Periurban agriculture: do the current EU agri-environmental policy programmes fit with it?

Linda Arata and Paolo Sckokai (Università Cattolica)

Gianni Guastella and Stefano Pareglio (FEEM and Università Cattolica)

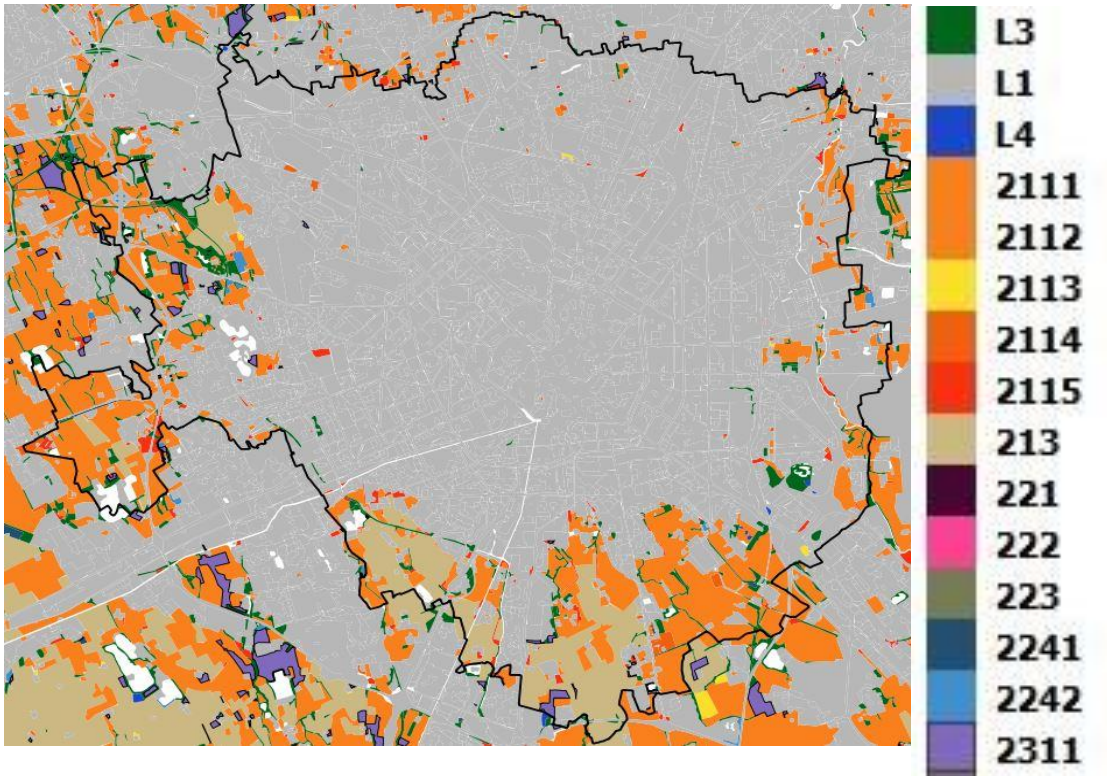
Riccardo Scarpa (Università di Verona, University of Durham, UK)

FEEM Seminar, 12 July 2018

BACKGROUND

- Due to the proximity to urban centres, peri-urban agriculture (PUA) faces challenges such as urban pressure for land use and environmental sensitivity by dwellers
- Thus, PUA cannot be focused on production only, but it must be multifunctional, by providing **ecological**, **cultural, recreational** and **social** services to dwellers
- Literature is focused on the evaluation of the recreational and cultural activities by the PUA. Literature investigating the value of the ecological benefits provided by some environmentally-friendly agricultural practices is rather limited, especially for PUA

BACKGROUND – The PUA of Milan



South and west side of the city

75% UAA under corn and rice

7.5% grassland

Legend: L3= permanent wood and semi-natural landscape; L1=anthropized areas; L4=wet areas**; L2111 and L2112= arable crops**; L2113, L2114 and L2115= horticultural crops; **L213= rice**; L221=vineyards; L222=orchards; L223=olive groves; L2241 and L2242= fast growing trees; L2311= permanent grassland

