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**Effects of norms and policy
incentives on household
recycling**
An international comparison

Abstract:

Increased household recycling is a policy goal in many countries. Household recycling is, to a large extent, based on voluntary efforts. It is thus interesting to understand the mechanisms behind household voluntary contributions to recycling, and how they are affected by various policy measures. In this study, we describe the differences in factors affecting household recycling activities across 10 OECD countries. We find that the most important motivations for household recycling are the belief that recycling is good for the environment and that recycling is a civic duty. Increasing the supply of recycling services has a significant effect on household recycling, and door-to-door collection and drop-off centres are the two most effective methods in this respect. Furthermore, the results indicate that the design of monetary incentives may be important to avoid crowding out of morally motivated voluntary contributions, illustrated by the Korean success with volume-based fees.

Keywords: Household recycling, norms, international comparison.

JEL classification: C21, H42

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1. Introduction

Waste generation and resource depletion have been major concerns in many countries, and increased household recycling has been seen as a means to reduce these problems. Household recycling relies heavily on voluntary contributions from individual households. Some countries use economic incentives and regulations to stimulate this effort; in others, few or no incentives exist. Authorities in many countries provide recycling facilities (bins, containers, etc.) with virtually no official sanction possibilities. Despite this, households make considerable efforts—sorting, folding, washing, carrying and transporting sorted waste, even when no economic incentives exist. This implies that non-economic motivations are important for household recycling activities. When intrinsic motivations are important, introducing economic incentives or other regulations may affect how households see their role in providing recycling services. For authorities to achieve their aim of increased household recycling and to secure the most efficient design of the chosen policy instruments, it is thus important to understand the mechanisms behind voluntary recycling contributions and how they are affected by the introduction of economic incentives.

Based on the empirical literature, several factors seem to affect household recycling. Many studies have shown that monetary incentives and providing different types of recycling facilities matters (Hong et al., 1993; Jenkins et al., 2000; Jakus et al., 1996; Tiller et al., 1997; Reschovsky and Stone, 1994; Van Houtven and Morris, 1999; Bruvoll, 2001 and Fullerton and Kinnaman, 2002). Furthermore, the opportunity cost of time spent on recycling activities is found to be of importance (Jakus et al., 1996; Hong et al., 1993 and Halvorsen, 2008). Others have examined motivations for household recycling efforts, giving advice on how to increase voluntary recycling efforts; see, e.g., Vinning and Ebreo (1990), Hornik et al., (1995), Hopper and Nielsen (1991), De Young (1986).

Norms have been shown to be a considerable determinant of all voluntary contributions, including household recycling activities (Rabin, 1998; Frey, 1994; Deci and Ryan, 1985; Festinger, 1957; Schwartz, 1970; Tøgersen, 1994; Bruvoll and Nyborg, 2004). If household behaviour is motivated by norms, introducing economic incentives may crowd out the intrinsically motivated behaviour (Frey, 1994 and 1997). In an empirical study discussing the motivations for household recycling as well as the effects of economic incentives, Tøgersen (1994) found evidence of reframing and crowding out of moral norms when economic incentives are introduced in the form of differentiated garbage fees.

In an effort to shed light on how all these factors interact, Halvorsen (2008) developed a method for analysing the effects on household recycling of many factors simultaneously, explicitly modelling the effects of norms and the opportunity cost of time spent on recycling. This study was carried out on a sample of Norwegian households. The study found that norms, the supply of recycling services and the alternative cost of time significantly influenced household recycling. There were also indications of crowding-out effects, as households tend to reduce their recycling efforts when recycling is perceived as mandatory. Unfortunately, the data included little information about renovation fees, and it was thus not possible to test for the crowding-out effects found in Töggersen (1994).

In this study, we conduct an international comparison of household recycling behaviour, and discuss how differences in policy measures, norms and attitudes affect household recycling. We use the behavioural model developed in Halvorsen (2008) to study how household recycling is affected by both intrinsic motivation and economic incentives. The analysis is based on data from a survey conducted by the OECD's environmental directorate, containing information about household recycling efforts in 10 OECD countries.¹ The data contain information about household attitudes towards environmental issues, reasons for recycling, recycling programs available, price tariffs and household characteristics. The data include large variations in recycling policy programs and price tariffs used (both within and across countries) and provide an opportunity to analyse the effects of differences and interactions between norms, attitudes and various policy instruments on household recycling efforts in different countries, thus expanding the analysis in Halvorsen (2008).

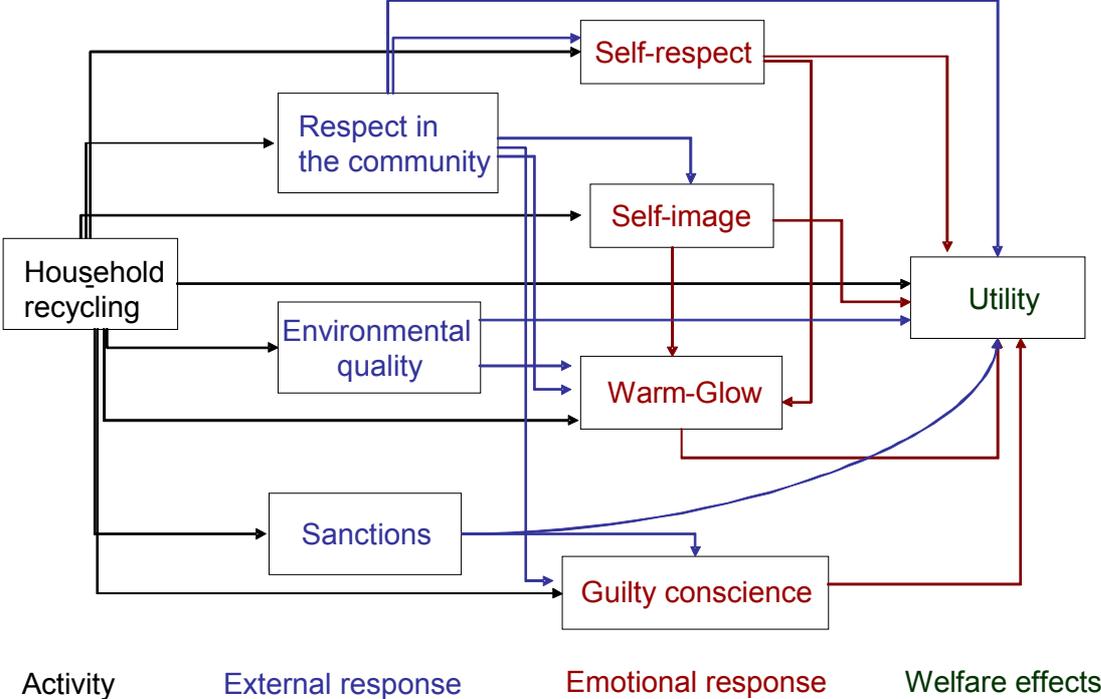
2. How do Norms and Policy Incentives Affect Recycling Behaviour?

