Progress of the SEFIRA Project: Focus on the Discrete Choice Analysis Pilot

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Structure

1. Quick overview of the SEFIRA project
2. Frames the role of acceptability, socio-economic environment and individual behaviour
3. Shows how *Discrete Choice Models* (DCMs) can constrain the role of individual acceptability in air quality improvement.
The first part provides a... 

1 quick overview of the SEFIRA project

2 Frames the role of acceptability, socio-economic environment and individual behaviour

3 Description of discrete choice models (DCM) use in the study of the role of acceptability in individual choices concerning air quality improvement
Why SEFIRA?

Because...

...the cost-benefit analysis, although a valuable tool, is of limited value in assessing the wider acceptability of policies, particularly in relation to the impact on individual behaviour.

Indeed...

“We have learned that public awareness is of key importance for the implementation of existing air policy, as well as for the success of any future air pollution strategy”

Janez Potočnik
European Commissioner for Environment
(Final speech at Brussels EU Green Week 2013 - 07/06/2013)
SEFIRA’s objectives

- To integrate scientific and technical knowledge on air quality with socio-economic aspects of air pollution policies (multidisciplinary approach);
- To study socio-economic implications of individual responses to air pollution policies;
- To apply *Discrete Choice Models* (DCMs) to the study of the role of individual acceptability in air quality improvement;
- To provide specific interdisciplinary reports in support of the implementation of the EU air policy through dissemination among key stakeholders.
A multidisciplinary team

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<thead>
<tr>
<th>Field</th>
<th>Logo 1</th>
<th>Logo 2</th>
<th>Logo 3</th>
<th>Logo 4</th>
<th>Logo 5</th>
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The SEFIRA workplan

WP1: Coordination and management

WP2: Atmospheric science and policies review

WP3: Individuality law, society, environmental science

WP4: Pilot research
Discrete Choice Experiment

WP5: Integration and policy design

WP6: Communication and outreach
The SEFIRA workplan

WP1: Coordination and management

WP2: Atmospheric science and policies review

WP3: Individuality law, society, environmental science

WP4: Pilot research Discrete Choice Experiment

WP5: Integration and policy design

WP6: Communication and outreach
The second part shows...

1. Presents an overview of the SEFIRA project

2. How do we frame the role of acceptability, socio-economic environment, and individual behaviour in air quality policies?

3. Shows how we apply discrete choice models (DCM) to the study of the role of acceptability in individual choices concerning air quality improvement;
The DCM Pilot Project

WP4 goal
Understanding how individuals valuate different acceptability drivers/attributes related to air quality policies;

WP4 methodology
Discrete Choice Models (Ben Akiva, Lerman 1985, McFadden 1973-1978, Manski, McFadden, 1981);

WP4 challenge
Verifying if it is possible to integrate Discrete Choice Experiment results in the GAINS model.
The role of Acceptability (1)

- **Acceptability** is crucial for the implementation and effectiveness of policies.

- There are different **drivers** affecting the individual acceptability: problem perception, social norms, knowledge about options, perceived effectiveness and efficiency, equity and fairness, socio-economic and system characteristics, etc.

- It is important to understand the existing **links** among acceptability drivers and policies, but also the **trade-offs** among the different drivers.
The role of Acceptability (2)

- **Discrete Choice Models** focus on identifying the underlying influences on an individual’s choice behaviour, estimating the attributes’ trade-offs (e.g. efficiency vs. fairness; budget constraints vs. policy efficacy).

- For environmental policies requiring people’s willingness to change their behaviour, the role of policy acceptability is particularly relevant (e.g. it is the individual who decide to change the own heating system).

- **Discrete Choice Experiments** in SEFIRA are used to understand the role of selected acceptability drivers/attributes concerning air quality policies.
The role of Individual Behaviour

- The standard environmental literature makes a distinction between technical and non-technical measures to improve air quality.

- SEFIRA focuses on the role of individual behaviour for successful policies.

- An option for the future could be to distinguish between behavioural and non-behavioural measures (or the extent to which the measure is behavioural)
The third part shows...

1. Presents an overview of the SEFIRA project
2. Frames the role of acceptability, socio-economic environment and individual behaviour
3. How *Discrete Choice Models* (DCMs) can constrain the role of individual acceptability in air quality improvement.
What are DCMs? (1)

- DCMs are statistical and econometric models used to describe, explain, and predict *choices* between two or more discrete alternatives;

- The aim is to analyse *people’s preferences*, and which variables (characteristics) affect their choices;

- The focus is on the *choice behaviour* of a single individual as described by specific variables.
What are DCMs? (2)

- DCMs are based on the economic theory of the consumer and the principle of random utility maximization;

- The models estimate the probability that a person chooses a particular alternative.

