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Identifying various types of protesters in contingent valuation using latent class analysis

By

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ABSTRACT

Recent studies on protesting in contingent valuation (CV) suggest that respondents are not unmistakably protesters or non-protesters. Thus, an unambiguously identification of these two groups may be inappropriate. Applying latent class analysis in two CV studies we propose an alternative approach to identify protesting. It assumes that a finite number of latent subgroups (classes) exists in a population, and, while class membership is treated as probabilistic, that members of each class share similar attitudes or preferences. In both CV studies we find various classes with different degrees and characteristics of protesting, and mean willingness to pay varies accordingly.

Keywords: Contingent valuation, forest biodiversity, latent class analysis, protest responses, surface water, willingness to pay

1. Introduction

Identification and treatment of protest responses in stated preference studies is still an unsettled topic. In the literature protest responses are mainly seen as responses that express a zero willingness to pay (WTP) because people *protest* against some part of the survey, e.g., the valuation scenario or the use of money to assess nature, although people actually do value the good in question. Thus, protest responses are solely determined among those who are not willing to pay mostly using ad hoc debriefing questions. Subsequently, those identified as protesters are excluded from further analysis. On the other hand, authors such as Jorgensen and Syme (2000) argue, firstly, that protesting reflects an attitude toward paying money for the good in question that is based on a set of protest beliefs which are mutually interdependent, and, secondly, that this attitude is present among both those who are not willing to pay and those who are willing to pay for the good in question. Furthermore, the attitude influences respondents' answers to the WTP question. In this case censoring the sample based on responses to a combination of debriefing questions may not be justified. Jorgensen and Syme therefore conclude that not only those who reject to pay for the good in question should be presented attitudinal questions concerning their protest attitude but also those who are willing to pay (see also Meyerhoff & Liebe, 2006; Collins & Rosenberger, 2007).

A promising method to analyse the effect of a protest attitude when all respondents have been presented attitudinal questions is latent class analysis (LCA), or, more precisely, latent class cluster analysis (Vermunt & Magidson, 2009). It assumes that a finite number of latent subgroups can be found in a population arising from response patterns of individuals who share similar attitudes or preferences. As membership to one of the latent classes can not be observed, it is treated as probabilistic. LCA is used increasingly often in environmental valuation studies. This comprises revealed preference studies (Scarpa & Thiene, 2005) as well as stated preference studies (Boxall & Adamowicz, 2002; Morey et al., 2006). Recently, Morey et al. (2008) have presented an application of LCA to preferences for landscape preservation. Using responses to a set of 16 attitudinal questions they identify four different preference classes. Aldrich et al. (2007) have applied LCA, in addition to cluster analysis, to responses to the attitudinal questions belonging to the New Environmental Paradigm. They aimed at accounting for unobserved preference heterogeneity among respondents to their contingent valuation concerning recovery of two endangered species. In the context of analysing protest responses in contingent valuation and in choice experiments Meyerhoff & Liebe (2008) suggest that applying LCA may be an interesting option.[1] Also, Morey et al. (2008) conclude that LCA may be used to identify a class of scenario rejecters, for example.

In this paper we present results from applying the LCA to two applications of the contingent valuation method. Both studies were developed and conducted independently from each other. However, in both studies all respondents were presented attitudinal questions to identify protesters. One study concerns changes in forest biodiversity on a regional level in Germany and

[1] The suggestion to use LCA in the context of protest responses was actually made by Ricardo Scarpa at the EAERE-conference in Bremen 2005 while commenting on a paper concerning a comparison of protest responses in a contingent valuation and in a choice experiment by two of the present authors.

was carried out in 2004. The other study concerns the quality of tab water and surface water in Poland and was carried out in 2007. In the present analysis we focus on the data with respect to surface water quality.

2. Treatment of protest responses in contingent valuation studies

The treatment of protest responses in stated preference surveys can be – roughly – assigned to two different approaches. The first one, and this one is still applied by the majority of researchers, is to confine identification and treatment of protesters to those respondents who are not willing to pay. In general, respondents who stated a zero willingness to pay are presented a set of debriefing questions and the answers to these questions are used to determine whether people were protesting or whether they state a true willingness to pay of zero. One problem of this approach is, as was pointed out by Brouwer (2008) once again, that criteria determining whether an interviewee is a protest bidder or not are often arbitrary (see also Jorgensen et al. 1999; Meyerhoff & Liebe, 2006). Thus, a respondent who is determined as a protester in one study may be classified as having a true zero willingness to pay in another study and vice versa. Moreover, subsequent treatment such as dropping protesters from further analysis can strongly bias welfare estimates. For example, assuming that protesters have a zero WTP may underestimate their true WTP and assuming that their WTP equals the mean WTP of those who stated a positive WTP may overstate it.

A method to deal with this problem is to employ sample selection models. In this case protesters are still identified through answers to a set of debriefing questions but they remain in the sample and, thus, allow incorporating protest responses in WTP estimations (Brox et al., 2003; Strazzera et al., 2003; Collins & Rosenberger, 2007). For example, Collins and Rosenberger (2007) found in their study on watershed restoration that protesters do have positive WTP values when applying their two-equation selection model. But as the correlation between the error terms of both equations, the selection and outcome equation, was positive, WTP of protesters is supposed to be lower compared to those who stated a positive WTP in the survey. Compared to the results from the sample selection model, assigning protesters a zero WTP would result in an underestimation of 10 percentage points and assigning protesters the mean WTP value of those who stated a positive WTP would have resulted in an overestimation of 14 percentage points.

