UNDERSTANDING THE DISTRIBUTION OF ECONOMIC BENEFITS FROM IMPROVING COASTAL AND MARINE ECOSYSTEMS

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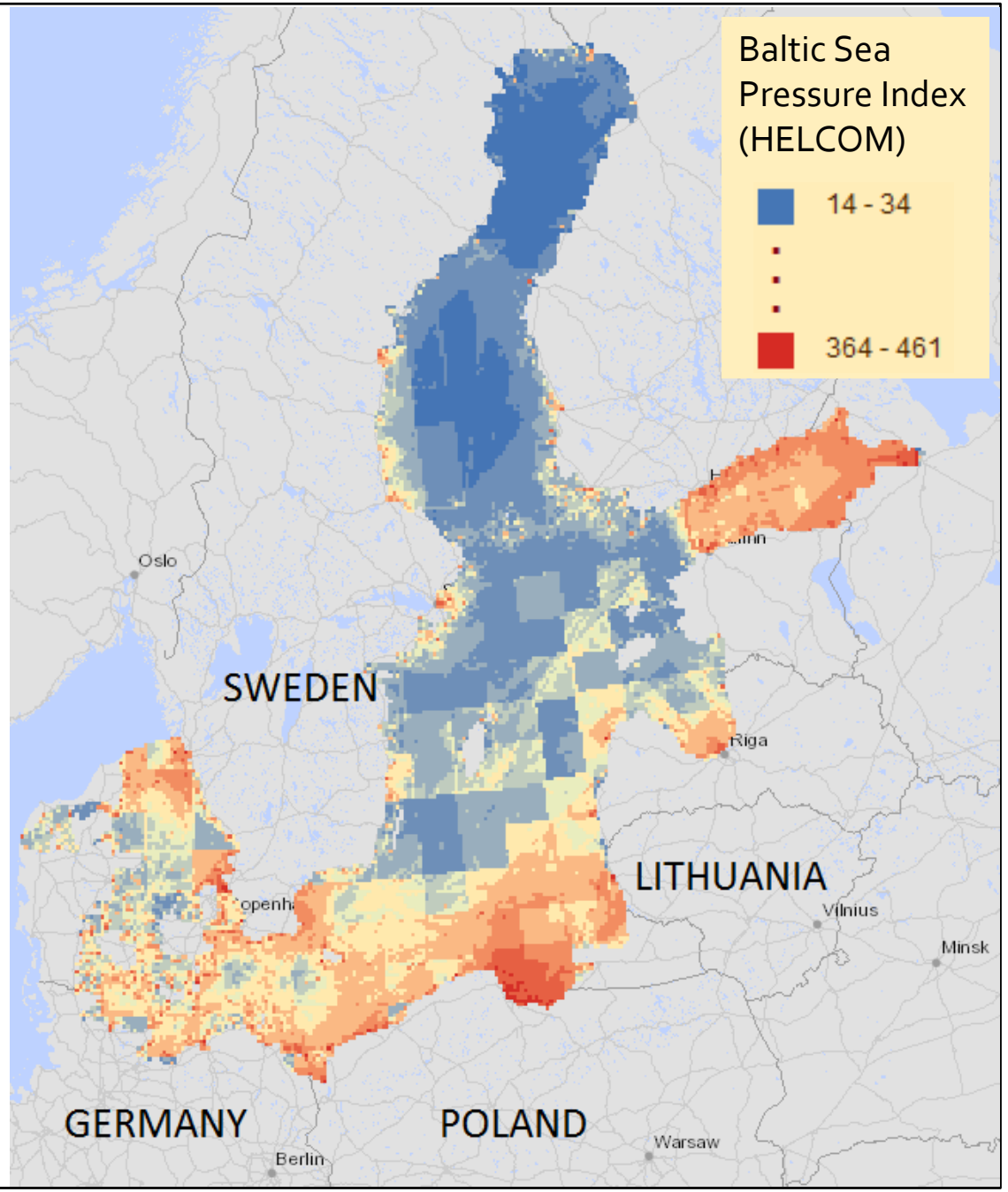
Baltic Sea in danger

- Particularly endangered by human activities
- Surrounded by nine countries:
  - densely populated in coastal areas
  - using marine waters extensively
- Limited water exchange because of the very narrow and shallow oceanic connection
- Accumulation of nutrients, hazardous substances and invasive species
- One of the most threatened marine environments in the world (World Wide Fund for Nature, 2011)



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Marine Strategy Framework Directive

- Developed by the European Commission
- A regulatory framework to protect the EU marine waters
- The aim: to achieve Good Environmental Status (GES) in EU marine waters by 2020
- It sets out qualitative descriptors what the environment will look like when GES is achieved
- Every EU state determines what each descriptor means in practice and how to achieve GES

Need for a cost-benefit analysis

- To support the selection of the measures for achieving GES, the Directive requires an impact assessment, including a cost-benefit analysis.

- The aspects of the marine environment for which improvements are needed can be easily identified.
- The costs of the improvement actions can be readily estimated.

- But the valuation of the benefits from these actions is challenging.

- Our general aim: to evaluate the welfare benefits to citizens from improving environmental status of the Baltic Sea and reaching GES.
- We take the example of Latvia.

