Using multiple discrete-continuous choice models in stated preference research

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Motivation

Discrete Choice Experiments have become a leading method in stated preference research
- Provide detailed data regarding consumers' preferences
- Attribute-focused

DCEs can be applied when we have a discrete set of mutually exclusive alternatives
- Realistic when we think about choosing a specific policy for a given topic
  - Or choosing a route/mode for the trip
- Not realistic in many situations faced by the consumers
  - Recreation
  - Groceries \ food choice

DCE could be easily extended by asking respondents how much of each alternative they would want to consume, instead of asking them for their most preferred one

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DCE could be easily extended by asking respondents how much of each alternative they would want to consume, instead of asking them for their most preferred one

This is basically what we do

Multiple Discrete Continuous choice model

Regular choice model (MNL/MXL) is not appropriate for the data of such a form, and so we employ MDCEV model instead (following Bhat, 2008):

$$U(y_{i1}, y_{i2}, \ldots, y_{iJ}) = \sum\nolimits_{j=1}^{J} \psi_{ij} \frac{\gamma_j}{\alpha_j} \left(\left(\left(\frac{y_{ij}}{\gamma_j} + 1 \right)^{\alpha_j} - 1 \right) \right)$$

$$s.t. \sum\nolimits_{j=1}^{J} p_j y_{ij} = I_i$$

With: $\psi_{ij} = \exp\left(x_{ij} \beta_i + \varepsilon_{ij} \right)$

Our research

We run two stated preference studies focused on agri-environmental-climate measures

- ◦ One from the perspective of the farmers, and the other from the perspective of the consumers
- ◦ Practice-based schemes vs. results-based schemes
- ◦ Surveys run in several EU countries

The case of farmers

–In DCE for farmers, standard approach – ask 2 questions – Kuhfuss et al (ERAE, 2016)

– "Choose your preferred option/contract"

– farmers' willingness to enroll

– contract adoption/number of farms

+ "What area of your land would you engage in the chosen alternative?"

– acreage allocation when a contract is chosen

– proportion of farmland enrolled

– more effort on decision, with multiple choice cards:

– Does it influence the results?

– What share of farmers declare partial participation?

– Who does? Which areas they enroll?

The case of farmers – choice card

	Practice-based contract	Results-based contract	No contract
Annual payment per ha of arable land enrolled in the contract	200 EUR (fixed if practices are implemented)	112 – 448 EUR (depending on measured biodiversity level)	0 EUR
Bonus payment depending on the biodiversity of the farm's environs (annually, per ha of arable land enrolled)	8 – 32 EUR (depending on the measured biodiversity level of the area surrounding your farm)	19 – 29 EUR (depending on the measured biodiversity level of area surrounding your farm)	0 EUR
How much arable land would you enroll?	_____ ha	_____ ha	_____ ha

The case of farmers – choice card

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Bonus payment depending on the biodiversity of the farm's environs (annually, per ha of arable land enrolled)	8 – 32 EUR (depending on the measured biodiversity level of the area surrounding your farm)	Range: Min. 8 Max. 90 ...ing Ex. 18-22, 20-60, 45-75, 30-90	0 EUR
How much arable land would you enroll?	_____ ha	_____ ha	_____ ha

Practice-based - remunerated for implementing specific practices for arable land enrolled in the contract. In this case, whether or not you implemented the practices according to the contract requirements would be monitored.

The annual payment per ha of arable land enrolled will be a fixed amount.

Depending on the **expert-measured biodiversity level of the area surrounding your farm ("the farm's environs")**, you may receive a bonus payment. This will to a great extent depend on whether your neighboring farmers also adopt measures to conserve, or even increase, the biodiversity of their farms.

The case of farmers – choice card

	Practice-based contract	Results-based contract	No contract
Annual payment per ha of arable land enrolled in the contract	200 EUR (fixed if practices are implemented)	112 – 448 EUR (depending on measured biodiversity level)	Range: Min. 50 Max. 450 Ex. 140-170, 150-450
Bonus payment depending on the biodiversity of the farm's environs (annually, per ha of arable land enrolled)	8 – 32 EUR (depending on the measured biodiversity level of the area surrounding your farm)	19 – 29 EUR (depending on the measured biodiversity level of area surrounding your farm)	Range: Min. 8 Max. 90 Ex. 18-22, 20-60, 45-75, 30-90
How much arable land would you enroll?	_____ ha	_____ ha	_____ ha

Result-based - remunerated for the expert-measured biodiversity level of the arable land enrolled in the contract. The measurement will take into account various characteristics of your farm, such as soil life, flowering and native plants, and ecological corridors, and combine them to assign a single biodiversity index result for all the land enrolled in the contract.