In this section, we give a short description of the main mechanisms for how norms and policy incentives are assumed to affect utility in the model presented in Halvorsen (2008). In this model, it is assumed that how we live up to norms influences how we feel about ourselves and how we are viewed by others. These effects will in turn affect our welfare and thus our behaviour. The main mechanisms in the model are illustrated in Figure 1. Our actions, in this case household recycling (first column in Figure 1), are assumed to influence our emotions (third column in Figure 1) both directly and indirectly through the reactions we receive from others and the effect our actions have on the

¹ The data were collected as part of the OECD's project "Household Behaviour and Environmental Policy" (www.oecd.org/env/cpe/consumption). This paper is the sole responsibility of the author. The opinions expressed and arguments employed here do not necessarily reflect the official views of the OECD or of the governments of its member countries.

environment (second column in Figure 1). All these effects may influence the utility we receive from recycling activities (fourth column in Figure 1).

Figure 1: Main effect on utility of household recycling in Halvorsen (2008)



Utility is assumed to increase with the respect we receive in the community, self-respect, the opportunity we have to promote a positive self-image (Blamey, 1998) and the warm glow we receive from contributing to a just cause (Andreoni, 1990). The household is also assumed to face sanctions, mainly in the form of social sanctions from the local community or from renovation workers, and to have feelings of guilt if the household does not recycle sufficiently, thereby reducing utility. Environmental quality is assumed to increase with the total quantity of recycling in society, both from the household and from other households. How our actions are viewed by others is also assumed to evoke an emotional response. For instance, sanctions and a bad reputation in the community are assumed to increase the household’s feelings of guilt, and the warm-glow feeling is assumed to increase if the respondent anticipates more respect in the community. Furthermore, one emotional feeling may also evoke another emotional feeling. For instance, increased self-respect and a positive self-image, as well as the respect we receive from others, may boost the warm-glow feeling by contributing to a worthwhile cause.

The existence and strength of norms will affect the emotional responses to our actions and those of others. If a norm is strong, the household needs to recycle more in order to obtain the same level of respect and self-image. Furthermore, the sanctions and feelings of guilt are also more powerful when a norm is strong. Introducing policy incentives may influence the cost of recycling (both the monetary cost and the opportunity cost of time) as well as the norm to recycle in society. Introducing new policy incentives may either strengthen an existing norm (e.g., if it sends a message that increased recycling is prioritized by the government), or reduce it (if households feel that it is now acceptable to purchase recycling services instead of recycling themselves).

When deciding on their recycling effort, the household is assumed to evaluate all these effects, maximizing their utility for a given time and money budget.

3. The Data

The data were gathered in February 2008 based on a web panel, from questions on five different areas of environmentally related household behaviour: waste generation and recycling, transportation choices, energy-saving measures, organic food consumption and water use. Additionally, information about socio-demographic background, attitudes towards environmental issues, household characteristics and stated preferences towards hypothetical changes in environmental policies are included in the questionnaire. The survey was answered by 10,251 respondents distributed evenly among 10 participating countries: Australia, Canada, Czech Republic, France, Italy, Korea, Mexico, Norway, Netherland and Sweden. (See the appendix for a list of the main questions used in this analysis. See also www.oecd.org/env/cpe/consumption for a description of the entire questionnaire.)

The survey included several questions related to household recycling efforts and recycling services available to the household: which materials the household recycles, the percentage of waste recycled, the collection services available for recyclable materials, how often recyclables are collected, and how the household is charged for these recycling services.² To measure the alternative cost of time used recycling, a willingness-to-pay question was asked: “If the current system were to be changed in such a way that you need not separate your waste at home at all, but this is done on your behalf by a third party, how much would you be willing to pay each month for this service?” The questionnaire also

² Note that in this survey, the respondents were asked about the current recycling services available and what kind of fee they face. Some respondents may not know all the details about their municipality’s recycling policy. However, it is their beliefs with respect to these variables that determine their behaviour, not regulations and options they do not know of. The effect of these variables in the estimation must therefore be interpreted as the effects of the perceived regulatory system.

includes several questions concerning the respondent's attitudes towards various environmental problems (see the appendix for more information).

Most of the mechanisms discussed in Figure 1 cannot be observed directly. However, several of the questions asked in this questionnaire may be used as indicators of differences in the social and moral commitment to recycling and in the expectations about the environmental effects of recycling activities. For instance, respondents who agree that each individual can contribute to a better environment and who recycle because they believe it is beneficial to the environment, will have higher expectations about the value of their efforts than others. In turn, this will probably result in a larger moral commitment to contributing than from respondents who do not share these expectations, who feel their recycling efforts are futile or who believe that environmental impacts are frequently overstated. Respondents who are concerned with the moral aspects need to recycle more in order to obtain the same level of self-respect and good conscience, compared with respondents who are not concerned equally. We thus expect these variables to increase household recycling efforts. The moral commitment to contributing is probably less for those who believe that the environmental problems will be solved by technological progress or feel that it is the responsibility of future generations to find a solution to environmental problems. Respondents who believe that environmental policies should not lead to increased monetary costs may be divided into two groups: one with a low moral commitment, agreeing as long as it does not cost them anything; and one with a high moral commitment, objecting to the possibility of "slinking away from our obligations" and believing that "we cannot buy our way out of this crisis, we need to act".

Some of the questions may also be used to identify the interaction between policy measures and norms on recycling. For instance, perceiving recycling as mandatory may affect norms in several ways: either by strengthening existing norms, by introducing new norms, or by crowding out existing norms. If governmental legislation tightens norms, it will increase social sanctions and feelings of guilt if the respondent does not comply, increasing recycling efforts. If the norm is impaired, it will reduce recycling efforts. Households may also expect that total recycling will increase in the community when recycling is a joint effort secured by legislation, resulting in a higher environmental quality. Observing that perceiving recycling as mandatory reduces household recycling activities is an indication that the crowding-out effects are strongest. Observing that it increases recycling is an indication of a strengthening of norms and average expectations.

