detritus | Multidisciplinary Journal for Waste Resources & Residues

CISA

RELEVANCE OF SELECTED MEASURES IN TRANSITION TO A CIRCULAR ECONOMY: THE CASE OF THE CZECH REPUBLIC

Jan Slavík [1], Jiri Remr [2,*] and Eliska Vejchodská [3]

[1] *Faculty of Social and Economic Studies, Jan Evangelista Purkyně University in Ústí nad Labem, Czech Republic*
[2] *INESAN, Institute for Evaluations and Social Analyses, Prague, Czech Republic*
[3] *Faculty of Humanities, Charles University in Prague, Czech Republic, and Faculty of Social and Economic Studies, Jan Evangelista Purkyně University in Ústí nad Labem, Czech Republic*

Article Info:
Received:
15 January 2018
Revised:
16 March 2018
Accepted:
23 March 2018
Available online:
31 March 2018

Keywords:
Recycling
Social norms
Social environment
Separation awareness
P&E campaigns

ABSTRACT

To accelerate the transition to a circular economy European member states have applied a broad range of policy instruments. Based on recycling rates and public participation in recycling efforts the Czech Republic would also appear to be on the way to a circular economy. However, the environmental effect of policy instruments (e.g. promotion and education campaigns) will soon be exhausted, as recycling rates are no longer rising significantly. Convinced recyclers are already carrying out effective recycling; however, how to motivate chronic non-recyclers to increase their public participation in recycling efforts is questionable. This paper examines the impact of social norms and the social environment in an attempt to explain recycling behaviour. Furthermore, awareness of waste separation options and programs is viewed as an important variable that determines how non-recyclers perform with regard to recycling.

1. INTRODUCTION

Undoubtedly, a significant driver of the contemporary environmental policy is the circular economy paradigm. Circular economy, unlike an economy based on linear material flows, is aimed at reducing the need for raw materials and waste disposal (Bilitewski, 2012; Elia et al., 2017), or maintaining the added value in products for as long as possible, and thus minimising waste production (Di Maio et al., 2017). Therefore, the circular economy paradigm is a combination of ecological, economic, technological, and social issues. As such, circular economy has gained increasing attention amongst scholars, policymakers, and industry representatives in recent decades (Geissdoerfer et al., 2017).

The implementation of the circular economy paradigm raises the question as to which are the priority fields of intervention. Based on the current state of knowledge, a circular economy constitutes an innovative business model with a focus on new approaches to product design and production (Mathews and Tan, 2011; Bocken et al., 2016; Ramani, 2010; Tukker, 2015). Haas et al. (2015) stressed the necessity of innovative high-quality recycling technologies. Furthermore, effective cooperation between key actors on the supply chain is crucial in order to reap the benefits of a circular economy (Desrochers, 2004; Chertow, 2007; Lehtoranta et al., 2011; Martin et al., 2015).

The intention to close the loop of product lifecycles through increased recycling and re-use cannot be achieved in the absence of well-designed incentives aimed at both the production sector (Hagelüken et al., 2016) and consumers, with regard to increasing the rates of recycling of municipal waste or to achieve a zero-waste target (Ghisellini et al., 2016).

How to convince residents to participate in recycling programs represents one of the main tasks of the waste management policy. People's willingness to recycle different materials is influenced by perceived convenience of separation, such as a short distance to waste bins (Domina and Koch, 2002; Hage et al., 2009; Ando and Gosselin, 2005; Mueller, 2013; Struk, 2017), ease of access of drop-off centres (Derksen and Gatrell, 1993; Domina and Koch, 2002; González-Torre and Adenso-Díaz, 2005), or space needed for the storage of recyclable materials at home (Ando and Gosselin, 2000; Bernstad et al., 2013). Furthermore, the perceived convenience is also dependent on efforts needed to recycle (e.g. time) (Garces et al., 2002), or cost spent on recycling activities (Ewing, 2001). Miafodzyeva and Brandt (2013) also indicate other variables including frequency of collection, technical mismatches, cleanliness of recycling sites, handling problems, or design of collection points as those that determine the convenience of recycling efforts.

However, convenience that depends on technical or or-

* Corresponding author:
Jiri Remr
email: jiri.remr@inesan.eu

Detritus / Volume 01 - 2018 / pages 144-154
https://doi.org/10.26403/detritus/2018.12

ganisational conditions for separation reflects only a limited part of the story of consumers' recycling behaviour. According to Miafodzyeva and Brandt (2013), strong predictors of recycling behaviour are typically moral norms as well as available information and environmental concern. Other non-pecuniary predictors include warm-glow effect as individual's satisfaction from a pro-environmental action (Halvorsen, 2008) and social norms as shared perceptions of appropriate behaviour in a society (Abbott et al., 2013). According to Farrow et al. (2017), social norms via social interactions affect the behaviour of an individual in many different areas of pro-environmental actions. Some scholars even refer to social norms as possible solutions for many environmental problems (Nyborg et al., 2016).

In our study, we focus on the role of social norms and their influence on the recycling behaviour of consumers in greater depth. The Czech Republic may be perceived as a country with a mature recycling system as the convenience of recycling (in terms of distance and availability) has already reached a high level. A certain part of society however is still not willing to take part in recycling efforts. We will refer to these people as "chronic non-recyclers" and will seek to uncover the reasons for their non-recycling behaviour with a focus on their social environment and information available. Our aim is to identify ways of motivating chronic non-recyclers to participate in waste separation and recycling.

We analysed a sample of 1611 cases representing the Czech adult population using relevant statistical methods such as frequency analysis, reliability checks, and ordered logit model. Data originated from extensive research studies conducted during the year 2017.

First, the current knowledge of social norms and social environment (Section 2), and of awareness of recycling (Section 3) is illustrated, continuing with a description of the Czech waste separation system (Section 4) and defining the methods used in our analysis (Section 5). In the last part, we present the results obtained and discuss them in detail (Section 6).

2. SOCIAL NORMS AND SOCIAL ENVIRONMENT

Recycling has been becoming a routine behaviour for individuals and a social norm following decades of promotion and education (P&E) campaigns aimed at increasing convenience and removing obstacles perceived by people when using separation systems. Nyborg et al. (2016) defined social norms as "a predominant behavioural pattern within a group, supported by a shared understanding of acceptable actions and sustained through social interactions within that group". However, Hage et al. (2009) argues that it is difficult to distinguish between social and moral norms as these social interactions activate moral norms. Defining social norms, the pressure of the community and potential sanctions are significant aspects in shaping behavioural patterns.