The annual payment per ha of arable/ land enrolled will be a range, depending on the measured biodiversity level.

Depending on the **expert-measured biodiversity level of the area surrounding your farm ("the farm's environs")**, (...)

The case of farmers – results (DE)

In 60% of choices the land was enrolled in a single contract, in 20% in two contracts and in 20% in all three
- About 35% of farmers have enrolled some land in both, practice-based and results-based contract

50% of farmers were always choosing the same number of contracts
- 40% always 1, 4% always 2, and 6% always 3
- Only 9% always chooses "*no contract*"

In MDCEV we constrain the farmers by their available land, rather than their income
- DCE is in the form of WTA, so income is not really constraining

The case of farmers – results (DE)

Betas	Means	Stds
Practice-based contract	0.258	4.464 ***
Results-based contract	-0.437 *	4.303 ***
Annual payment (100)	0.642 ***	1.441 ***
AP varation	0.142	0.859 ***
Bonus payment (100)	0.597 ***	1.790 ***
BP variation	0.122	0.848 ***

	Coef
Alpha: common for all alt	-0.141 ***
Gamma: Practice-based contract	3.023 ***
Gamma: Results-based contract	2.998 ***
Gamma: No contract	5.213 ***

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- We observe significant effect of (mean) payments
- Variation in payments does not seem to have a significant effect
- We see weak negative effect of ASC for results-based contracts
- High significance of all standard deviations of random parameters

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- Negative alpha indicates marginal utilities decrease faster than in logarithmic form
- Gamma coefficient is significantly different for "No contract" option, indicating different shape of utility for this alternative

The case of farmers – questions / issues

How to estimate WTA in such a case?

◦ Current algorithms for MDCEV models assume income-based budget constraint, which we do not have here

Reasons for insignificance of variations in payments? Different functional form?

◦ Should they be included in alpha/gamma coefs?

Farmers are producers, whereas MDCEV models are motivated by the consumer choice theory – what is the alternative?

◦ Maybe some insights from the freight/transportation studies?
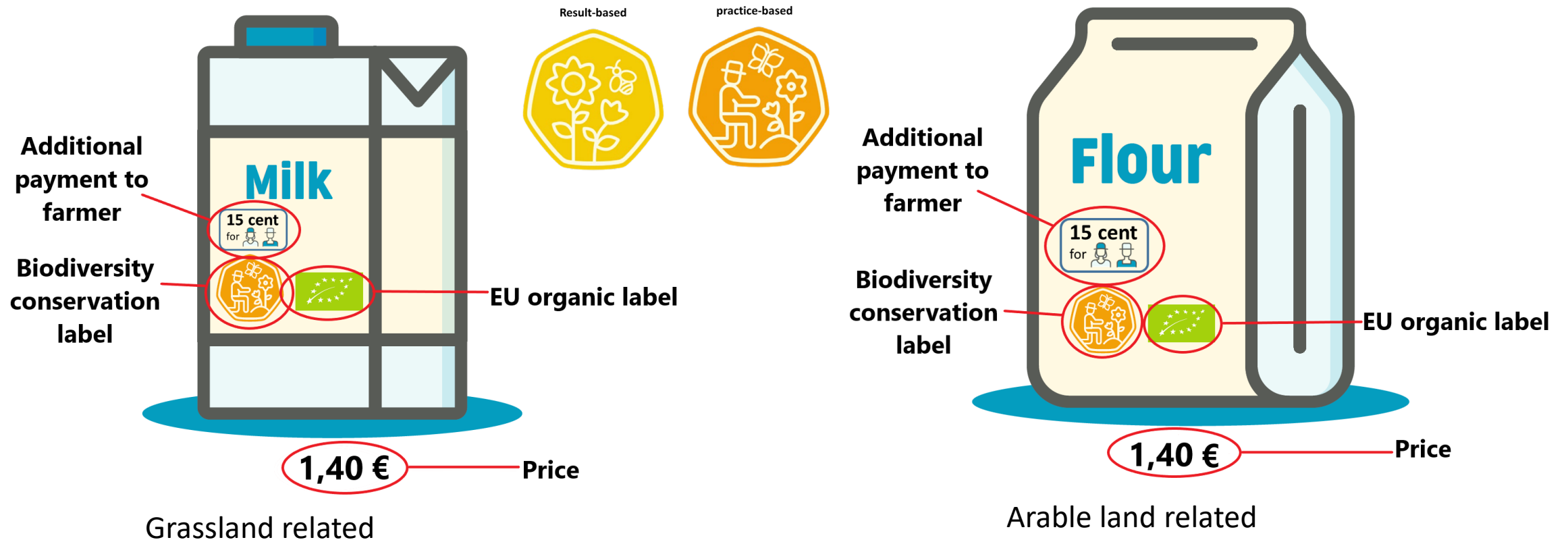
The case of farmers – questions / issues

