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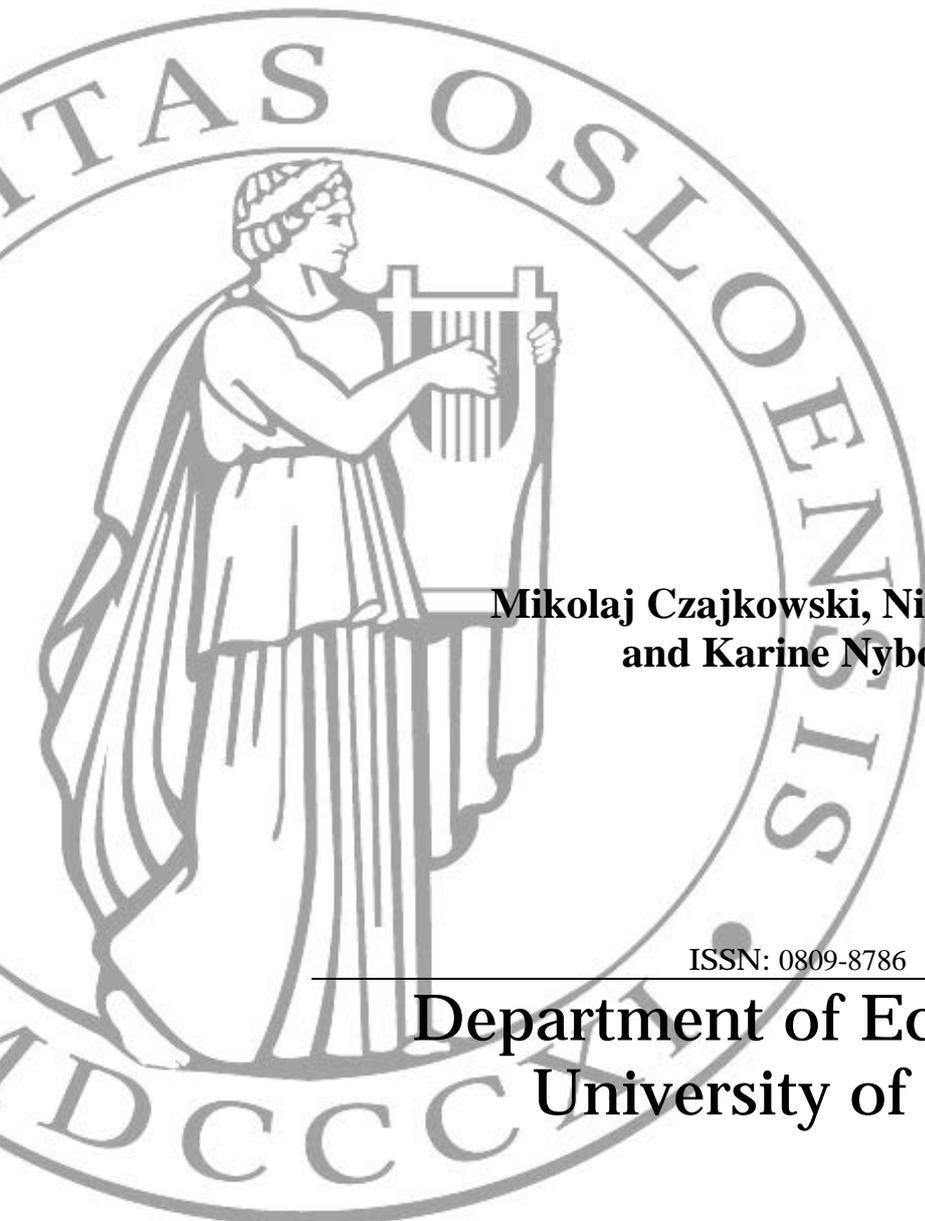
Soial Norms, Morals and Self-interest as Determinants of Pro-environment Behaviours

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Last 10 Memoranda

Social norms, morals and self-interest as determinants of pro-environment behaviours

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Abstract:

This paper considers the role which selfish, moral and social incentives and pressures play in explaining the extent to which stated choices over pro-environment behaviours vary across individuals. The empirical context is choices over household waste contracts and recycling actions in Poland. A theoretical model is used to show how cost-based motives and the desire for a positive self- and social image combine to determine the utility from alternative choices of recycling behaviour. We then describe a choice experiment designed to empirically investigate the effects such drivers have on stated choices. Using a latent class model, we distingush three types of individual who are described as duty-orientated recyclers, budget recyclers and *homo oeconomicus*. These groups vary in their preferences for how frequently waste is collected, and the number of categories into which household waste must be recycled. Our results have implications for the design of future policies aimed at improving participation in recycling schemes.

Highlights:

- What determines recycling behaviour?
- What best explains the allocation of people into different preference types – social norms, self-interest, or moral duty?
- Why do many respondents apparently prefer home sorting to central facility sorting, even at a cost?

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1. Introduction

What determines people's decisions to participate in "pro-environment" behaviours such as recycling or volunteering for a local conservation group?

A considerable empirical literature has arisen in the specific context of recycling, which attempts to explain why some people recycle more than others (Iyer et al., 2007; Nixon et al., 2009; Nigbur et al., 2010). Possible explanations which have been proposed point to the costs of alternative waste disposal options, the nature of facilities available for recycling, and the role of self-image and social pressures, as potential drivers of pro-environmental behaviour (e.g., Brekke et al., 2010). However, we are not aware of any previous studies which have looked jointly at social pressures, moral motives and the costs of recycling actions in a stated preference, random utility perspective. This, as we argue below, seems a useful way of modelling people's choices over recycling.

In a recent stated preference study of households in Poland, Czajkowski et al. (2014) found that people prefer to home sort into more categories as part of a municipal recycling programme, even when (i) this is costly to them (in terms of time and inconvenience) and (ii) when the alternatives offered to individuals involved the same level of sorting, but performed at a central waste handling facility instead. But why? A simple economic calculation would suggest that, unless the effort to sort waste into different categories for recycling (paper, cans, bottles, compostables etc.) saves money or generates other private benefits, then less home sorting would be preferred to more, as long as effort is costly. The data available to Czajkowski et al. (2014) did not permit them to explain statistically what kind of benefits caused some individuals to prefer waste collection contracts requiring higher levels of home sorting. This paper is an attempt to provide such explanations.