Study objectives

1. To provide welfare value estimates for environmental improvements and reaching GES in the Latvian costal and marine waters
2. To identify the variation in preferences for the improvements related to differences in socio-demographics
3. To propose a statistically efficient approach of explaining the socio-demographic-related variability in preferences

Methodology: A stated preference survey

- Used to determine public's preferences, especially towards non-market goods
- In specially designed surveys respondents state what they prefer
  (which policy option; what characteristics of the good / policy)
- Flexible – a possibility of valuation of hypothetical states;
  here, valuation of (yet not introduced) improvements towards reaching GES
- Important for cost-benefit analysis – estimation of the benefits
- Two main methods: contingent valuation and discrete choice experiment

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directly asks people to state their values for a change / a good in dollars

the values are inferred from people's hypothetical choices between (at least) two options

Methodology: A discrete choice experiment

	Program A	Program B	No additional actions
Reduced number of native species	No such areas	On small areas	On large areas
Water quality for recreation	Bad	Good	Bad
New harmful alien species establishing	Rarely	Almost none	Often
Your yearly payment	5 LVL	2 LVL	0 LVL
Your choice:	○	○	○

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- The attributes refer to these descriptors.

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Good, Moderate
Almost none, rarely
10, 5, 2 LVL

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Action plan for reaching GES

Some additional actions

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- A coercive payment mechanism (e.g., tax)
- 12 choice tasks per respondent, randomised
- The design optimized for Bayesian D-efficiency of a multinomial logit model with priors from a pilot study and personal interviews.

Survey administration

- 1,247 Latvians
- Representative for the general population of Latvia with respect to nationality, gender, age, place of residence (administrative region), and education level

Computer Assisted Web Interviews (CAWI)	Computer Assisted Personal Interviews (CAPI)
over the internet	at the place of residence
606 respondents	641 respondents
in the age of 18-54	in the age of 35-74

- The questionnaires did not differ between CAWI and CAPI.
- The combined approach was used
  - to maintain the sample representativeness,
  - to reduce the costs of data collection.
- Internet interviews are recommended when the use of Internet exceeds 60% – this is not the case for Latvians above 55 years old.

Random Utility Model (McFadden, 1974)

FOUNDATION OF PREFERENCE MODELLING BASED ON DISCRETE CHOICE DATA

- Utility of consumer *i* from choosing alternative *j* in choice task *t* (U_{ijt}):

$$U_{ijt} = \alpha_i X_{ijt}^{c} + \mathbf{b}_i ' \mathbf{X}_{ijt}^{-c} + e_{ijt}$$

monetary attribute

non-monetary attributes

error term (deviations from the mean parameters' estimates)

- A consumer derives utility from: observable characteristics of the good and unobservable factors (random component)

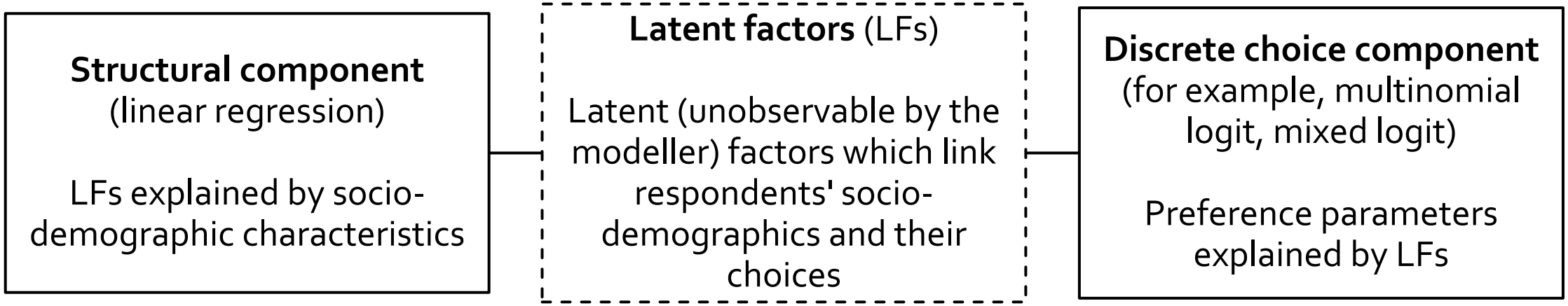
- How much an average consumer is willing to pay (WTP) for the improvement related to attribute *k*?

$$WTP_k = -\frac{b_k}{\alpha}$$

How to explain socio-demographic-related variability in preferences?

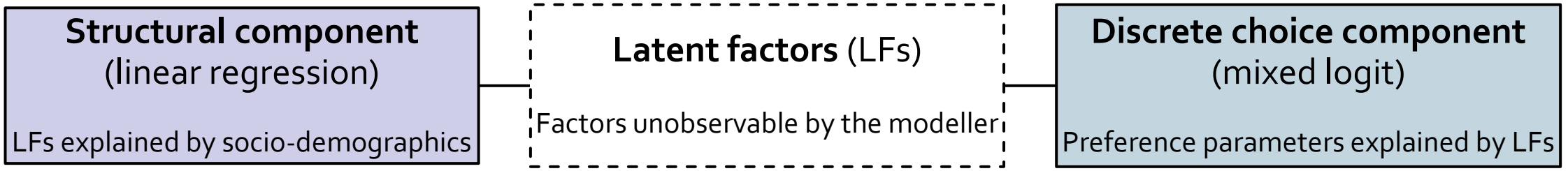
Common approaches	Problems
• Interact socio-demographic variables with the choice attributes (e.g., Axhausen et al. 2008; Longo et al. 2008; Kosenius 2010; Ziegler 2012)	• Many socio-demographic variables included often appear insignificant because of being strongly correlated with each other. • Many additional coefficients needed to be estimated substantially lower the number of the degrees of freedom.
• A two-step procedure: – Identify a sub-set of factors which best explain variance of socio-demographics – Use individual factor scores to explain respondents' choices (e.g., Salomon and Ben-Akiva 1983; Boxall and Adamowicz 2002; Milon and Scrogin 2006)	• Not statistically efficient – the factors which best capture the variance of socio-demographics are not necessarily those which provide the most explanatory power in modelling respondents' choices.

