A Cross-Country Study of Waste Prevention and Recycling

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Abstract

With worldwide concern for how and where to dispose of household waste, policy-makers are increasingly looking for tools to efficiently and effectively reduce the amount of waste households produce. Using a comprehensive household-level data set involving 10,251 respondents from a cross-section of ten countries (Australia, Canada, Czech Republic, France, Italy, Korea, Mexico, Netherlands, Norway, and Sweden), we examine waste policy, recycling behavior, and waste prevention. Unlike previous work, we empirically make comparisons across countries, incorporate attitudinal characteristics, and allow for potential correlation between the decisions of recycling different materials.

Keywords: waste management; waste prevention, recycling

JEL Classifications: D10, H23, Q28

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1 Introduction

In recent years, the issue of how a society should deal with municipal solid waste has become an important policy problem. Despite an increasing awareness of the external effects of waste generation and a growing resistance by society to the development of new landfills and incineration facilities, municipal solid waste has grown drastically over the last decades as a result of higher incomes, more intensive use of packaging materials and disposable goods, and increased purchases of durable material goods.[1] Projections suggest solid waste will continue to grow despite current efforts to reduce the material content of products and to stimulate the reuse of products and packaging and the recycling of materials and substances.

In response to the increasing environmental pressures of municipal waste, many countries have begun to explore ways of reducing and disposing of it more effectively. In targeting one of the main sources of municipal waste, household or residential waste,[2] municipal governments (which tend to be responsible for carrying out waste management and recycling services and for developing waste management programs and can thus have much influence on waste reduction through policies and legislative measures) have grown particularly interested in experimenting with unit pricing systems and improving recycling services. In the US, for example, the number of jurisdictions with some sort of pay-as-you-throw or unit pricing program increased from about 1,000 in 1993 to almost 7,100 in 2006 or about 25 percent of all US communities [31]; in Canada, the share of households with access to at least one type of recycling program increased from about 70 percent in 1994 to 93 percent in 2006 [32].

To assist policy makers in the design of efficient policies that effectively induce households to minimize waste through recycling and/or waste prevention, a better understanding of household behavior is however necessary. To this end, a new activity on "Household Behavior and Environmental Policy" was initiated in 2005 by the OECD which covered not only waste generation and recycling but four other areas of household consumption identified as important environmental policy targets, namely, energy use, organic food consumption, personal transport and water use. As part of the activity, a questionnaire on environment-related household behavior covering each of the above five areas was designed and a web-based access panel was used in early 2008 to implement the household survey in ten countries representing the three OECD regions (North America, Europe and Asia-Pacific): Australia, Canada, Czech Republic, France, Italy, Korea, Mexico, Netherlands, Norway and Sweden. Approximately 1,000 households per country participated

[1] Within the OECD region, municipal waste generation increased by about 58 percent from 1980 to 2000 and 4.6 percent between 2000 and 2005; under the assumption of no new policies, total municipal waste is projected to increase by 38 percent from 2005 to 2030 and per capita municipal waste by 25 percent (from 557 kg to 694 kg) over the same period [27].

[2] In 2005, for example, households produced over 75 percent of municipal waste in Korea, Germany, the U.K., Mexico, Belgium, the Netherlands, the Slovak Republic, Luxembourg, Denmark and Spain [27].

in the study (10,251 in total) providing information on socio-demographic and attitudinal characteristics and on policy variables in each of the areas under consideration.

In this paper, the 2008 OECD household-level dataset is employed to examine several questions pertaining to recycling behavior and waste prevention, including (i) whether user fees for waste *disposal* have significant effects on waste recycling rates relative to flat fees and whether these effects vary significantly by material and/or by type of unit pricing, (ii) whether the presence of a recycling program strengthens or weakens the impact of a user fee system on recycling and, if so, whether there is significant variation across materials, (iii) the extent to which household waste recycling decisions depend on attributes of recycling programs and whether there is significant variation across materials, (iv) how general attitudes towards the environment influence waste recycling levels and whether the presence of economic incentives and/or other forms of governmental intervention erodes or enhances the relevance of intrinsic motivation, and (v) whether user fees have significant effects on waste *prevention* relative to flat fees.

The empirical literature on municipal waste management is mostly concerned with waste production and recycling decisions and focuses on the effects of socio-demographic variables and unit pricing systems on such decisions, although there are some recent attempts to quantify the role of attitudes and the importance of cultural and social influences in the decision-making process. In general, there is some agreement that user fees for waste disposal, mostly bag-based systems, are effective at reducing waste and/or increasing recycling [4, 5, 10, 13, 19, 21, 25, 26, 29, 31, 35], although there are instances in which they have no impact on waste disposal decisions [17, 19, 22, 24, 30, 33]. While the impact of unit pricing on waste disposal or recycling is well documented, little to nothing is known about its impact on source reduction and on consumption and/or consumption patterns. Furthermore, although different types of unit pricing (for example, bag- or volume-based, subscription-based, frequency-based) are considered in the literature,[3] there exists minimal evidence about their relative effects. In most of the available comparative analyses, a bag-based program is more effective at reducing waste and, to a lesser extent, at increasing recycling than a block payment system [5, 24, 26, 35]. In a more comprehensive analysis of different types of unit pricing, weight- and bag-based programs have comparable effects on waste management decisions but perform better than frequency- and subscription-based programs [5]. In terms of its impact on recycling, a frequency-based program is however equivalent to a weight-based system [33].