In what follows, we present results from a new study using the same discrete choice experiment design as in Czajkowski et al. (2014), but with more attitudinal and de-briefing questions devoted to investigating why some people prefer at-home recycling vs. recycling in a central sorting facility. This allows us to jointly consider the relative effects of social pressure, individual moral motivations and the net costs of waste disposal. We are also able to model the determinants of a number of latent classes into which people can be probabilistically grouped in terms of their preferences. Our findings indicate that the preference to sort is motivated by two main factors: the desire to save money, and a feeling that sorting one's own waste is a moral duty. Social pressures do play a role, but only for one group of recyclers.

We find a strong correlation between preferring more sorting (even at a cost) and a reported feeling of personal moral duty to recycle oneself. Neither social pressure by one's neighbours nor satisfaction from the act of sorting itself appear to be important for the majority of individuals. Taking preference heterogeneity into account, we identify three distinct latent preference classes which we term, respectively, *duty-oriented recyclers*, *budget recyclers*, and *homo oeconomicus.*

The *duty-oriented recyclers* have a substantial willingness to pay for more sorting, and are characterized by a strong feeling of moral duty to sort themselves. They do not seem afraid of being judged by their neighbours, while tending to judge others who do not sort. The *budget recyclers* are more likely to find sorting cumbersome; however, they have lower incomes, and tend to believe that personal sorting will (eventually) save them and everyone else money. While their WTP for sorting into two categories is positive, but small, they are indifferent between sorting into two and five

categories. The *homo oeconomicus* class has a strongly negative WTP to sort in five categories. They find sorting even more cumbersome than the budget recyclers do; they feel no moral obligation to sort, but are likely to expect judgment from others.

In what follows, the existing empirical literature on what determines variations in recycling behaviour is briefly summarized, before a conceptual model is proposed which captures the three main types of driver which we feel to be particularly interesting. The next section explains the design of the empirical study, and the econometric approach taken. Results for a simple MNL model, an MNL model with interactions and a latent class model are then presented, before a Discussion and Conclusions section.

2. What does the empirical literature tell us about decisions to recycle?

Most of the empirical literature on recycling at the household level[4] has focused on the direct cost to households of engaging in recycling effort – such as the availability of curbside pick-up recycling rather than "bring" systems where consumers must transport recyclables to central collection points – and on the opportunity cost of *not* recycling, as reflected by the price paid for waste collection (Hong et al., 1993). This latter factor has received increasing attention as more municipalities and countries have introduced variable fees for solid waste collection over time (Reichenbach, 2008). Recent US evidence shows a substantial effect on recycling effort from increasing the marginal cost of household rubbish disposal through a (higher) variable collection fee on the volume of waste that households generate (Huang et al., 2011).

Another influence on recycling behaviour is the "inconvenience factor", which can be thought of as a measure of the time, space and effort needed to be allocated by a household to achieve a given level of recycling activity. Jenkins et al. (2003) study 1,049 households in 20 US metropolitan areas, looking at the influence of the availability of a curbside collection scheme for recyclables as one measure of this inconvenience factor. They find that for all materials (glass, newspaper, plastic bottles, aluminium, yard waste and newspapers), presence of curbside recycling schemes increases recycling effort, but that in no case is the unit price of waste collection a significant determinant of recycling effort. Kipperberg (2007) confirms the findings of Jenkins et al. using Norwegian data, estimating separate ordered logit models for 5 different categories of waste. Abbott et al. (2013) investigate the log of recycling volume per capita using data from English local authorities. They find that it is well explained by the quality of recycling infrastructure provided, and a "social norm", which they construct as a mean level of recycling in a reference group of local authorities. Finally, with regard to an "inconvenience factor", Kuo et al. (2010) show for 18 cities in Taiwan and Japan that actual recycling rates depend on the frequency of collection of both recyclables and rubbish intended for landfilling. Kipperberg et al. (2012) show that some of the variation in stated preferences for waste management across households can be explained with the design characteristics of the recycling system employed in an area, and its financial cost to households.

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[4] Note that there is also an emerging literature which models recycling behaviour at the level of municipalities (organisations of local government responsible for household waste collection), looking for example at their willingness to set up curbside collection schemes (De Jaeger et al., 2008). Another literature looks at variations in recycling rates across countries (Mazzanti et al., 2008).

Another feature that has been shown to matter is income. Huhtala (2010) reports results from a contingent valuation study in Finland, which collected 1,131 responses to a questionnaire on WTP for alternative future waste management options for Helsinki. She found WTP for recycling to be decreasing in household income, which she attributes to the higher opportunity costs of time for high-income households.

A summary of the above is that the nature of the recycling and household waste schemes provided, the costs of waste collection to households, and household characteristics all help determine household recycling activities.

Another strand of literature has investigated the extent to which indicators of social capital and community norms influence recycling behaviour. Kurz et al. (2007) show that a proxy for "sense of community" is closely related to engagement with recycling in Northern Ireland. Videras et al. (2012) find that, for a sample of over 2,000 US households, intensity and strength of social ties, and pro-environment community norms, are linked to recycling behaviour: "…individuals who have strong connections with neighbours and who think most neighbours do things to help the environment are more likely to recycle" (p.42). Knussen et al. (2004), in a study of stated intentions to participate in "bring" recycling schemes in Glasgow, Scotland, found that 29% of the variation in intentions was explained by measures of attitudes, opportunities and what they refer to as subjective norms, in this case the degree to which respondents felt that their families and friends thought that recycling was a good thing.

A desire to conform to one's own ethical standards or a perceived sense of personal duty may also be important. Hage et al. (2009) study 2,800 households in Sweden, and relate self-reported recycling activity (participation in a packaging waste recovery scheme) to measures of feelings of personal responsibility. They find that self-reported recycling rates are increasing in the degree of agreement with a statement "I recognize a moral obligation to recycle", and that recycling rates also rise, the higher one perceives the degree of recycling by one's neighbours to be. Bruvoll et al. (2002), in a survey of 1,162 Norwegian citizens, find that the most frequently cited motivation for home sorting of recyclables was "I should do what I want others to do", with "I want to think of myself as a responsible person" as the second most highly reported reason. Respondents to this study were also faced with the following question: "Assume that a recycling company can make use of your waste. New technology makes it possible to sort waste centrally so that the environmental effect will be the same. The company collects the unsorted waste from your home. Would you make use of the offer if this did not increase your expenses, or would you prefer to sort yourself?" 72 percent of the respondents of Bruvoll et al. (2002) reported that they would make use of the offer, hence preferring separation of recyclables by others rather than by themselves.