Our approach how to explain the socio-demographic-related variability in preferences



- Link of multiple socio-demographics with preferences.
- Identification of the most important factors (LFs) which drive these relationships.
- Our approach fits into the class of "hybrid choice" models (Ben-Akiva et al. 2002) – structural models that incorporate choice and non-choice components.
- Here, we have no measurement component (no attitudinal variables).
- We show how the hybrid choice model framework can be used to explain the observed heterogeneity in respondents' preferences attributed to their socio-demographic characteristics.

Our approach



$$\mathbf{LF}_i = \mathbf{Y}_i\boldsymbol{\varphi} + \boldsymbol{\eta}_i$$

$\mathbf{Y}$ - socio-demographic characteristics

$\boldsymbol{\eta}$ - normally distributed error terms with zero mean and a diagonal covariance matrix

The utility derived by individual *i* from choosing alternative *j* in choice task *t*

$$U_{ijt} = \mathbf{X}_{ijt}\boldsymbol{\beta}_i + \varepsilon_{ijt}$$

$\mathbf{X}$ - attribute levels

ε - a stochastic component; identification of the model relies on normalising its variance: $\mathrm{var}(\varepsilon_{ijt}) = \pi^2/6$

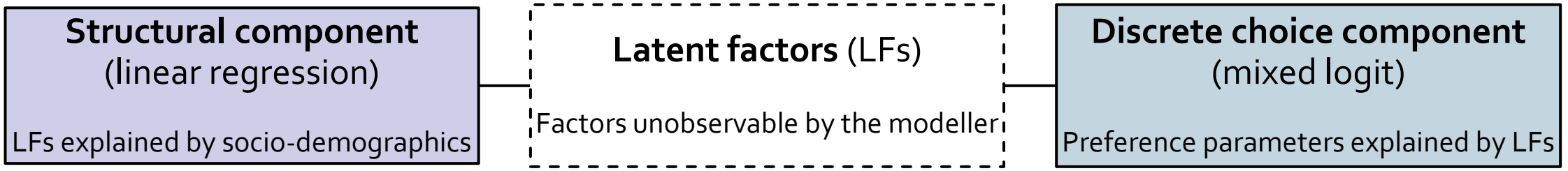
$\boldsymbol{\beta}_i = \mathbf{b} + \mathbf{u}_i\boldsymbol{\tau} + \mathbf{LF}_i\boldsymbol{\gamma}$

$\mathbf{b}$ - means of the parameters,

$\mathbf{u}_i\boldsymbol{\tau}$ - deviations from the means (unobserved preference heterogeneity)

$\mathbf{LF}_i\boldsymbol{\gamma}$ - a component that allows individual preferences to be a function of latent factors

Our approach



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- For interpretation, we normalise the mean of each LF to zero.

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Our approach

Structural component (linear regression)

LFs explained by socio-demographics

Latent factors (LFs)

Factors unobservable by the modeller

Discrete choice component (mixed logit)

Preference parameters explained by LFs

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- For interpretation, we normalise the mean of each LF to zero.

We use a money-metric utility function;
A model in willingness-to-pay (WTP) space

$$U_{ijt} = X^c_{ijt}\beta^c_i + \mathbf{X}^{-c}_{ijt}\boldsymbol{\beta}^{-c}_i + \varepsilon_{ijt}$$
$$= \beta^c_i \left(X^c_{ijt} + \mathbf{X}^{-c}_{ijt} \frac{\boldsymbol{\beta}^{-c}_i}{\beta^c_i} \right) + \varepsilon_{ijt}$$

