Protest Beliefs in Contingent Valuation: Latent Variable and Latent Class Models

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OUTLINE:

- MOTIVATION
- CASE STUDY
- METHODOLOGY
- ESTIMATION RESULTS
- CONCLUSION

MOTIVATION

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- "Protest bids are valuations that are intended to express displeasure with some part of contingent market rather than to reveal true preferences."(Edwards&Anderson, 1987)
- The protest beliefs of respondents are identified by their answers to the attitudinal questions (protest indicators).

MOTIVATION

There are two approaches to treat protest beliefs:

1. Continuous Approach
    a) Additive Index
    b) Latent Variable Model (LVM)
2. Discrete Approach
    a) Ad Hoc Criteria
    b) Latent Class Model (LCM)

MOTIVATION

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    - all attitudinal questions that represent protest beliefs are summed up.

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Meyerfoff and Liebe (2006) and (2008), among others.

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Problem

each attitudinal question is given equal weight.

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not possible to identify NON-PROTESTERS.

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    - respondents are removed from the sample based on some criteria.

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no objective selection criteria.

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2. Discrete Approach

   b) Latent Class Model (LCM)

   - respondents are *endogenously* classified to the particular class based on the answers to the attitudinal questions.

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within class homogeneity assumption (???).

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within class homogeneity assumption (???).

Solution

to combine the features of a LVM and a LCM, namely, a factor mixture model (FMM).

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The contribution of this paper:

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(i) to compare alternative approaches for treating protest beliefs in terms of the estimated WTP and statistical performance (Ad Hoc Criteria, LVM and LCM) .

(ii) to relax the within-class homogeneity assumption of the LCM by combining the features of the LVM and the LCM, estimating the FMM.

CASE STUDY

- Information was collected in 2006 in Douro Valley region, Portugal.
- In order to preserve the current landscape the farmers need to be compensated for the cost otherwise this landscape will be changed.
- The data contains 706 observations based on face-to-face interviews.
  Questionnare: **CV Answer**
- Taking into account your income and expenses of your family, would you be willing to pay **XX** euros every year to guarantee the preservation of the current landscape?

