STRUCTURAL ECONOMETRIC DEMAND ANALYSIS

DATA
Family Expenditure Surveys

THEORY
Consumer Choice Theory

ECONOMETRIC MODEL
Engel curves
Demand functions
THE ISSUE
Household expenditures for particular goods or services often display a large proportion of zeros that call for an economic explanation.

CENSORING MECHANISMS

- LACK OF RESOURCES
  - Non essential goods

- GOOD REFUSAL
  - Harmful and replaceable goods

- PURCHASE INFREQUENCY
  - Seasonal, Storable and durable goods
# Seminal papers

## Single equation models

<table>
<thead>
<tr>
<th>Model</th>
<th>Author</th>
<th>Censoring mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobit Model</td>
<td>Tobin (1958)</td>
<td>Lack of resources</td>
</tr>
<tr>
<td>Single hurdle model</td>
<td>Cragg (1971)</td>
<td>Good refusal</td>
</tr>
<tr>
<td>Double hurdle model</td>
<td>Cragg (1971)</td>
<td>Good refusal and lack of resources</td>
</tr>
<tr>
<td></td>
<td>Blundell (1987)</td>
<td></td>
</tr>
<tr>
<td>P-Tobit model</td>
<td>Deaton and Irish (1984)</td>
<td>Purchase infrequency and lack of resources</td>
</tr>
</tbody>
</table>

## Systems of demand equations

<table>
<thead>
<tr>
<th>Author</th>
<th>Censoring mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wales and Woodland (1982)</td>
<td>Lack of resources</td>
</tr>
<tr>
<td>Hanemann (1984)</td>
<td>Good refusal</td>
</tr>
<tr>
<td>Robin and Meghir (1992)</td>
<td>Purchase infrequency</td>
</tr>
<tr>
<td>Boizot, Robin and Visser (2001)</td>
<td>Purchase infrequency</td>
</tr>
</tbody>
</table>
A comprehensive econometric framework: The triple-hurdle model

Latent variable relation  
censoring rule

Good selection  
\[ y_1^* = \beta_1' x_1 + \epsilon_1 \]  
\[ l_1 = \begin{cases} 
1 & \text{if } y_1^* > 0 \\
0 & \text{if } y_1^* \leq 0 
\end{cases} \]

Good consumption  
\[ y_2^* = \beta_2' x_2 + \epsilon_2 \]  
\[ l_2 = \begin{cases} 
1 & \text{if } y_2^* > 0 \\
0 & \text{if } y_2^* \leq 0 
\end{cases} \]

Good purchase  
\[ y_3^* = \beta_3' x_3 + \epsilon_3 \]  
\[ l_3 = \begin{cases} 
1 & \text{if } y_3^* > 0 \\
0 & \text{if } y_3^* \leq 0 
\end{cases} \]

(1)

\[
\begin{bmatrix}
\epsilon_1 \\
\epsilon_2 \\
\epsilon_3
\end{bmatrix} \sim \mathcal{N}
\begin{bmatrix}
0 \\
0 \\
0
\end{bmatrix}
; 
\begin{bmatrix}
1 & \sigma \rho_{12} & \rho_{13} \\
\sigma \rho_{12} & \sigma^2 & \sigma \rho_{23} \\
\rho_{13} & \sigma \rho_{23} & 1
\end{bmatrix}
\]

(2)

Observation equation:  
\[ y = \frac{y_2^*}{P\{l_1 l_2 l_3 = 1\}} l_1 l_2 l_3 \]
Using a priori information to specify particular hurdle models

- One or more censoring mechanisms are ineffective. If the “lack of resources” mechanism is inoperative, the desired consumption equation is respecified to enforce non-negative consumption levels according to the following specifications:
  - log-normal: $\ln y^*_2 \sim N(\beta' x_2, \sigma^2)$,
  - truncated normal: $y^*_2 \sim NT_{R^+}(\beta' x_2, \sigma^2)$

- Some or all correlation coefficients $\rho_{12}, \rho_{13}, \rho_{23}$ may be set equal to zero entailing a partial or total independance between the censoring mechanisms
The full set of mhurdle models

× logical inconsistent model
mhurdle rationale

- Syntax:
  ```r
  mhurdle(formula, data, subset, weights, na.action, 
          start = NULL, dist = c("l","t","n"), res = FALSE, 
          sel = TRUE, ifr = FALSE, corr = FALSE, ...)
  ```

  two-parts formula  \( y \sim x1 + x2 \mid s1 + s2 \)

- Starting values

- Numerical optimisation methods: `maxLik`
An expenditure model for cigarettes in France (2001)

Survey time length excludes purchase infrequency as a relevant censoring mechanism

A priori relevant censoring mechanisms

✓ Good selection mechanism (SEL),
✓ Lack of ressources mechanism (RES),
✓ Good selection and lack of ressources mechanisms (SEL/RES).
Choice of explanatory variables

Good selection equation:
- Socio-professional status,
- Socio-demographic characteristics of family head
- Stress factors
- Health

Good consumption equation:
- Income
- Socio-professional status,
- Socio-demographic characteristics of family head
- Education-Training
- Financial situation
- Sports practice
Model validation and selection

Quality of fit measures

<table>
<thead>
<tr>
<th></th>
<th>RES</th>
<th>RES/SEL</th>
<th>SEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Censored</td>
<td>0.34</td>
<td>0.32</td>
<td>0.35</td>
</tr>
<tr>
<td>Uncensored</td>
<td>0.03</td>
<td>0.06</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Vuong test

<table>
<thead>
<tr>
<th></th>
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<th>RES/SEL</th>
<th>SEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RES</td>
<td>♦</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RES/SEL</td>
<td>6.82</td>
<td>♦</td>
<td></td>
</tr>
<tr>
<td>SEL</td>
<td>9.87</td>
<td>7.05</td>
<td>♦</td>
</tr>
</tbody>
</table>

\[ H_0 : A \sim B \iff t_\alpha < V < t_{1-\alpha} \]
\[ H_1 : A \succ B \iff V \to \infty \]
\[ H_2 : A \prec B \iff V \to -\infty \]