Marginal rate of substitution of X^c for X^{-c}
Marginal WTP

$\mathbf{X}^{-c}_{ijt}$ - non-cost attributes

X^c_{ijt} - a cost attribute

$\boldsymbol{\beta}^{-c}_i$ - normally distributed

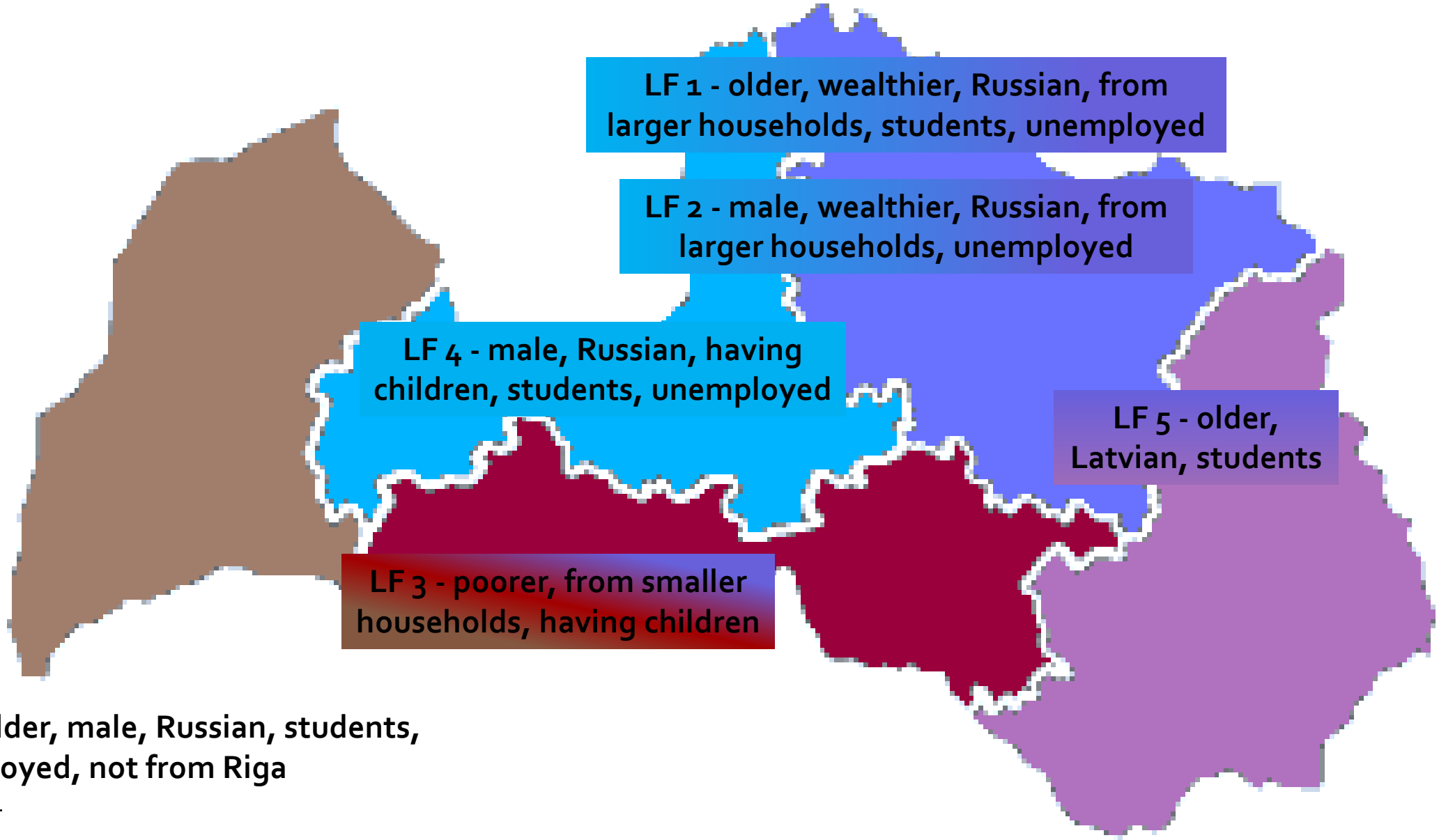
β^c_i - log-normally distributed

Structural component

- Six latent factors – the best specification in terms of the Akaike information criterion
- Latent factors explained by all available socio-demographic characteristics

	Age	Male	Latvian	HH size	Children	Education	Occupation (Reference: Full-time)	Region of residence (Reference: Riga)	Income
LF 1	+		–	+		+	Stronger for student and unemployed	Stronger for Pieriga and Vidzeme	+
LF 2		+	–	+		+	Stronger for unemployed	Stronger for Pieriga and Vidzeme	+
LF 3				–	+		Weaker for unemployed	Weaker for Pieriga and Latgale	–
LF 4		+	–		+	+	Stronger for student and unemployed Weaker for part-time	Stronger for Pieriga, Vidzeme and Zemgale	
LF 5	+		+				Stronger for student Weaker for retired and at home	Weaker for Kurzeme and Zemgale	
LF 6	+	+	–			+	Stronger for student and unemployed	Stronger for everywhere	

Structural component



LF 6 - older, male, Russian, students, unemployed, not from Riga

Discrete choice component

	Means (main effects)	St. dev.	Interaction with LF 1	Interaction with LF 2	Interaction with LF 3	Interaction with LF 4	Interaction with LF 5	Interaction with LF 6
Status quo	8.21***	55.30***	0.04	39.85**	28.27***	-24.43***	-0.63**	16.65***
	(0.48)	(1.95)	(0.23)	(15.57)	(10.08)	(8.15)	(0.26)	(5.31)
Reduced number of native species:								
On small areas	0.38**	0.42***	-0.30	2.14***	-0.08	0.69**	0.10	-1.60***
	(0.17)	(0.07)	(0.20)	(0.76)	(0.22)	(0.33)	(0.16)	(0.54)
No such areas	0.20	0.25***	0.75**	2.53***	0.03	2.50***	-0.08	-3.66***
	(0.21)	(0.08)	(0.30)	(0.94)	(0.27)	(0.87)	(0.23)	(1.19)
Water quality for recreation:								
Moderate	4.25***	0.02	3.69***	-7.41**	-3.65***	8.24***	-1.57***	-4.52***
	(0.21)	(0.06)	(1.15)	(3.43)	(1.31)	(2.74)	(0.27)	(1.48)
Good	4.79***	0.07	4.75***	-11.80**	-2.30***	13.13***	-1.59***	-5.35***
	(0.28)	(0.08)	(1.47)	(5.00)	(0.89)	(4.35)	(0.38)	(1.71)
New harmful alien species establishing:								
Rarely	1.64***	0.09	1.08***	-2.07*	-2.69***	1.90***	0.50***	-1.37***
	(0.17)	(0.09)	(0.36)	(1.20)	(0.96)	(0.67)	(0.15)	(0.51)
Almost none	0.89***	0.38***	1.74***	-1.38	-1.76***	1.63***	0.36**	-1.99***
	(0.19)	(0.07)	(0.54)	(0.86)	(0.66)	(0.63)	(0.16)	(0.67)
Cost	-0.11	0.12	0.60**	2.63*	2.85***	-1.68***	-0.16	0.62**
	(0.09)	(0.10)	(0.24)	(1.42)	(1.01)	(0.55)	(0.15)	(0.28)