CASE STUDY

Questionnare: **Attitudinal Questions (Protest Indicators)**

Q4. The landscape should be preserved with the current taxes

Q5. I think this payment will be used for other purposes

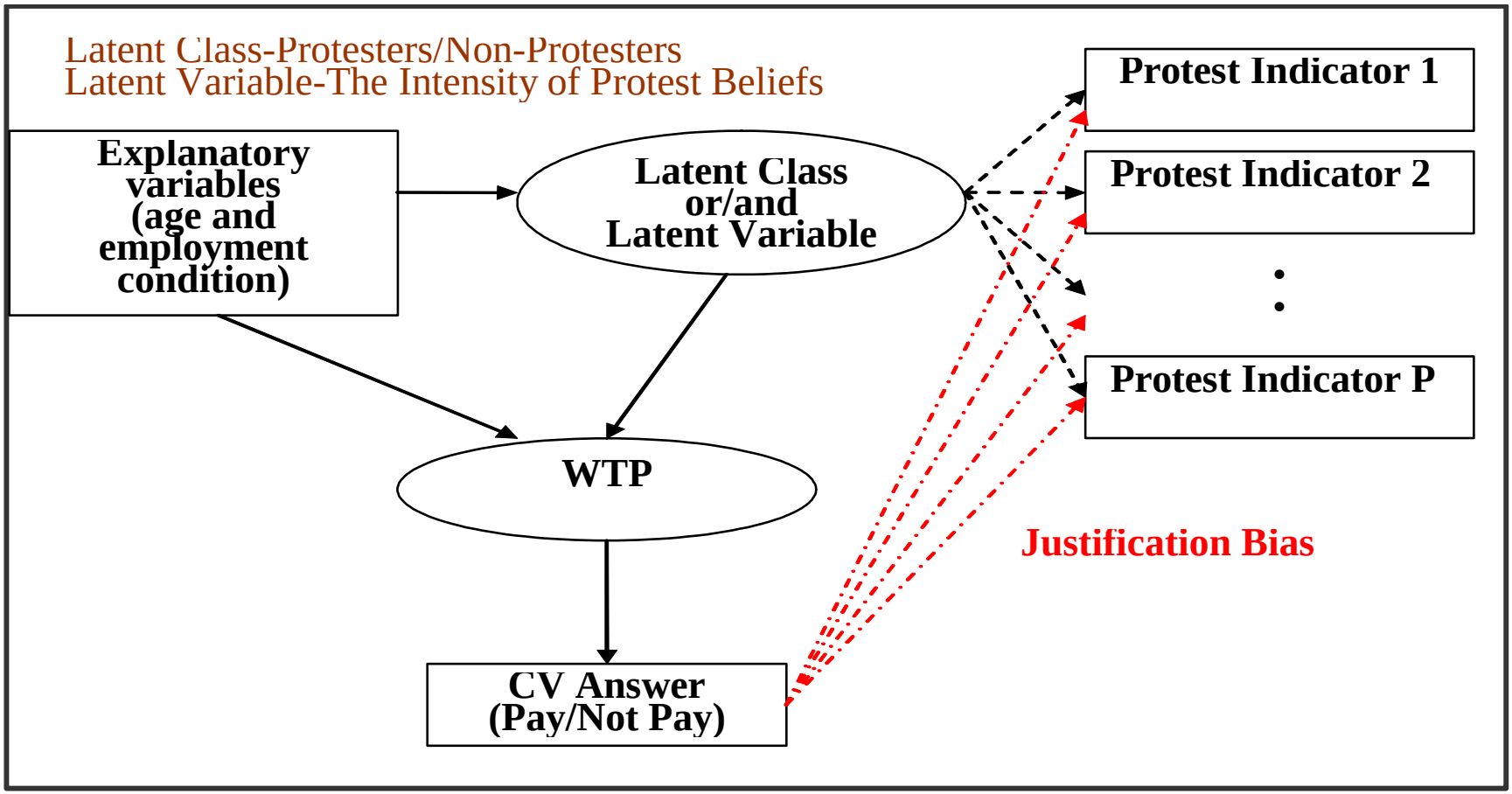
Q8. It is not fair to ask to pay

Q10. This payment will not insure the preservation the landscape

Q11. I already pay enough taxes for this preservation

Likert Scale 1=strongly disagree to 5=strongly agree

METHODOLOGY



ESTIMATION RESULTS

CV Answer Part:

	LVM	LCM		FMM	
		Protesters	Non-Protesters	Protesters	Non-Protesters
Dependent Variable (Pay/ Not Pay)					
constant	1.448 (0.00)	2.099 (0.08)	1.404 (0.00)	1.357 (0.28)	1.558 (0.00)
intensity	-0.098 (0.76)	-	-	-1.695 (0.142)	-0.012 (0.98)
ln(Bid)	-0.617 (0.00)	-1.011 (0.01)	-0.541 (0.00)	-0.885 (0.03)	-0.59 (0.00)
Number of People	706	172	534	202	504
MD(WTP)	10.45	8	13.4	4.63	14.02

ESTIMATION RESULTS

Factor Loadings:

	FMM	
	Protesters	Non-Protesters
Q4	1.505	-0.08
	(0.00)	(0.63)
Q5	0.527	1.550
	(0.37)	(0.00)
Q8	1.546	0.993
	(0.00)	(0.00)
Q10	1.314	1.706
	(0.02)	(0.00)
Q11	4.917	0.69
	(0.392)	(0.00)

ESTIMATION RESULTS

Structural/Membership Equation:

Explanatory Variable	LVM	LCM		FMM	
		Protesters	Non-Protesters	Protesters	Non-Protesters
Dependent Variable (Class/ Intensity)					
Constant	-	-0.342 (0.56)	0.342 (0.56)	0.29 (0.62)	-0.29 (0.62)
Age	-0.009 (0.01)	-0.033 (0.00)	0.033 (0.00)	-0.036 (0.00)	0.036 (0.00)
EmpCondition	0.24 (0.05)	0.801 (0.02)	-0.801 (0.02)	0.547 (0.10)	-0.547 (0.10)

- We can conclude that young and employed people have higher protest beliefs.