Hage et al. (2009) considers social norms as norms enforced by sanctions from others. According to Halvorsen (2010), when the social norm is strong, sanctions (and feelings of guilt) are significant predictors of pro-environmental behaviour. However, Abbott et al. (2013) stated that sanctions are not required, when: "social norms become internalised so that they do not require an external sanction mechanism or … the degree of conformity amongst the population and the level of expectation are sufficiently high for compliance without the need for the threat of external sanctions". Furthermore, Benabou and Tirole (2006) found that rewards and punishments aimed at supporting desirable behaviour produced perverse effects when intrinsic motivations were crowded out by extrinsic incentives. Thøgersen (2008) argued that when individuals identify the social norm as legitimate on their own, and not due to threats of sanctions, they will not attempt to evade.

Hage et al. (2009) mentioned social norms as a predictor of recycling behaviour particularly in situations in which recycling is a publicly visible activity and individuals face community pressure (e.g. neighbours, friends, colleagues). If recycling is not a visible activity (and no community expectations concerning the behaviour arise), moral norms have higher importance in predicting recycling behaviour (Hage et al., 2009). According to Abbott et al. (2013), kerbside collection of recyclables is a visible action apparent to peers that build a positive self-image.

Thanks to intrinsic motivation, i.e. moral norms or other internal variables (Barr, 2007; Saphores and Nixon, 2014) people recycle waste even in systems lacking the extrinsic motivation stimuli such as charges or fees. Nevertheless, part of the population maintains that it is normal not to recycle (so called 'chronic non-recyclers', or 'reluctant recyclers'). According to Thomas and Sharp (2013), some society fractions may hold even non-recycling norms. Based on the UK, reported recycling rates remain rather low, particularly among younger people aged between 18 and 24, in lower social classes, and among those living in flats or terraced housing. Their decision not to recycle is based on a relatively lower concern for waste separation in comparison with other social issues, inconvenience, or on lack of information relating to waste separation (Pocock et al., 2008). According to Yau (2010), the difficulties in a high-rise setting arise as a consequence of collective action problem typical for anonymous actors. However, when economic incentives (such as different types of rewards) are introduced, the motivation effect can be maintained.

Answering the question of how to engage the 'chronic non-recyclers' or 'reluctant recyclers' (label used by Brekke et al., 2007) in waste separation may be challenging. It is particularly difficult when the waste separation system already reflects the needs and expectations of households. These systems are highly mature and this attribute influences its performance (Miliute-Plepiene et al., 2016).

Above all, the social pressure on the individual's intention to recycle is based on a sense of community, or on socioeconomic status of the neighbourhoods (Kurz et al., 2007). Social approval is important for an individual. Blasch and Ohndorf (2015) describe social approval as a source of private utility – a kind of immaterial reward that individuals receive when they conform to social norms. These results correspond with the research of Vicente and Reis (2008), Halvorsen (2010), or White and Hyde (2012). According to

these authors, the way in which individual behaviour is perceived by others, activates emotional reactions – e.g. bad reputation in the community increases a feeling of guilt and vice versa. If the individual expects recycling to help him gain social approval in the community, then the warm glow effect from this activity will increase.

The importance of social acceptance provided by family members, friends, or neighbours was confirmed by Vining and Ebreo (1990), Oskamp et al. (1991, Ewing (2001) and Bruvoll et al. (2002). Social pressure imposed by other family members (especially children) plays a special role in influencing attitudes towards recycling (Meneses and Palacio, 2005; Thomas and Sharp, 2013). As reported by Vicente and Reis (2008), children are not able merely to alert household members that recycling is worthwhile: their attitudes also represent an investment in the future. As adults, they will be responsible for implementing recycling patterns in their own households. Ewing (2008) added that approximately 50% of households reported how the opinion of other household members was highly appreciated and considered.

Aronson et al. (2005) described other important reasons producing a significant influence of social group on the behaviour of an individual - social norms are crucial in shaping the behaviour of people who are uncertain about what decision to take. Individuals believe that others are better informed and are therefore inclined to behave in the same way as their peers – these peers help individuals identify the solution to their uncertainty.

Abbott et al. (2013) reported that the advantage of social norms consists in the function of community as a monitoring and enforcement unit without governmental intervention if social norms are sufficiently activated. In this respect, public representatives might adapt measures aimed at activation of recycling efforts via activation of social norms together with implementation of social control opportunities, e.g. kerbside collection scheme.

3. WASTE SEPARATION AWARENESS

The willingness to separate waste is also influenced by knowledge of separate collection and recycling system. P&E campaigns may provide arguments supporting waste separation and initiate a two-step flow of communication aimed at encouraging people to discuss recycling amongst themselves. This is essential as current data show that opinion-leaders of chronic non-recyclers, people who are closest to the respondent, are usually opponents of waste separation, rather than supporters. P&E campaigns can play an important role in bringing the issue of recycling and its positive impact on the environment to the attention of opinion-leaders, who can consequently influence the attitudes and behaviour of other people in their social surroundings. However, Halvorsen (2010) concluded that the effectiveness of P&E campaigns has reached its limits as this measure has been used for a long time in the majority of countries and already reached a large part of society. To motivate those lacking motivation to recycle may prove difficult. On the other hand, to prevent recycling decay (decrease of public participation on recycling efforts) Woodard et al. (2005) recommended long-term P&E campaigns.

The more information people have regarding recycling issues (i.e. placement of collection points, information about materials that can be separated or collection times and frequency), the more likely they are to participate in waste separation (Hornik et al., 1995; Garces et al., 2002; McDonald and Oates, 2003; Barr, 2007). Furthermore, De Young (1989), McDonald and Oates (2003) and Ewing (2001) identified significant lack of knowledge as the main obstacle to public participation in recycling. The amount of information about recycling has been identified as a difference between recyclers and non-recyclers (MacDonald and Oates, 2003; Oskamp et al., 1991). However, Vining and Ebreo (1990) noted that the hypothesis of a correlation between knowledge and attitudes (or behaviour) was rejected by some authors.