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Significant standard deviations –
unobserved heterogeneity in respondents' preferences

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Preferences of an average respondent,
excluding the impact of the socio-demographics on preferences

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	(0.48)	(1.95)	(0.23)	(15.57)	(10.08)	(8.15)	(0.26)	(5.31)
Reduced number of native species:								
On small areas	0.38**	0.42***	-0.30	2.14***	-0.08	0.69**	0.10	-1.60***
	(0.17)	(0.07)	(0.20)	(0.76)	(0.22)	(0.33)	(0.16)	(0.54)
No such areas	0.20	0.25***	0.75**	2.53***	0.03	2.50***	-0.08	-3.66***
	(0.21)	(0.08)	(0.30)	(0.94)	(0.27)	(0.87)	(0.23)	(1.19)
Water quality for recreation:								
Moderate	4.25***	0.02	3.69***	-7.41**	-3.65***	8.24***	-1.57***	-4.52***
	(0.21)	(0.06)	(1.15)	(3.43)	(1.31)	(2.74)	(0.27)	(1.48)
Good	4.79***	0.07	4.75***	-11.80**	-2.30***	13.13***	-1.59***	-5.35***
	(0.28)	(0.08)	(1.47)	(5.00)	(0.89)	(4.35)	(0.38)	(1.71)
New harmful alien species establishing:								
Rarely	1.64***	0.09	1.08***	-2.07*	-2.69***	1.90***	0.50***	-1.37***
	(0.17)	(0.09)	(0.36)	(1.20)	(0.96)	(0.67)	(0.15)	(0.51)
Almost none	0.89***	0.38***	1.74***	-1.38	-1.76***	1.63***	0.36**	-1.99***
	(0.19)	(0.07)	(0.54)	(0.86)	(0.66)	(0.63)	(0.16)	(0.67)
Cost	-0.11	0.12	0.60**	2.63*	2.85***	-1.68***	-0.16	0.62**
	(0.09)	(0.10)	(0.24)	(1.42)	(1.01)	(0.55)	(0.15)	(0.28)

Policy supporters

LF 1 - older, wealthier, Russian, from larger households, students, unemployed, from Centre and North

LF 4 - male, Russian, having children, students, unemployed, from Centre

Discrete choice component

	Means (main effects)	St. dev.	Interaction with LF 1	Interaction with LF 2	Interaction with LF 3	Interaction with LF 4	Interaction with LF 5	Interaction with LF 6
Status quo	8.21*** (0.48)	55.30*** (1.95)	0.04 (0.23)	39.85** (15.57)	28.27*** (10.08)	-24.43*** (8.15)	-0.63** (0.26)	16.65*** (5.31)
Reduced number of native species:								
On small areas	0.38** (0.17)	0.42*** (0.07)	-0.30 (0.20)	2.14*** (0.76)	-0.08 (0.22)	0.69** (0.33)	0.10 (0.16)	-1.60*** (0.54)
No such areas	0.20 (0.21)	0.25*** (0.08)	0.75** (0.30)	2.53*** (0.94)	0.03 (0.27)	2.50*** (0.87)	-0.08 (0.23)	-3.66*** (1.19)
Water quality for recreation:								
Moderate	4.25*** (0.21)	0.02 (0.06)	3.69*** (1.15)	-7.41** (3.43)	-3.65*** (1.31)	8.24*** (2.74)	-1.57*** (0.27)	-4.52*** (1.48)
Good	4.79*** (0.28)	0.07 (0.08)	4.75*** (1.47)	-11.80** (5.00)	-2.30*** (0.89)	13.13*** (4.35)	-1.59*** (0.38)	-5.35*** (1.71)
New harmful alien species establishing:								
Rarely	1.64*** (0.17)	0.09 (0.09)	1.08*** (0.36)	-2.07* (1.20)	-2.69*** (0.96)	1.90*** (0.67)	0.50*** (0.15)	-1.37*** (0.51)
Almost none	0.89*** (0.19)	0.38*** (0.07)	1.74*** (0.54)	-1.38 (0.86)	-1.76*** (0.66)	1.63*** (0.63)	0.36** (0.16)	-1.99*** (0.67)
Cost	-0.11 (0.09)	0.12 (0.10)	0.60** (0.24)	2.63* (1.42)	2.85*** (1.01)	-1.68*** (0.55)	-0.16 (0.15)	0.62** (0.28)