Another source of crowding-out effects discussed in the literature is the introduction of differentiated garbage fees. The argument is that if the municipality offers a differentiated fee, it signals that it is acceptable to pay instead of to recycle. This will weaken moral and social norms, and will reduce feelings of guilt, community and self-respect and the warm-glow feelings associated with recycling. This weakening of norms will in turn reduce household recycling efforts. If this is the case, we would expect household recycling efforts to be lower for respondents with differentiated fees and for respondents who recycle to save/receive money.

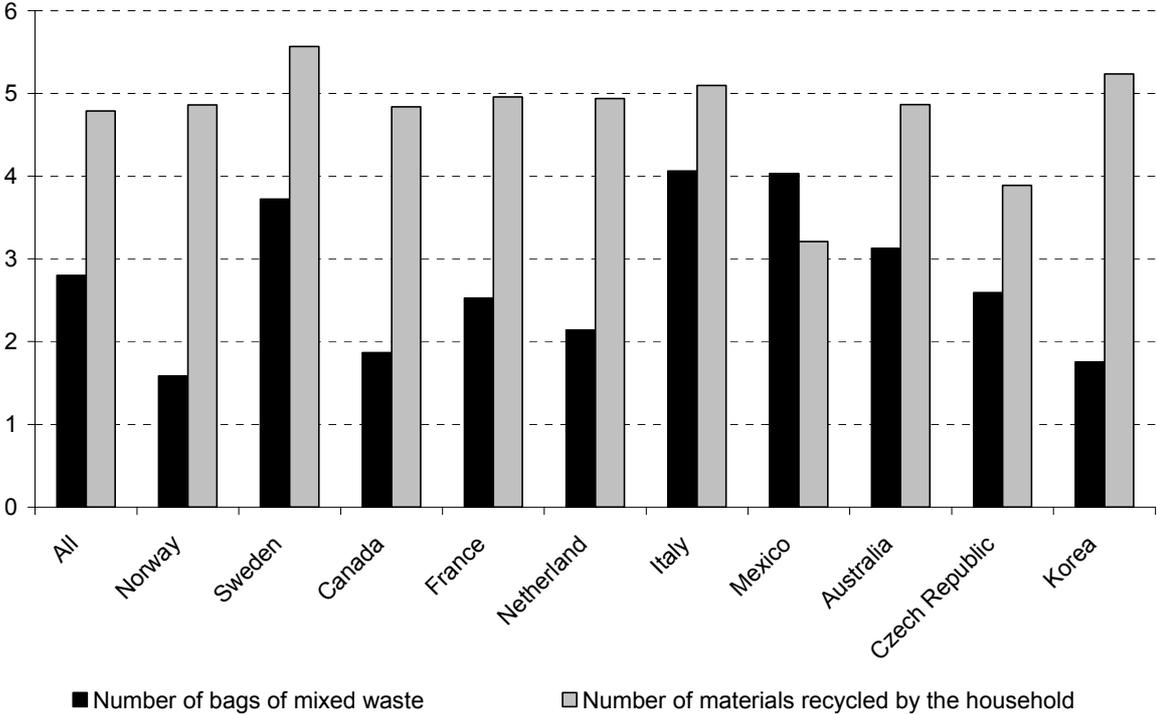
Agreeing that recycling is a civic duty is an indication of a wish to receive respect by living up to one's duties, and respondents who recycle because they want to be seen as responsible people indicate a desire to increase the respect they receive in the community. In our model, both of these effects are assumed to increase utility and the warm-glow feeling of recycling, which also has a positive effect on utility. Thus, they are assumed to increase recycling activities. If the respondents recycle merely to avoid sanctions and a guilty conscience, the utility effects are negative and will increase the opportunity cost of time, which in turn may reduce recycling efforts.

Also important for the household's recycling decision is the opportunity cost of the time used for recycling. It can be shown that the willingness to pay (WTP) for leaving recycling to others may be used as a measure of the individual household's opportunity costs of time used for recycling. This is because the WTP is a proxy for the household's compensating variation (CV) for leaving household recycling to others, which is defined as a measure of all utility effects from the total recycling efforts measured in monetary terms (Mitchell and Carson, 1989; Johansson, 1993), which in optimum equals the opportunity cost of time spent recycling (see Halvorsen, 2008). The WTP may be either positive or negative, depending on household preferences. If recycling has a net positive effect on utility, the WTP for leaving recycling to others is negative. On the other hand, if the net utility effect is negative—that is, the household is better off if a firm does all the recycling—the WTP is positive.

4. International Comparison

We start the analysis with an international comparison of household recycling behaviour and the main variables describing differences in incentives (prices, supply of recycling services) and motivations for recycling (norms and attitudes). Figure 2 presents the mean value of household waste generation and recycling efforts by country. Waste generation is recorded as the number of bags of mixed waste put out for collection by households each week, and recycling efforts are measured by the number of materials recycled by the household (the maximum number being eight).