In addition to user fees, governments often rely on recycling programs as a means of diverting waste

[3] A subscription-based program entails households to pre-commit to a certain number of bags over a given period of time for which they pay independently of whether they use them. In terms of the unit of measurement upon which a payment is established, a subscription-based program is not much different from a bag-based program, although variation in average and marginal fees is likely to result across blocks or levels of commitment under the former but not under the latter.

from landfills. There is evidence that communities with recycling programs have higher recycling rates but not necessarily for every type of recyclables. Furthermore, curbside recycling programs do tend to be more effective in the presence of a unit pricing system, and vice versa [4, 30]. In general, households are sensitive to the time intensity of recycling activities and respond favorably to initiatives intended to make collection more accessible [22, 23, 30] or to reduce sorting requirements [23]. Households are also responsive to changes in collection frequency and recycle more as collection becomes more frequent [10, 23]. Knowledge about recycling programs has a positive effect on whether households recycle [30] but experience with recycling programs may not contribute to increasing the probability of recycling consistently across different types of recyclables [22]. If curbside recycling is based on mandatory participation, independently of whether unit pricing is in place, it is however not clear whether and how households' decisions over recycling are affected.

Another policy instrument that is often implemented, although limited to particular waste items, is a refundable deposit system. Very little is known about the empirical impact of such a policy on households' waste disposal and recycling activities in spite of the extensive theoretical work that supports their implementation [1, 6, 7, 8, 9, 13, 15, 28].

Although educational programs are not commonly considered policy instruments, there is some evidence suggesting that they can be of assistance in waste diversion efforts. Environmental activism or awareness and knowledge about available management options do in fact contribute to less waste discarding and more recycling [5, 20, 22, 25, 30]. Particularly interesting is the finding that knowledge and social influence from neighbours, friends and family members are the most effective predictors of recycling, implying that, once educated about recycling (importance, availability and how to recycle quickly and conveniently), individuals tend to recycle more [20]. Less commonly studied are attitudinal elements of influence and the limited evidence seems to suggest that they can play a role in waste disposal decisions. A positive attitude towards composting does in fact lead to a lower demand for garbage collection services while the perception that recycling is difficult induces households to recycle less [33]. Some recent evidence also suggests that moral and social motivations can positively affect households' recycling decisions [2, 16], although it is not clear whether and how the presence of economic incentives or mandatory recycling affects their relevance.

The question about possible interaction effects between policy instruments and socio-demographic or attitudinal characteristics is an important one and as relevant to policy makers as the question about possible substitution or complementary effects among different policy instruments. Although limiting, the available evidence does suggest that policy-induced changes in waste disposal and recycling are affected by socio-demographic variables. Specifically, the effect of unit pricing is smaller in low-income households, in households that subscribe to more daily newspapers, for households with infants and for married couples [14]. Unit pricing is also more effective in larger households but is less effective among home-owners [35]. As for the effect of external intervention (through economic incentives or regulatory measures) on intrinsic motivation, there could either be a crowding out, if the intervention is perceived to be controlling, or a crowding in, if it is perceived to be acknowledging [11]. Although there exists some evidence suggesting that, when households have strong moral motives for environmentally responsible behavior, policies relying on economic incentives may be ineffective as they may undermine individuals' sense of civic duty [12], there is support to date in the specific household waste area for a crowding in with either no erosion of personal motives in the presence of economic incentives or perceived mandatory recycling [16], or a large proportion of the positive effect of unit pricing on recycling and composting attributable to personal norms and self-efficacy beliefs [34].

The remainder of the paper is structured as follows: in Section 2, the dataset is described; in Section 3, the estimation procedures employed are detailed; in Section 4, results are presented and commented upon in relation to existing studies; in Section 5, policy recommendations are drawn based upon the empirical findings of the analysis; finally, in Section 6, concluding remarks are given.

2 Data and Variables

The data set employed in this study was gathered by Lightspeed Online Research Inc. for the OECD in February 2008 through an international web-based panel that involved 10,251 respondents.[4] The explanatory variables used are listed with brief descriptions in Table 1. Aside from variables commonly considered in the empirical study of household waste decisions (age, household size, education, etc.), the list includes attitudinal characteristics (rank of environmental concerns, relevance of waste generation as an environmental concern, environmental attitude and concern for environmental issues), three four-point Likert variables to capture the extent of relevance (from not at all important with a value of 1 to very important with a value of 4) of recycling motives (environmental benefits, the belief that recycling is a civic duty and the desire to be seen as a responsible citizen), an indicator to reflect the perception that recycling is mandatory, and a four-point Likert variable (from not at all important with a value of 1 to very important with a value of 4) to measure the importance of mandatory recycling, whenever it is an

[4] In light of possible sample bias (due to the means of implementation of the survey) and strategic bias (due to the nature of the survey), the OECD performed several qualitative data checks on socio-demographic variables and other variables specific to the five areas of household consumption considered in the survey. The results of the data corroboration can be found at http://www.oecd.org/dataoecd/55/19/44101274.pdf.

applicable motive, in motivating recycling.