BACKGROUND - The PUA of Milan

- Intensive agriculture and high compliance costs with environmentally friendly practices
- The farms engaged in no-production activities mainly provide recreational and cultural services (walking trails, agro-tourisms, recreational events)

Recreational services:
No interference with the production. The activities usually imply a direct reward from the user

Agri-environmental services:
Trade-off with the production. Imply an income foregone (decrease in the production and/or increase in the costs): public subsidies needed

BACKGROUND – Agri-environmental Measures (AEMs)

- There exist public subsidies (per hectare payment) for agri-environmental measures (AEMs) adopted by the farmers. These AEMs and related subsidies are defined at EU level (Common Agriculture Policy) and detailed at regional level (Rural Development Programme of Lombardia).

  . 25% of EU Utilised Agricultural Area (UAA) is under AEMs

- The **AEMs** do **not** make **any distinction between PUA and not PUA:** same type of measures and same payment level

BACKGROUND – Agri-environmental Measures (AEMs)

Currently, AEMs are either not implemented or adopted by just a very few farmers in the peri-urban agricultural area of Milan: **high compliance costs** and too **low subsidy level** for this area

How much would be the **benefits for the dwellers** generated by an **improved adoption of AEMs** by the PUA of Milan?

Is there a mismatch between the adoption rate of AEMs and their social desirability in the PUA of Milan?

Is the development of ad hoc agri-environmental policies for PUA desirable?

OBJECTIVES

Investigate the **willingness to pay (WTP) of the dwellers of Milan** for the **ecological benefits** provided by some environmentally-friendly agricultural practices to be implemented **by the PUA of Milan**

OBJECTIVES

We analyse the WTP for the following agricultural practices:

1) **organic farming**, as a way of reducing nitrogen leaching and nitrous oxide emissions;
2) **fast growing trees plantation,** as a way of increasing carbon sequestration;
3) **field strip management**, as a way of strengthening biodiversity;
4) **cover crops**, as a way of reducing nitrogen leaching.

All the four practices are included in the list of AEMs of the RDP of Lombardia region (they receive a per hectare payment)

CHOICE EXPERIMENT - Questionnaire

Structure of the questionnaire (600 dwellers of Milan):

1. **Introduction** to the agriculture in the periurban area of Milan (map, prevalence of cereal production,...)
2. Detailed description of the **four agri-environmental practices** of the study + current level of adoption of the practices + potential improved levels of farmer adoption subject to the payment of an additional municipal tax.
3. For each potential practices level the **associated ecological benefits** is underlined. Higher level of farmer adoption, higher ecological benefits.
4. **Socio-demographic questions**, questions about sensitivity of the respondents to the environnmental issue and familiarity with the peri-urban area
5. **Honesty priming task** (to reduce the hypothetical bias issue of CE)
6. **6 choice sets** where the respondent has to choose the **most preferred alternative**. An alternative is composed by a combination of practices levels and by the tax the respondent should pay in order to guarantee the achievement of those practices levels.

CHOICE EXPERIMENT – Choice Sets

Example of a choice set

	Alternative 1	Alternative 2	Status quo
Organic farming (% of the UAA)	10%	20%	3%
Fast growing trees plantation (% of the UAA)	5%	2%	0.5%
Biodiversity-strips	wildflowers	reduced fert	absent
Cover crops	no	yes	no
Tax on each citizen older than 18 years (euro/person/year)	30	15	0
I CHOOSE:			

CHOICE EXPERIMENT – Experimental Design

- The overall number of choice sets available from combining all possible practices levels is 72,900 $((3^3 \cdot 2 \cdot 5)^2$
- In order to reduce this number a **Fractional factorial Bayesian efficient design** has been constructed
- An efficient design minimizes the standard errors of the coefficient estimates of the model and requires the use of some priors
- A **pilot study** on a small sample of Milan dwellers has been carried out to test the wording and length of the survey as well as to get the priors estimates to construct the efficient design

CHOICE EXPERIMENT – Experimental Design

- In the **pilot study**, an "**orthogonal in the difference**" fractional design has been adopted (which maximizes the differences in the levels for the same practice across alternatives)
- Using the Bayesian version of the efficient design, we account for the uncertainty relative to the prior values
- The final design has 30 choice sets which have been divided among 5 blocks (6 choice sets each) and each respondent has been allocated to only one of the 5 blocks.