The amount of available information affects not only the propensity to recycle, but also attitudes towards recycling. Without correct information about recycling, it becomes more difficult to participate in the recycling schemes (Alexander et al., 2009). According to Barr (2007), when speaking about knowledge, it is necessary to differentiate between abstract knowledge (i.e. general knowledge about the environment and overall awareness of environmental issues) and instrumental knowledge (especially the awareness about what, where and how to recycle). In this respect, instrumental knowledge was found to be a significant driver of behavioural change (Hornik et al., 1995; Shaw et al., 2006; Barr, 2007). To increase instrumental knowledge, education of what, where and how to recycle is desirable (Chen and Tung, 2010). P&E campaigns should focus on both instrumental and abstract knowledge (Lakhan, 2014).

To equip non-recyclers with information, either direct (leaflets, doorstep campaigns) or indirect (mass media) communication channels can be used. Some authors argue that direct communication is more effective (Vicente and Reis, 2008). Bernstad (2014) found written information to be ineffective in increasing the separation rate of food waste, as the knowledge of the receiver was overestimated; language difficulties have arisen, and timing of the P&E campaign and ambiguity of the message delivered have been indicated as potential issues. Concerning the effectiveness of oral communication – e.g. using doorstep campaigns, the results obtained are ambiguous. While Dai et al. (2015) or Bernstad et al. (2013) reported how doorstepping intervention led to a statistically significant increase of food waste diversion, Alexander et al. (2009) found doorstepping as ineffective in increasing the set-out rate. Alexander et al. (2009) considered doorstepping the best approach mainly in areas where the population was 'hard-to-reach' (e.g. block of flats).

Garces et al. (2002) saw P&E campaigns as key strategies of local representatives aimed at increasing public participation in recycling efforts. Meneses and Palacio (2005), or Timlett and Williams (2008) emphasised the educational system as a significant driving force in supporting recycling efforts. Woodard et al. (2005) or Shaw et al. (2006) found P&E campaigns important when separation systems alter and new schemes are established. Although

education seems to be a significant determinant in shaping recycling behaviour, von Borgstede and Anderson (2010) stated that the lack of formal education is not a barrier to information attention.

P&E campaigns should be targeted at specific social groups. According to Chen and Tung (2010), education should be targeted towards children. Meneses and Palacio (2005) concluded that marketing activities should concentrate on the middle-aged (46-60) with primary education level. Miliute-Plepiene et al. (2016) stated that P&E campaigns should focus on promoting recycling efforts amongst those close to householders (e.g. neighbours, relatives, or friends), thus making recycling more visible in the social environment, particularly in early-stage recycling schemes.

4. SPECIFICS OF THE CZECH WAY OF SEPARATE COLLECTION

Pilot projects of the separate collection of recyclables in the Czech Republic were introduced in 1997 as the packaging recovery organisation EKO-KOM was established. To raise recycling and participation rates, policy-makers at national (Ministry of the Environment) and local (municipal representatives) levels used primarily non-monetary incentives such as P&E campaigns. As a legal obligation, municipal waste management ordinances mandated households to separate their waste, although this obligation was not regularly controlled and enforced.

P&E campaigns in the Czech Republic cover the entire range of communication channels, including mass media (TV, radio) and direct media (billboards, websites, etc.). On a local level, educational and informational activities for children and adults have been implemented. In 2003, the nationwide P&E campaign began using the slogan "Don't be lazy: separate waste", to gently skewer all sorts of excuses for why people do not recycle. In 2009, a new slogan was introduced, "It's meaningful: separate waste", focused specifically on non-recyclers featuring a series of reasons for avoiding recycling.

Not only non-monetary incentives such as P&E campaigns, but also monetary incentives are applied to increase public participation in recycling schemes. Monetary incentives (e.g. unit-based fees) have been introduced in almost 20% municipalities, which are not only effective (Sauer et al., 2008; Slavik and Pavel, 2013), but also positively influence administrative costs and total costs of the municipal waste management system (Slavik and Pavel, 2013). Unfortunately, unit-based fees are perceived as more exacting from an organizational point of view, and therefore, municipalities prefer fixed fees without any motivation (Slavik et al., 2009). Another monetary incentive - deposits - has only limited effectiveness as they are applied only on refillable glass bottles.

From an organisational point of view, the Czech municipal waste management system is based on kerbside collection of municipal solid waste and a relatively dense system of collection points (drop-off centres) for recyclables (paper and cardboard, glass, plastics, and beverage cartons). As the effectiveness of separate collection in the Czech Republic is highly influenced by the convenience of the system (expressed by the distance between households and collection points) (Struk, 2017), the increasing number of collection points (expressed also by decreasing proximity of containers for recyclables) is one of the key measures in increasing public participation in waste separation (see Table 1).

The effectiveness of separation (see Table 1) represents the amount of separately collected recyclables (paper and cardboard, glass, plastics, cartons) in terms of container-based collection (drop-off centres), and collection in bags. Municipal systems of separate collection are supplemented also by seasonal mobile collection for biowaste and bulky waste. Furthermore, some municipalities operate recycling centres where people can deposit hazardous waste or recyclables (usually without payment).

5. METHOD USED IN STATISTICAL ANALYSIS

To assess the statistical significance of our predictors, we used ordinal regression analysis – ordered logit model. We used this model for an ordinal character of predicted variables that provide information on ranking, but not the distance between the different categories. This approach of analysis resembles statistical methods used elsewhere, e.g. in Hage et al. (2009).

5.1 Variables in the model

In our research, we tested the impact of selected factors on waste separation declared by households. Self-reported recycling behaviour as the dependent variable is a common approach to study recycling behaviour; the same approach can be found in Derksen and Gartrell, 1993 or Miliute-Plepiene et al., 2016. However, we are aware of the limitations of this approach expressed by Bernstad et al. (2013), when not all households claiming to recycle actually do so regularly, or fail to recycle all materials. This overestimation of self-reported (declared) recycling is caused by a social desirability effect. Since data relating to actual recycling rates are not available, we focused on self-reported (declared) recycling.

In our study, all dependent constructs were operationalized using the answers to two statements for each construct. The respondent´s agreement with each statement was measured on a four or seven point Likert scale. The tested model was based on six predictors operationalized using responses to twelve statements (Figure 1). This figure also provides information about wording of the statements that appeared in the survey instrument (the questionnaire).

TABLE 1: Development of selected waste separation outcomes in the Czech Republic.