ESTIMATION RESULTS

Justification Bias:

	LVM	LCM		FMM	
		Protesters	Non-Protesters	Protesters	Non-Protesters
Independent Variable (Ans)					
Q4	-0.744 (0.04)	-0.768 (0.25)	-0.371 (0.08)	0.672 (0.56)	-0.469 (0.06)
Q5	-1.402 (0.00)	-0.679 (0.09)	-1.045 (0.00)	-0.142 (0.87)	-1.662 (0.07)
Q8	-1.903 (0.00)	-1.553 (0.01)	-1.547 (0.00)	-0.503 (0.57)	1.862 (0.00)
Q10	-1.977 (0.01)	-1.503 (0.00)	-1.212 (0.00)	-0.27 (0.81)	-1.862 (0.08)
Q11	-1.69 (0.00)	-0.836 (0.31)	-1.396 (0.00)	2.48 (0.39)	-1.687 (0.00)

ESTIMATION RESULTS

Criteria & Tests:

	LVM	LCM		FMM	
Entropy	-	0.865		0.748	
AIC	8527	8462		8309	
BIC	8682	8722		8623	
Adjusted BIC	8574	8541		8404	
Log-likelihood	-4229	-4174		-4085	
Number of Parameters	34	57		69	
Number of observations	706	172	534	202	504
LMR /BPLRT Test (p-value)	-	(0.00)/(0.00)		(0.00)/(0.00)	

- The FMM fits data better

ESTIMATION RESULTS

- $\Rightarrow$ the intensity of protest beliefs is not significant in the CV part of the LVM and the FMM (value vs. distribution???).
- $\Rightarrow$ the presence of heterogeneity within class
- $\Rightarrow$ the median willingness-to-pay for the LVM (**10.45**), the LCM (**8 vs 13.4**) and the **FMM** (**4.63 vs 14.02**).
- $\Rightarrow$ young and employed people have higher protest beliefs.
- $\Rightarrow$ justification bias is significant for the LVM, the LCM (Non-Protesters) and the FMM (Non-Protesters).

CONCLUSION

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- different representations of psychological and attitudinal aspects give different estimated WTPs with policy implications.
- the FMM is more flexible and fits data better.

APPENDIX

Variable	Mean	SD	Min	Max	Description
CV Answer	0.32	0.47	0	1	Answer to the CV question(1=Pay,0=Not Pay)
Bid	46.7	29.7	10	100	Bid for the CV question in Euros
Age	45.3	13.7	18	85	The age of the respondent
Emp	0.78	0.41	0	1	Employment Condition(1=Employed,0=otherwise)

APPENDIX (*Attitudinal Questions*)

Q1. The values are too high
Q2. I can't afford to pay anything right now
Q3. The landscape preservation is not my problem
Q4. The landscape should be preserved with the current taxes
Q5. I think money will be used for other purposes
Q6. The residents of the region should pay for this preservation
Q7. The local authorities and tourist operators should pay for this preservation
Q8. It is not fair to ask me to pay
Q9. I would rather pay more important things
Q10. This payment will not insure the preservation of the landscape
Q11. I already pay enough taxes for this preservation
Q12. It is necessary to pay to visit and benefit from this region more often
Q13. It is necessary to pay to insure the preservation of this landscape because it is unique
Q14. It is necessary to pay to insure the preservation of this landscape because it is beautiful
Q15. It is necessary to pay to insure the preservation of nature and biodiversity in this region

APPENDIX (*Factor Analysis*)
Factor loadings

Attitudinal Questions	Factors		
	1st	2nd	3rd
Q1	**0.344**	0.161	-0.079
Q2	**0.713**	-0.004	0.09
Q3	**0.554**	0.192	0.006
Q4	-0.261	**0.506**	-0.011
Q5	0.014	**0.669**	0.044
Q6	**0.432**	-0.052	0.181
Q7	-0.09	0.184	0.044
Q8	0.182	**0.631**	-0.044
Q9	**0.342**	0.187	-0.152
Q10	0.005	**0.777**	0.019
Q11	-0.045	**0.74**	0.072
Q12	0.006	0.027	**0.933**
Q13	-0.008	-0.02	**0.962**
Q14	0.016	0.012	**0.974**
Q15	-0.008	-0.012	**0.962**

Distribution of answers to the attitudinal questions (in %)

Attitudinal Questions	Likert Scale				
	1	2	3	4	5
Q4	0.4	3.8	7.1	60.9	27.8
Q5	1.1	10.8	28.9	41.5	17.7
Q8	1.4	15.4	15.6	52.1	15.4
Q10	0.6	12.5	31.6	38.2	17.1
Q11	0.7	5.4	12.3	54.4	27.2

METHODOLOGY (*Latent Variable Model*)