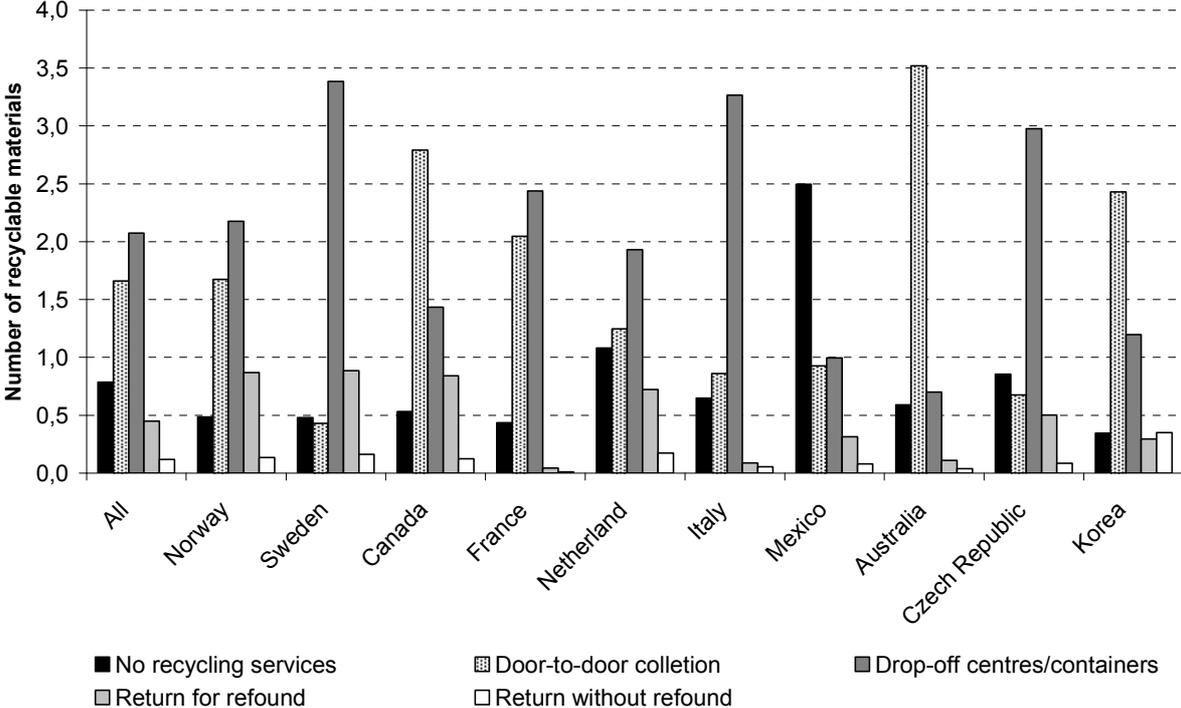
Figure 2: Mean household waste generation and recycling by country



We see that there are relatively large variations in the mean number of bags of mixed waste produced by households in different countries. Korea, Norway, Canada, the Netherlands and France are among the countries with the lowest amounts of mixed waste, whereas Mexican, Italian and Swedish households produce the most mixed waste. The number of materials recycled may be the reason for the relatively high mixed waste generation in the Mexican case. However, this cannot explain the numbers for Sweden and Italy, where the means of recycled materials are relatively high compared with mixed waste generation. One explanation may be that although the mean number of materials recycled is high in these countries, the intensity of recycling may vary, resulting in variation in the mixed waste output. Another, more reasonable explanation, is that the size of the mixed waste bags counted by the respondents varies across countries. For instance, a standard Norwegian garbage bag collected at the curb may contain 180 litres (the bins in Oslo even contain 240 litres), whereas the standard French bag contains approximately 80 litres. Although the size of the bags to be counted was illustrated in the questionnaire, there is a possibility that some respondents did not take this information into account or did not appreciate the full implications of this information, when answering the questions. Suspecting this to be a problem in the data, we find it difficult to determine whether increased recycling has reduced mixed waste generation based on the results of this analysis. We thus focus on household recycling behaviour in the rest of this analysis. Looking at the number of

materials the households report they recycle, we see that Swedes recycle most materials on average, whereas the lowest recorded mean was for the Mexican households. The difference in these two means is more than two materials, which amounts to a difference of more than 73 per cent compared with the Mexican mean.

Figure 3: Mean quantity of recycled materials with various collection services by country



There may be several reasons for the relatively large difference in mean recycling efforts across countries. First, we consider the variations in recycling programmes across countries. In the survey, the respondents reported the number of materials for which they have access to the following services: “door-to-door collection”, “drop-off centres or containers”, “return with refund” or “return without refund”, shown in Figure 3. The figure illustrates the diversity of the organization of recycling services. For instance, we see that in most countries, most recycled materials are transported to drop-off centres or containers by the household. The exceptions are Korea and Canada, with the highest share of door-to-door collection services for recycled materials, and Mexico, with the highest reported share of recycled materials with no collection services at all. We also see some return-with-refund services, especially in Norway, where bottle-deposit schemes are used comprehensively, but also in Sweden and the Netherlands. The level of available recycling services may be one reason for the low Mexican and high Swedish recycling rates. However, Canadians and Australians recycle relatively

little compared with the high number of materials collected at the door (door-to-door collection services probably have the lowest time cost of recycling). The relatively low Czech recycling effort (see Figure 2) also contrasts with the relatively good recycling program offered. Thus, differences in recycling programs are not the only determinant of household recycling.