MODEL – The Random Utility Theory

The Random Utility Theory

The theoretical background of CE is Random utility theory. The individual's *n* indirect utility from alternative *j* can be represented by two components:

$$U_{nj} = V_{nj} + \varepsilon_{nj}$$

Deterministic component of utility (it contains factor observable by the analyst)

Random component of utility (known by the individual, but not observed by the researcher)

Individual n chooses alternative j if $U_{nj} > U_{ni}$ for $\forall j \neq i$

As we do not observe U_{nj} we can infer the probability of consumer *n* choosing alternative *j* as:

$$\Pr_{nj} = \Pr(V_{nj} + \varepsilon_{nj} > V_{ni} + \varepsilon_{ni}) \quad \text{for} \quad \forall j \neq i$$

MODEL – The Lancaster Theory

The Lancaster Theory

The utility an individual derives from a packaged good depends on the utility he derives from each of the good's attributes.

The four AEMs assessed can be considered as the attributes of a packaged "environmental good", and thus:

$$U_{njs} = \beta_1 x_{1,njs} + \beta_2 x_{2,njs} + \beta_3 x_{3,njs} + \beta_4 x_{4,njs} + \varepsilon_{njs}$$

MODEL - RPL model with error component

The **Random Parameter Logit** (RPL) model:

- addresses the individual heterogeneity in tastes: each individual is assumed to have a specific value for each parameter
- estimates the distribution for the parameters associated to each practice (mean and standard deviation)
- avoid the Independence of Irrelevant Alternatives (IIA) assumption implied by the MNL model

The **Error Component** (EC) model allows to:

- account for correlation in the random component between utilities of alternatives different from the status quo

MODEL - RPL model with error component

$$U_{nSQt} = Acs_{SQ} + \beta X_{nSQt} + \eta_n X_{nSQt} + \gamma S_n Asc_{SQ} + \varepsilon_{nSQt} \quad for\ the\ status\ quo$$

$$U_{n1t} = \beta X_{n1t} + \eta_n X_{n1t} + \nu_{n1t} + \varepsilon_{n1t} \quad for\ alternative\ 1$$

$$U_{n2t} = \beta X_{n2t} + \eta_n X_{n2t} + \nu_{n2t} + \varepsilon_{n2t} \quad for\ alternative\ 2$$

t= index for the choice set

Asc= alternative specific constant for the status quo

X= vector of practice levels

β= vector of expected value for the coefficients associated to the practices

η= vector of individual deviations from the expected value of the coefficients

S= vector of the socio-demographic variables

γ= vector of parameters for the socio-demographic variables

ν= error component ~ N(0, σ^2).

ε= extreme values distributed errors

MODEL - RPL model with error component

The probability of individual n observed sequence of choices is:

$$P_n = \int \prod_t^T \left[\frac{e^{X_{njt}\mu_n + v_{njt}}}{\sum_{j=1}^{J} e^{X_{njt}\mu_n + v_{njt}}} \right] f(\mu)\phi(0,\sigma^2)\, d\mu dv$$