To capture possible linkages between unit pricing and recycling services and between different types of motivation (economic versus moral and/or social), as well as possible differences in how unit pricing affects different segments of the population, various interaction indicators are also constructed. For possible complementary effects among policies, an indicator is created for each material to allow for any interaction between the presence of unit pricing and the presence of any type of recycling service (door-to-door service, drop off, refundable deposit system and non-refundable deposit system). For possible crowding in or out effects of unit pricing, interaction variables are constructed between the presence of unit pricing and whether recycling is perceived to be mandated, the importance of taking the environmental benefits of recycling into account, and the extent to which recycling is motivated by a sense of civic duty or by a desire to be seen as a responsible citizen. Interaction variables are also created between the presence of unit pricing and income, the number of rooms and whether the residence is owned, is a house, has a garden or is located in an urban/suburban area.

[TABLES 1 and 2]

We provide some summary statistics pertaining to policy instruments (collection services, financing methods, collection frequency and recycling intensities for the five recyclable materials) for the entire sample in Table 2. In general, and not unexpectedly, door-to-door and drop off programs are more common than refundable deposit and bring back with no refund systems, although curbside collection is more widespread in Australia, Canada and Korea while collection at drop off centers are more prevalent in the Czech Republic, France, Italy and Sweden. Across the five materials, refundable deposit systems are mostly implemented for glass, particularly in Canada and the Czech Republic, and plastic, particularly in Netherlands, Norway and Sweden. Of the ten countries, Mexico has the highest proportion of households reporting no service across the five materials.

In terms of charges, if any, households pay for the collection and management of mixed waste, flat fees are widely used in every country but Korea where most households pay according to volume and Mexico where over 40 percent of the respondents report facing no charge. Of the remaining systems, charging households according to their size is common in Italy and, to a lesser extent, in the Czech Republic. Mixed waste is mostly collected at least once a week, with France, Italy, Korea and Mexico showing higher rates for more frequent collection. Recycling participation tends to be relatively high for each material but food and, to a lesser extent, aluminum, and in each country but Korea. Korea has a lower participation rate for glass, plastic, aluminum and paper recycling but a higher participation rate for food recycling. Aluminum recycling participation is also quite low in France, Italy and Norway (zero percent recycling reported by around 40 percent of respondents) and extremely low in the Czech Republic and Netherlands (zero percent recycling reported by around 80 percent of respondents). Although the lower participation rates in Korea do not seem to be linked to an absence of services (which is noticeably greater than in the other countries), the lower participation rates for aluminum recycling in the Czech Republic and Netherlands and, to a lesser extent, in France and Italy are consistent with the higher proportions of respondents in these countries reporting having no service.

In this paper, two separate but related decisions are considered: recycling and waste prevention. For each decision, two questions are posited: whether to participate and, if so, to what extent to participate. For the recycling decision, the relevant dependent variables are: (1) indicators for recycling particular materials (glass, plastic, aluminum, paper and food) and (2) proportions of materials recycled as captured by integers 1 to 5 (approximately 0%, 25%, 50%, 75% and 100%). For the waste prevention decision, the dependent variables considered are: (1) an indicator for taking a recycling logo into account in purchasing decisions and (2) the regularity of purchasing/using refillable containers through the assignment of 1 to the "Never" option, 2 to the "Occasionally" option, 3 to the "Often" option and 4 to the "Always" option.

3 Methodology

To assess the impact of the above defined explanatory variables on household recycling and waste prevention behaviour, binary probit and ordered probit specifications are employed. Specifically, a probit analysis is used to study the decisions about whether to recycle and whether to engage in waste prevention, and an ordered probit analysis for the decisions about the proportion of recyclable materials to recycle and the regularity of purchasing/using refillable containers (see the Appendix for a brief outline of the probit and ordered probit models). As it is quite possible for the decision of recycling a particular material to be correlated with the decision of recycling a different material, a multivariate probit analysis is also carried out for the recycling participation decisions about the five materials under consideration. Although the costs and benefits of recycling a particular material depend upon its volume and weight characteristics as well as upon the type of service available for its collection, thus suggesting that the decision of recycling that material is independent of recycling participation decisions pertaining to other materials, there are valid arguments suggesting otherwise. Among such arguments, (i) waste management policies targeting recycling may be introduced simultaneously for different types of materials and, in the specific case of drop off service, centres may be placed in the same area even when co-mingling different materials is not permitted; (ii) recycling may entail fixed costs associated, for example, with the collection of information about available collection services and the purchase of additional bins so that the incremental cost of recycling an additional material may decrease when another material is already being recycled; (iii) economies of scope may exist as sorting a particular material is equivalent to sorting, at least partially, the other materials.

For household i, the multivariate probit model can be written as

$$y_{im}^{*} = \boldsymbol{\beta}_m' \mathbf{x}_{im} + \varepsilon_{im}$$

and the resulting measurement equation as

$$y_{im} = \begin{cases} 1 & \text{if } y_{im}^{*} > 0 \\ 0 & \text{if } y_{im}^{*} \leq 0, \end{cases}$$

for $m = 1, \ldots, M$, where M is the number of equations (or materials in the present case). The error terms are distributed as a multivariate normal variable with a mean of 0 and a covariance matrix V with $V_{mg} = 1$ if $m = g$, where m, $g = 1, \ldots, M$, and $V_{mg} = \rho_{mg} = \rho_{gm}$ if $m \neq g$. Estimation of multivariate probit models requires the computation of multivariate normal probability distribution functions which, for integrals of level greater than three, can be accomplished with simulation methods. One of such methods is the Geweke-Hajivassiliou-Keane (GHK) algorithm which is based upon the idea that the joint probabilities can be written as a succession of conditional probabilities.