The second approach of treating protest responses supposes that protesting represents an attitude towards paying for the good in question. This attitude grounds on a set of protest beliefs that are mutually interdependent (Jorgensen & Syme, 2000). Moreover, this attitude may not only be hold by those who are not willing to pay but also by those who are willing to pay (Jorgensen et al., 1999; Meyerhoff & Liebe, 2006). Censoring one type of belief and not censoring another type, when both might represent the same underlying attitude, may thus be indefensible. Therefore, these studies argue in favour of presenting all respondents attitudinal questions concerning protest beliefs and to restrain from dropping respondents from the sample based on any kind of protest definition.

An approach to determine the impact of protesting when all respondents have been presented attitudinal questions and remain in the sample is to use Latent Class Analysis (LCA). Based on the response pattern to a set of attitudinal questions a finite number of attitude classes. i.e., comprising people with a similar protest attitude can be determined and WTP estimates can be calculated according to the classes. Then, using knowledge of the class sizes, i.e., their share of the whole sample, aggregated welfare measures can be calculated that take into account the influence of the protest attitude on the WTP values. The advantage is that no selection bias is introduced by the researcher. Furthermore, for those respondents who stated a positive WTP but also hold a protest attitude ─ Collins and Rosenberger (2007) call them partial protesters ─ the effect of protesting on WTP values is considered.

3. Data

3.1 CVM on forest biodiversity

The objective of the CVM study was to estimate the benefits people would derive from different levels of forest biodiversity in the area of the Solling and Harz in Germany. Both the Solling and the Harz are part of the mountain ranges in the south of Lower Saxony, in which there are naturally occurring beech forests. Historical land use such as intensive forest grazing and timber use led to widespread devastation at the end of the 18th century. Subsequently, the area was reforested mainly with Norway spruce, still covering large parts of the mountain ranges. In response to this situation, the government of Lower Saxony introduced in 1991 the forest strategy program “LÖWE” (Langfristige Ökologische Waldentwicklung; long term ecological forest development) for the state owned forests. Among other objectives, the program aims at enlarging broadleaved and mixed forests. Overall, the intended forest management measures will cause changes in forest biodiversity, e.g., the kinds of plant and animal species present as well as the number of species. The expected changes in forest biodiversity were described to respondents by using the following four attributes: habitats for protected and endangered plant and animal species, number of plant and animal species, forest stand structure and landscape diversity.

In order to determine respondents WTP interviewees were directly asked whether they are willing to pay to change forest biodiversity in the region. Afterwards, they were presented the changes in the forest biodiversity attributes according to the LÖWE conversion programme together with a payment ladder. It ranged from €0.50 to €130. As a payment vehicle a contribution to a fund “forest conversion” was used. This fund would be managed by the Forest Planning Office of Lower Saxony. The data were collected in autumn 2004 by a survey company in face-to-face interviews. The sampling population was restricted to citizens 18 years and older living in private households in the Solling and Harz region. Random sampling was obtained using a three-stage process (cities/sample points representative for the study region/population; households selected by random walk; and randomly determined respondents within households). This resulted in 324 interviews. Due to missing data 321 interviews are useable for further analysis in this study. The items used to identify protest attitudes are presented in Section 4.2.

3.2 CVM on surface water quality

Poland belongs to the group of countries with the lowest water resources in Europe (1.6 thousand m^3 of surface water per capita). Apart from water scarcity, the other problem is water quality. In Poland, till 2004 the three-grade classification for the condition of surface water was in effect, where class I denoted water suitable for drinking, class II complied with requirement for an animal husbandry and class III water for irrigation purposes. Waters chemically and bacteriological polluted or excessively fertilized by biogens were defined as "out of classes". According to the last national water quality examination in 2003, only 3% of the surface waters belonged to the class I, and more then half was recognized as "out of classes" (GUS, 2005). In terms of tap water quality a lot remains to be done as well as in a case of surface waters quality. The results of the tap water examination in urban agglomerations in Poland in 2001 show that in more than 2/3 controlled cities tap water did not fulfil requirements for drinking water (NIK, 2002). Poles rarely drink tap water without boiling it first.

The aim of the CV study was to estimate benefits from improvements in water quality in Poland – both tap and surface water quality. The survey was conducted face-to-face in respondents' homes by a professional polling agency. Overall, 813 people representative for the adult population from urban municipalities with respect to sex, age, education, income level, and geography were interviewed. The main survey was carried out in November 2007 preceded by a pilot study on a sample of 50 people. The survey focused on cities to obtain homogeneity of the sample in terms of access to water and waste water networks.

The survey consisted of two parts. The first referred to the tap water quality, the other to the surface water quality. The policy context was described as a 3 year investment program to upgrade the water supply network and to build new purification plants (to improve tap water quality), and enlarging the sewerage network and modernization and construction of new sewage treatment plants (a scenario in the surface quality part). Respondents were informed that if the proposed program will not achieve public support it won't be implemented for the next 10 years.

The part concerning the surface water quality was referred to lakes, rivers, ponds, canals etc. in the respondents' surroundings, i.e., up to 20 km around their place of residence. Water quality was classified by a five-level scale based on a CV study about eutrophication from Norway (Bergland et al., 1995). Each water quality class was presented by proxies such as: usefulness for drinking, swimming, fishing, and irrigation and a visual description. The potential water quality improvement was defined as achieving the water quality standard described by level II: water "quite transparent", suitable for drinking after boiling, useful for swimming, very good for fishing and for agriculture purposes.

In the valuation scenario an increase in respondents' monthly water and sewerage bill was used as the payment vehicle. Respondents were asked to state their maximum WTP ticking the amount on a payment ladder ranging from PLN 0.50 to PLN 1000. In the case of surface water quality 779 observations were used to estimate WTP. All respondents, irrespective of whether they were willing to pay, were presented the attitudinal questions to identify protesters. The items used to determine the protest attitudes are described in Section 4.2.