In a paper very relevant to our own work, Brekke et al. (2010) consider the role of what they refer to as *duty orientation* (see also Brekke et al., 2003; Nyborg, 2011). Duty-oriented individuals prefer to keep an image of themselves as socially responsible people. They may thus be willing to recycle even at a personal cost – provided that recycling is perceived as their personal responsibility. If in doubt whether they are in fact personally responsible for recycling, they may look to the behaviour of their peers; if so, their recycling actions can be increasing in the degree to which they believe others are also recycling. Brekke et al. (2010) test this hypothesis using data from a survey of glass recycling by Norwegian households. The survey includes information on whether individuals perceive recycling to

be a moral responsibility, how common they thought recycling to be amongst their friends and family, how sure they were about this, and a dummy variable for self-reported glass recycling behaviour. The authors find that the feeling of personal responsibility is increasing in how common people thought recycling to be amongst friends and family; further, the more certain respondents were of this frequency estimate, the higher the feeling of personal responsibility. As perceived responsibility increases, glass recycling becomes more likely. Moreover, while the study indicated a direct effect of social sanctions (the fear of negative reactions from others) on recycling behaviour, the main effect of social sanctions appeared to arise indirectly, through their effect on feelings of personal responsibility. The Brekke et al. (2010) study did not, however, explore whether respondents preferred to sort themselves or to leave the sorting to others, the topic we will be turning to below.

3. Conceptual framework

How can we think of duty-orientated motives for recycling in economic terms? To fix ideas, consider an individual who cares about her private consumption c; a public good G, which we may think of as environmental quality; her own self-image as socially responsible person S, and what she expects to be others' image of her, J:

$$ U = u(c, G) + S + J , \tag{1} $$

where u is a quasi-concave and increasing function. Let $g \geq 0$ be the person's contribution to the public good (environmental quality) by means of recycling contributions; to avoid making the model unnecessarily complex, we will not distinguish between recycling contributions in terms of time or effort on the one hand and money one the other. Let the budget restriction be given by

$$ W = c + pg , \tag{2} $$

where W is the individual's generalized or full income, taking into account her available time as well as monetary income. Similarly, c must be interpreted as generalized private consumption, including leisure. p is an implicit price of contributions to the environment in terms of lost (generalized) consumption; if recycling is cumbersome, this corresponds to a higher p, and if sorting is fun or otherwise intrinsically rewarding, this reduces p.

Total supply of the public good depends on the contribution of every individual in society. However, assume that the society is large, and that the single individual's contribution is too small, relative to the total level of G, to make it possible for her to noticeably perceive the change in G due to her own contribution. She will thus, when making her choices, treat environmental quality G as if it were exogenously fixed.

Nevertheless, she may contribute to the environment due to image concerns (self-image and others' image of her). Assume that self-image is given by

$$ S = -\frac{\alpha}{2}\left(g - g^*\right)^2 , \tag{3} $$

where α is a weakly positive constant, and $g^* \geq 0$ is i's view of the contribution she thinks she should ideally make (see Brekke et al., 2003; Brekke et al., 2010; Nyborg, 2011). Any deviation from the morally ideal behaviour yields a psychological loss, which may be thought of as cognitive dissonance. The morally ideal contribution g^* may be viewed as a measure of the individual's perceived moral responsibility for recycling.

In addition, assume that believed judgement from others is given by

$$J = -\frac{\beta}{2}\left(g - g^{**}\right)^2 \tag{4}$$

where β is a weakly positive constant, and $g^{**} \geq 0$ is the individual's belief about *her peers'* view of the morally ideal contribution for a person like herself. If no peers can observe her contribution, $\beta = 0$. In the present paper, the ideal contributions g^* and g^{**} are taken to be exogenously given. However, note that in several previous papers, the morally ideal contribution has been assumed to be increasing in the social value of contributions (Brekke et al., 2003; Brekke et al., 2010; Nyborg, 2011).[5]

When deciding how much to recycle, the individual maximizes eq. (1) with respect to g, given (2) – (4). This yields the following first order condition for an interior utility maximum[6]:

$$g = \frac{\alpha g^* + \beta g^{**} - p u_c'}{\alpha + \beta} \tag{5}$$

where u_c' is the marginal utility of consumption. That is, whether and how much the individual will recycle depends on the extent to which she feel a duty to do so (g^* and g^{**}), the strength of her preference to conform to these duties (α and β), and the loss of generalized consumption benefits caused by the marginal recycling effort ($p u_c'$). If the moral and social motivations to recycle are always too weak compared to the private costs, the individual prefers not to recycle at all. That is, if $\alpha g^* + \beta g^{**} < p u_c'$ for any positive level of g, the utility maximum is a corner solution, since g cannot take negative values.[7]

If the individual believes that her peers' view of the morally ideal recycling level is different from her own, she may have to trade off her desire for a good self-image against the desire to be judged favourably. By differentiation of eq. (5), one can see that if g^* increases marginally, all else fixed, the optimal contribution increases by $\frac{\alpha}{\alpha+\beta}$. Similarly, if g^{**} increases marginally, all else fixed, the optimal contribution increases by $\frac{\beta}{\alpha+\beta}$. Consequently, if recycling is costly and/or burdensome, and you do not find intrinsic pleasure in it, a model like the one sketched above implies that you will

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[5] Note that if g* is exceeded, the contribution to self-image of further contributions is negative. The same holds for g** with respect to others' image of the individual. Intuitively, if you think too much recycling is a waste of time and energy, you may find too much recycling silly or even socially harmful. If g* and g** both equal the maximal possible recycling level, the image functions will effectively be restricted to their increasing parts.

[6] Recall that G is considered exogenous, implying $\partial G / \partial g = 0$ (from the individual's point of view).

[7] That is, if $\alpha g^* + \beta g^{**} < p u_c'$ for any positive level of g, the utility maximum is a corner solution, since g cannot take negative values.

recycle only if your preferences for image concerns are sufficiently strong, and, in addition, that your perception of the duty imposed on you by yourself and others is sufficiently strong.[8]

Below, we estimate the effects of perceived moral responsibility and peer pressure on recycling choices. We do so via indices which represent individual's rating of the extent to which neighbours judge them with respect to their recycling behaviour and the importance to them of a positive self-image from recycling. With regard to the marginal recycling effort (pu_c') we estimate the effects of changes in the financial cost to the household of waste collection contracts (which reduces freely disposable income) and the net effort or pleasure in recycling. Note that although the above model may be helpful in thinking about the relationship between moral responsibility, peer pressure and recycling behaviour, our estimated coefficients for moral responsibility and peer pressure do not correspond exactly to the parameters α and β, since g* and g** above were measured in units of recycling, while our questionnaire responses indicate the level of agreement with verbal statements not quantifying specific recycling levels.