Policy opponents

LF 3 - poorer, from smaller households, having children

LF 6 - older, male, Russian, students, unemployed, not from Riga

Discrete choice component

	Means (main effects)	St. dev.	Interaction with LF 1	Interaction with LF 2	Interaction with LF 3	Interaction with LF 4	Interaction with LF 5	Interaction with LF 6
Status quo	8.21***	55.30***	0.04	39.85**	28.27***	-24.43***	-0.63**	16.65***
	(0.48)	(1.95)	(0.23)	(15.57)	(10.08)	(8.15)	(0.26)	(5.31)
Reduced number of native species:								
On small areas	0.38**	0.42***	-0.30	2.14***	-0.08	0.69**	0.10	-1.60***
	(0.17)	(0.07)	(0.20)	(0.76)	(0.22)	(0.33)	(0.16)	(0.54)
No such areas	0.20	0.25***	0.75**	2.53***	0.03	2.50***	-0.08	-3.66***
	(0.21)	(0.08)	(0.30)	(0.94)	(0.27)	(0.87)	(0.23)	(1.19)
Water quality for recreation:								
Moderate	4.25***	0.02	3.69***	-7.41**	-3.65***	8.24***	-1.57***	-4.52***
	(0.21)	(0.06)	(1.15)	(3.43)	(1.31)	(2.74)	(0.27)	(1.48)
Good	4.79***	0.07	4.75***	-11.80**	-2.30***	13.13***	-1.59***	-5.35***
	(0.28)	(0.08)	(1.47)	(5.00)	(0.89)	(4.35)	(0.38)	(1.71)
New harmful alien species establishing:								
Rarely	1.64***	0.09	1.08***	-2.07*	-2.69***	1.90***	0.50***	-1.37***
	(0.17)	(0.09)	(0.36)	(1.20)	(0.96)	(0.67)	(0.15)	(0.51)
Almost none	0.89***	0.38***	1.74***	-1.38	-1.76***	1.63***	0.36**	-1.99***
	(0.19)	(0.07)	(0.54)	(0.86)	(0.66)	(0.63)	(0.16)	(0.67)
Cost	-0.11	0.12	0.60**	2.63*	2.85***	-1.68***	-0.16	0.62**
	(0.09)	(0.10)	(0.24)	(1.42)	(1.01)	(0.55)	(0.15)	(0.28)

LF 2 - male, wealthier, Russian, from larger households, unemployed, from Centre and North

LF 5 - older, Latvian, students, from West

How the model can be applied

to examine differences in preferences related to socio-demographics

	Student	**Family head**	**Businessman**	**Single mother**	**Pensioner**
Age	20	45	35	30	70
Male	No	Yes	Yes	No	Yes
Latvian	Yes	Yes	No	No	Yes
Household size	1	6	2	2	1
Number of children	0	4	0	1	0
Education	General secondary	Vocational secondary	Higher	Complete compulsory	Complete compulsory
Occupation	Student	Full-time	Self-employed	Home	Retired
Region	Riga	Vidzeme	Riga	Pieriga	Kurzeme
Net monthly personal income	50 LVL (20th percentile)	410 LVL (70th percentile)	710 LVL (90th percentile)	Missing	260 LVL (50th percentile)

How the model can be applied

to examine differences in preferences related to socio-demographics

	Student	Family head	Businessman	Single mother	Pensioner
Status quo	-17.18*** (-19.32; -15.03)	11.10*** (9.55; 12.65)	5.91*** (5.03; 6.80)	-0.01 (-1.79; 1.76)	12.37*** (10.05; 14.70)
Reduced number of native species: *On small areas*	1.20** (0.07; 2.32)	1.49*** (0.48; 2.50)	0.73** (0.15; 1.30)	-0.06 (-1.14; 1.02)	-1.53** (-2.81; -0.26)
Reduced number of native species: *No such areas*	2.40** (0.57; 4.23)	2.43*** (0.84; 4.00)	0.86* (-0.10; 1.82)	-0.62 (-2.38; 1.13)	-4.64*** (-6.70; -2.58)
Water quality for recreation: *Moderate*	6.94*** (5.05; 8.84)	4.27*** (2.75; 5.80)	5.60*** (4.72; 6.47)	8.10*** (6.35; 9.85)	-2.26** (-4.28; -0.25)
Water quality for recreation: *Good*	11.17*** (9.42; 12.94)	7.77*** (6.01; 9.53)	6.66*** (5.45; 7.86)	9.16*** (7.05; 11.28)	-4.44*** (-6.52; -2.36)
New harmful alien species establishing: *Rarely*	2.13*** (0.76; 3.51)	3.23*** (1.79; 4.68)	2.12*** (1.19; 3.06)	1.40* (-0.05; 2.84)	-1.76** (-3.47; -0.05)
New harmful alien species establishing: *Almost none*	1.96*** (0.53; 3.40)	2.34*** (0.85; 3.84)	1.15*** (0.30; 2.00)	-0.14 (-1.56; 1.27)	-2.78*** (-4.54; -1.01)
Cost	-0.83* (-1.79; 0.14)	-0.08 (-1.03; 0.86)	-0.52* (-1.09; 0.05)	-1.37*** (-2.30; -0.45)	0.26 (-0.93; 1.44)

Simulated mean WTPs for the attributes with 95% confidence intervals
***, ** and * - WTP significantly different from 0