Figure 4: Garbage fee systems by country³

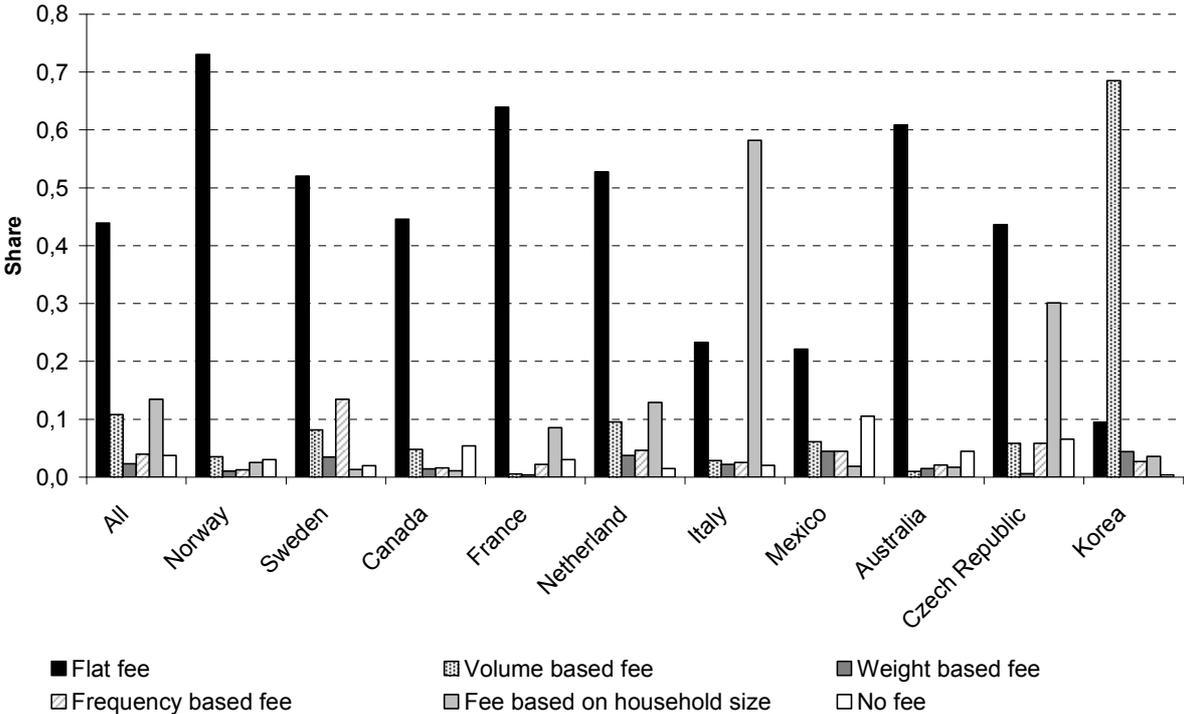
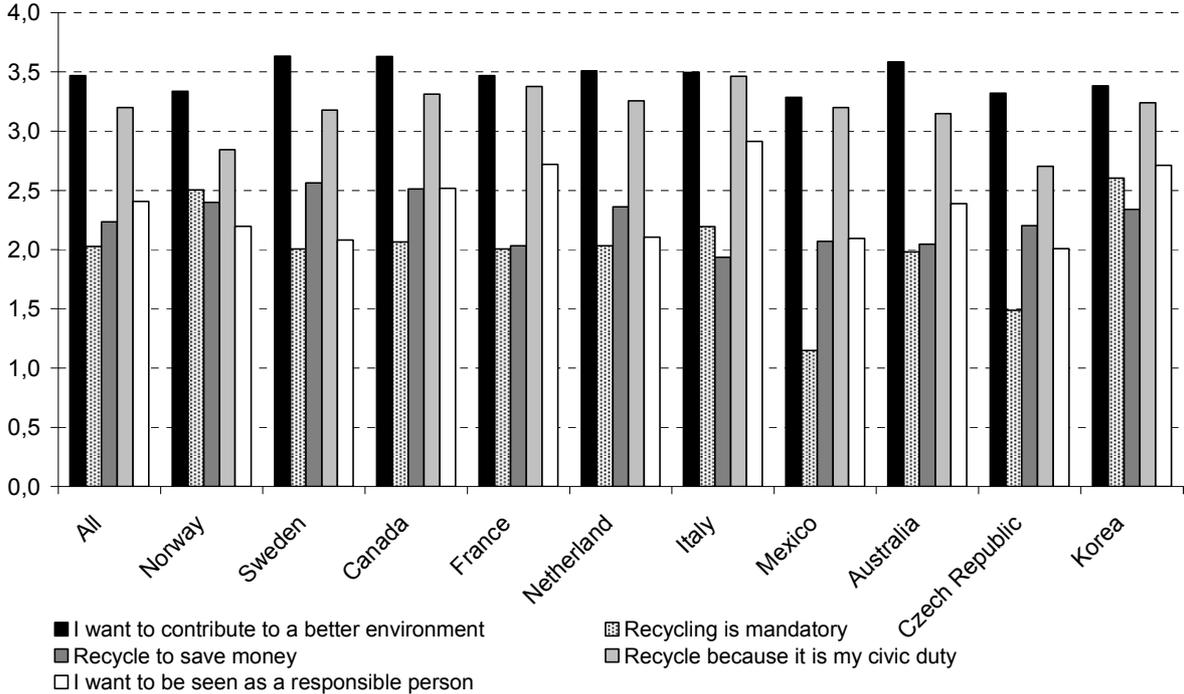


Figure 4 shows the share of respondents reporting to have a flat fee, volume-based fee, weight-based fee, frequency-based fee, fee based on household size, or no fee, by country. The predominant fee used in most countries is a flat fee. The exceptions are Italy and Czech Republic, where a considerable share of households pay fees based on household size, and Korea, where the predominant fee is a volume-based fee. The frequency-based fee is employed mainly in Sweden, while in Mexico, many households report having no fee. Weight-based fees exist in most countries but are very rarely employed.

³ The shares do not sum to one, as the responses “Other” and “Don’t know” are excluded from the figure.

Figure 5: Reasons for recycling by country.



In addition to the incentives embedded in recycling programs, there are several other factors affecting household recycling rooted in norms and the opportunities of each individual household to recycle. Figure 5 illustrates the mean score on the motives for recycling given by the households on a scale from 1 to 4, where 1 is “not at all important” and 4 is “very important”. The motivation for recycling with the highest mean score in all countries is the wish to contribute to a better environment, followed by a moral commitment to recycling because it is viewed as a civic duty. For the rest of the motivations, there is no systematic trend across countries. However, some results do stand out, such as the low mean score of respondents perceiving recycling to be mandatory in Mexico and the Czech Republic, indicating that the social pressure to increase recycling is lower in these countries.

Figure 6: Household income (€10 000) and monthly alternative cost of time used recycling (€) by country