	2006 (*2008)	2012	2016
Effectiveness of separation (Kg/inhabitant * year)	27.9	39.1	44.8
Number of containers (Pcs)	146131	229000	307000
Proximity of containers (m)	115	102	96

Source: Grolmus (2009), Grolmus (2013), EKO-KOM (2017)

The first hypothesis tested in our model is as follows:

H1: A higher level of waste separation awareness has a positive impact on declared waste separation.

In this respect, we distinguished two types of knowledge – general knowledge and instrumental knowledge (Barr, 2007). General knowledge comprises overall information about the waste management system and its usefulness, and about communication reminding individuals to separate their waste. This information may be an important waste separation driver as it enables comprehension of waste separation tasks and provides individuals with key information relating to the importance and impacts of their efforts. Instrumental knowledge covers practical information relating to performing waste separation under the given circumstances. Therefore, this information focuses on types of materials and packaging collected separately, on materials collected within the specific area, on location of the nearest containers etc.

Our second hypothesis reads as follows:

H2: There is a statistical significant relationship between social environment of an individual and his/her declared waste separation.

We entered four constructs into our model – attitudes of others, activity in discussions, behaviour of primary social group, and perceived social control. By variable "attitudes of others", we tested whether or not the opinion of family members, relatives, colleagues or friends (those we considered as a primary social group) influences respondents. In other words, we tested to which extent respondents display the same attitudes towards waste separation and recycling as those close to them. Moreover, we considered not only the opinion of others about recycling but also their behaviour, which respondents were able to recognise. Therefore, we included the reflection of relevant behaviour of primary social group into our model. We also hypothesised that discussions about waste separation might indicate the presence of the topic in everyday life of respondents, and therefore the taking place of similar discussions might increase waste separation efforts (this effect reflects the variable "activity in discussions"). Finally, our model involved perceived social control hypothesised as a predictor of waste separation behaviour, due to the fact that perceived social control imposes pressure on individuals to behave in a desired way.

As mentioned above, all original statements from the questionnaire were transformed into constructs suitable for regression analysis. Each construct (except for activity in discussions) was composed of three levels reflecting the intensity of the phenomenon. Knowledge (both general and instrumental) was then distinguished as high, medium or low; attitudes of others appeared as positive (i.e. in favour of recycling), neutral or negative; behaviour of others varied from being engaged in waste separation through being neutral, to rejecting waste separation, with perceived social control being high, limited or low. Activity in discussions was binary (high–low). Table 2 provides an overview of ordinal level of constructs.

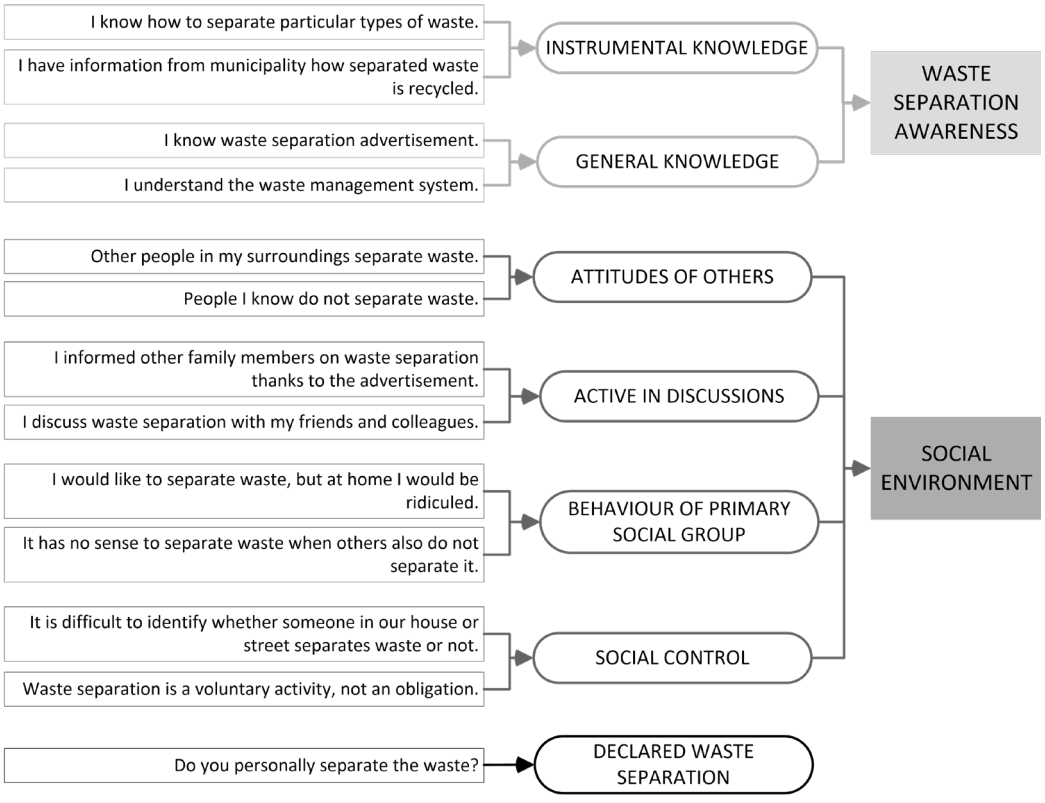

FIGURE 1: Wording of statements indicating key variables.

TABLE 2: Summary statistics of the key variables in the model.

Variables	Coding	Mean	Std. Deviation
DEPENDENT VARIABLE			
Attitude towards waste separation	1 = engaged	1.53	0.700
	2 = neutral		
	3 = rejecting		
DEPENDENT VARIABLES (PREDICTORS)			
Waste separation awareness			
Instrumental knowledge	1 = high	1.66	0.604
	2 = medium		
	3 = low		
General knowledge	1 = high	2.27	0.625
	2 = medium		
	3 = low		
Social environment			
Attitudes of others	1 = positive	1.98	0.598
	2 = neutral		
	3 = negative		
Active in discussions	1 = high	1.86	0.348
	2 = low		
Behaviour of primary social group	1 = engaged	1.19	0,457
	2 = neutral		
	3 = rejecting		
Social control	1 = high	2.30	0.602
	2 = limited		
	3 = low		

5.2 Sample, sampling technique and data collection method

The target population was the general population of the Czech Republic aged 18 – 74 years comprising only Czech residents living permanently in the Czech Republic.