4. Latent-class model on protesting and items to identify protesting

4.1 Latent-class model

In general, latent class analysis (LCA) assumes that a sample of individuals is drawn from a population that consists of a finite number of latent classes, called C. Each element in the sample can be regarded as a draw from one of these C latent classes with the number of classes and their sizes not known a priori. In the context of responses to attitudinal questions such as, for example, toward a landscape or toward paying money for the provision of environmental goods, the underlying assumption is that individuals with a similar attitude will show response patterns that are highly correlated. As people with different attitudes will show different response patterns, a sample can be divided into a finite number of classes each time having a similar attitude. LCA assumes that each individual belongs to one and only one class. Once class membership has been determined it is moreover assumed that the answers to a series of questions are uncorrelated. The log-likelihood function for a C-class model for attitudinal data as in our surveys is

$$\ln L = \sum_{i=1}^{N} \ln \left[\sum_{c=1}^{C} \Pr(c) \prod_{q=1}^{Q} \prod_{s=1}^{S} (\pi_{qs|c})^{x_{iqs}} \right], \tag{1}$$

where N is the number of respondents, C the number of classes, Q the number of attitudinal question, S the number of responses, Pr(c) the unconditional probability that any respondent in the sample will belong to class c, and $\pi_{qs|c}$ the probability that a respondent in class c gives answer s to attitudinal question q (Aldrich et al., 2007; Morey et al., 2008). The probability Pr(c) can be specified additionally as a function of observable covariates (e.g., age, sex, income, education). In the present application, however, we omit incorporating of covariates to focus on the main research issue and with respect to the number of attitudinal questions also for the sake of simplicity. Maximum likelihood estimations were conducted using Latent Gold 4.5 (Vermunt & Madigson, 2005a) with 30 to 50 random starting points (depending on the model) to avoid the problem of local maxima (Uebersax, 2000).

Criteria for model fit and number of classes

As the number of classes is unknown a priori and is outside the space of estimable parameters, the use of multiple information criteria is usually recommended. In general, they are based on the log likelihood at convergence (log L), sample size (N) and the number of parameters (k). In this study we use the Bayesian Information Criterion (BIC = −2 log L+(logN)k), the Akaike Information Criterion 3 (AIC3 = −2logL+3k), and the Consistent Akaike Information Criterion (CAIC = −2 logL+[(logN) + 1] k) (Vermunt & Magidson, 2005b). These criteria weight the fit and the parsimony of a model; the lower their value the better the model. The usual procedure is to estimate models with a varying number of classes (2, 3, 4, 5, …) and to compare the value of the information criteria among estimations. However, the information criteria may not indicate a unique solution. Selection of the number of classes thus often requires using additional information such as size and signs of parameters and, as Swait (2007) points out, common sense.

4.2 Items used to measure protest beliefs

Both the biodiversity and the surface-water survey were developed independently from each other. Thus, the items used to determine protesters or protest beliefs differ. To make results more comparable we set up various categories reflecting aspects of protesting and assigned the items used in each survey to one of these categories. Table 1 presents the items used in the surveys and their assignment to the various categories.

As categories we set up IMPORTANCE, RESPONSIBILITY, TRUST, ABILITY TO PAY, INSTRUMENT, and YARDSTICK MONEY. The first, IMPORTANCE, gathers items that reveal whether provision of the good in question, higher quality of surface water or higher levels of forest biodiversity, is important to the respondent. Protesters are expected to state that provision of the good is important to them. Otherwise they would have a true WTP of zero. Next, RESPONSIBILTY includes items that measure whether respondents think that they themselves are responsible for financing the provision of the good or whether somebody else is in charge, e.g., the national government or the European Union. People who would protest are expected to indicate that others are responsible for financing the provision of the good. The third category is called TRUST. The items assigned to this category are intended to indicate whether respondents believe that the good in question will indeed be provided as stated in the survey, i.e., respondents trust the named institutions and believe that the money collected will be used as stated in the survey. Protesters are expected to express distrust.

The next category ABILITY TO PAY addresses whether people think that they are not able to pay in the present situation or that they could not state a WTP as high as they would like to pay because of their present budget constraints. Protesters should tend to express that their ability to pay is restricted. The category INSTRUMENT assembles items measuring whether people would prefer to pay, for example, in a different way (raising taxes or cut public spending) or whether they would prefer to pay to a different institution. Protesters are expected to answer that they would prefer to pay in different ways (e.g., using another payment vehicle) or to different institutions. Finally, YARDSTICK MONEY contains an item that addresses whether people refuse to assess nature in monetary terms. Only in the forest biodiversity sample an item to measure this aspect of protesting was employed. Protesters are, of course, expected to reject the idea of assessing nature in monetary terms.

In both surveys all respondents were presented the items described in Table 1. The response scales used in both surveys differ. In the forest biodiversity survey the scale comprises the five levels “completely agree – agree – neither disagree nor agree – disagree – completely disagree” and in the surface water survey it comprises the four levels “certainly yes – rather yes – rather no – certainly no” plus a “don’t know” option. In the analysis responses were specified as nominal.[2]

[2]To avoid misunderstandings, the “don’t know” option in the surface water study is not identical with the “neither disagree nor agree” category on the five-point scale in the biodiversity study. “Don’t know” means that a respondent is not able to answer the statement (e.g., the respondent has no clear opinion on the statement), whereas “neither ... nor …” means that a respondent has a clear opinion which lies in-between agreement and disagreement (a graduation on the scale).