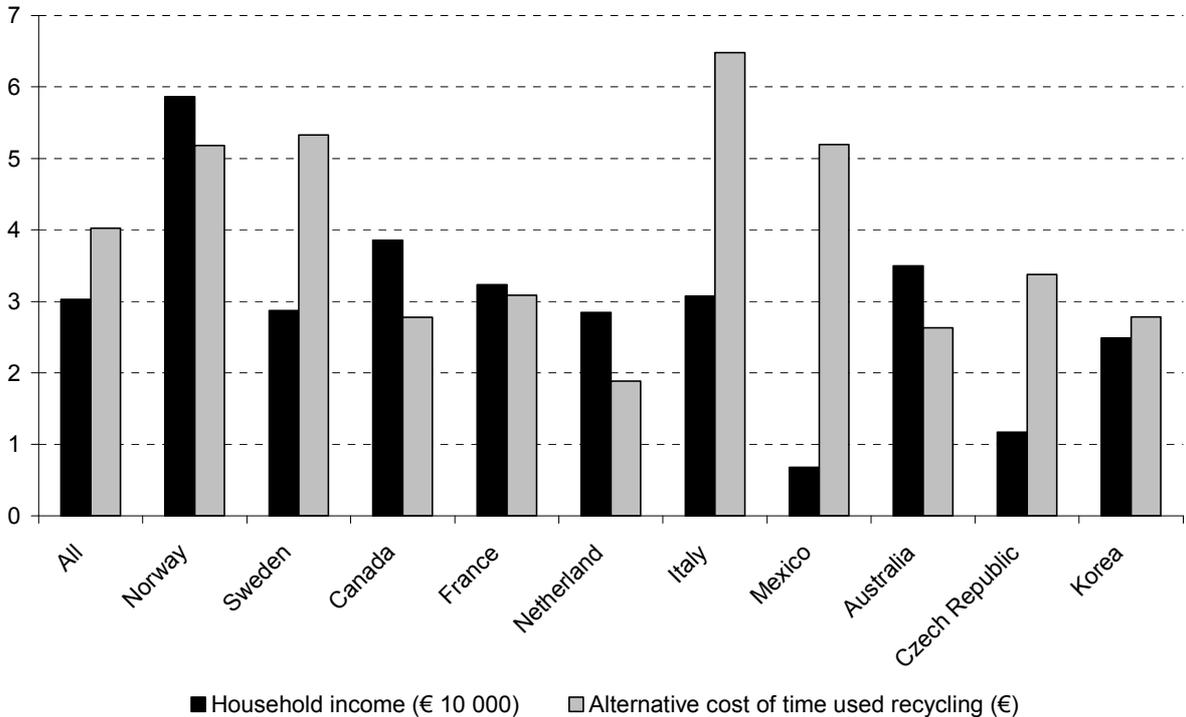


Figure 6 illustrates the variation in mean household income and monthly willingness to pay for leaving household recycling to others.⁴ The respondents’ willingness to pay for leaving their recycling efforts to a recycling company may be interpreted as the alternative cost of time used recycling measured in monetary terms (compensating variation), which equals how much income they are willing to forgo or to demand as compensation, to be relieved of their recycling activities.⁵ The figure reveals large differences in both household income and the WTP across countries: Norwegian households have the highest, and Mexican and Czech households the lowest mean household income in the sample. The Italian households have the highest mean WTP, whereas the Dutch have the lowest mean WTP for leaving recycling to a third party. The largest difference between the ability to pay, as measured by household income, and the WTP to leave recycling to others are in the Mexican sample, whereas this difference is lowest in the French sample. This means that, corrected for the ability to pay (that is, household income), the Mexican subsample has the highest alternative cost of time used for recycling. This may explain why Mexicans have the lowest mean recycling in this sample.

⁴ Income and the WTP are not corrected for differences in purchasing power across countries.

⁵ See the discussion in Halvorsen (2008) for more information.

5. What Determines Household Recycling?

As indicated by the figures presented in the previous section, there are many factors that may explain the variation in recycling across households in this sample. To study the relative impact of the factors, taking into account that they may reinforce or counteract each other, we include them all in our regression analysis to determine their partial effect on household recycling activities.

5.1 Econometric Specification

We aim to identify the effects on household recycling of norms, opportunity cost of time, recycling programs supplied, household characteristics and cultural differences across countries, and how they interact. The equation to be estimated is:

$$(1) \quad R_h = \alpha_0 + \sum_j \alpha_j C_{jh} + \sum_k \beta_k HC_{kh} + \sum_n \delta_n N_{nh} \left(1 + \sum_j \tilde{\delta}_j C_{jh} \right) + \sum_r \rho_r RS_{rh} \left(1 + \sum_j \tilde{\rho}_j C_{jh} \right) + \sum_p \kappa_p P_{ph} \left(1 + \sum_j \tilde{\kappa}_j C_{jh} \right) + \varphi WTP_h + u_h.$$

Household recycling, measured by the number of materials recycled by the household (R_h), is assumed to be a linear function of various household characteristics (HC_{kh}), the alternative cost of time used recycling (WTP_h), variables indicating norms and attitudes (N_{nh}), and the supply of recycling services (RS_{rh}) and the pricing of these services (P_{ph}) (see Table 1 for a complete list of variables.)

We allow for heterogeneity across countries with respect to how these factors affect household recycling. This is done by interacting the variables with country specific dummies (C_{jh}), which measure the effects of the variables by country relative to a reference group of countries. Thus, the mean effect of norm-variable n on the recycling of household h in country j is given by:

$$\frac{\partial R_h}{\partial N_n} = \delta_n (1 + \delta_j).$$

The variation across countries in household recycling not captured by these variables will be captured by a country-specific constant term (α_j), and variation in the distribution of household recycling not explained by this function will be captured by the error term (u_h), which may vary across countries.

The estimated coefficients will give the gross/total partial effect on recycling of a variable *ceteris paribus*; that is, all other things being equal. For instance, introducing monetary incentives in the form of a differentiated garbage fee is meant to encourage recycling but may also crowd out morally motivated behaviour. The sign of the coefficient reveals whether the crowding-out effects or the price incentive is the strongest. That the estimated coefficients measure partial effects (often referred to as *ceteris paribus*), means that the coefficients measure the total effect of a variable when we compare two otherwise equal households.

5.2 Estimation Results

Table 1 presents the results from a maximum likelihood estimation of Equation 1. Part A of the table presents the effects of household characteristics on household recycling, part B presents the effects of norms and attitudes, part C presents the effects of supply of recycling services, part D presents the effects of price incentives, and part E presents the effects of the opportunity cost of time, whereas part F presents the heterogeneity in these effects across countries. The first column presents the coefficient, and the last column gives the p-values.⁶

Table 1. Results from an ML estimation of household recycling (n = 8868)

	<i>Coefficient</i>	<i>p-value</i>
Constant	-0.2581	0.0649
Korea (0, 1)	2.7459	0.0000
Sweden (0, 1)	0.6409	0.0104
A. Household characteristics (β_k):		
Income (€1000)	0.0041	0.0000
Couple	0.2299	0.0000
Living in a detached house	0.2307	0.0000
City	-0.1241	0.0013
Number of years living in primary residence	0.1207	0.0000

⁶ We only include variables in the estimation that are significant at the 10% level or better, or coefficients that are of particular interest from a theoretical point of view.

Table 1 (cont.)