The sampling technique applied was the multistage random procedure using random route. Since no adequate sampling frame (register or list of inhabitants) was available, with respect to the method of data collection (face-to-face interviews) when random digit dialling could not be used, primary sampling units were selected. Subsequently, within primary sampling units, addresses were identified and households were selected. Finally, the interviewers visited the pre-selected addresses, attempted to contact the pre-selected households, identified the prospective respondent using the Kish-table (Kish, 1949) and invited the relevant individual to participate. Altogether 186 primary sampling units throughout the Czech Republic were selected; within each primary sampling unit a maximum of 20 addresses were identified. Interviewers contacted 3148 households and performed 1611 interviews (response-rate was 51.2%). However, due to incompleteness of some of these interviews, when respondents refused to provide key socio-demographic data, the database comprised a total of 1579 cases used for analysis.

Fieldwork took place during March 2017. Average duration of an interview was approx. 35 minutes; interviews were focused on waste separation solely. From a total of 1611 interviews, 20% were supervised (by check-backs) and verified in terms of compliance with ethical standards (e.g. confidentiality, informed consent).

6. RESULTS AND DISCUSSION

Table 3 provides the results of ordered logit model. Statistically significant variables comprise instrumental knowledge, general knowledge, attitudes of others, activity in discussions, and behaviour of social group. This supports both of our hypotheses that waste separation awareness, as well as social environment of an individual, are relevant predictors of waste separation behaviour. It is obvious that instrumental knowledge is a stronger predictor of declared waste separation than general knowledge. At the same time, the data indicate a strong effect of enabling environment (behaviour of primary group) and overall responsiveness (activity in discussions and attitudes of others). The only statistically insignificant variable in the model is perceived social control.

In the case of social groups, respondents share their attitudes toward waste separation with other members of their primary social group (particularly household or family). In accordance with Abbott et al. (2013) and Miliute-Plepiene et al. (2016), we also found that people

TABLE 3: Results of ordered logit model.

Parameter estimates	Estimate	Wald
Threshold (constant)		
Attitude towards waste separation		
1 = engaged	-3.407***	77.395
2 = neutral	-0.91**	6.046
3 = rejecting	0	.
Location (predictors)		
Instrumental knowledge		
1 = high	**-0.912*** **	16.104
2 = medium	-0.175	0.682
3 = low	0	.
General knowledge		
1 = high	**-0.576** **	5.508
2 = medium	**-0.364*** **	9.019
3 = low	0	.
Attitudes of others		
1 = positive	**-1.029*** **	23.674
2 = neutral	**-0.422*** **	7.895
3 = negative	0	.
Active in discussions		
1 = high	**-0.941*** **	19.426
2 = low	0	.
Behaviour of primary social group		
1 = engaged	**-2.908*** **	77.77
2 = neutral	-0.271	0.646
3 = rejecting	0	.
Perceived social control		
1 = high	0.159	0.506
2 = limited	0.038	0.105
3 = low	0	.

Note 1: Number of observations = 1573;
2 Log Likelihood = 592.414***
Chi-Square (Pearson) = 320.742
Nagelkerke = 0.402

Note 2: Threshold in the model corresponds to constant in linear regression models, location is the component that includes the predictors, estimates are the regression coefficients, and Wald is the parametric statistical test that measures the statistical significance of the coefficients.

Note 3: Parameters set to zero are redundant.
*** = significant at 1% level;
** = significant at 5% level;
* = significant at 10% level

who separate waste are surrounded by others who act in a similar way, whereas those who do not separate waste are surrounded by people who do likewise. This creates the basis for social determination of recycling.

In this respect, it should be mentioned that primary social groups (particularly families) are coherent in their approach to waste separation, as shown in Table 4. The majority of household-members either separate waste (see 38 percent who separate continuously and 31% who do so at least occasionally) or do not separate it at all, as is the case for 18% of respondents. Despite such strong coherence when 87% of households behave the same way, in a small number of cases the efforts of an individual may differ from the behaviour of other household members. In 4% of cases the respondent refers only occasional separation, although the household as a whole accounts for continual recyclers. Similarly, in 1% of households the respondent does not separate waste at all, in spite of the fact that other members separate at least occasionally. In 5% of households, the respondent separates continuously, whereas other members do so only occasionally, and in 2% the respondent refers an at least occasional separation, although the rest of the household does not separate at all.

Our results confirmed the importance of family members, and other close relatives in shaping attitudes towards recycling (Thomas and Sharp, 2013; Meneses and Palacio, 2005). Therefore, P&E campaigns should be targeted at those who live in close contact, i.e. relatives in the same household (compare with Miliute-Plepiene et al., 2016). However, these P&E initiatives are effective only when adequate recycling infrastructures (i.e. technical and organisational conditions) are available (Lakhan, 2014).

In accordance with Hage et al. (2009), perceived social control has a statistically insignificant impact on the decision of individuals to separate waste or not. This may be related to local institutional conditions. In our research, respondents found it difficult to identify those who separated or failed to separate waste in their house, block of flats or street (see Table 5).

Another explanation why social control only produces a low impact on waste separation is that waste separation is perceived as a voluntary activity, as a demonstration of willingness to do something for the environment or to satisfy an individual intrinsic motivation (see Table 6). The majority of people in the Czech Republic are not aware that waste separation is legally enforced by law (§ 17 of the Czech Waste Act No. 185/2001 Coll. states that individuals and other waste producers are obliged to separate waste). However, neither law nor social norms sanction non-recy-

TABLE 4: Relationship of waste separation of the respondent and the whole household.

		Waste separation by the respondents			
		Separate continuously	Separate occasionally	Do not separate at all	Total
Waste separation by anybody in the household	Separate continuously	**38%**	4%	0%	43%
	Separate occasionally	5%	**31%**	1%	38%
	Do not separate at all	0%	2%	18%	20%
	Total	44%	37%	19%	100%

TABLE 5: Results of questions focused on the opportunity for social control.

It is difficult to identify whether or not someone separates waste in our house, block of flats or street.	
	Valid percentage
7 = Definitely agree	15%
6	19%
5	28%
4 = Neither, nor	22%
3	9%
2	3%
1 = Definitely disagree	5%
Total	**100%**
Mean = 4.79; standard deviation = 1.540; missing cases = 90	

TABLE 6: Results of questions focused on the opportunity for social control.

Waste separation is a voluntary activity, not an obligation.	
	Valid percentage
1 = Definitely agree	33%
2 = Agree	42%
3 = Disagree	17%
4 = Definitely disagree	8%
Total	100%
Mean = 3.00; standard deviation = 0.908; missing cases = 34	

cling behaviours (for further discussion, see Abbott et al., 2013).