Table 1: Items used to determine protest beliefs

Response scale	Forest biodiversity (Germany)	Protesters tend to …	Surface water (Poland)	Protesters tend to say …
	completely disagree – disagree – neither disagree nor agree – agree - completely agree		certainly yes – rather yes – rather no – certainly no – don't know	
IMPORTANCE	Compared to other policy measures forest conversion is not important. (Not important)	disagree	The quality of surface water is an important issue in Poland. (Quality in Poland important)	yes
	Today's share of broadleaved forests in the LH region is absolutely sufficient. From my point of view there is no need to increase it. (No need)	disagree	The quality of surface water in the surroundings where I live is an important issue. (Quality in surrounding important)	yes
RESPONSIBILITY	Above all those who enjoy biodiversity in forests should pay for the measures. (Those who enjoy)	disagree	This program should be financed by the government or EU. (Financed by government/EU)	yes
	It is my right to have a high level of forest biodiversity and not something I should have to pay extra for. (My right)	agree	This program should be financed by industry or farmers. (Financed by industry/farmers)	yes
			I think that my lifestyle influences the pollution of surface water in the place where I live. (Lifestyle)	no

TRUST	Implementation of forest conversion by the Forest Planning Agency is credible. (Implementation is credible)	disagree	I believe that money collected from increased fees would be used for surface water quality improvement. (Believe money used for improvement)	no
			I believe that the programme to improve surface water quality would be implemented in the next few years. (Believe in implementation)	no
ABILITY TO PAY	I already pay enough for other things. Thus, I do not have to pay additionally for forest conversion. (Pay already enough)	agree	If my income would be higher I would be willing to pay for water quality improvements in the surroundings where I live. (WTP if income higher)	no
INSTRUMENT	Lower Saxony should cut public spending on other things instead of expecting a voluntary contribution from me. (Cut public spending)	agree	For improving surface water quality I would prefer to pay in a different way. (Pay in a different way)	yes
	In order to finance forest conversion taxes should be increased for all people. (Increase tax instead)	agree	I would prefer paying to a different institution for improving surface water quality. (Pay to different institution)	yes
YARDSTICK MONEY	I refuse to assess nature in monetary terms. (Monetary valuation)	agree		

5. Results

5.1 Descriptive statistics: describing the samples

Table 2 provides some basic descriptive statistics. With respect to age and sex both samples do not differ much. The figures for net household income differ significantly with a larger mean value in the forest biodiversity sample. The number of people per household is on average somewhat larger in the surface water sample. Due to differences in the education system in Poland and Germany we do not adjust the categories. For the Polish sample, education is measured using the three levels “Low”, “Medium”, and “High” with “Low” meaning primary school, secondary school or vocational education, “Medium” – a general secondary education or a technical secondary education with the degree qualifying for university admission (Polish: matura), “High” – an education with a university degree (bachelor or master degree). For the German sample education is expressed in years of education measured as follows: without degree (7 years), degree from secondary school after 8 years (German: Volks-/ Hauptschulabschluss), degree from secondary school after 10 years (German: mittlere Reife/Realschulabschluss), degree from secondary school after 12 years qualifying for admission to a university of applied sciences (German: Fachhochschulreife), degree secondary school after 13 years qualifying for university admission (German: Abitur), degree from a university of applied sciences (16 years), university degree (18 years).

Table 2: Descriptive statistics: describing the samples

Variable	Description	Sample	
		Forest biodiversity	**Surface water**
		Mean (Sd)	Mean (Sd)
Age	Age of respondents in years	47.28 (16.49)	48.83 (18.04)
Woman	(1 = yes)	0.53 (0.50)	0.54 (0.50)
PPH	Number of people per household	2.43 (1.32)	3.05 (1.41)
Income	Net income per household per month (€ / PLN)	1902.72* (922.38)	2492.79** (1712.31)
Education	Low		0.38 (0.49)
	Medium		0.44 (0.50)
	High		0.18 (0.39)
	Years of education	9.89 (2.70)	
WTP	In-principle WTP (1 = yes)	0.31 (0.46)	0.43 (0.50)
WTP	Mean WTP per year (€ / PLN)	6.04 (17.94)	50.50 (119.05)
N		321	779

Note: * due to missing values calculated based on 288 observations; ** due to missing values calculated based on 531 observations; nominal exchange rate in 2007: €1 = PLN 3.78.

Table 2 also reports the share of respondents who are willing to pay at all and the average WTP per year for the whole sample. In the surface water sample around 40% of the respondents are willing to pay, while in the forest biodiversity sample around one third is willing to pay. Mean willingness to pay per year per respondent in the forest biodiversity sample is € 6.0 and in the surface water sample PLN 50.5 (≈ € 13.4 per year).

5.2 Latent protest classes

Number of classes

Table 3 reports the goodness of fit measures for both samples each time for 2 to 6 latent classes. As the figures show, for both samples they do not allow a clear-cut identification of the optimal number of classes. In the surface water sample, BIC and CAIC suggest a four class model while the AIC3 measure indicates a six class model. Based on the former two measures and based on parameter estimates we opted for the more parsimonious four class model. For the forest biodiversity sample we opted for a three class model because compared to the two class model it shows a large decrease in AIC3. The BIC and CAIC indicate a two class model but their increase is somewhat lower than the decrease of the AIC3 value when we move to the three class model.

Apart from the guidance provided by the information criteria we also opted for a four class surface water model and a three class forest biodiversity model because of better comparability of both models. As the response scale in the first sample included a “don’t know” option, which was not used in the response scale of the forest biodiversity sample, we expected that the latent class model for the surface water sample would have an additional class that primarily gathering those who use often the “don’t know” option.