4 Results

The results of the empirical models estimated with a probit (binary, multivariate or ordered) procedure are presented and discussed below according to whether the questions are about recycling (Tables 3a, 3b and 4) or waste prevention (Table 5).

4.1 Determinants of Recycling

The results of the multivariate analysis (Table 3a) suggest that the decisions of recycling different materials are correlated. In fact, the hypothesis that the ten off-diagonal coefficients of the variance-covariance matrix are simultaneously equal to zero is rejected, with $\chi^{2(10)} = 1414.57$, at 1 percent.[5] Association is always positive (that is, recycling a particular material has a positive influence on the decision to recycle another material) and is stronger among glass, plastic, aluminum and paper, which tend to be recycled together with the same type of collection service. Association between food and any of the remaining materials is still positive but rather low ranging from 0.15 (between food and glass) to 0.23 (between food and paper).

[5] These coefficients (ρ_{ij} for $i, j = 1, \ldots, 5$ with $i \neq j$ and $\rho_{ij} = \rho_{ji}$) measure the strength of linear association between recycling a particular material and recycling any of the remaining materials.

In general, country fixed effects are significant for both the decision about whether to recycle and that about how much to recycle, suggesting that institutional and cultural factors, which tend to be country specific, play an important role in household recycling behavior. More specifically, Sweden tends to enjoy a higher recycling participation rate than the Czech Republic and France for all materials, Italy and Mexico for all materials but food, and the Netherlands and Norway for all materials but paper and food. Sweden has however a lower participation rate than Korea and, with the exception of food, Australia. Relative to Canada, Sweden has a comparable recycling participation rate for glass, aluminum and paper, a lower rate for plastic, and a higher rate for food. Not only does Sweden have a higher recycling participation rate but also a higher recycling intensity; in fact, with the exceptions of Italy, Korea and Norway for the recycling of food, households in Sweden tend to recycle greater proportions of their recyclable materials. No significant difference in intensity exists, however, for aluminum recycling between Sweden and Australia, Canada and Korea, for paper recycling between Sweden and the Netherlands and Norway, and for food recycling between Sweden and the Netherlands.

Being married or living as a couple has a positive effect on recycling participation only for plastic and on recycling intensity for glass, plastic, aluminum and paper. Men tend to participate less in plastic and paper recycling but have higher recycling participation and intensity for aluminum. Age is also an important factor: in general, young individuals participate less in recycling and tend to recycle less, with plastic being the only recyclable out of the five materials considered in the empirical analysis for which young individuals have both a higher recycling participation and a higher recycling intensity. Household size does not seem to matter for members of at least five years of age; however the number of children below five reduces glass, plastic and paper recycling. Education matters mostly at low levels with individuals without a high school diploma recycling less glass, plastic, aluminum and paper than individuals with a post-graduate degree; for glass recycling, however, individuals with a university degree tend to have higher participation and intensity than individuals without high school, with high school or with some post-secondary education. Employment status is most relevant for the recycling of aluminum with those working on a full-time or part-time basis, retirees, househusbands/wives and students recycling more; retirees also participate more in the recycling of plastic, together with those holding a full-time position, and food while househusbands/wives have a higher participation rate for paper recycling. Among individuals with a job or in retirement, middle/senior executives and salaried (office) employees participate less in the recycling of plastic and aluminum and recycle smaller proportions of aluminum and food. Income seems to matter only for the recycling of glass and, to a lesser extent, for the recycling of plastic and aluminum, although its marginal effect is very low suggesting that differences in recycling are most noticeable when very rich individuals are compared to very poor individuals; specifically, richer individuals are more likely to recycle glass and tend to recycle larger proportions of glass, plastic and aluminum.

Household characteristics (whether the primary residence is owned, is a house, has a garden or is in a suburban/urban area, how many rooms, excluding bathrooms, it has and how long it has been the primary residence) are mostly significant. Ownership and size of residence as captured by the number of rooms tend to increase recycling with the former variable having however no significant effect on food recycling and the latter having no significant effect on plastic and aluminum recycling. The presence of a garden matters only for food recycling although it has a positive effect on recycling participation for glass and plastic. Having a house (detached or semi-detached) tends to reduce the probability of recycling glass, plastic and paper but to increase recycling participation and intensity for food. Living in an urban or suburban area has a negative effect only on food recycling. Finally, having lived in the primary residence for more than 15 years, which would imply a stronger neighborhood attachment, has a positive effect on both recycling participation and intensity.