4. Design of the Empirical Study

4.1. Methodology – the discrete choice experiment approach

In this paper, we use a choice experiment approach to estimate the preferences of individuals for household recycling. Discrete Choice Experiments (DCE) have been widely applied in the environmental, health, food and transport economics literatures (Hanley et al., 2013; Carson et al., 2014). DCE are a stated preference method, where respondents make choices over goods or policy options described in terms of the attributes of these goods or policies, and the levels that they take. A price or cost attribute is usually included in the design, to allow willingness to pay for changes in any non-price attribute to be calculated.

DCE are based on random utility theory, which states that the utility function can be disaggregated into deterministic and stochastic (random) components. Assumptions about the nature of this random component and the nature of preferences in terms of how they vary across respondents lead to a variety of econometric specifications. In section 5, the (conditional) multinomial logit and its extensions allowing for preference heterogeneity which are used in the empirical analysis of this paper are set out in detail.

The main advantage of using the DCE approach here is that preferences and willingness to pay for different attributes of recycling schemes can be directly estimated, along with the impact of a number of potential determinants of recycling choice behaviour, such as selfish interest, social pressures and sense of moral duty.

4.2. Questionnaire design

The empirical data used in this paper comes from a DCE study conducted in Poland in 2013. Polish law requires sorting municipal waste since the beginning of 2010. However, it is not specified in law

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[8] For related models, see Brekke et al. (2003), Bruvoll et al. (2004), Nyborg et al. (2006) and Nyborg (2011).

exactly how this sorting should take place – whether household waste should be collected in an already-sorted state (that is, sorted by the household), or collected un-sorted and then sorted centrally. The hypothetical scenario of our study coincided with government's plans to make each municipality (instead of private companies) responsible for waste management, by setting 'waste fees' for all households and hiring private companies to collect municipal waste from them. The sorting method can be selected by each municipality independently, and collected at a range of frequencies.[9]

Based on focus groups and a pilot study, we used the following attributes to describe a set of hypothetical future alternative contracts for waste considered by respondents:

- The number of categories waste needs to be sorted into before it will be collected (1, 2, or 5 categories);

- The number of times each month that waste is collected from your property (1, 2, 4 times per month);

- A cost to the household per month (the bill they will face for waste collection).

The number of home sorting categories ranged from 1 (no sorting required), through 2 (recyclables, non-recyclables) to 5 (paper, glass, metals, plastic, other). The respondents were informed, however, that in every case the collected waste would undergo a central screening process, and due to regulatory requirements, even if it was collected unsorted it would still be sorted in a central professional sorting facility. Thus, irrespective of people's choices at the household level, a fixed level of recycling would be attained at the municipal level. The survey also reminded people that sorting into more categories required more space in the household and more time and effort, and that a lower frequency of collecting waste requires that waste is stored on respondent's property longer. All levels of the attributes used in our study (including cost) were derived from observing the range of current practices of waste-collecting companies in 2013.

The experimental design consisted of 6 choice-tasks each with 3 alternatives per respondent; there were 4 questionnaire versions (blocks). An example choice card (translated) is presented in Figure 1. The design for our DCE was optimized for D-efficiency of a multinomial logit model using Bayesian priors (Ferrini et al., 2007) and all prior estimates were assumed to be normally distributed, with their means derived from the MNL model estimated on the dataset from the pilot survey, and standard deviations equal to 0.25 of each parameter mean.

We also included a range of de-briefing questions, which collect information on the motives of the respondent for making their recycling choices (see Annex 1 for details). The meaning of these variables is summarized below:

- *Troublesome* – Sorting waste at home is troublesome
- *Satisfying* – Sorting waste myself would give me a satisfaction
- *Cost-saving* – Sorting waste will allow to reduce my bills

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[9] The rationale for this change was to reduce the illegal trash dumping as well as impose more stringent recycling targets, in order to comply with EU Landfill Directive (1999/31; provide reductions in landfilling) and the EU Waste Framework Directive (2008/98; reaching minimum target levels of recycling).

- *Neighbours-judge* – My neighbours will judge me unfavourably, if I don't sort waste at home
- *I-judge* – I judge neighbours who don't sort waste at home unfavourably
- *Everyone-should* – Sorting waste is something everyone should do on his own
- *Moral-duty* – Sorting waste at home is my moral/ethical duty

Further, we collected Likert-scale data on whether people thought that home sorting was likely to be more effective than sorting at a central facility (*Better*), how *Careful* the respondent would be in (if) home sorting, and whether they were well-informed about how to sort waste into the correct categories (*Know*).

The survey was sent out by mail to 8,000 random households of two Polish towns – Józefów and Hrubieszów – in March 2013. These towns were selected because their inhabitants live in stand-alone houses, rather than in apartment buildings (since residents of apartments typically do not have a direct influence on what recycling scheme is implemented for the entire building and because they are less concerned about collection frequency – the waste is stored in a common, designated space rather than on one's property). At the time of the study there were many different waste collection companies which differed with respect to how frequently they collected waste and to what degree they required household waste to be sorted. It was at each household's discretion whether to sign an agreement with one of the companies to collect their waste.

5. Results

5.1. Econometric approach

Even though respondents' utility is not directly observed, they make choices revealing their preferences between the available alternatives. Discrete choice experiments face respondents with carefully designed choice situations, making it possible to apply statistical methods to model preferences. Formally, assume that the utility derived from respondent i's choice of alternative j can be modelled using the typical random utility framework (McFadden, 1974):

$$U_i \left(Alternative = j \right) = U_{ij} = \boldsymbol{\beta}'_j \mathbf{X}_{ij} + \varepsilon_{ij}, \qquad (6)$$

where $\mathbf{X}_j$ is a vector of attribute levels, and $\boldsymbol{\beta}$ is a vector of parameters of the utility function associated with these attributes, and the stochastic component ε represents part of the utility which is known by the individual but is unobserved by the analyst. This makes it possible to explain why apparently identical individuals (equal in all characteristics which can be observed) may choose different alternatives (Manski, 1977).