Table 3: Goodness of fit criteria for cases of 2 to 6 latent classes

			Forest biodiversity		
Classes	2	3	4	5	6
N parameters	73	110	147	184	221
Log-Likelihood	-4136	-4037	-3975	-3920	**-3885**
BIC	**8694**	8708	8798	8902	9045
AIC3	8491	**8390**	8403	8392	8432
CAIC	**8767**	8818	8945	9086	9266
			Surface water		
Classes	2	3	4	5	6
N parameters	79	119	159	199	255
Log-Likelihood	-9647	-9311	-9137	-9010	**-8892**
BIC	19820	19414	**19333**	19345	19375
AIC3	19531	18979	18751	18617	**18501**
CAIC	19899	19533	**19492**	19544	19614

Protesting against paying for changes in forest biodiversity

Table 4 reports the estimated response probabilities for the forest biodiversity protest model with three classes. The classes are sorted according to their class size. The parameter estimates except for the item used to measure TRUST are significant at the 5 per cent level. Socio-demographics by classes are presented in Table 5.

Class 1 (partial protesters): The largest class (51% of the sample) seems to assemble *partial protesters,* i.e. respondents who protest to some degree but are at the same time on average willing to pay. In this class 29% are willing to pay a positive amount and the mean WTP is with € 3.7 much smaller as of class 2 (marginal protesters). The partial protesters state more often than the marginal protesters that it is their right to have high levels of biodiversity; they agree more often with cutting public spending and reject more often to assess nature in monetary terms. But the response pattern does not show so much protesting as it is expressed in class 3 (strong protesters). Finally, partial protesters, compared to marginal protesters, are more likely to state that forest conversion is not important and that the current share of broadleaved forests is large enough. Thus, they are less likely to be in favour of forest conversion and increasing forest biodiversity.

Class 2 (marginal protesters): This class comprises 28% of the sample. Mean WTP is with € 15.1 significantly higher as in the other two classes. A majority of respondents in this class attach a high importance to forest biodiversity, e.g., 49% “completely disagree” with the statement that forest biodiversity is not important compared to other policy measures and 40% “completely disagree” with the statement that there is no need to increase the share of broadleaved forests. In contrast, only 1% “completely agrees” with the statement that they already pay enough for other things and, compared to the other two classes, and only 7% “completely agree” with the statement that it is their right to have a high level of biodiversity. The share of those who “completely agree” with the statement concerning assessment of nature in monetary terms is still close to a quarter (23%). Finally, 22% “completely disagree” with the statement that public spending should be cut on other things to finance forest conversion. However, respondents in this class have a very positive attitude towards forest biodiversity and are likely to express a rather weak protest attitude. Therefore, this class is labelled “marginal protesters”.

Class 3 (strong protesters): The smallest class collects 20% of the sample. Among those who are assigned to this class only 6% are willing to pay a positive amount for forest biodiversity. The mean WTP is € 0.7. The response pattern of this class is to a large extent consistent with a pattern we would expect from protest responses as commonly defined in the literature. Respondents in this class, for example, have a very high probability of completely agreeing with the statement that it is their right to have a high level of forest biodiversity. Moreover, the probability that members of this class respond that they already pay enough, that the government should cut public spending and that they refuse to assess nature in monetary terms is high, too. This class is accordingly labelled “strong protesters”. Nevertheless, in this class there is no clear tendency for a positive or negative attitude toward forest biodiversity (IMPORTANCE).

Table 4: Percentage response probabilities by class – forest biodiversity

Category	Item label		Class 1		Class 2		Class 3	
		Label	Partial protesters		Marginal protesters		Strong protesters	
		Class size	51%	N = 170	28%	N = 84	20%	N = 67
			%	s.e.	%	s.e.	%	s.e.
IMPORTANCE	Not important	Completely disagree	7	0,03	49	0,06	28	0,06
		Disagree	25	0,04	25	0,04	16	0,05
		Neither … nor …	22	0,04	15	0,05	19	0,05
		Agree	29	0,04	11	0,04	17	0,05
		Completely agree	18	0,03	0	0,01	19	0,05
	No need	Completely disagree	4	0,03	40	0,06	24	0,06
		Disagree	18	0,04	35	0,06	12	0,04
		Neither … nor …	36	0,04	18	0,05	28	0,06
		Agree	26	0,04	8	0,03	10	0,04
		Completely agree	15	0,02	0	0,00	26	0,06
RESPONSIBILITY	Those who enjoy	Completely disagree	14	0,03	53	0,06	39	0,06
		Disagree	30	0,04	22	0,05	12	0,05
		Neither … nor …	36	0,04	14	0,04	17	0,05
		Agree	18	0,03	7	0,03	8	0,04
		Completely agree	3	0,01	3	0,02	24	0,06
	My right	Completely disagree	1	0,01	28	0,05	0	0,01
		Disagree	17	0,03	18	0,05	0	0,01
		Neither … nor …	35	0,04	36	0,06	13	0,05
		Agree	37	0,04	11	0,04	0	0,01
		Completely agree	10	0,03	7	0,03	87	0,05
TRUST	Credibility	Completely disagree Disagree Neither … nor … Agree Completely agree	not significant		not significant		not significant	