The absence of sanctions, and consequently a lack of feelings of guilt (Halvorsen, 2010) might contribute towards decreasing the perceived importance of waste separation and recycling behaviour. However, sanctions based on social control are not necessarily a prerequisite of recycling behaviours. As Abbott et al. (2013) reported, when social norms are internalized by individuals, sanctions are not necessary. Furthermore, Benabou and Tirole (2006) warn against the perverse effects of sanctions when intrinsic motivations may be crowded-out by extrinsic ones.

Another explanation is related to the system of waste separation applied in the Czech Republic. Although container-based separate collection prevails, containers are not located primarily at public places where social control is possible. The location of containers does not reflect perceived social control argumentation, but rather other factors such as, for example, the proximity of containers from homes, containers must be located on publicly owned land and accessible to collection vehicles etc. Therefore, the strength of social control is limited by technical and organisational conditions and the role of moral norms increase (Hage et al., 2009). According to Abbott et al. (2013) who call for an increase in recycling efforts through the activation of social norms, together with the creation of opportunities for social control, we would also like to emphasise the suitable location of collection points. Kerbside collection does not seem to be an adequate solution, as this collection system is based on collection points.

As mentioned above, general and instrumental knowledge are statistically significant predictors of waste separation in line with the results summarized by Miafodzyeva and Brandt (2013). P&E campaigns seem therefore to be a good way of increasing waste separation efforts. However, as Miliute-Plepiene et al. (2016) reported, P&E campaigns are less effective in systems in which technical infrastructures enhance the carrying out of recycling without perceived barriers.

Targeting P&E campaigns is not an easy task, particularly when non-recyclers represent a heterogeneous segment of the population. Indeed, differences were observed between the two groups in terms of gender (when males dominate within non-recyclers), social status (higher share of lower social groups among non-recyclers) and housing type correlated with social group (Table 7). Another significant difference in composition of both groups is based on age; there is a concomitant higher share of younger respondents (particularly singles) and older respondents (living alone) amongst the non-recyclers. Therefore, it is difficult to deliver specific information directly to the relevant individuals through use of nationwide media or similar communication tools.

Another challenge encountered in attempting to further strengthen the waste separation effort is that the demand for information differs between recyclers and non-recyclers. Recyclers are interested in information such as how the waste is processed, what products could be produced from recycled material, where new containers will be placed, or what specific waste fractions can be separated. The wish-list of non-recyclers is however different; they prefer information on overall benefits gained by sorting waste, general information about the waste management systems as such, how much waste separation costs, who benefits from the system and what the perspective of the waste separation is (Barr, 2007). Starr and Nicolson (2015) reported how P&E campaigns are effective when the under-informed population is targeted. However, non-recyclers cannot be compared to an under-informed population, as their information demands are different. Thus, Lakhan (2014) pointed out that P&E campaigns should provide not only abstract, but also instrumental, knowledge. The importance of well-targeted P&E campaigns arises when the waste separation systems alter, or new systems are established (Shaw et al., 2006). P&E campaigns are an effective instrument when the aim is to increase public involvement in recycling (Read, 1999), but as Woodard et al. (2005) added, P&E campaigns need to run continuously to avoid drop-off of public participation

Data relating to public participation in collection systems and the trend of recycling rates over the past few years in the Czech Republic (EKO-KOM, 2017) indicate that extensive growth of separated waste amounts resulting from an improved participation rate is reaching its limits. Recycling efforts are based on engagement of those who are willing to recycle. Further increase in effectiveness of recycling would therefore imply persuading the 'non-recyclers'. However, to achieve this by means of the traditional

TABLE 7: Socio-demographic variables and their relation to waste separation behaviour.

		Respondents' waste separation behaviour	
		Recyclers	**Non-recyclers**
Gender	Male	48%	57%
	Female	52%	43%
	Total	100% (N=1276)	100% (N=303)
Age	Less than 20 years	5%	7%
	20–29 years	15%	19%
	30–39 years	20%	21%
	40–49 years	19%	16%
	50–59 years	18%	11%
	60 years or older	22%	27%
	Total	100% (N=1276)	100% (N=303)
Social status	A (high class)	6%	2%
	B (higher middle class)	21%	10%
	C (lower middle class)	41%	39%
	D (lower class)	19%	30%
	E (underclass)	13%	20%
Housing type	Family house	44%	32%
	Block of flats	56%	68%
	Total	100% (N=1271)	100% (N=303)

communication tools such as P&E campaigns, may prove expensive and inefficient. In this respect, new media and innovative below-the-line communication tools focusing on the social environment of individuals might play a crucial role in influencing behavioural patterns.

7. CONCLUSIONS

A whole range of policy measures (or instruments) is available with the aim of engaging people in systems of municipal waste separation and thus, achieving a circular economy. These measures may be both direct (affecting the decision-making of individuals, i.e. financial incentives) and indirect (e.g. P&E campaigns). In addition to these policy-driven (intentional) measures, spontaneous social processes that might affect the intention of individuals to behave in certain are also implemented. These spontaneous processes include the behaviour of other people reflected by an individual, declared behaviour of primary social group (family), participating in discussions about waste separation and social control.

The results obtained in our study confirmed that awareness of waste separation, together with the social environment of an individual are significant predictors of waste separation behaviour. On the other hand, perceived social control proved to be statistically insignificant in justifying recycling behaviour. These results dictate the need for adequate policy measures to increase public participation, particularly amongst those who are not willing to participate in waste separation. Of the currently available policy instruments, soft measures such as P&E campaigns seem to produce an adequate impact on recycling behaviour when the separation systems can count on adequate infrastructures.

However, targeting P&E campaigns is not an easy task when non-recyclers represent a heterogeneous segment of the population. Furthermore, the demand for information differs between recyclers and non-recyclers. Whereas recyclers are interested in information such as how the waste is processed, what products could be produced from the recycled material, where new containers will be placed, and what can be separated, the demands of non-recyclers is largely different. They prefer information relating to the overall benefits to be gained from waste separation, general and introductory information on waste management systems as such, information on the costs of waste separation, and the future of waste separation.