The evidence supporting the importance of attitudinal characteristics in recycling decisions is strong. Of the four variables included in the empirical analysis which capture individuals' attitudes towards waste generation and, more generally, towards the environment, the index measuring the level of concern for environmental problems (ENVCNCRN_INDX) has a positive effect on glass, plastic, aluminum and food recycling. The marginal effects in Table 3b, which are computed at the mean values of the independent variables, suggest that a unit increase in ENVCNCRN_INDX, holding the other variables at their mean values, leads to a increase in the probability of recycling participation by approximately 0.05 for aluminum and 0.02 for glass, plastic and food. The index summarizing individuals' environmental attitude based on the extent of agreement or disagreement with five statements about the environment (ENVATTIT_INDX) increases recycling for glass, plastic and aluminum. In terms of marginal effects, a unit increase in ENVATTIT_INDX, holding the other explanatory variables at their mean values, increases the probability of recycling participation by approximately 0.04 for aluminum and 0.01 for glass and plastic. Of the remaining two variables describing environmental attitudes (ENVRANK and WSTE_CNCRN), WSTE_CNCRN, an indicator which records whether waste generation is of concern, has generally no relevance in recycling decisions, although it reduces aluminum recycling and increases the intensity of glass recycling. The ranking of environmental concerns (ENVRANK), on the other hand, reduces recycling participation for aluminum and paper (by approximately 0.01 when environmental concerns move down in their ranking by one place, holding the other variables at their mean values) and recycling intensity for every material but plastic and food.

The results for the effects of the indices included in the analysis to capture different types of motivation for recycling (MTVRCYLENVR_LRKT, MTVRCYLDUTY_LRKT, and MTVRCYLRESP_LRKT) suggest that one of the most important factors motivating recycling in general (that is, across the five materials) is whether and the extent to which it is considered to be beneficial for the environment. This finding resonates with the conclusion that attitudes towards the environment are far more important in recycling decisions than attitudes towards waste generation. Of the two indices reflecting personal motives for recycling based on social considerations, MTVRCYLDUTY_LRKT, which signals the presence (and measures the importance) of a sense of civic duty, is quite relevant in inducing individuals to recycle more, independently of the material; furthermore, there is no evidence that the positive effect of MTVRCYLDUTY_LRKT decreases as user charges for waste disposal are introduced (that is, there is no crowding out). On the other hand, MTVRCYLRESP_LRKT, which signals the presence (and measures the importance) of a social pressure to act responsibly (and thus a desire to be seen as a responsible citizen), is mostly insignificant but has a negative effect on food recycling intensity that however tends to be lower under a unit pricing system as reflected in the positive and significant effect of the interaction term between the presence of unit pricing and MTVRCYLRESP_LRKT.

The presence of a unit pricing system for waste disposal, whether based on volume or weight or frequency, does not have a strong effect on the decision of whether to recycle; participation in aluminum and food recycling is however higher by 0.15 and 0.24 under a weight-based fee program while participation in paper and food recycling is higher by 0.07 and 0.21 under a volume-based fee program. Weight- and frequency-based charges have quite a positive effect on food recycling but are otherwise ineffective; on the other hand, volume-based charges have significant and positive effects on recycling intensity for every material but plastic. Although the results do suggest that economic instruments (that is, user fees for waste disposal) can promote recycling, the evidence is not as convincing as one would expect, especially for charges levied according to weight and frequency, based on theoretical predictions and empirical findings in most of the studies on recycling (for example, [5, 10]). As in [22], one of the very few studies which reports no significance for unit pricing, most of the observations (about 80 percent) come from communities without some form of unit pricing, which either charge a flat fee or a fee based on the size of the household or do not charge at all for waste collection. Of the remaining observations, 1,108 (or 12.6 percent) are from communities with a volume-based fee, 405 (or 4.6 percent) from communities with a frequency-based fee, and 241 (or 2.7 percent) from communities with a weight-based fee.

When unit pricing is assessed in conjunction with collection services for recyclables, the evidence based on the estimated coefficients does not suggest that the presence of collection programs for recyclables is likely to increase the effectiveness of unit pricing rather than to decrease it. Hence, from a policy point of view, collection services for recyclables and unit pricing may be substitutable as opposed to being complementary approaches, a result which may counter the finding in the literature that unit pricing is more effective if combined with curbside recycling and vice versa [4]. The absence of any evidence supporting complementarity between unit pricing and collection services for recyclables (mostly curbside and drop off), along with the presence (in the cases of plastic, aluminum and food) of some evidence supporting substitutability between the two policies, may explain why user charges (particularly, volume- and weight-based fees as frequency-based fees do not directly provide incentives to recycle) are not found to be effective at increasing recycling participation. Indeed, when observations with curbside collection for recyclables are excluded from the empirical analysis, the results of the ordered probit estimation, which are reported in Table 5 only for the relevant variables (namely, curbside collection of recyclables and weight-, volume- and frequency-based fees), show that unit pricing based on volume or frequency has always a positive effect on recycling independently of the material while unit pricing based on weight has a positive effect on glass, aluminum and food recycling.

Although a unit pricing system for mixed waste and a door-to-door collection program for recyclables seem to be substitutes, the former may be the redundant policy in that its positive effect on recycling disappears when observations with curbside collection for recyclables are excluded from the analysis; the effect on recycling of a door-to-door collection program is however always present and positive independently of whether observations with a user fee system are excluded. This difference is likely attributable to the different channels through which the two policies affect recycling. A door-to-door collection program has a direct effect on recycling through a reduction in its time cost; a unit pricing system has an indirect effect on recycling through a reduction in the cost of disposing of mixed waste. Hence, the time cost of recycling in the absence of curbside collection may be a more relevant consideration in recycling decisions than its money benefit in the presence of unit pricing. When curbside collection for recyclables is introduced, individuals tend to recycle more in light of the reduced time cost of recycling; a unit pricing system for mixed waste may then provide no additional incentive (in the form of money saving) for recycling. When curbside collection for recyclables is not available, the money saving aspect of recycling in the presence of a unit pricing system may be sufficient to offset the time cost of recycling (either through a drop-off program or a deposit system with or without refund), thus inducing individuals to recycle.