How the model can be applied

to examine differences in preferences related to socio-demographics

	Student	Family head	Businessman	Single mother	Pensioner
Status quo	-17.18*** (-19.32; -15.03)	11.10*** (9.55; 12.65)	5.91*** (5.03; 6.80)	-0.01 (-1.79; 1.76)	12.37*** (10.05; 14.70)
Reduced number of native species: *On small areas*	1.20** (0.07; 2.32)	1.49*** (0.48; 2.50)	0.73** (0.15; 1.30)	-0.06 (-1.14; 1.02)	-1.53** (-2.81; -0.26)
Reduced number of native species: *No such areas*	2.40** (0.57; 4.23)	2.43*** (0.84; 4.00)	0.86* (-0.10; 1.82)	-0.62 (-2.38; 1.13)	-4.64*** (-6.70; -2.58)
Water quality for recreation: *Moderate*	6.94*** (5.05; 8.84)	4.27*** (2.75; 5.80)	5.60*** (4.72; 6.47)	8.10*** (6.35; 9.85)	-2.26** (-4.28; -0.25)
Water quality for recreation: *Good*	11.17*** (9.42; 12.94)	7.77*** (6.01; 9.53)	6.66*** (5.45; 7.86)	9.16*** (7.05; 11.28)	-4.44*** (-6.52; -2.36)
New harmful alien species establishing: *Rarely*	2.13*** (0.76; 3.51)	3.23*** (1.79; 4.68)	2.12*** (1.19; 3.06)	1.40* (-0.05; 2.84)	-1.76** (-3.47; -0.05)
New harmful alien species establishing: *Almost none*	1.96*** (0.53; 3.40)	2.34*** (0.85; 3.84)	1.15*** (0.30; 2.00)	-0.14 (-1.56; 1.27)	-2.78*** (-4.54; -1.01)
Cost	-0.83* (-1.79; 0.14)	-0.08 (-1.03; 0.86)	-0.52* (-1.09; 0.05)	-1.37*** (-2.30; -0.45)	0.26 (-0.93; 1.44)

Student - most in favor of the actions, against the status quo

Pensioner - on the opposite edge

How the model can be applied

to examine differences in preferences related to socio-demographics

	Student	Family head	Businessman	Single mother	Pensioner
Status quo	-17.18*** (-19.32; -15.03)	11.10*** (9.55; 12.65)	5.91*** (5.03; 6.80)	-0.01 (-1.79; 1.76)	12.37*** (10.05; 14.70)
Reduced number of native species: *On small areas*	1.20** (0.07; 2.32)	1.49*** (0.48; 2.50)	0.73** (0.15; 1.30)	-0.06 (-1.14; 1.02)	-1.53** (-2.81; -0.26)
Reduced number of native species: *No such areas*	2.40** (0.57; 4.23)	2.43*** (0.84; 4.00)	0.86* (-0.10; 1.82)	-0.62 (-2.38; 1.13)	-4.64*** (-6.70; -2.58)
Water quality for recreation: *Moderate*	6.94*** (5.05; 8.84)	4.27*** (2.75; 5.80)	5.60*** (4.72; 6.47)	8.10*** (6.35; 9.85)	-2.26** (-4.28; -0.25)
Water quality for recreation: *Good*	11.17*** (9.42; 12.94)	7.77*** (6.01; 9.53)	6.66*** (5.45; 7.86)	9.16*** (7.05; 11.28)	-4.44*** (-6.52; -2.36)
New harmful alien species establishing: *Rarely*	2.13*** (0.76; 3.51)	3.23*** (1.79; 4.68)	2.12*** (1.19; 3.06)	1.40* (-0.05; 2.84)	-1.76** (-3.47; -0.05)
New harmful alien species establishing: *Almost none*	1.96*** (0.53; 3.40)	2.34*** (0.85; 3.84)	1.15*** (0.30; 2.00)	-0.14 (-1.56; 1.27)	-2.78*** (-4.54; -1.01)
Cost	-0.83* (-1.79; 0.14)	-0.08 (-1.03; 0.86)	-0.52* (-1.09; 0.05)	-1.37*** (-2.30; -0.45)	0.26 (-0.93; 1.44)

Family head and businessman - for the actions, but strong preference towards the status quo

Single mother - interested only in having better water quality for recreation

How the model can be applied

to examine differences in preferences related to socio-demographics

	Student	Family head	Businessman	Single mother	Pensioner
Status quo	-17.18*** (-19.32; -15.03)	11.10*** (9.55; 12.65)	5.91*** (5.03; 6.80)	-0.01 (-1.79; 1.76)	12.37*** (10.05; 14.70)
Reduced number of native species: *On small areas*	1.20** (0.07; 2.32)	1.49*** (0.48; 2.50)	0.73** (0.15; 1.30)	-0.06 (-1.14; 1.02)	-1.53** (-2.81; -0.26)
Reduced number of native species: *No such areas*	2.40** (0.57; 4.23)	2.43*** (0.84; 4.00)	0.86* (-0.10; 1.82)	-0.62 (-2.38; 1.13)	-4.64*** (-6.70; -2.58)
Water quality for recreation: *Moderate*	6.94*** (5.05; 8.84)	4.27*** (2.75; 5.80)	5.60*** (4.72; 6.47)	8.10*** (6.35; 9.85)	-2.26** (-4.28; -0.25)
Water quality for recreation: *Good*	11.17*** (9.42; 12.94)	7.77*** (6.01; 9.53)	6.66*** (5.45; 7.86)	9.16*** (7.05; 11.28)	-4.44*** (-6.52; -2.36)
New harmful alien species establishing: *Rarely*	2.13*** (0.76; 3.51)	3.23*** (1.79; 4.68)	2.12*** (1.19; 3.06)	1.40* (-0.05; 2.84)	-1.76** (-3.47; -0.05)
New harmful alien species establishing: *Almost none*	1.96*** (0.53; 3.40)	2.34*** (0.85; 3.84)	1.15*** (0.30; 2.00)	-0.14 (-1.56; 1.27)	-2.78*** (-4.54; -1.01)
Cost	-0.83* (-1.79; 0.14)	-0.08 (-1.03; 0.86)	-0.52* (-1.09; 0.05)	-1.37*** (-2.30; -0.45)	0.26 (-0.93; 1.44)