$\frac{e^{X_{njt}\mu_n}}{\sum_{j=1}^{J} e^{X_{njt}\mu_n}}$ = logit probability

$f(\mu)$ = probability density function of the coefficients of the practices

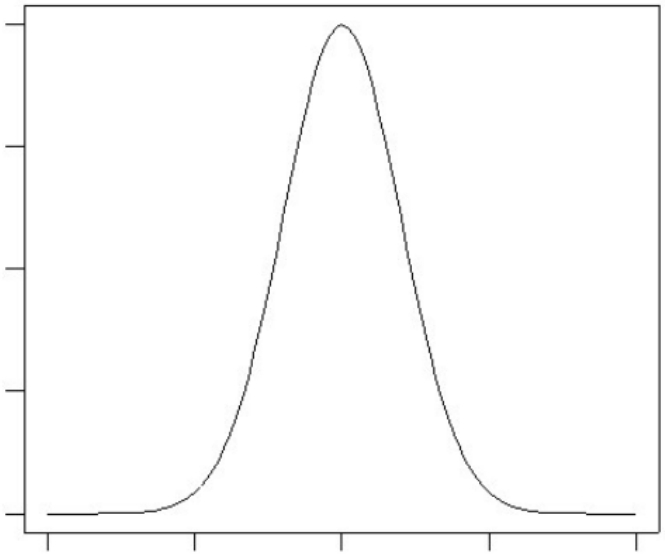
$\phi(0,\sigma^2)$ = normal density

Estimation procedure: **Simulated Maximum Likelihood** (SML)

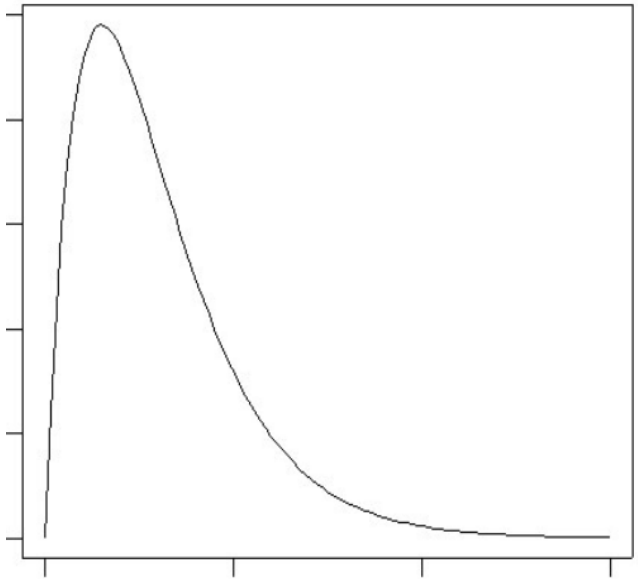
The SML maximises the **probability of the sum of the sequence of choices** among individuals.

MODEL – WTP-Space

Estimated Normal distribution for organic farming practices $\beta_{n,organic}$



Estimated logarithmic distribution for the tax $\beta_{n,tax}$



Once the coefficients are estimated the WTP is computed by randomly drawing from the distribution of $\beta_{n,organic}$ and $\beta_{n,tax}$ and take the average over the draws : $$WTP = \left(\sum_{draw=1}^{Draw} \frac{\beta_{n,practice,draw}}{\beta_{n,tax,draw}} \right) / Draw$$

MODEL – WTP-Space

- Issue of potential very large variance of WTP, because $\beta_{n,tax}$ can take very small values in some draws.

- To avoid this issue, we re-parametrized the model such that the WTP for each practice is directly estimate (WTP-space)

RESULTS: WTP Estimates

	Estimates	Std. Error
ASC (status quo)	-22.5	7.2 ***
Age	0.2	0.1 ***
Degree	13.8	2.4 ***
Occupied	2.2	2.6
Family Size	-6.4	1.5 ***
Middle Income Class	-14.4	2.9 ***
High Income Class	-26.6	3.8 ***
Male	-21.1	2.5 ***
Number of Visits	0.0	0.0
Env. Assoc. membership	-19.0	3.3 ***
Beta(euro/person/year)		
10% UAA organic	13.5	1.5 ***
20% UAA organic	15.8	1.4 ***
2% UAA forest	9.0	1.5 ***
5% UAA forest	13.2	1.6 ***
Biodiversity strips- reduced chemicals	5.6	1.5 ***
Biodiversity strips- wildflowers	16.3	1.4 ***
Cover crops	11.6	1.2 ***
Standard deviation		
10% UAA organic	3.7	2.0 *
20% UAA organic	19.8	1.6 ***
2% UAA forest	3.2	1.9 *
5% UAA forest	17.5	1.6 ***
Biodiversity strips- reduced chemicals	4.2	1.8 **
Biodiversity strips- wildflowers	20.7	1.6 ***
Cover crops	2.4	1.5
Error component	74.1	4.7 ***