When all respondents are assumed to have the same preferences (i.e., for all i, $\boldsymbol{\beta}_i = \boldsymbol{\beta}$) and the random component of the utility function is assumed to be distributed independently and identically (iid) across individuals and alternatives – Extreme Value type 1 distribution – the Multinomial Logit Model (MNL) is derived, with the following convenient closed-form expression of the probability of choosing alternative j from a set of J available alternatives:

$$P(j|J) = \frac{\exp(\boldsymbol{\beta}'\mathbf{x}_{ij})}{\sum_{k=1}^{J}\exp(\boldsymbol{\beta}'\mathbf{x}_{ik})}. \qquad (7)$$

The MNL model is very popular for its simplicity and is usually a first step in statistical analysis of DCE data. However, it implausibly assumes that all respondents have the same coefficients in their utility functions. One way of relaxing this assumption is to interact socioeconomic characteristics and attitudinal variables with choice attributes when estimating the choice model. Another is to allow individual preference parameters to be random variables which follow a discrete distribution, i.e. take one of a few possible values. This way the Latent Class (LC) model is formed.

The LC model assumes there is an a priori specified number of latent 'types' of preferences. Within any latent class, there is only one vector of parameters which describes preferences for the choice attributes and levels. However, this vector varies across latent classes. Each respondent can then be assigned a probability of belonging to one of the latent classes, conditional on (i) the choices they made and (ii) their observable socio-demographic characteristics and (iii) their stated attitudes and beliefs. Even though respondents' individual-specific preferences are a probability-weighted mixture of a small set of "preference types", identifying these distinct types of preferences in the sample is a popular way of allowing for respondents' preference heterogeneity. In addition, using observable socio-demographic characteristics to statistically explain respondents' probabilities of belonging to each of the latent classes is a convenient way of providing insight into who each 'type' of respondents are. In the empirical analysis that follows, we utilize this latent class method to identify attitudes and reasons which drive the differences in our respondents' preferences for recycling.

5.2. Results

Results from the attitudinal questions are shown in Figure 1. Slightly less than half the sample agreed that "sorting waste at home is troublesome", whilst just over 50% agreed that "sorting waste myself would give me a satisfaction". About 2/3rds of respondents agreed that "sorting waste will allow to reduce my bills", which likely reflects their expectations about the effects of current actions on the future costs of waste collection and sorting. Around ¼ of people agreed with the statement "my neighbours will judge me unfavourably, if I don't sort waste at home", but just over 50% agreed that they would also judge other people who do not sort at home.[10] Finally, about 75% agreed that sorting waste at home was their moral or ethical duty, with a similar fraction agreeing that "sorting waste is something everyone should do on his own". This data is used below to explain preference heterogeneity within the LC model.

Simple MNL model

We started, though, by estimating a simple MNL model to explain stated choices of waste management contract (Table 1). This showed that, on average, people prefer to sort into more

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[10] The different responses to these two questions do not necessarily mean that respondents are more judging than they expect their neighbours to be. Being judged by one's neighbours requires observability, which is implicit in the second question, but hardly in the first.

categories rather than fewer, since sorting into 2 or 5 categories rather than no sorting both positively influence the probability of choosing a particular alternative (ceteris paribus). On average, people preferred waste to be collected either twice or four times per month rather than only once per month, and prefer cheaper waste contracts to more expensive ones. The result that a positive preference exists for (costly) home sorting mirrors that reported for a different data set in Czajkowski et al. (2014). This is the puzzle which the current paper now explores.

Preference heterogeneity (1): MNL model with interactions

As noted above, one simple way of studying the extent to which preferences for recycling vary across respondents and which factors determine this variation in preferences is to include socio-economic and attitudinal variables as interactions in the MNL model (note that such variables cannot be included in a conditional model individually, they need to enter as interactions with alternative-specific variables, i.e. choice attributes). In the MNL model with interactions, indices of respondent's attitudes[11] were thus interacted with their preference parameters for the choice attributes. This allows us to verify, if e.g., respondents who scored higher on the "sorting waste at home is my moral/ethical duty" question expressed systematically different preferences for the choice attributes than those who scored lower on this attitudinal variable. We also tested if respondents' socio-demographic characteristics (such as age, sex, education, household size, no. of children, income) could add to explaining their choices. Of these, however, only income turned out statistically significant. The results of the model are presented in Table 2.

The results of the MNL model with interactions show that respondents who agreed more strongly that recycling is their moral duty preferred sorting into more categories and with less frequent collection. Note in particular the sizable and highly significant coefficients for the interaction of the moral duty variable with increasing number of sorting categories, hinting at duty-oriented motives. Note also that there is no significant interaction effect between reported feelings of satisfaction with personal recycling actions and more sorting categories. Concerning social sanctions, the interaction effect with expected neighbour judgment is statistically insignificant for two sorting categories, and in fact negative for five sorting categories.

A separate reason for preferring to sort into more categories seemed to be the belief that this would eventually decrease household bills, and to some extent, being convinced that one can do the sorting better than in the sorting facility (only for five sorting categories). Respondents who found in-home sorting more troublesome were less likely to prefer sorting into five categories. Those with higher incomes tended to prefer two sorting categories, as compared to both no sorting and five categories.[12] Hence, while feelings of moral duty appear to play a role, there is no indication so far

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[11] Respondents' 1-to-5 Likert-scale answers to each of the attitude questions were normalized, such that their mean in the sample was 0 and their standard deviation 1. This allow us to focus on each respondent's deviation from the mean 'level' of attitudes in the sample as an explanatory variable of their preferences for the choice attributes.

[12] Some of our explanatory variables may be picking up similar factors. To investigate this further, we estimated an ordered logit model explaining 'Moral-duty' responses with the normalized scores based on all the other attitude and socio-demographic variables. Results are available upon request. They show significant, positive correlations between 'Moral-duty' and 'Everyone-should', 'Know', 'Satisfying', 'Careful' and 'I-judge', and significant, negative correlations with income and 'Troublesome'. The coefficients for 'Cost-saving', 'Neighbours-judge' and 'Better' were not statistically significant. This may indicate a distinct difference

that the observed strong preference for more sorting categories is driven by pleasurable feelings for sorting *per se* or by social sanctions.

Preference Heterogeneity (2): a latent class model

We next investigated the nature of preference heterogeneity within the sample, and how this was related to measures of attitudes towards recycling, using a latent class (LC) approach. This shows how preferences for any attribute level vary across un-observed latent classes of respondents. Within each class, there is an assumption of preference homogeneity. However, preferences vary across classes, and individuals are only probabilistically assigned to membership of any class. Initial analysis suggested that a 3-class LC model best explained stated choices. Table 3 shows results for this model. As may be seen, the probabilities of belonging to class 1, class 2 or class 3 are 0.28, 0.48 and 0.22, respectively.