ABILITY TO PAY	Enough	Completely disagree	0	0,01	35	0,06	6	0,03
		Disagree	14	0,03	19	0,05	1	0,02
		Neither … nor …	31	0,04	27	0,06	3	0,03
		Agree	34	0,04	4	0,03	11	0,04
		Completely agree	21	0,03	1	0,04	78	0,06
INSTRUMENT	Cut public spending	Completely disagree	3	0,02	22	0,05	4	0,03
		Disagree	14	0,03	26	0,05	2	0,02
		Neither … nor …	37	0,04	24	0,05	8	0,08
		Agree	35	0,04	10	0,04	8	0,04
		Completely agree	11	0,03	18	0,05	78	0,06
	Increase tax instead	Completely disagree	33	0,04	68	0,06	76	0,06
		Disagree	22	0,03	14	0,04	07	0,03
		Neither … nor …	21	0,03	9	0,04	04	0,03
		Agree	17	0,03	7	0,03	00	0,00
		Completely agree	6	0,02	1	0,01	13	0,04
YARDSTICK MONEY	Monetary valuation	Completely disagree	0	0,00	24	0,05	8	0,03
		Disagree	18	0,03	21	0,05	5	0,03
		Neither … nor …	34	0,04	23	0,06	13	0,06
		Agree	40	0,04	9	0,04	10	0,04
		Completely agree	8	0,02	23	0,05	64	0,07
WTP (yes / no)		No	71%		47%		94%	
		Yes	29%		53%		6%	
WTP (mean per year in €)		Mean	3.69		15.06		0.68	

Note: N = 321; due to rounding the probabilities do not always sum to 100.

As mentioned earlier, we did not include individual covariates in the model. Table 5 shows socio-demographics according to the three classes of the latent class model. One thing that emerges from the descriptive statistics is that in class 3 — the strong protesters — are more males, are on average slightly older, household income as well as the percentage of users is significantly lower.

Table 5: Socio-demographics according to latent classes – forest biodiversity

Class label	Class 1 Partial protesters	Class 2 Marginal pro-testers	Class 3 Strong protesters
Class size	170.00	84.00	67.00
Age	47.15	45.61	49.70
Women (%)	0.56	0.52	0.46
People per household	2.25	2.71	2.51
Net household income* (€)	1936.00	2038.65	1664.13
Education (years)	9.61	10.89	9.34
User (%)	61.60	65.20	41.80

Note: *Due to missing values net income per household is calculated based on a lower number of interviews: class1, n = 153; class 2, n = 72; class 3, n = 63.

Summarizing, in the latent class model for the forest biodiversity sample all three classes show a response pattern that does include aspects of protesting according to our measurement instruments. Even in class 2 (marginal protesters), which has the highest mean WTP, a quarter of the class members refuses to assess nature in monetary terms. The results therefore indicate that beliefs belonging to a protest attitude are not clear cut but more like a continuum ranging from stronger to weaker protesting. Thus, we tried to express these degrees by choosing labels reflecting the gradual differences between classes.

Protesting against paying for higher levels of surface water quality

Table 6 shows the response probabilities for the surface water protest model based on four classes.[3] All parameter estimates for the items are significant at the 5 per cent level. The socio-demographics by classes are reported in Table 7.

Class 1 (benefiting/partial protesters): With 33% the biggest group it also gathers the largest share of people who are willing to pay (64% of the class) and the highest mean WTP

[3] The model showed a couple of large bivariate residuals between some of the independent variables. Instead of adding more classes we included direct effects between these variables when the bivariate residual were larger than 3.84 (Vermunt & Magidson, 2005).

per month (PLN 6.5). This class collects respondents who are the most certain in their responses, i.e., across all classes they show the highest proportion of “certainly yes” responses. Thus, they strongly agree that surface water quality is an important issue in both Poland as a country and also in their surrounding. Also, with respect to responsibility these people are likely to agree that their lifestyle is one reason for the low surface water quality. This belief, together with the fact that class 1 has the highest share of respondents who have been using surface waters in their surrounding for recreation in the last 12 months (see Table 7), might explain why they are willing to pay the highest amount for improving water quality. Additionally, members of this class are most likely to believe that their money will be used for implementing measures to improve water quality (32% “certainly yes” responses) and believe that measures will take place in the next few years (28% “certainly yes” responses). On the other hand, 27% of them would certainly prefer to pay in a different way and 19% to a different institution than to municipal water-sewerage companies. This indicates institutional distrust, i.e., an aspect of protesting. As members of this group articulate some protest beliefs but at the same time express that the good in question is (very) important to them we label them “benefiting protesters”. The overall response pattern comes close to what can be called partial protesters (which gives benefiting/partial protesters).

Class 2 (uncertain/partial protesters): The second class comprises 29% of the sample and the share of respondents who are willing to pay is 54% with a mean WTP of PLN 5.0. Overall, this class shows a similar pattern of protest beliefs as class 1 (benefiting protesters). An obvious difference is that respondents in class 2 tend to choose often the response options “rather yes” instead of “certainly yes”. Also they are more likely to respond “rather no”. Overall, members of class 2 thus show a higher degree of response uncertainty than the benefiting protesters. Taking this into account class 2 is labelled “uncertain protesters”. Since, at the same time and comparable with class 1, this class expresses both some importance of the good in question and some protest beliefs they also belong to the broader class of partial protesters (which gives uncertain/partial protesters).

Class 3 (distrusting protesters): This class comprises 21% of the sample. One fifth of the class members are willing to pay and the mean WTP is PLN 1.9. People allocated to class 3 are likely to express distrust toward the quality improvement measures, i.e., they have a high likelihood to respond “rather no” or even “certainly no” with respect to their belief in an improvement of water quality and in the implementation of the presented measures (TRUST). This indicates strong protest beliefs. Paying in a different way and toward a different institution is on the other hand not a major concern of these respondents. Moreover, they are especially likely to answer “rather no” with respect to water quality problems in their surrounding (IMPORTANCE) and accordingly are likely to respond “rather no” or “certainly no” to the items aiming at a relationship between their lifestyle and water quality problems. This might be connected to the fact that this group has the smallest share of surface water users (27%). As the most salient characteristic of this class is their members’ scepticism toward implementation of and improvements due to the proposed measures we label it “distrusting protesters”.