The influence of perceived social control on recycling efforts seems to be limited (at least under the examined Czech conditions). Individuals did not find it easy to identify those who separated or failed to separate waste in their house or street, with waste separation being perceived as a voluntary activity, demonstration of an effort to do something for the environment or to satisfy an individual intrinsic motivation, rather than an obligation. To increase social control, the organisation of separate collection would need to be rearranged.

ACKNOWLEDGEMENTS

We wish to thank the Czech Science Foundation for financial support (Project No. 16-14409S – 'Demographic development and behavioural aspects (e.g. 'crowding-out effect') and their impact on the municipal waste charging policy). The authors would like to thank two anonymous

reviewers for their useful comments and to Michal Struck for his extensive feedback.

REFERENCES

Abbott, A., Nandeibam, S. and O'Shea, L. (2013). Recycling: Social norms and warm-glow revisited. Ecol. Econ., vol. 90, 10-18.

Alexander, C., Smaje, C., Timlett, R. and Williams, I. (2009). Improving social technologies for recycling. Waste Resour. Manage., vol. WR0, 1-14

Ando, A.W. and Gosselin, A.Y. (2005). Recycling in multifamily dwellings: does convenience matter? Econ. Inq., vol. 43, n. 2, 426–438

Aronson, E., T.D. Wilson, and Akert, R.M. (2005). Social Psychology. Fifth Edition. New Jersey: Pearson Education International.

Barr, S. (2007). Factors influencing environmental attitudes and behaviors: A U.K. case study of household waste management. Environ. Behav., vol. 39, n. 4, 435 – 473.

Bénabou, R. and Tirole, J. (2006). Incentives and prosocial behaviour. Am. Econ. Rev., vol. 96, n. 5, 1652-1678

Bernstad, A., la Cour Jansen, J. and Aspegren, A. (2013). Door-stepping as a strategy for improved food waste recycling behaviour – Evaluation of a full-scale experiment. Resour. Conserv. Recy., vol. 73, 94-2013

Bernstad, A. (2014). Household food waste separation behaviour and the importance of convenience. Waste Manage., vol. 34, 1317-1323

Bilitewski, B. (2012). The circular economy and its risks. Waste Manage., vol. 32, 1-2

Blasch, J. and Ohndorf, M. (2015). Altruism, moral norms and social approval: Joint determinants of individual offset behaviour. Ecol. Econ., vol. 116, 251-260.

Bocken, N.M.P., de Pauw, I., Bakker, C. and van der Grinten, B. (2016). Product design and business model strategies for a circular economy. J. Ind. Prod. Eng., vol. 33, 308-320

Brekke, K.A., Kipperberg, G. and Nyborg, K. (2007). Reluctant recyclers: social interaction in responsibility ascription. Memorandum No. 16/2007. Department of Economics, University of Oslo.

Bruvoll, A., Halvorsen, B., and Nyborg, K. (2002). Households' recycling efforts. Resour. Conserv. Recy., vol. 36, n. 4, 337-354

Chertow, M.R. (2007). Uncovering industrial symbiosis. J. Ind. Ecol., vol. 11, n. 1, 11-30

Dai, Y.C., Gordon, M.P.R., Ye, J.Y., Xu, D.Y., Lin, Z.Y., Robinson, N.K.L., Woodard, R. and Harder, M.K. (2015). Why doorstepping can increase household waste recycling. Resour. Conserv. Recy., vol. 102, 9-19

Derksen, L. and Gartrell, J. (1993). The social context of recycling. Am. Sociol. Rev., vol. 58, n. 3, 434-442.

Desrochers, P. (2004). Industrial symbiosis: the case for market coordination. J. Clean. Prod., vol. 12, 1099-1110

Di Maio, F., Rem, P.C., Baldé, K. and Polder, M. (2017). Measuring resource efficiency and circular economy: A market value approach. Resour. Conserv. Recy., vol. 122, 163-171

Domina, T. and Koch, K. (2002). Convenience and frequency of recycling implications for including textiles in curbside recycling programs. Environ. Behav., vol. 34, n. 2, 216–238,

EKO-KOM (2017). Množství vytříděných odpadů v ČR loni vzrostlo. Co Čech, to bezmála 45 kilogramů vytříděného odpadu. Tisková zpráva. Praha. 11.5.2017

Elia, V., Gnoni, M.G. and Tornese, F. (2017). Measuring circular economy strategies through index methods: A critical analysis. J. Clean. Prod., vol. 142, 2741-1751

Ewing, G. (2001). Altruistic, egoistic, and normative effects on curbside recycling. Environ. Behav., vol. 33, n. 6, 733-764

Farrow, K., Grolleau, G. and Ibanez, L. (2017). Social norms and pro-environmental behaviour: a review of the evidence. Ecol. Econ., vol. 140, 1-13.

Garces, C., Lafuente, A., Pedraja, M. and Rivera, P. (2002). Urban waste recycling behaviour: Antecedents of participation in a selective collection program. Environ. Manage., vol. 30, n. p3, 378-390

Geissdoerfer, M., Savaget, P., Bocken, N.M.P. and Hulting, E.J. (2017). The circular economy – A new sustainability paradigm. J. Clean. Prod., vol. 143, 757-768

Ghisellini, P., Cialani, C., and Ulgiati, S. (2016). A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. J. Clean. Prod., vol. 114, 11-32.

Gonzáles-Torre, P.L. and Adenso-Díaz, B. (2005). Influence of distance on the motivation and frequency of household recycling. Waste Manage., vol. 25, n. 1, 15–23

Grolmus, L. (2009). 10 let úspešného rozvoje třídění odpadů ve spolupráci s obcemi. Proceedings 'Odpady a obce', 10. – 11-6.2009

Grolmus, L. (2013). Výsledky systému EKO-KOM za rok 2012. Proceedings 'Odpady a obce', 12. – 13.6.2013 in Hradec Králové

Haas, W., Krausmann, F., Wiedenhofer, D., and Heinz, M. (2015). How circular is the global economy? An assessment of material flows, waste production, and recycling in the European union and the world in 2005. J. Ind. Ecol., vo. 19, n. 5, 765-777.

Hage, O., Söderholm, P. and Berglund, C. (2009). Norms and economic motivation inhousehold recycling: empirical evidence from Sweden. Resour. Conserv. Recy, vol. 53, n. 3, 155–165,

Hagelüken, C., Lee-Shin, J. U., Carpentier, A., and Heron, C. (2016). The EU circular economy and its relevance to metal recycling. Recy., vol. 1, n. 2, 242-253.