Among the variables which are most consistently significant across the five materials and influence recycling participation and intensity in accordance with theoretical predictions, there are: whether some type of collection service is in place, the frequency of curbside collection if available, whether recycling is mandated by the government as captured by the applicability of mandatory recycling as a factor motivating recycling, and the frequency of mixed waste pick-up. In general, having any type of service (door-to-door, drop off, bring back with refund, bring back with no refund) results in more recycling. In terms of marginal effects, the availability of curbside recycling has its greatest impact on the probability of recycling aluminum, which increases by approximately 0.43 compared to 0.37 for food, 0.21 for plastic, 0.16 for paper and 0.11 for glass. Under a drop off system, the largest impact on recycling participation is detected for aluminum with a 0.34 increase, followed by food with a 0.26 increase, plastic with a 0.15 increase and both glass and paper with a 0.11 increase. Under a refundable deposit system, the probability of recycling increases by 0.22 for aluminum, 0.16 for food, 0.12 for plastic and 0.05 for both glass and paper. Finally, under a bring back with no refund system, food experiences the largest increase in recycling probability, followed by aluminum and the other three materials in exactly the same order as under a drop off system or a refundable deposit system; specifically, the probability of recycling participation increases by 0.26 for food, 0.15 for aluminum, 0.07 for plastic and 0.03 for glass and paper. Hence, collection programs for recyclables seem to be most effective for aluminum and food and least effective for glass and paper. Furthermore, of the four types of collection programs, curbside recycling is the most effective independently of the material while a refundable deposit system is the least effective for food and a bring back with no refund system is the least effective for the remaining materials (glass, plastic, aluminum and paper).

While the presence of curbside collection for recyclables increases recycling, the frequency of collection has a negative impact on both recycling participation and intensity for all materials, although the impact is statistically significant only for plastic, aluminum and paper in the decision about whether to recycle, and for every material but food in the decision about how much to recycle. However there does not seem to be any difference in terms of recycling participation between once a week collection and less than once a week collection for any of the materials but aluminum. Increasing how often mixed waste is collected also reduces recycling, with food recycling experiencing the largest adjustment in participation. For glass and paper, recycling participation tends to be statistically responsive only to a shift from less than once a week collection to once a week collection.

Under mandatory recycling, individuals tend to exhibit higher recycling participation and intensity, particularly for glass, plastic and paper; however individuals for whom mandatory recycling is an important factor in motivating their recycling decisions are not likely to recycle more, with the exception of food and, for the participation decision although with the opposite effect, glass. In terms of marginal effects, the probability of recycling when mandatory recycling is an applicable factor motivating recycling is higher by 0.06 for glass, 0.04 for plastic and 0.05 for paper; furthermore, as mandatory recycling becomes a more relevant consideration in recycling decisions, the probability of recycling increases by 0.03 for food but remains unchanged for the other materials. The presence of unit pricing reduces the effect of mandatory recycling on recycling participation for glass, plastic and aluminum, and on recycling intensity for glass and paper.

As for the interaction terms between unit pricing and some socio-demographic characteristics, the evidence is a bit scattered with the presence of unit pricing strengthening the effect of (1) income on plastic and food recycling participation, (2) living in a house on glass and plastic recycling participation, (3) living in an urban or suburban area on glass and plastic recycling participation, and (4) having a garden on aluminum recycling participation, while weakening the effect of (1) owning the primary residence on glass recycling intensity, aluminum recycling participation and paper recycling participation and intensity, (2) living in a house on food recycling participation and intensity, and (3) size of primary residence as reflected in the number of rooms (excluding bathrooms) on food recycling participation.

[TABLES 3a, 3b, 4]

4.2 Determinants of Waste Prevention

In the absence of consumption figures and, more specifically, information on the waste content of consumption, the question about waste prevention and the factors contributing to waste prevention is addressed indirectly through a binary question about the importance of recycling logo information in purchasing decisions and a question about using refillable containers involving an ordinal choice over regularity of use.

Based on the country fixed effects, with the Czech Republic excluded from the binary probit estimation because of unavailability of a recycling logo, there exist institutional and cultural factors which yield differences across countries. For example, while the results of the binary probit estimation suggest that the probability of engaging in waste prevention as captured by the probability of taking into account recycling logo/label information in purchasing decisions is higher in Sweden than in any of the remaining eight countries, the results of the ordered probit estimation suggest that the intensity of waste prevention as captured by how regularly refillable containers are used is, for the most part, lower in Sweden than in the other countries.