Table 6: Percentage response probabilities by class – surface water

Category	Item label		Class 1		Class 2		Class 3		Class 4	
		Label	Benefiting/partial protesters		Uncertain/partial protesters		Distrusting protesters		Don't know protesters	
		Class size	33%	N = 256	29%	N = 229	21	N = 167	17%	N = 127
			%	s.e.	%	s.e.	%	s.e.	%	s.e.
IMPORTANCE	Quality in Poland important	Certainly yes	85	0.03	27	0.04	24	0.04	37	0.06
		Rather yes	13	0.03	71	0.04	55	0.05	38	0.05
		Rather no	0	0.00	1	0.01	21	0.04	10	0.03
		Certainly no	0	0.00	0	0.00	0	0.00	3	0.02
		Don't know	2	0.01	1	0.01	1	0.01	12	0.03
	Quality in surrounding important	Certainly yes	80	0.03	18	0.04	15	0.04	29	0.05
		Rather yes	15	0.03	76	0.04	39	0.05	40	0.05
		Rather no	3	0.01	6	0.02	40	0.05	14	0.04
		Certainly no	0	0.00	0	0.00	4	0.02	6	0.02
		Don't know	2	0.01	0	0.00	2	0.01	11	0.03
RESPONSIBILITY	Financed by government or EU	Certainly yes	89	0.02	43	0.04	53	0.05	65	0.05
		Rather yes	9	0.02	55	0.04	41	0.05	27	0.05
		Rather no	1	0.01	0	0.00	6	0.02	0	0.00
		Certainly no	0	0.00	0	0.00	0	0.00	0	0.00
		Don't know	0	0.00	2	0.10	0	0.00	8	0.02
	Financed by industry or farmers	Certainly yes	50	0.04	12	0.03	25	0.04	32	0.05
		Rather yes	28	0.03	46	0.04	29	0.04	32	0.05
		Rather no	12	0.02	26	0.03	40	0.05	5	0.03
		Certainly no	9	0.02	5	0.02	6	0.02	10	0.03
		Don't know	0	0.01	11	0.02	0	0.00	21	0.04
	Lifestyle	Certainly yes	31	0.03	5	0.02	0	0.00	2	0.01
		Rather yes	30	0.03	62	0.05	12	0.04	14	0.04
		Rather no	19	0.03	27	0.04	68	0.05	24	0.04
		Certainly no	20	0.03	4	0.02	19	0.04	40	0.05
		Don't know	0	0.00	1	0.01	0	0.01	20	0.04

TRUST	Believe money used for improvement	Certainly yes	32	0.03	4	0.02	0	0.00	12	0.04
		Rather yes	41	0.03	73	0.04	40	0.05	21	0.05
		Rather no	18	0.03	20	0.03	40	0.05	19	0.04
		Certainly no	6	0.02	1	0.01	8	0.03	10	0.03
		Don't know	3	0.02	2	0.02	12	0.03	39	0.05
	Believe in implementation	Certainly yes	28	0.03	5	0.02	0	0.00	2	0.01
		Rather yes	44	0.04	69	0.04	19	0.04	13	0.04
		Rather no	18	0.03	20	0.04	60	0.05	15	0.04
		Certainly no	8	0.02	2	0.01	14	0.03	23	0.04
		Don't know	3	0.01	5	0.02	5	0.02	47	0.05
ABILITY TO PAY	WTP if income higher	Certainly yes	72	0.04	4	0.02	2	0.02	11	0.04
		Rather yes	24	0.04	84	0.04	27	0.06	26	0.05
		Rather no	3	0.02	8	0.03	54	0.06	21	0.04
		Certainly no	3	0.02	8	0.03	54	0.06	21	0.04
		Don't know	0	0.01	2	0.01	3	0.02	14	0.03
INSTRUMENT	Pay in a different way	Certainly yes	27	0.03	2	0.01	8	0.02	0	0.00
		Rather yes	27	0.03	43	0.04	17	0.04	5	0.03
		Rather no	23	0.03	37	0.04	48	0.05	9	0.03
		Certainly no	13	0.02	3	0.02	23	0.04	33	0.05
		Don't know	10	0.03	16	0.03	3	0.02	53	0.05
	Pay to a different institution	Certainly yes	19	0.03	1	0.01	6	0.02	0	0.00
		Rather yes	26	0.03	36	0.04	23	0.04	4	0.02
		Rather no	20	0.03	42	0.04	40	0.05	14	0.04
		Certainly no	22	0.03	2	0.02	22	0.04	29	0.05
		Don't know	11	0.03	18	0.03	9	0.03	53	0.05
WTP (yes / no)		No in %	37		46		80		84	
		Yes in %	64		54		20		16	
WTP (mean per month in PLN)		Mean	6.5		5.0		1.9		1.4	

Note: N = 779; due to rounding the probabilities do not always sum to 100.

Class 4 (don't know protesters): This class is the smallest one (17%). Among its members the lowest share of people are willing to pay (16%) and also the mean WTP (PLN 1.4) is low. It is above all characterised by the frequent use of the "don't know" option as a response to the attitudinal questions. Especially with respect to items out of the categories TRUST and INSTRUMENT respondents in this class are very likely to answer "don't know" expressing that they have no clear opinion. At the same time they also express aspects of protesting by assigning the responsibility for paying to others, e.g., the European Union or industry and farmers, and they do not see connections between their lifestyle and surface water quality. However, regarding their main characteristic this group is labeled "don't know protester".