Halvorsen, B. (2008). Effects of norms and opportunity cost of time on household recycling. Land Econ., vol. 84, n. 3, 501-516

Halvorsen, B. (2010). Effects of norms and policy incentives on household recycling: An international comparison. Discussion Papers No. 627, Statistics Norway, Research Department.

Hornik, J., Cherian, J., Madansky, M. and Narayana, Ch. (1995). Determinants of recycling behaviour: A synthesis of research results. J. Soc. Econ., vol. 24, n. 1, 105-127

Chen, M.F. and Tung, P.J. (2010). The moderating effect of perceived lack of facilities on consumers' recycling intentions. Environ. Behav., vol. 42, n. 6., 824 – 844.

Kish, L. (1949). A procedure for objective respondent selection within the household. J. Am. Stat. Asoc., vol. 44, n. 247, 380-387.

Kurz, T., Linden, M. and Sheehy, N. (2007). Attitudinal and community influences on participation in new curbside recycling initiatives in Northern Ireland. Environ. Behav., vol. 39, n. 3, 367-391

Lakhan, C. (2014). Exploring the relationship between municipal promotion and education investments and recycling rate performance in Otario, Canada. Resour. Conserv. Recy., vol. 92, 222-229

Lehtoranta, S., Nissinen, A., Mattila, T. and Melanen, M. (2011). Industrial symbiosis and the policy instruments of sustainable consumption and production. J. Clean. Prod., vol. 19, 1865-1875.

Martin, M., Svensson, N. and Eklund, M. (2015). Who gets the benefits? An approach for assessing the environmental performance of industrial symbiosis. J. Clean. Prod., vol. 98, 1-9.

Mathews, J.A. and Tan, H. (2011). Progress towards a circular economy: the drivers and inhibitors of eco-industrial initiative. J. Ind. Ecol., vol. 15, 435-457

Meneses, G.D. and Palacio, A.B. (2005). Recycling behaviour: A multidimensional approach. Environ. Behav., vol. 37, n. 6, 837-860

Miafodzyeva, S. and Brandt, N. (2013). Recycling behaviour among householders: Synthesizing determinants via a meta-analysis. Waste Biomass Valor., vol. 4, 221 – 235.

Miliute-Plepiene, J., Hage, O., Plapys, A. and Reipas, A. (2016). What motivates households recycling behaviour in recycling schemes of different maturity? Lessons from Lithuania and Sweden. Resour. Conserv. Recy., vol. 113, 40-52

Mueller, W. (2013). The effectiveness of recycling policy options: Waste diversion or just diversions? Waste Manage., vol. 33, 508-518

Nyborg, K., Anderies, J. M., Dannenberg, A., Lindahl, T., Schill, C., Schlüter, M., ... and de Zeeuw, A. (2016). Social norms as solutions. Science, vol. 354, n. 6308, 42-43.

Pocock R, Stone I, Clive H, Smith R. and Wilczak S. (2008). Barriers to Recycling at Home. Banbury, UK: Waste and Resources Action Programme

Ramani, K., Ramanujan, D., Bernstein, W.Z., Zhao, F., Sutherland, J., Handwerker, C., Choi, J.-K., Kim, H. and Thurston, D. (2010). Integrated sustainable life cycle design: a review. J. Mech. Des., vol. 132, 1-15

Read, A.D. (1999). "A weekly doorstep recycling collection, I had no idea we could!" Overcoming the local barriers to participation. Resour. Conserv. Recy., vol. 26, 217 - 249

Saphores, J.D and Nixon, H. (2014). How effective are current household recycling policies? Results from a natinal survey of U.S. households. Resour. Conserv. Recy., vol. 92, 1-10

Sauer, P., Parizkova, L. and Hadrabova, A. (2008). Charging systems for municipal solid waste: Experience from the Czech Republic. Waste Manage., vol. 28, 2772 - 2777

Shaw, P.J., Lyas, J.K., Hudson, M.D. (2006). Quantitative analysis of re-

cyclable materials composition: Tools to support decision making in kerbside recycling. Resour. Conserv. Recy., vol. 48, 263 - 279
Slavik, J. (ed.) (2009). Poplatkové systémy v obcích – rizika a příležitosti pro odpadové hospodářství. Praha: IREAS.
Slavik, J. and Pavel, J. (2013). Do the variable charges really increase the effectiveness and economy of waste management? A case study of the Czech Republic. Resour. Conserv. Recy., vol. 70, 68-77.
Starr, J. and Nicolson, C. (2015). Patterns in trash: Factors driving municipal recycling in Massachusetts. Resour. Conserv. Recy., vol. 99, 7 - 18
Struk, M. (2017). Distance and incentives matter: The separation of recyclable municipal waste. Resour. Conserv. Recy., vol.122, 155 – 162
Thogersen, J. (2008). Social norms and cooperation in real-life social dilemmas. J. Econ. Psych., vol. 29, 458-472.
Thomas, C. and Sharp, V. (2013). Understanding the normalisation of recycling behaviour and its implications for other pro-environmental behaviours: A review of social norms and recycling. Resour. Conserv. Recy., vol. 79, 11 – 20
Timlett, R.E. and Williams, I.D. (2008). Public participation and recycling performance in England: A comparison of tools for behaviour change. Resour. Conserv. Recy., vol. 52, 622 - 634
Tukker, A. (2015). Product services for a resource-efficient and circular economy – a review. J. Clean. Prod., vol. 97, 76 – 91
Vicente, P. and Reis, E. (2008). Factors influencing households' participation in recycling. Waste Manage. Res., vol. 26, n. 2, 140 - 146
Vining, J., Ebreo, A. (1990). What makes a recycler? A comparison of recycling motivations in four communities. Environ. Manag., vol. 16, n. 6, 785-797.
Von Borgstede, Ch. and Anderson, K. (2010). Environmental information – explanatory factors for information behaviour. Sustainability, vol. 2, 2785-2798
Woodard, R., Bench, M. and Harder, M.K. (2005). The development of a UK kerbside scheme using known practice. J. Environ. Manag., vol. 75, 115-127
White, K.M. and Hyde, M.K. (2012). The role of self-perceptions in the prediction of household recycling behaviour in Australia. Environ. Behav., vol. 44, n. 6, 785-799
Yau, Y. (2010). Domestic waste recycling, collective action and economic incentive: The case in Hong Kong. Waste Management. vol. 30, n. 12, 2440