In terms of preference parameters, individuals who are more likely to belong to class 1 prefer sorting into more categories, and prefer a frequency of collection of twice per month compared to once per month. Individuals in class 1 are more likely to view recycling as a moral duty, are more likely to judge negatively other people who do not recycle, and are more likely to gain satisfaction from the act of home sorting. At the same time, they tend to disagree that self-sorting is troublesome. Their willingness to pay for more sorting categories is significant and substantial. In a sense, then, individuals in class 1 can be viewed as **"duty-oriented recyclers".**

People more likely to be in class 2 prefer sorting into 2 categories rather than none, but are statistically indifferent between 2 and 5 categories. Class 2 shows a significant preference for collection only once per month rather than twice or 4 times. An individual is more likely to have the preferences of this class the more they believe that recycling will eventually save them money, and have a lower household income. They do not think recycling is a moral duty, and derive less satisfaction from home sorting than class 1. They tend to be more likely to think that home sorting is troublesome than class 1, but less so than class 3. They do think neighbours will judge them negatively if they do not home sort, although less definitely than respondents in class 1. They have a positive willingness to pay for a higher number of sorting categories, but it is very small compared to that of class 1. Along with the negative, significant estimate on the fee charged for the waste contract, this suggests that people more likely to be in class 2 are mainly motivated by cost-savings considerations. We label people more likely to be in latent class 2 as **"budget recyclers",** since it seems like the most important determinants of their preferences are related to the desire to save money.

People more likely to belong to latent class 3 attach a strong, negative weight to having to sort into 5 categories. They prefer more frequent waste collection services. As with the other two latent classes, they prefer cheaper contracts to more expensive ones. They are less inclined to feel moral responsibility for recycling than those in class 1 or 2, and have higher incomes than them. They do not get satisfaction from home sorting, and find home sorting to be more troublesome, in

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between the motives of moral responsibility on the one hand, and social pressures on the other, which accords with the conceptual model of section 3.

comparison with class 1 and 2. While they tend to agree more that they are being judged by their neighbours, they are less inclined to judge others themselves. Although the label may not be altogether fitting, we term people more likely to belong to class 3 as "homo oeconomicus**".**

6. Discussion and conclusions

The motivation for this paper is to investigate the determinants of individuals' stated preferences for pro-environmental behaviour: in particular, for household recycling. A conceptual model is used to show how three types of factors – economic factors affecting the net costs of recycling; personal moral sentiments; and social pressures – can all contribute to an individual's decision over how much to recycle. These factors have all been highlighted before in the literature, but this paper is, to our knowledge, the first to compare them within a stated preference, choice experiment setting.

The conceptual model is then applied to a case study of the preferences of Polish households for recycling, as reflected in their stated choices over alternative waste contracts. In part, this setting was chosen to help to try and explain a "paradox" found using the same choice experiment design for a different sample of respondents by Czajkowski et al. (2014): namely that some individuals preferred to engage in costly personal recycling activity even if this had no effect on the overall level of recycling in their municipality.

The main empirical findings are that, again for this sample, many people "want to sort". The single most important determinant of this behaviour seems to be a feeling of personal moral responsibility to recycle, although economic and hassle factors are also important. Fear of social pressures are less important. A MNL model with interactions is used to gain these insights. Then, using latent class modelling, three groups of individuals were identified. In two of these, the "paradox" of wanting to engage in costly sorting is again found, but for different reasons. One group, labelled the duty-oriented recyclers, have a moral duty towards recycling, gain personal satisfaction from sorting, and are more likely to judge badly neighbours who do not sort. A second group, labelled the budget recyclers, prefer to sort into 2 rather than no categories. They seem to be motivated mainly by a belief that recycling will eventually save them money, and tend to belong to lower income groups. They also do not believe that recycling is a moral duty. Finally, a third group are willing to pay to avoid sorting into 5 categories, find home sorting to be troublesome, and do not derive utility from the act of sorting. These individuals seem to be closest to the kind of 'homo oeconomicus' behaviour which is assumed in many econometric studies on the effects of changes in the price of recycling on behaviour (noted in section 2).

It is interesting that the "paradox" found in this paper differs from the finding in Bruvoll et al. (2002), who found that the majority of their sample preferred sorting to be done by a central facility, rather than doing it themselves. Two possible explanations can be offered. The first is a sample selection effect: the Norwegian respondents in Bruvoll et al. were questioned as part of an omnibus survey, whereas the participants in our survey were only questioned about recycling. Clearly, one's incentives to participate in a general survey are likely to be different to one's incentives to participate in a survey about an environmental issue, so that the sample selection process may have worked differently in the two studies. Second, the framing of choices varies across the two studies,

in terms of the institutional context within which recycling is undertaken in Norway and Poland, and the information which was provided to respondents.

Our data cannot explain *why* so many respondents appear to consider sorting at home a moral duty, even when told that sorting could alternatively be done in a central sorting facility. With respect to this, however, differences between the present study and the Bruvoll et al. (2002) study may have played a role. First, the questions used for the present study were preceded by a couple of questions concerning local street cleanliness and local social engagement, which may possibly have triggered a feeling that waste is something one should take care of oneself. The survey instrument also mentioned the possibility that central sorting might involve higher costs than home sorting. The Bruvoll et al. (2002) study, on the other hand, made no such mention of increased costs, but instead asked respondents to assume that 'a recycling company can make use of your waste'. These differences may, of course, have contributed to different responses.

In summary, like Hage et al. (2009), we find that both economic motives and the desire to retain a positive self-image are important motives for self-reported recycling actions. The empirical data supports this view for our sample of Polish householders. However, there is evidence of significant variation in the role these motivations play across individuals. This suggests that the effectiveness of policy to encourage more recycling may differ substantially between individuals and groups. For example, while some may respond to fees charged for waste collection, others may respond more strongly to campaigns emphasizing their moral responsibility.

In our study, respondents were faced with a context in which each household's waste collection contract was allowed to differ from that of its neighbours. In many communities, waste collection contracts are made by the local authorities, and the resulting collection scheme is identical for all household. Our results provide a reminder that in such situations, households will respond differently to the waste collection scheme chosen. While some may be positive to schemes demanding substantial voluntary effort on households' part, others will be negative, which may possibly influence the quality of these individuals' sorting. The heterogeneity of recycling motivation thus needs to be taken into account when collective choices between home sorting and central sorting are made.