Table 7 reports socio-demographics for each class of the surface water protest model. It can be seen that members in class 4 – don't know protesters – are on average older and to a higher degree low educated compared with members of the other classes. Furthermore, class 3 with a low income is also the class where respondents are strongly distrusting the appropriate utilization of the money for an improvement of surface water quality.

Table 7: Socio-demographics according to latent classes – surface water

	Class 1	Class 2	Class 3	Class 4
Class label	**Benefiting/partial protesters**	**Uncertain/partial protesters**	**Distrusting protesters**	**Don't know protesters**
Class size	256	229	167	127
Age	48.37	46.78	47.05	55.93
Women (%)	49.24	56.42	55.46	59.57
People per household	3.10	3.12	3.05	2.85
Net household income* (PLN)	2468.55	2744.93	2317.83	2341.43
Missing income data (%)	27.02	35.05	29.81	38.02
Education (%) Low	34.60	37.24	38.90	43.13
Medium	48.31	43.65	43.40	35.85
High	17.09	19.11	17.71	21.05
Users (%)	46.40	39.73	26.70	31.60

Note: *Due to missing values net income per household is calculated based on a lower number of interviews: class1, n = 188; class 2, n = 147; class 3, n = 119; class 4, n = 77.

Summarizing, the pattern of protesting is for the surface water sample not as obvious as it is for the forest biodiversity sample. Looking at the responses it is more difficult to differentiate between stronger and weaker protesting. The classes 1 and 2 both show a pattern that could be described as "partial protesting" with respondents in class 1 expressing a higher importance of the good than members of class 2 and respondents in class 2 expressing less cer-

tainty about their beliefs than members of class 1, i.e., they are more likely to respond “rather yes” or “rather no”. Members of class 3 express strong protest with respect to their distrust toward both the program described in the valuation scenario and toward the implementation process. To accentuate this strong distrust we have labelled class 3 “distrusting protesters”. Finally, (as expected) members of class 4 show a clear pattern of “don’t know” responses. Thus, class 4 received the label “don’t know protesters”.

6. Discussion and conclusions

In the present paper we use latent class analysis to determine subgroups in two CVM studies, one on forest biodiversity and the other on surface water, with respect to their protest beliefs towards paying money. Using latent class analysis was motivated by the finding of several studies that there might be no clear-cut dividing line between respondents who protest and respondents who do not protest in a stated preference survey. Protesting may rather be gradual ranging from strong to weak protesting while influencing respondents’ WTP. Latent class analysis is thus appealing because people are probabilistically assigned to subgroups of a sample based on, for example, response patterns to attitudinal questions.

In the present analysis, which is to our knowledge the first application of latent class analysis to the problem of investigating protest responses in stated preference surveys, we take advantage of the fact that in both surveys the attitudinal questions used to determine protest beliefs were presented to both respondents who were willing to pay and who were not willing to pay. To make results more comparable we set up a frame to which we assigned the different attitudinal questions from the independently developed surveys. Categories within this frame are IMPORTANCE, RESPONSIBILTY, TRUST, ABILITY TO PAY, INSTRUMENT, and YARDSTICK MONEY. However, the primary objective of this study was not to compare types of protesting across both samples. Rather, we wanted to demonstrate the usefulness of this approach for investigating protest responses in stated preference surveys.

Based on, among other things, the calculated goodness of fit criteria we opted for a three class model in the forest biodiversity sample and a four class model in the surface water sample. In the former case it is rather obvious that classes express differing degrees of protesting. Thus, we labeled the three classes “marginal protesters”, “partial protesters”, and “strong protesters”. The percentage of group members who are willing to pay and the mean WTP varies according to the degree of protesting. In the second sample separating respondents based on their degree of protesting is much more difficult. Accordingly, we ended with labelling all four classes as protesters who have different main characteristics. For example, while members of the first two classes both express what could be labeled partial protest, the first class expresses a higher importance of the good and the second class expresses a higher degree of response uncertainty.

Potential reasons why the latent class model for the surface water sample did not result in an obvious separation of respondents are manifold. Firstly, choosing the number of classes

is often not unambiguously. One information criterion as well as the bivariate residuals indicates that adding more classes might be appropriate. However, estimations with a higher number of classes did not end up in more distinguished classes. Another reason might be that the set of attitudinal questions did not express clearly enough aspects of protesting against paying for higher surface water quality. On the other hand, the results could also be read as a confirmation that protest beliefs are strongly mutually interdependent, as Jorgensen and Syme (2000) argue.

Anyway, future applications of the presented approach would require sharpening the survey instrument, i.e., the attitudinal questions and the response scales. Moreover, individual covariates should be added to the latent class models in order to explain class membership. In the present application we restrained from doing so keeping the focus on the protest beliefs. As the tables with the socio-demographics show that some characteristics vary noticeable with classes the significance of the models may thus increase when these and other characteristics are included in the membership function.

Finally, we think that a big advantage of using latent class analysis to identify protesting is that this approach can be implemented in a survey rather easily. This becomes obvious when it is compared, for example, to the approach Dziegielewska and Mendelsohn (2007) have proposed. According to them respondents have to meet three criteria before they are defined as protesters: First, they have to answer “no” to a system of DC questions, second, they have to refuse to pay anything to a set of open ended questions and third must agree with all attitudinal questions used to identify protesters. This means that a significant amount of interview time has to be used to identify protesters. We think that the latent class approach is much less “costly” because a smaller set of attitudinal questions can be presented to all respondents. As we strongly believe that protesting will remain a concern for stated preference surveys we think that moving further in the direction presented here is promising.

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