No significant differences in WTP for the reduced number of native species

How the model can be applied

to examine differences in preferences related to socio-demographics

	Student	Family head	Businessman	Single mother	Pensioner
Status quo	-17.18*** (-19.32; -15.03)	11.10*** (9.55; 12.65)	5.91*** (5.03; 6.80)	-0.01 (-1.79; 1.76)	12.37*** (10.05; 14.70)
Reduced number of native species: *On small areas*	1.20** (0.07; 2.32)	1.49*** (0.48; 2.50)	0.73** (0.15; 1.30)	-0.06 (-1.14; 1.02)	-1.53** (-2.81; -0.26)
Reduced number of native species: *No such areas*	2.40** (0.57; 4.23)	2.43*** (0.84; 4.00)	0.86* (-0.10; 1.82)	-0.62 (-2.38; 1.13)	-4.64*** (-6.70; -2.58)
Water quality for recreation: *Moderate*	6.94*** (5.05; 8.84)	4.27*** (2.75; 5.80)	5.60*** (4.72; 6.47)	8.10*** (6.35; 9.85)	-2.26** (-4.28; -0.25)
Water quality for recreation: *Good*	11.17*** (9.42; 12.94)	7.77*** (6.01; 9.53)	6.66*** (5.45; 7.86)	9.16*** (7.05; 11.28)	-4.44*** (-6.52; -2.36)
New harmful alien species establishing: *Rarely*	2.13*** (0.76; 3.51)	3.23*** (1.79; 4.68)	2.12*** (1.19; 3.06)	1.40* (-0.05; 2.84)	-1.76** (-3.47; -0.05)
New harmful alien species establishing: *Almost none*	1.96*** (0.53; 3.40)	2.34*** (0.85; 3.84)	1.15*** (0.30; 2.00)	-0.14 (-1.56; 1.27)	-2.78*** (-4.54; -1.01)
Cost	-0.83* (-1.79; 0.14)	-0.08 (-1.03; 0.86)	-0.52* (-1.09; 0.05)	-1.37*** (-2.30; -0.45)	0.26 (-0.93; 1.44)

Some significant differences in WTP for better water quality for recreation
E.g., the single mother is willing to pay more than the family head for the improvement to a moderate state.

How the model can be applied

to examine differences in preferences related to socio-demographics

	Student	Family head	Businessman	Single mother	Pensioner
Status quo	-17.18*** (-19.32; -15.03)	11.10*** (9.55; 12.65)	5.91*** (5.03; 6.80)	-0.01 (-1.79; 1.76)	12.37*** (10.05; 14.70)
Reduced number of native species: *On small areas*	1.20** (0.07; 2.32)	1.49*** (0.48; 2.50)	0.73** (0.15; 1.30)	-0.06 (-1.14; 1.02)	-1.53** (-2.81; -0.26)
Reduced number of native species: *No such areas*	2.40** (0.57; 4.23)	2.43*** (0.84; 4.00)	0.86* (-0.10; 1.82)	-0.62 (-2.38; 1.13)	-4.64*** (-6.70; -2.58)
Water quality for recreation: *Moderate*	6.94*** (5.05; 8.84)	4.27*** (2.75; 5.80)	5.60*** (4.72; 6.47)	8.10*** (6.35; 9.85)	-2.26** (-4.28; -0.25)
Water quality for recreation: *Good*	11.17*** (9.42; 12.94)	7.77*** (6.01; 9.53)	6.66*** (5.45; 7.86)	9.16*** (7.05; 11.28)	-4.44*** (-6.52; -2.36)
New harmful alien species establishing: *Rarely*	2.13*** (0.76; 3.51)	3.23*** (1.79; 4.68)	2.12*** (1.19; 3.06)	1.40* (-0.05; 2.84)	-1.76** (-3.47; -0.05)
New harmful alien species establishing: *Almost none*	1.96*** (0.53; 3.40)	2.34*** (0.85; 3.84)	1.15*** (0.30; 2.00)	-0.14 (-1.56; 1.27)	-2.78*** (-4.54; -1.01)
Cost	-0.83* (-1.79; 0.14)	-0.08 (-1.03; 0.86)	-0.52* (-1.09; 0.05)	-1.37*** (-2.30; -0.45)	0.26 (-0.93; 1.44)

No significant differences in WTP for limiting occurrences of new harmful alien species

Conclusions

- On average, Latvians are willing to pay for marine waters improvements.
- However, a substantial share of them reveals aversion towards **any** new policy.
- Latvians are willing to pay
  - the most for improving the recreational water quality (4.5 LVL per year),
  - and much less for avoiding loss in marine biodiversity and limiting new occurrences of invasive alien species (0.4-1.6 LVL per year).
- Lack of sensitivity to scope.
- The economic effectiveness of reaching the Good Ecological Status in coastal and marine waters of Latvia is doubtful.

Conclusions

- We find substantial preference heterogeneity among Latvians towards the environmental improvements.
- We are able to attribute much of this heterogeneity to socio-demographic differences.
- We identify six unobservable factors correlated with respondents' socio-demographics which affect the respondents' preferences towards the environmental improvements.
- Our approach of explaining the socio-demographic-related preference heterogeneity:
  - places no arbitrary assumptions on which socio-demographic variables to include,
  - simultaneously models the links between socio-demographics and factors unobservable by the modeller, and the links between these factors and respondents' preferences,
  - allows to limit the number of explanatory variables interacted with the choice attributes,
  - is more statistically efficient than the commonly used approaches.
- Accounting for heterogeneity is important for improving the model fit and obtaining more useful value estimates for policy formation.

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