Log Likelihood: -3019
Number of observations: 3612

RESULTS: WTP Estimates (interaction with Income Classes)

	Estimates	Std. Error	
Beta(euro/person/year)			
10% UAA organic	11.45	2.83	***
20% UAA organic	26.17	2.51	***
2% UAA forest	4.21	2.76	
5% UAA forest	10.93	2.89	***
Biodiversity strips- reduced chemicals	7.39	2.80	***
Biodiversity strips- wildflowers	18.59	2.88	***
Cover crops	16.08	2.26	***
Interaction terms with the dummy for the Middle Income Class			
10% UAA organic	-0.03	3.64	
20% UAA organic	-11.83	3.00	***
2% UAA forest	5.64	3.56	
5% UAA forest	8.12	3.56	**
Biodiversity strips- reduced chemicals	2.83	3.58	
Biodiversity strips- wildflowers	-6.62	3.77	*
Cover crops	-1.31	2.80	
Interaction terms with the dummy for the High Income Class			
10% UAA organic	2.09	4.34	
20% UAA organic	-7.86	4.53	*
2% UAA forest	16.59	4.86	***
5% UAA forest	7.44	4.89	
Biodiversity strips- reduced chemicals	-2.91	4.64	
Biodiversity strips- wildflowers	-1.74	4.62	
Cover crops	-1.30	3.64	
Standard deviation			

Log Likelihood: -3007
Number of observations: 3612

RESULTS: Share of population of Milan with positive WTP

Model with no interaction with Income Classes

	Model 1
10% UAA organic	>99.9
20% UAA organic	78.7
2% UAA forest	99.8
5% UAA forest	77.4
Biodiversity strips- reduced chemicals	91
Biodiversity strips- wildflowers	78.5
Cover crops	>99.9

RESULTS: Share of population of Milan with positive WTP

Model with interaction with Income Classes

	Model 2		
	Low Income Class	*Medium Income Class*	*High Income Class*
10% UAA organic	76.1	76.1	79.93
20% UAA organic	88.27	74.2	79.65
2% UAA forest	98.27	>99.9	>99.9
5% UAA forest	75.169	88.07	87.26
Biodiversity strips-reduced chemicals	71.89	78.8	63.67
Biodiversity strips-wildflowers	78.5	69.49	76.1
Cover crops	>99.9	>99.9	>99.9

CONCLUSIONS

- **Dwellers of Milan** on average **are WTP for the ecological benefits** provided by some environmentally-friendly agricultural practices in the **peri-urban area**
- The **order of magnitude of the WTP** is between 5 and 16 euro/person/year
- The **WTP is heterogenous across respondents** and respondent perceive differently the status quo alternative from the other alternatives (positive and significant error component)
- For some environmentally-friendly agricultural practices the average WTP is different according to the income class.

CONCLUSIONS

- In the peri-urban area of Milan, the uptake rate of agri-environmental practices is very low while the social desirability of these practices seems to be high: **agri-environmental policies specifically targeted to the peri-urban agriculture must be considered**

THANKS FOR YOUR ATTENTION

CHOICE EXPERIMENT – Practices Levels

Organic farming (% UAA)	Reduction in nitrogen leaching and in the nitrous oxide emissions	3% (status quo), 10%, 20%
Fast growing tree plantation (% UAA)	Carbon sequestration, refreshing, shadowing	0.5% (status quo), 2%, 5%
Biodiversity strips	Effects on farmland bird population and on pollinators	absent (status quo), strips with the main crop but reduced fertilisers and pesticides strips sown with wildflowers beneficial for birds and pollinators
Cover crops	Reduction in nitrogen leaching	Not adopted (status quo), adopted
Tax on each citizens older than 18 years (euro/person/year)		0 (status quo), 5, 15,30, 50, 70