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Figure 1. Example of a choice card

Choice Situation 1.	Alternative 1	Alternative 2	Alternative 3
Method of sorting in household	Into 5 categories	Into 2 categories	None
Frequency of collection	Once every 4 weeks	Once every 2 weeks	Once every week
Monthly cost for your household	75 PLN	50 PLN	100 PLN
Your choice:	☐	☐	☐

Figure 2. Respondents' attitudes with respect to in-home sorting

Figure 2. Respondents' attitudes with respect to in-home sorting

Legend: I definitely disagree | I somewhat disagree | I neither agree nor disagree | I somewhat agree | I definitely agree
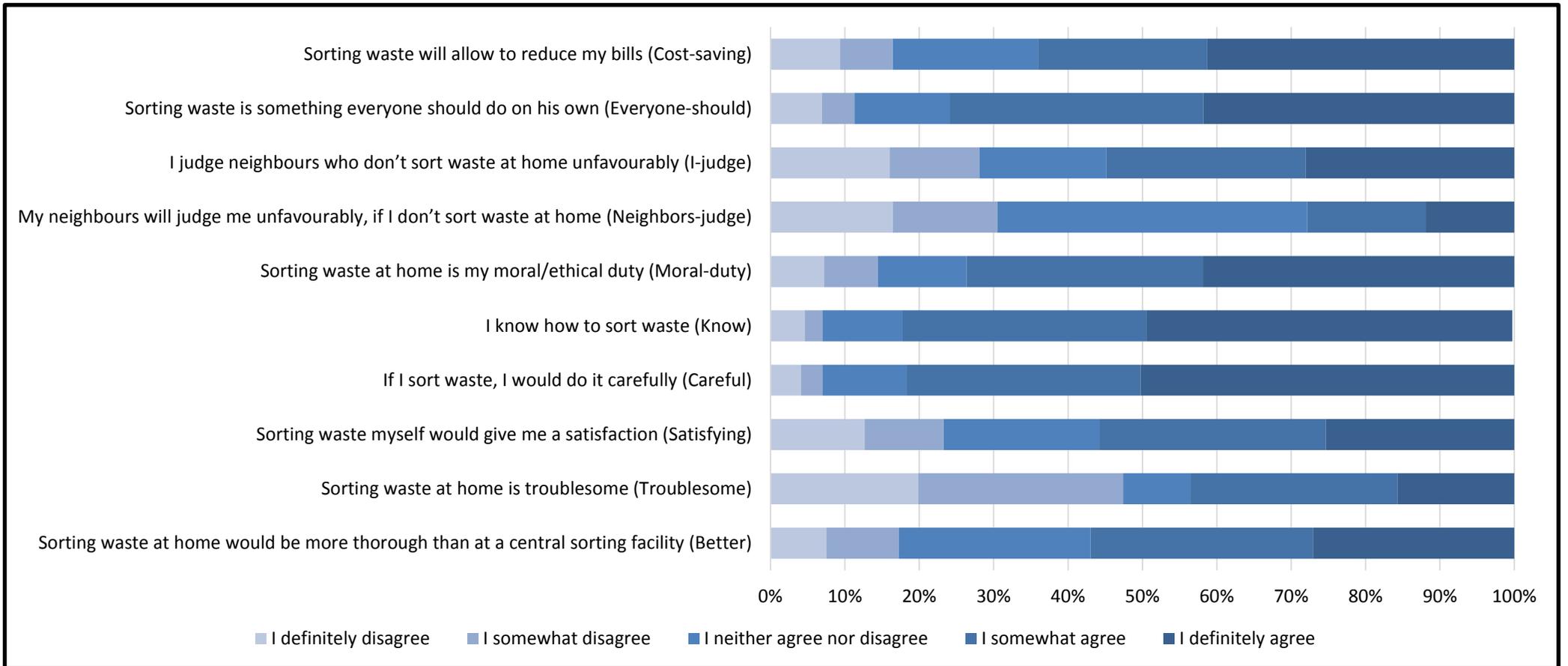
Table 1. General preferences with respect to waste management contract characteristics – the results of the multinomial logit model

Variable	Coefficient (standard error)	WTP (95% c.i.)
sort2	0.6144*** (0.0978)	15.66*** (11.18 - 20.14)
sort5	0.7314*** (0.0708)	18.64*** (15.32 - 21.95)
time2	0.463*** (0.1020)	11.8*** (6.41 - 17.19)
time4	0.2601*** (0.0758)	6.63*** (2.9 - 10.36)
fee	-0.0392*** (0.0015)	–
Model characteristics		
Log likelihood	-1398.35	
Log-likelihood (constant only)	-2026.50	
McFadden's pseudo R^2	0.3100	
AIC/*n*	1.5171	
n (observations)	1850	
k (parameters)	5	

***, **, * Significance at 1%, 5%, 10% level

Table 2. Observed preference heterogeneity with respect to waste management contract characteristics – the results of the multinomial logit model with interactions

