determines the level of MIXING between the SCALE heterogeneity and the PARAMETER heterogeneity.
3. EMPIRICAL APPLICATION: The DCE: Econometric model

- The GMNL-WTP space specification

\[ U_{njt} = \sigma_n \beta_{p,n} (-p + \left( \frac{\beta'_n}{\beta_{p,n}} \right) X_{njt}) + [\gamma \eta_n + (1-\gamma)\sigma_n \eta_n] X_{njt} + \epsilon_{njt} \]

- GMNL model can be REPARAMETRIZED.

- Directly GIVES the individual-specific WTP ESTIMATES.

- BYPASSES the NECESSITY of specifying the distribution of the RATIO of two RANDOM parameters.
3. EMPIRICAL APPLICATION: The DCE: Econometric model

- Latent Class model (LC)

- The LC DETERMINE the PROBABILITY of an individual to belong to the CLASSES and the class PROBABILITIES of CHOOSING one alternative CONDITIONAL on the preferences within each CLASS.

\[
\Pr(y_{i,j,t} = 1 \mid i \in C) = \frac{\exp(\beta_c' X_{i,j,t})}{\sum_{j=1}^{J} \exp(\beta_c' X_{i,j,t})}
\]
3. EMPIRICAL APPLICATION: The DCE: Econometric model

- Willingness to pay (price continuous coding)

\[ IP_{\text{Product_attribute}} = -\left( \frac{\beta_{\text{Product_attribute}}}{\beta_{\text{monetary_attribute}}} \right) \]

- The relative importance (Price as effect coding)

\[ I_k = \frac{\left( \max \beta_k - \min \beta_k \right)}{\sum_{k=1}^{K} \left( \max \beta_k - \min \beta_k \right)} \]

- To compare with the relative importance of attributes obtained from linear scale from 0 to 10.
3. EMPIRICAL APPLICATION: The DCE: Econometric model

- HALTON Sequence estimation in Nlogit 5
  - Authors differ in the appropriate value.
  - Train recommends **SEVERAL HUNDRED**
  - Bhat suggests **1,000** as an appropriate value
  - We used **500 DRAWS**

- NORMAL DISTRIBUTION
### 4. RESULTS: Sensory results

#### Creating the Sensory Experience

<table>
<thead>
<tr>
<th>Type of pork meat</th>
<th>Overall liking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original sausage from non-castrated</td>
<td>5.46&lt;sup&gt;c&lt;/sup&gt; (1.61)</td>
</tr>
<tr>
<td>Sausage from non-castrated WITH MASKING STRATEGY</td>
<td>6.42&lt;sup&gt;a&lt;/sup&gt; (1.18)</td>
</tr>
<tr>
<td>Original sausage from castrated pig</td>
<td>5.91&lt;sup&gt;b&lt;/sup&gt; (1.30)</td>
</tr>
<tr>
<td>Sausage from castrated pig WITH MASKING STRATEGY</td>
<td>6.62&lt;sup&gt;a&lt;/sup&gt; (1.29)</td>
</tr>
</tbody>
</table>

- The **APPLIED MASKING STRATEGY** had a **POSITIVE EFFECT** on frankfurter sausage **ACCEPTANCE**.
- No difference between **CASTRATED** or **NON-CASTRATED**
- GOODNESS OF FIT
  - Psuedo $R^2$
  - AIC information criteria
  - Log_likelhood improvement

- Th GMNL-WTP space showed the highest GOODNESS OF FIT.
BEFORE THE EATING EXPERIENCE, consumers exhibit a preference for meat obtained from PIGS REARED IN NATURAL CONDITION (i.e. non-castrated) as a potential preference for a positive pig welfare.

Class 3 (Non-preference).
However, **AFTER TASTING** The utility of **CASTRATION** decrease → **ANIMAL WELFARE** turns to be **NON-RELEVANT**.
- For the **BRAND**, consumers do not prefer **PRIVATE** brands.

- **NON-SIGNIFICANT DIFFERENCES** BEFORE and AFTER eating.
- FLAVOUR, BEFORE eating → NEGATIVE EXPECTED PREFERENCE.
- However, AFTER eating their utility become POSITIVE
- **TAU PARAMETER** that captures the **SCALE HETEROGENEITY**
  - High and significant scale before tasting
  - Non-significant scale after tasting
- After the sensory experience the **VARIATION OF THE DEGREE OF UNCERTAINTY DECREASED** significantly.
- NEXT STEPS
  - WTP comparisons
  - RELATIVE IMPORTANCE comparisons with the Likert Scale
  - Include NON-ATTENDANCE
  - HOLD-OUT task
5. CONCLUSIONS

- The SENSORY EXPERIENCE may had impact on:

  1. PREFERENCE
     - Consumers would prefer MEAT QUALITY than ANIMAL WELFARE.

  2. SCALE PARAMETER.
     - The SENSORY EXPERIENCE DECREASED the degree of UNCERTAINTY.

- WTP-SPACE model seems to best fit the data.
5. CONCLUSIONS

These results HIGHLIGHT the IMPORTANCE of the DIRECT PROMOTION and the in situ MARKETING TECHNIQUES of these types of product in the retail point by GIVING POTENTIAL CONSUMERS THE OPPORTUNITY to test the product.
Thank you for your attention