- The output might be used for:
  - Forecasting, scenario analysis, valuation (WTP/WTA), understanding of the role of particular attributes on the choice.

\[ P_{in} = \frac{e^{V_{in}}}{\sum_{j \in C_n} e^{V_{jn}}} \]
<table>
<thead>
<tr>
<th>List of terms</th>
<th>Summary description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy package</td>
<td>it is a bundle of measures</td>
<td>A set of air quality measures</td>
</tr>
<tr>
<td>Measure</td>
<td>It is a single policy intervention</td>
<td>Photovoltaic, energy efficiency building, road traffic restriction</td>
</tr>
<tr>
<td>Attribute [1, 2, .. n]</td>
<td>It describes a measure</td>
<td>Fairness, mortality</td>
</tr>
<tr>
<td>Attribute-level [a, b, .. m]</td>
<td>It describes the attribute range/wideness</td>
<td>Measure cost: 30€, 60€, 90€ Mortality: 10% death reduction, 20% death reduction,</td>
</tr>
<tr>
<td>Alternative</td>
<td>It is a choice option characterized by a mixed bundle of attributes-levels</td>
<td>Alternative X: 1a, 2b, .. 3n Alternative Y: 1c, 2b, .. 3m Alternative Z: ....</td>
</tr>
<tr>
<td>Choice experiment</td>
<td>It is a choice exercise (scenario) including more alternatives</td>
<td></td>
</tr>
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</table>
How Choice Experiments work

In a DCE survey, respondents are asked to:

• **Choose** among at least two **alternatives**, that alternative with the highest utility.

\[
U_i = V_i + \varepsilon_i \quad P_{in} = P(U_i \geq U_j \forall J \in j = 1,\ldots,J; i \neq j)
\]

In the SEFIRA-WP4 pilot project, the alternatives will be two air quality policies that are characterized by a short list of **attributes**, each having different attribute-levels.

• **Repeat the choice** for several scenarios/choice experiments (with different attribute-levels).
An example of DCE

Choice Experiment n. 1:

<table>
<thead>
<tr>
<th>Attributes:</th>
<th>wood pellet boiler</th>
<th>solid wood fired boiler</th>
<th>district heat</th>
<th>electricity</th>
<th>ground heat pump</th>
<th>oil boiler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment cost</td>
<td>13,000</td>
<td>10,000</td>
<td>10,000</td>
<td>9,000</td>
<td>10,000</td>
<td>5,000</td>
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<tr>
<td>Operating cost (euro/year)</td>
<td>1,500</td>
<td>950</td>
<td>1,400</td>
<td>3,100</td>
<td>1,150</td>
<td>3,150</td>
</tr>
<tr>
<td>CO2 emissions</td>
<td>1,300</td>
<td>600</td>
<td>3,300</td>
<td>1,100</td>
<td>400</td>
<td>9,000</td>
</tr>
<tr>
<td>Fine particle emissions</td>
<td>1,400</td>
<td>1,100</td>
<td>1,100</td>
<td>120</td>
<td>220</td>
<td>40</td>
</tr>
<tr>
<td>Requirement own work</td>
<td>2 hours/month</td>
<td>20 hours/month</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>15 min/month</td>
</tr>
</tbody>
</table>

I CHOOSE: □ □ □ □ □ □ □

Choice Experiment n. 2:

<table>
<thead>
<tr>
<th>Attributes:</th>
<th>wood pellet boiler</th>
<th>solid wood fired boiler</th>
<th>district heat</th>
<th>electricity</th>
<th>ground heat pump</th>
<th>oil boiler</th>
</tr>
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<tbody>
<tr>
<td>Investment cost</td>
<td>10,000</td>
<td>9,000</td>
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### The structure of DCEs

<table>
<thead>
<tr>
<th>Experimental Design Structure</th>
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<tbody>
<tr>
<td>Alternatives, attribute, attributes-levels and range</td>
</tr>
<tr>
<td>Labelled and unlabelled choice experiment</td>
</tr>
<tr>
<td>Type of respondent answers: choice, ranking, rating</td>
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<table>
<thead>
<tr>
<th>Questionnaire structure</th>
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<tbody>
<tr>
<td>Socio-demo-economic questions: age, gender</td>
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<tr>
<td>Stated Preference choice experiments</td>
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<td>Post-choice experiment</td>
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<tr>
<th>Data collection and sampling strategy</th>
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<tr>
<td>5 Countries: DE, DK, IT, PL, UK</td>
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<tr>
<td>2/3 cities for each Country</td>
</tr>
<tr>
<td>5,000 # CATI interviews</td>
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<th>Model estimation and interpretation (validy tests)</th>
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<td>Acceptability weights</td>
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**Present work**
- Winter 2014
- Spring 2015
- Next June
- The structure of DCEs
Experimental Design Structure

- **Two alternatives** showing generic measures able to improve air quality.
- A limited subset of **attributes** extracted from a full list elaborated with IIASA will be inconcluded in the SEFIRA choice experiment. Some of there are:
  - the **individual monetary cost of the measure** (€),
  - **level of personal engagement/lifestyle** (using frequently public transport, cycling or walking instead of using a car; replace the use of equipment with newer ones more energy efficient; change the heating system from higher-emitting to lower-emitting),
  - **Time horizon of the measure** (the measure will produce its environmental benefits by: 1 year, 2 years, 4 years).
The Challenge: DCM <-> GAINS

Our understanding of how people evaluate different acceptability attributes related to air quality policies will be used to verify the possible integration GAINS with DCMs.

How?

We aim at using the policy acceptability weights identified through our DCE in the optimization process of GAINS in order to rank air quality measures using acceptability criteria.
Final remarks

- Individual acceptability of an environmental policy should be considered in policy implementation process.

- DCMs are a promising methodology to analyse individual choices in the environmental field.

- Integration with GAINS is a promising opportunity to help local and national decision making process.
Thank you for your attention
Kiitos huomiota

Project Office

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SEFIRA

Socio Economic implications For Individual Responses to Air pollution policies in EU+27

EU FP7 Coordinated action

Start date June 2013, duration 36 months