	Attribute	Main effect	Interaction										
			Better	Troublesome	Satisfying	Careful	Know	Moral-duty	Meighbors-judge	I-judge	Everyone-should	Cost-saving	Income
Full model[13]	sort2	0.7073***	-0.1294	-0.1708	-0.2072	0.1805	-0.0548	0.3214**	-0.1312	0.0099	-0.0714	0.2714**	0.2405**
		(0.1121)	(0.1227)	(0.1278)	(0.1404)	(0.1427)	(0.1293)	(0.1532)	(0.1356)	(0.1602)	(0.1819)	(0.1276)	(0.1084)
	sort5	0.8118***	0.1561*	-0.3436***	0.1217	-0.1043	-0.1069	0.4252***	-0.1519*	0.0295	0.1205	0.1895**	0.049
		(0.0793)	(0.0829)	(0.0838)	(0.0994)	(0.1150)	(0.0910)	(0.1127)	(0.0923)	(0.1085)	(0.1337)	(0.0886)	(0.0825)
	time2	0.4833***	-0.1744	0.2022	0.062	0.2843*	-0.091	-0.5259***	0.1015	0.1686	0.1258	0.0132	0.4193***
		(0.1171)	(0.1245)	(0.1288)	(0.1435)	(0.1610)	(0.1423)	(0.1644)	(0.1468)	(0.173)	(0.1994)	(0.1392)	(0.1069)
	time4	0.2928***	-0.1895**	0.1297	-0.0246	0.4487***	-0.1534	-0.3524***	0.1258	0.0044	0.102	0.1414	0.4753***
		(0.0828)	(0.0891)	(0.0894)	(0.1062)	(0.1246)	(0.1034)	(0.1302)	(0.0913)	(0.1075)	(0.1332)	(0.0942)	(0.0838)
	fee	-0.0434***	0.0049***	0.0027	0.0021	-0.0057**	0.003	0.0011	-0.0004	-0.0007	0.002	-0.0074***	0.0055***
		(0.0017)	(0.0019)	(0.0018)	(0.0020)	(0.0023)	(0.0020)	(0.0023)	(0.0021)	(0.0024)	(0.0029)	(0.0020)	(0.0016)
Restricted model[14]	sort2	0.6853***	-0.1327	-0.1589	–	0.0842	–	0.2200*	-0.1613	–	–	0.2504**	0.2598**
		(0.1098)	(0.1179)	(0.1220)		(0.1217)		(0.1289)	(0.1085)			(0.1212)	(0.1041)
	sort5	0.8055***	0.1563*	-0.3746***	–	-0.0895	–	0.4989***	-0.1237	–	–	0.2122**	0.0662
		(0.0781)	(0.0818)	(0.0809)		(0.0960)		(0.0932)	(0.0790)			(0.0835)	(0.0781)
	time2	0.4695***	-0.1712	0.1878	–	0.2976**	–	-0.4136***	0.2021*	–	–	0.0594	0.4356***
		(0.1155)	(0.1202)	(0.1253)		(0.1390)		(0.1404)	(0.1202)			(0.1319)	(0.1044)
	time4	0.2794***	-0.1858**	0.1084	–	0.3983***	–	-0.3647***	0.1390*	–	–	0.1537*	0.4801***
		(0.0816)	(0.0867)	(0.0837)		(0.1065)		(0.1047)	(0.0800)			(0.0892)	(0.0805)
	fee	-0.0429***	0.0049***	0.0028	–	-0.0036*	–	0.0033*	-0.0006	–	–	-0.0066***	0.0051***
		(0.0017)	(0.0018)	(0.0018)		(0.0019)		(0.0020)	(0.0016)			(0.0019)	(0.0016)

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[13] Model characteristics: Log-likelihood = -1257.5296; McFadden's pseudo R^2 = 0.3795; AIC/n = 1.4244; n (observations) = 1850; k (parameters) = 60
[14] Model characteristics: Log-likelihood = -1269.8760; McFadden's pseudo R^2 = 0.3734; AIC/n = 1.4161; n (observations) = 1850; k (parameters) = 40

Table 3. Unobserved preference heterogeneity with respect to waste management contract characteristics – the results of the latent class model

Variable	Coefficient (standard error)			WTP (95% c.i.)		
	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
sort2	2.3369***	0.5814***	0.2226***	58.83***	6.23**	13.87
	(0.0910)	(0.1325)	(0.0331)	(42.49 - 75.16)	(0.24 - 12.22)	(-6.5 - 34.24)
sort5	3.4176***	0.6096***	-0.6293***	86.03***	6.53***	-39.21**
	(0.0343)	(0.1044)	(0.0352)	(68.03 - 104.03)	(2.91 - 10.15)	(-72.52 - -5.9)
time2	0.4225***	-0.1603**	0.8232***	10.64	-1.72	51.29***
	(0.1071)	(0.0721)	(0.0354)	(-3.66 - 24.93)	(-8.44 - 5)	(16.71 - 85.87)
time4	0.0281	-0.4170***	0.9013***	0.71	-4.47**	56.15***
	(0.0331)	(0.0144)	(0.0169)	(-5.22 - 6.63)	(-7.93 - -1)	(28.95 - 83.36)
fee	-0.0397***	-0.0933***	-0.0161***	–	–	–
	(0.0001)	(0.0000)	(0.0000)			
Class membership probability variables						
constant	-0.6615	1.4347***	0	–	–	–
	(0.7541)	(0.4711)	(baseline)			
better	0.8587*	0.0842	0	–	–	–
	(0.4688)	(0.4040)	(baseline)			
troublesome	-1.4561***	-0.6596*	0	–	–	–
	(0.4742)	(0.3794)	(baseline)			
satisfying	1.1560**	0.2739	0	–	–	–
	(0.5876)	(0.4970)	(baseline)			
careful	-1.0838	-0.6104	0	–	–	–
	(0.7771)	(0.5165)	(baseline)			
know	-0.4458	-0.2606	0	–	–	–
	(0.6730)	(0.4808)	(baseline)			
moral-duty	2.2765***	0.6113	0	–	–	–
	(0.7395)	(0.4782)	(baseline)			
neighbours-judge	-1.6445***	-0.4852	0	–	–	–
	(0.5425)	(0.4683)	(baseline)			
i-judge	1.0396**	0.7545	0	–	–	–
	(0.5216)	(0.4738)	(baseline)			
everyone-should	-0.1927	-0.3496	0	–	–	–
	(0.7982)	(0.4939)	(baseline)			
cost-saving	0.2251	0.9978**	0	–	–	–
	(0.4909)	(0.4273)	(baseline)			
income	-0.0372	-0.1465***	0	–	–	–
	(0.0404)	(0.0386)	(baseline)			
Class probability	0.2880	0.4880	0.2240	–	–	–
Model characteristics						
Log-likelihood	-1196.75					
Log-likelihood (constant only)	-2026.50					
McFadden's pseudo R^2	0.4094					
AIC/*n*	1.3359					
n (observations)	1850					
k (parameters)	39					

***, **, * Significance at 1%, 5%, 10% level

Annex 1. Attitudinal questions aimed at discovering respondents' motivation

Please indicate to what extent do you agree or disagree with all following statements:

	I definitely disagree	I somewhat disagree	I neither agree nor disagree	I somewhat agree	I definitely agree
1. Sorting waste at home would be more thorough than at a central sorting facility					
2. Sorting waste at home is troublesome					
3. Sorting waste myself would give me a satisfaction					
4. If I sort waste, I would do it carefully					
5. I know how to sort waste					
6. Sorting waste at home is my moral/ethical duty					
7. My neighbours will judge me unfavourably, if I don't sort waste at home					
8. I judge neighbours who don't sort waste at home unfavourably					
9. Sorting waste is something everyone should do on his own					
10. Sorting waste will allow to reduce my bills					