	<i>Coefficient</i>	<i>p-value</i>
B. Norms, attitudes, expectations and identity statements (δ_n):		
Member of an organization (0, 1)	0.2051	0.0000
Environmental issues should be dealt with by future generations (1, 2, 3, 4)	-0.0511	0.0017
Environmental policies should not cost me extra money (1, 2, 3, 4)	-0.0272	0.0776
Concerned about waste generation (1, 2, 3, 4)	0.0547	0.0090
Concerned about climatic change (1, 2, 3, 4)	-0.0643	0.0007
Concerned about water pollution (1, 2, 3, 4)	0.0458	0.0266
Concerned about genetically modified organisms (1, 2, 3, 4)	0.0605	0.0000
Recycle because it is beneficial for the environment (1, 2, 3, 4)	0.6373	0.0000
Recycle because it is mandated by the government (1, 2, 3, 4)	0.0759	0.0000
Recycle to save money (1, 2, 3, 4)	0.0062	0.6458
Recycle because I think it is my civic duty (1, 2, 3, 4)	0.1840	0.0000
C. Supply of recycling services (ρ_r):		
Number of recycled materials with no service	-0.1877	0.0000
Mixed waste collected less than once a week (0, 1)	0.4640	0.0000
Number of recycled materials with door-to-door collection	0.3476	0.0000
Number of recycled materials with drop-off centres/containers	0.2853	0.0000
Number of materials with "return with refund"	0.0735	0.0056
Number of recycled materials with "return without refund"	0.1559	0.0002
Number of recycled materials collected less than once a week	0.1017	0.0004
D. Pricing mechanism (κ_p):		
Volume-based unit charge (0, 1)	0.1680	0.0084
Weight-based unit charge (0, 1)	-0.5161	0.0000
Frequency-based charge (0, 1)	-0.2262	0.0061
E. Opportunity cost of time (φ):		
WTP for leaving household recycling to others (€)	-0.0150	0.0000

Table 1 (cont.)

	<i>Coefficient</i>	<i>p-value</i>
F. Heterogeneity across countries:		
<i>i) Norms, attitude, expectations and identity statements ($\tilde{\delta}_j$):</i>		
Canada (0, 1)	0.1179	0.0003
Netherlands (0, 1)	0.1343	0.0000
France (0, 1)	0.2757	0.0000
Italy (0, 1)	0.1780	0.0000
Sweden (0, 1)	0.1986	0.0106
Australia (0, 1)	0.2088	0.0000
Korea (0, 1)	-0.3943	0.0000
<i>ii) Price mechanism ($\tilde{\kappa}_j$):</i>		
Netherlands (0, 1)	-1.7919	0.0000
Mexico (0, 1)	-1.6321	0.0002
<i>iii) Supply of recycling services ($\tilde{\rho}_j$):</i>		
Canada (0, 1)	-0.4232	0.0000
France (0, 1)	-0.4677	0.0000
Mexico (0, 1)	-0.7414	0.0000
Czech Republic (0, 1)	-0.3369	0.0000
Sweden (0, 1)	-0.2533	0.0008
Australia (0, 1)	-0.6154	0.0000
Korea (0, 1)	-0.6889	0.0000

The opportunity cost of time for a given income has a significant negative effect on household recycling (see part E of Table 1), as expected from economic theory (see Halvorsen, 2008 for a discussion). That is, the more valuable the households perceive their time doing other leisure activities instead of recycling, the less they will recycle. Recycling efforts increase significantly with household income, living in couples, living in detached houses and the longer the respondent has lived in his/her current residence. Furthermore, respondents living in cities recycle significantly less than other households, *ceteris paribus*. One reason for the last two effects may be that the social pressure to recycle from the local community is lower in urban areas and for respondents who have recently moved to an area, as their social relations are more detached from their neighbourhood. Higher pressure from social norms within the family or from the community may also be part of the reason that recycling activities are higher for couples and high-income households.

Looking at the effects of variables for norms, expectations and attitudes (part B of Table 1), we see that being a member of an environmental organization has a strong and significant positive effect on recycling. Respondents who are concerned about waste generation, water pollution and GMO also recycle significantly more than other households. The effects of the variables indicating environmental concerns are not as strong as the effect of membership in environmental organizations, and respondents who are concerned about climatic change recycle significantly less than other households. This may seem a bit surprising. However, these coefficients must be interpreted as the partial effects of a variable *ceteris paribus*, including equal beliefs in the environmental effects of our own actions. Thus, the negative effect of being concerned with climatic change may indicate that these households focus their environmental efforts on activities other than recycling. Furthermore, respondents who believe environmental issues should be dealt with by future generations, and respondents who believe that environmental policies should not cost them anything, recycle significantly less than other households. However, the strongest partial effect on household recycling activities is a belief that recycling is beneficial for the environment. Respondents who believe it is their civic duty to recycle also do so significantly more, and the coefficient is relatively large. Respondents, who recycle because it is mandatory do so significantly more than others, but the size of the coefficient is relatively small. These results are very similar to the results found in previous analysis studying the effects of norms on household recycling on other data (Bruvoll et al., 2002; Halvorsen, 2008). We also find several significant cultural differences in the way norms affect recycling behaviour, as these effects are stronger in most countries compared with Norway, the Czech Republic and Mexico (see part F(i) of Table 1). The exception is the Korean sample, which has a negative coefficient.

An interesting result is that respondents who report they recycle to save money do not recycle significantly more than other households. This may indicate that monetary incentives crowd out morally motivated behaviour. This is confirmed partly by the coefficients for the introduction of monetary incentives (see part D of Table 1), as households with either weight-based or frequency-based unit charges recycle significantly less than households with no monetary incentives to recycle (flat fee, fee based on household size or no fee). On the other hand, respondents with a volume-based unit charge (most of whom are Korean) recycle significantly more than other households. Thus, different types of monetary incentives seem to have a different effect on the crowding out of intrinsically motivated behaviour. In the Dutch and Mexican subsamples, monetary incentives also have much lower effects on recycling than in the other countries (see part F(ii) of Table 1), resulting in large negative crowding-out effects for all price incentives aimed at encouraging recycling in these countries. The data do not tell us why the introduction of monetary incentives seems to have such a

negative effect on recycling in these two countries; however, we cannot exclude that differences in the organization of the fees across countries have resulted in these crowding-out effects.

An increase in the number of recycled materials for which the authorities provide a service increases recycling activities on average (see part C of Table 1), and the strongest effects are achieved by door-to-door collection services followed by drop-off centres/containers. Looking at the heterogeneity across countries (see part F(iii) of Table 1), we see that increased supply has a much smaller effect on recycling in all countries compared with the Norwegian, Dutch and Italian subsamples. An increase in the number of recycled materials at the margin may even reduce recycling for some respondents in the countries with the most negative coefficients, such as Mexico, Australia and Korea. Australia and Korea are among the countries with the highest number of materials with collection services available. This indicates that recycling efforts may be adversely affected when government pressure to recycle gets too high. The opposite is the case for Mexico, which has one of the lowest reported supplies of recycling services and the highest alternative cost of time used recycling (see the discussion around Figures 3 and 6). One reason may be that there are considerable welfare losses when introducing new systems, where respondents need to change habits and to restructure how they normally do things in the household.