In terms of socio-demographic characteristics, relevant factors include: gender, age, education, employment status, income, presence of a garden and type of area of residency. In the estimation of the intensity of use for refillable containers, only four of these variables matter, namely, the male, age, garden and urban/suburban indicators. To be precise, older and/or male individuals, individuals without a garden and individuals living in an urban or suburban area tend to use refillable containers less regularly. At the same time, younger and/or male individuals as well as individuals with access to a garden are more likely to take recycling logo information into account in purchasing decisions; individuals living in an urban or suburban area, on the other hand, do not display any significantly different behavior in terms of considering recycling log information in purchasing decisions than individuals living in other types of area. Furthermore, individuals working full time, those working part time and househusbands/wives are less likely to consider recycling labels in their purchasing decisions by 0.08, 0.07 and 0.09, respectively. Richer individuals are less likely to pay attention to recycling labels when shopping, although any noticeable difference in behavior between rich and poor individuals requires a substantial income gap as the marginal effect of income is quite negligible.

Of the variables characterizing attitudes towards the environment or motivation for recycling, most are significant and have the expected effect on waste prevention. In particular, individuals who show a greater concern for environmental problems are more likely to engage in waste prevention both in terms of accounting for recycling labels in purchasing decisions and using refillable containers more regularly. Individuals who rank environmental concerns high in order of importance or show a stronger attitude towards the environment are more likely to take recycling labels into account in purchasing decisions but there is no evidence that they make more extensive use of refillable containers. As with the case for the recycling participation and intensity decisions, concern for waste generation is not an important determinant of waste prevention decisions. However individuals who believe that recycling is beneficial for the environment or that it is a civic duty tend to engage more in waste prevention activities while individuals who believe that recycling is a social responsibility tend to use refillable containers more often but are not more likely to account for recycling labels when shopping. Finally, individuals who face mandatory recycling are more likely to account for recycling labels in their purchasing decisions but tend to become less likely to do so as mandatory recycling becomes a more important consideration in their recycling decisions.

Unit pricing, whether based on weight, volume or frequency, does not seem to affect whether recycling labels are taken into account in purchasing decisions but does increase the probability of using refillable containers more regularly. The presence of recycling services is, for the most part, statistically insignificant in both the binary probit estimation and the ordered probit estimation. There exists some evidence however suggesting that individuals would pay greater attention to recycling labels if (i) their waste were to be collected less frequently, (ii) their recycled glass were to be collected less frequently, (iii) a bring back with no return system were not available for glass, (iv) curbside collection were available for tin and steel cans (aluminum), (v) tin and steel cans were collected at the curb more than once a week, and (vi) a drop off system were available for tin and steel cans. Individuals would also use refillable containers more often if a drop off system or a refundable deposit system were in place for tin and steel cans.

[TABLE 5]

5 Policy Implications

A result which is common to the two issues addressed in this paper about recycling and waste prevention relates to the presence of institutional and cultural elements, as captured by country-specific fixed effects, explaining variation in household behavior across countries. An important implication of this finding is that policy makers may derive some useful lessons by looking closely at countries, such as Sweden, which tend to consistently exhibit a more environmentally friendly behavior. Among factors to consider are countries' approaches to waste management and views on environmental problems when the whole product chain is taken into account. As the empirical analyses in this paper are based on partial equilibrium models which focus on the interaction between households and the government, variation across countries may result from differences in policies, regulations and actions taken at different stages of the product chain as well as differences on the supply side of collection services. Sweden in particular takes a holistic approach to waste management (and environmental problems in general) in that it holds producers and distributors of goods responsible for the waste they produce; in other words, companies are responsible by law for the collection of the entire waste stream resulting from their products either directly or through public or private contractors.

Of the four variables describing environmental concerns and attitudes, the one specific to waste generation has no impact on waste prevention and recycling efforts, with the exception of the decision about how much glass to recycle. The remaining variables do matter, almost consistently across the five types of recyclables. The importance of attitudes towards the environment in general (as opposed to waste generation) has implications for the design of effective informational measures targeting recycling and waste prevention. Informational measures presuppose a more psychological perspective of human behavior and aim at changing perceptions, motivations and knowledge levels. Hence, informational campaigns that stress how waste production contributes to environmental deterioration may be quite helpful in inducing individuals to recycle more and produce less waste. Unlike other environmental issues (for example, car pollution, climate change) to which individuals can relate more closely, waste generation may not be perceived as a major environmental problem and may in fact be viewed more as a practical nuisance because of its space requirement than as an environmental problem. That a favorable response may ensue from an increased awareness of the environmental implications of waste generation is also supported by the finding that individuals who believe that recycling is beneficial for the environment are more likely to recycle and engage in waste prevention.

As social considerations constitute an important determinant of both recycling and waste prevention decisions, informational measures that focus on social aspects may also assist in promoting recycling and waste prevention. Although there are two sources of social motivation considered in this study, namely, a belief that recycling is a civic duty and a desire to be seen as a responsible citizen, findings suggest that the social dimension of waste management comes from the former and thus from a desire to act responsibly as opposed to being seen as acting responsibly. Informational measures that build upon social considerations may then be potentially more effective if they present waste reduction as a moral responsibility rather than as a social pressure.

The evidence gathered in this study also suggests that information-based measures can coexist with pricing-based schemes, that is, governments can simultaneously implement both types of intervention. In fact, policies relying on economic incentives do not tend to reduce (or crowd out) individuals' intrinsic motivation for environmentally responsible behavior. In some instances (for example, food recycling participation), economic incentives may actually increase (or crowd in) individuals' intrinsic motives for environmentally responsible behavior and are thus more likely to be perceived as communicating norms and responsibilities (that is, acknowledging).