Does it make sense to compare the estimates with MXL?

◦ In case of Poland results are very similar

◦ When only a single alternative is chosen the MDCEV collapses to MXL

◦ Utility specification is very different, though. Should parameters have different interpretation?

	MDCEV		MXL	
	Mean	**Standard deviation**	**Mean**	**Standard deviation**
Practice-based	3.2477***	6.1745***	3.2283***	5.7482***
Results-based	2.5273***	5.5611***	2.0142***	5.4711***
Annual payment (in 100 €)	0.7627***	1.5122***	0.8035***	1.2323***
AP varation	-0.0303	0.1283***	-0.0282	0.0957***
Bonus payment (in 100 €)	1.0539***	3.4229***	0.7744***	3.1389***
BP variation	-0.1881*	1.129**	-0.2822**	1.1761***

The case of consumers

Investigating the effect of labels related to biodiversity conservation practices

Result-based

practice-based

Milk

Additional payment to farmer
- 15 cent for

Biodiversity conservation label

EU organic label

1,40 € — Price

Grassland related

Flour

Additional payment to farmer
- 15 cent for

Biodiversity conservation label

EU organic label

1,40 € — Price

Arable land related

The case of consumers – choice card

How much of each kind of milk would you buy? Please enter the number of litres you would purchase in each situation:

Milk +10 Cent for 👤👤

0,80 Euro

Milk +20 Cent for 👤👤

1,00 Euro
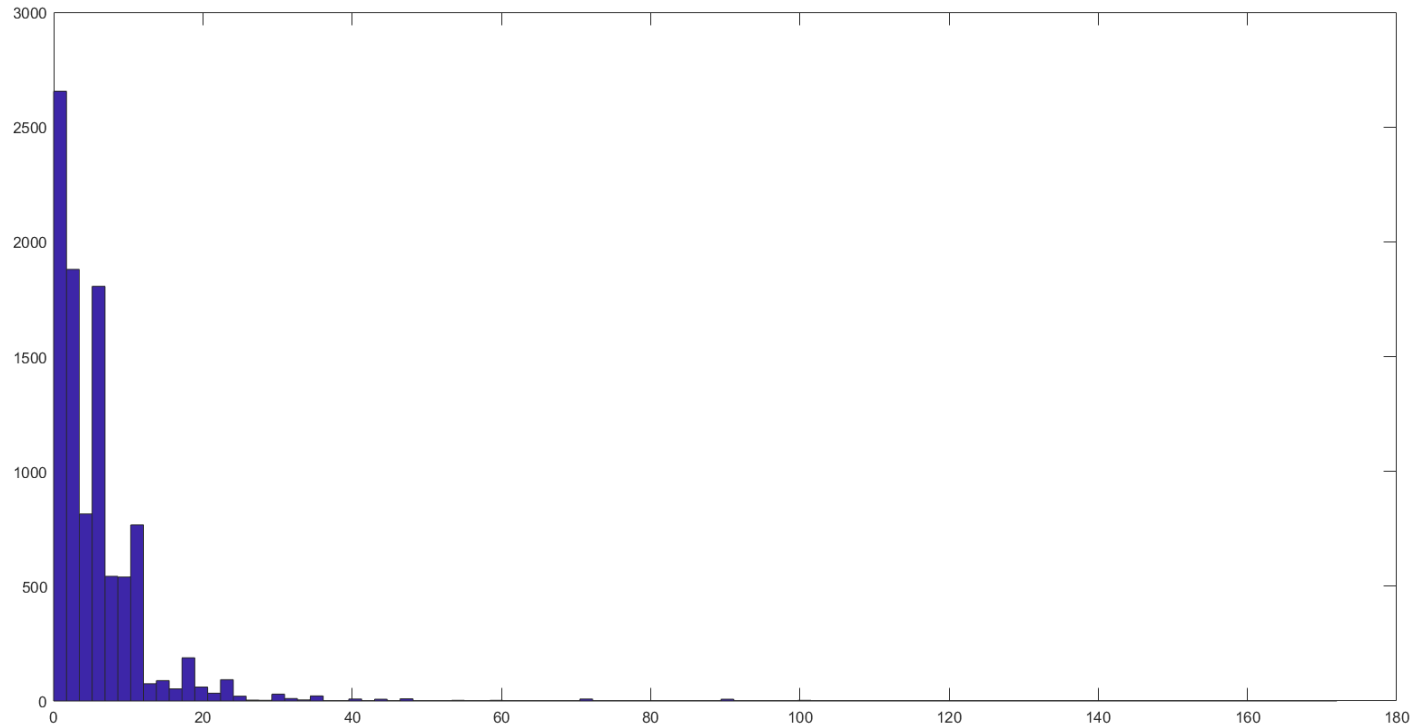
[ ] litres   **[ ] litres**   **[ ] neither (other milk or no milk)**

The case of consumers – results (ES/milk)

- Median consumer would buy 4 liters of milk
- In some cases extremely high values were reported
- In 40% of choice situations both milks were indicated
- In only 13% of choice situations neither milk was chosen

The case of consumers – results (milk)

- Very consistent estimates across the countries
- Not significant difference between practice- and results-based practices
- Alpha for milk alternatives vary between 0.12 and 0.29
- Coefficient for numeraire is close to 1

	DE	ES	HU	NL
Numeraire	7.313	7.071	6.579	7.474
Organic Label	0.127	0.233	0.167	0.142
Practice-based payment	0.120	0.162	0.155	0.151
Results-based payment	0.128	0.159	0.157	0.147
Additional payment	0.868	1.335	0.677	1.143
Alpha coefficients				
Milk A	0.243	0.286	0.121	0.203
Milk B	0.243	0.276	0.121	0.196
Numeraire	0.861	0.909	0.988	0.846

The case of consumers – results (flour)

- Very similar results for flour
- Shape of the utility slightly different: lower alphas
- In case of DE and NL alpha for numeraire is relatively low

	DE	ES	HU	NL
Numeraire	7.684	6.836	6.614	8.168
Organic Label	0.231	0.299	0.179	0.114
Practie-based payment	0.192	0.169	0.116	0.209
Results-based payment	0.181	0.145	0.110	0.181
Additional payment	1.330	2.005	0.512	1.611
Alpha coefficients				
Flour A	-0.128	-0.285	0.034	-0.280
Flour B	-0.118	-0.294	0.040	-0.256
Numeraire	0.778	0.978	0.959	0.720

Issues / Questions

◦ LHS variables are assumed to be continuous, but in many cases it would be more appropriate to assume a count data process

- ◦ Although in some cases respondents actually reported shares, e.g. 0.5 liters of milk
- ◦ Partially, the "expenditure" formulation of the model can avoid this problem (?)

◦ Does format of the question influence consumers' preferences?

- ◦ Would people actually buy two different milks at the same time?

◦ Again, does it make sense to compare with MXL?

ES/flour - relative to additional payment

	MDCEV	MXL
Numeraire / SQ	3.410	-1.936
Organic Label	0.149	0.149
Practie-based payment	0.084	0.101
Results-based payment	0.073	0.086
Additional payment	1.000	1.000
Price		0.168