The unexplained heterogeneity in recycling efforts across countries shows that the Swedish and Korean subsamples have higher recycling activities than may be explained by the variables included in this estimation, as illustrated by the positive significant effects for the constant term for these countries.

6. Policy Implications

The results from this analysis have some interesting policy implications regarding how to use policy instruments to increase household recycling. First, we notice that non-economic motivations are very important in explaining household recycling behaviour. The most important characteristics of households with a high recycling activity in the analysis are a strong moral commitment, a high expectation about the effectiveness of recycling to improve environmental quality and a positive attitude towards environmental policies in general. In particular, the most important explanatory factor is that households are convinced that their recycling efforts are important for improving environmental qualities. The attitude variables included in this estimation seem to have a different effect in different countries, increasing recycling most in France and least in Korea. Because Korea is one of the

countries with the highest recycling activities, this means that unobserved factors are of great importance as well, resulting in a very high constant term for Korea.

These results describe how variations in the underlying preferences affect current behaviour. They may be the result of government policies aiming to change behaviour through information campaigns or mandatory recycling, of differences in tradition and orthodoxy in the population, or of general public debate concerning environmental issues. We do not know from this analysis how these attitudes were developed, only that they affect behaviour. Knowing this, one could deduce that information campaigns to change norms and attitudes would be an effective policy tool in the future. However, information campaigns and recycling programs are already used heavily in most countries, and it is reasonable to assume that those who are not yet convinced will be hard to reach.

Differences across countries in the use of policy measures, such as introducing monetary incentives in the form of differentiated garbage fees or increased supply of recycling facilities, also have a significant effect on household recycling. Increasing the supply of recycling services generally has a good effect on household recycling, and door-to-door collection and drop-off centres are the two most effective. However, it seems that if the recycling burden is already heavy (many materials for which there exist recycling services), introducing services for new materials may reduce recycling overall. One explanation for this result may be crowding-out effects: introducing new services for materials that are perceived as less important may reduce the respondents' belief that this will help save the environment, which again may reduce the moral commitment to recycling. Thus, focusing recycling activities around the most important materials may be important to avoid the adverse effects of a government recycling program. At the other end of the scale, the estimations indicate that adding new materials to the recycling program in countries where the population is not used to recycling may not achieve the same effect on recycling activities as in other countries. The results indicate that this may be because the alternative cost of time used recycling is larger when introducing new systems, as households need to change their habits and to reorganize how they do their daily chores.

It also seems that introducing monetary incentives may, in some cases, have the opposite intended effect, as we find evidence of the same crowding-out effects as Tøgersen (1994). However, it seems possible to introduce monetary incentives successfully, as the results indicate that the Korean experiment with volume-based garbage fees succeeded in increasing household recycling. On the other hand, the results also indicate that the Dutch and Mexican use of price incentives was not so successful, as we find large crowding-out effects of all monetary incentives in these countries. It thus

seems that variations in the design of monetary incentives may be very important in avoiding crowding out of morally motivated voluntary contributions.

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Questions Used in this Analysis

The survey included the following questions related to household recycling efforts and recycling services available to the household.

<p>R1 Which of the following materials does your household recycle?</p>	<ul style="list-style-type: none"> • Glass bottles/containers • Plastic bottles/containers • Aluminium, tin and steel cans • Paper/cardboard • Food waste • Garden waste • Batteries • Pharmaceuticals/medicines • None of the above
<p>R2 Please indicate approximately what percentage of material x (Glass bottles/containers; plastic bottles/containers; aluminium, tin and steel cans; paper/cardboard; food waste; garden waste; batteries; pharmaceuticals/medicines) your household recycles.</p>	<ul style="list-style-type: none"> • 25% • 50% • 75% • 100% • Don't know
<p>RS1 What are the waste collection services available for recyclable materials (glass bottles/containers; plastic bottles/containers; aluminium, tin and steel cans; paper/cardboard) in your area?</p>	<ul style="list-style-type: none"> • Door-to-door collection • Drop-off centres/containers • Return with refund to the retailer /manufacturer • Return without refund to the retailer /manufacturer • No service available • Don't know
<p>RS2 How often are x (glass bottles/containers; plastic bottles/containers; aluminium, tin and steel cans; paper/cardboard) collected door-to-door?</p>	<ul style="list-style-type: none"> • More than once a week • Once a week • Less than once a week • Don't know
<p>RS3 How often is your household mixed waste collected (by a third party) from your primary residence or from containers where you dispose of your waste?</p>	<ul style="list-style-type: none"> • More than once a week • Once a week • Less than once a week • Don't know
<p>P1 How is your household charged for the collection and management of mixed waste in your primary residence?</p>	<ul style="list-style-type: none"> • Flat fee • Volume-based unit charge • Weight-based unit charge • Frequency-based charge • Charge based on household size • Other form of charging • Don't know

To measure the alternative cost of time used recycling, a willingness-to-pay question was asked.

<p>WTP If the current system were to be changed in such a way that you need not separate your waste at home at all but this is done on your behalf by a third party, how much would you be willing to pay each month for this service?</p>	<p>Optional amounts were given to the respondent (in their local currency) to choose from. The number of amounts given varied across countries, and ranged between 25 to 30 amounts.</p>
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The attitudinal questions were discrete on a scale from 1 (not concerned/strongly disagree) to 4 (very concerned/strongly agree).

<p>N1 How concerned are you about the following environmental issues?</p>	<ul style="list-style-type: none"> i) Waste generation ii) Air pollution iii) Climate change (global warming) iv) Water pollution v) Natural resource depletion vi) Genetically modified organisms (GMO) vii) Endangered species and biodiversity
<p>N2 To what extent do you agree with each of the following statements?</p>	<ul style="list-style-type: none"> i) Each individual can contribute to a better environment. ii) Environmental impacts are frequently overstated. iii) Environmental issues should be dealt with primarily by future generations. iv) Environmental issues will be resolved primarily through technological progress. v) Environmental policies introduced by the government to address environmental issues should not cost me extra money.
<p>N3 How important are the following factors in motivating your household to recycle?</p>	<ul style="list-style-type: none"> i) It is beneficial for the environment. ii) It is mandated by the government. iii) I want to save/receive money. iv) I think it is my civic duty. v) I want to be seen by others as a responsible citizen.