CV Answer Part:

$$u_n = \begin{cases} 1 & \text{if } \mathbf{WTP}_n > \text{Bid}_n \\ 0 & \text{otherwise} \end{cases}$$

$$\mathbf{P}_u(\mathbf{u}_n = \mathbf{1} | \mathbf{Z}_n, \mathbf{X}_n^*, Bid_n) = \mathbf{F}(\boldsymbol{\beta}_1 \mathbf{Z}_n + \boldsymbol{\beta}_2 \mathbf{X}_n^* + \boldsymbol{\beta}_3 \ln(Bid_n))$$

$$\text{Med}(\mathbf{WTP}_n) = \exp\left\{ -\frac{\boldsymbol{\beta}_1 \mathbf{Z}_n + \boldsymbol{\beta}_2 \mathbf{X}_n^*}{\boldsymbol{\beta}_3} \right\}$$

$\text{Med}(\mathbf{WTP}_n)$—the median willingness to pay for an individual n.
Bid_n—the randomly assigned bid to an individual n.
$\mathbf{Z}_n$—the social-econimic charachteristics of an individual n.
$\mathbf{X}_n^*$—the latent variable that represents protest beliefs of an individual n.

Latent Variable:

$$\mathbf{I}_n^* = \Theta \mathbf{Z}_n + \Lambda \mathbf{X}_n^* + \Psi u_n + \varepsilon_n$$

$$\mathbf{X}_n^* = \Pi \mathbf{X}_n^* + \Phi \mathbf{Z}_n + \xi_n$$

Likelihood Function:

$$\mathbf{L}(\theta) = \prod_{\mathbf{n=1}}^{\mathbf{N}} \left(\int_{X^*} \prod_{i=1,2} \mathbf{1}(\mathbf{u}_n = \mathbf{i}) \mathbf{P}_u(\mathbf{u}_n = \mathbf{i} | \mathbf{Z}_n, \mathbf{X}_n^*; \beta, \sigma) \times \right.$$
$$\left. \times \mathbf{g}_I(\mathbf{I}_n | \mathbf{Z}_n, \mathbf{X}_n^*; \Lambda, \Sigma_\varepsilon) \mathbf{g}_{\mathbf{X}^*}(\mathbf{X}_n^* | \mathbf{Z}_n; \Pi, \Phi, \Sigma_\xi) \mathbf{d}\mathbf{X}_n^* \right)$$

$\theta = (\beta_1, \beta_2, \beta_3, \Theta, \Lambda, \Phi, \Sigma_\varepsilon, \Sigma_\xi, \tau, \sigma)'$ is a vector of the parameters of the model .

METHODOLOGY (*Latent Class Model*)

CV Part:

$$u_n = \begin{cases} 1 & \text{if } \mathbf{WTP}_n^c > \text{Bid}_n \\ 0 & \text{otherwise} \end{cases}$$

$$\mathbf{P}_u(\mathbf{u}_n = \mathbf{1} | \mathbf{Z}_n, \text{Bid}_n, c) = \mathbf{F}(\beta_1^c \mathbf{Z}_n + \beta_2^c \ln(\text{Bid}_n))$$

$$\text{Med}(\mathbf{WTP}_n^c) = \exp\left\{ -\frac{\beta_1^c \mathbf{Z}_n}{\beta_2^c} \right\}.$$

c- the latent class.
$\text{Med}(\mathbf{WTP}_n)$−the median willingness to pay for an individual n.
Bid_n−the randomly assigned bid to an individual n.
$\mathbf{Z}_n$−the social-econimic charachteristics of an individual n.

Latent Class:

$$\mathbf{I}_n^* = \Theta^c \mathbf{Z}_n + \Psi^c u_n + \varepsilon_n^c$$

$$\mathbf{P}(c_n = c|\mathbf{Z}_n) = \frac{e^{\delta^c + \gamma^c \mathbf{Z}_n}}{\sum_{c=1}^{C} e^{\delta^c + \gamma^c \mathbf{Z}_n}} \qquad for\ c = 1, ..., C$$

Likelihood Function:

$$\mathbf{L}(\theta) = \left(\prod_{n=1}^{N} \sum_{c=1}^{C} \prod_{i=0,1} \mathbf{1}(u_n{=}i)\mathbf{P}(u_n = i|\mathbf{Z}_n, \text{Bid}_n, c)\times \right. \\ \left. \times \mathbf{g}(\mathbf{I}_n|\mathbf{Z}_n, c)\mathbf{P}(c_n = c|\mathbf{Z}_n) \right)$$

$\theta = \{(\beta_1^c, \beta_2^{\mathbf{c}}, \Theta^{\mathbf{c}}, \Psi^c, \Sigma_\varepsilon^c, \tau^{\mathbf{c}}, \delta^c, \gamma^c)', c = 1, 2, ..., C\}$ is a vector of parameters.