In addition to stimulating personal motives by stressing social aspects of recycling and waste prevention as well as their environmental implications, informational campaigns may also aid in facilitating the implementation of pricing instruments. Even if, distributional effects aside, pricing strategies can be considered as an effective and efficient way of managing environmental problems associated with private decision making, they are often perceived as significantly reducing individuals' quality of life and accordingly viewed as unacceptable policies. Acceptability of pricing instruments may then be enhanced through informational campaigns that not only educate the public about the environmental implications of waste generation but also clearly communicate how pricing policies can contribute to the alleviation of the environmental problems resulting from waste production.

In spite of the significant body of evidence in the waste generation and recycling literature that points to the contrary, user charges are not found to be very effective, particularly in the participation decisions. The only recyclable for which any of the three types of unit pricing seems to significantly affect recycling behavior is food; in fact, not only are individuals more likely to recycle food under either a weight-based or a volume-based program (by 0.24 and 0.21) but they are also more likely to recycle larger proportions of food under any of the three programs. Although the evidence in support of user charges is not as strong as theory and existing empirical studies would suggest, it is not completely absent as a positive effect of a volume-based unit pricing is detected in the decision about how much to recycle for all materials but plastic and a positive effect of unit pricing in general (that is, a system which charges for waste disposal either according to weight or volume or pick-up frequency) also comes up in the decision about how often to use/purchase refillable containers.

That frequency-based pricing schemes are not effective is not surprising given that individuals facing charges based on mixed waste collection frequency do not pay per unit of waste generated but per collection and can avoid some of their disposal costs simply by storing more waste at home without necessarily recycling more. That weight-based and volume-based charges are insignificant is however quite unexpected. Unfortunately, despite the greater policy heterogeneity resulting from the international setting, very few observations in the dataset are drawn from communities with some form of unit pricing. In the absence of stratification of communities by policy, only 241 respondents report paying for mixed waste collection by weight and 1,108 respondents report paying by volume. One result is that a unit pricing system for the collection of mixed waste and a door-to-door program for the collection of recyclables are not complements of one another, as previously gathered evidence suggests [4]. Furthermore, when unit pricing is assessed only for households without access to curbside collection of recyclables, findings reveal that weight- and frequency-based charges can also be effective at inducing individuals to recycle more, although they remain insignificant in the decision about whether to recycle. Unit pricing thus has no impact on recycling participation for any material but food independently of whether curbside collection of recyclables is available; however unit pricing is more effective at inducing recyclers to recycle more in the absence of curbside collection of recyclables (see Table 5). Furthermore, volume-based charges seem to perform better than weight- and frequency-based charges even in the absence of a door-to-door program; in fact, volume-based fees always increase recycling irrespective of the material while weight-based fees do not have any impact on the recycling of plastic and paper and frequency-based fees do not affect the recycling of paper. In contrast, when households with access to curbside collection of recyclables are not excluded from the analysis, volume-based charges do not matter in the paper recycling intensity decision and frequency- and weight-based charges only matter in the food recycling intensity decision. As a door-to-door collection program for recyclables is always effective independently of whether user charges are implemented and in both the decision about whether to recycle and the decision about how much to recycle, increasing recycling may be more easily achievable with policies that focus on the time cost of recycling as opposed to policies that stress the money benefit of recycling.

The evidence supporting the importance of the presence of a collection program for recyclables is quite strong. In general, the presence of any type of service (door-to-door, drop off, bring back with refund or bring back without refund) increases recycling participation and intensity but has mostly no effect on waste prevention. More specifically, any type of service program but a bring back without refund system yields benefits in both the decision about whether to recycle and that about how much to recycle; a bring back without refund system, on the other hand, does not affect how much glass individuals recycle, although it still impacts whether individuals do recycle glass. Based on the marginal effects estimated for the binary probit decision about recycling, a door-to-door program is as good as a drop off system for glass recycling but preferable for any other recyclable. As curbside collection may be more costly to administer than collection by means of a drop off center, the benefits from the additional recycling under the former would have to be weighed against its potentially higher provision cost. Hence, aluminum and food, for which curbside collection brings about a larger benefit over and above the benefit from a drop off system, may be better candidates for curbside collection.[6] A drop off system performs always better than a refundable deposit system and is particularly appealing for aluminum and food, both of which experience a larger increase in recycling than the other materials (an extra 0.12 for aluminum and an extra 0.10 for food, compared to an additional 0.06 for glass and paper and 0.03 for plastic). Finally, when a deposit refund system is compared to a bring back without refund system, the former is preferable to the latter for any material but food; not only a bring back without refund system has a larger effect on the probability of recycling food than a refundable deposit system but it is also comparable in terms of its impact to a drop off program. Needless to say, significant administrative cost differences may exist among the four types of

[6] Relative to a drop off system, food recycling increases by an additional 0.11 and aluminum recycling by an additional 0.09 when curbside collection is in place. On the other hand, the probability of recycling plastic increases by an additional 0.06 and that of recycling paper by an additional 0.05 when a door-to-door program is available as opposed to a drop off system.

services which policy makers would have to account for before deciding on which program to implement and for which material.

Although policy makers may consider mandating recycling to get individuals to recycle or to recycle more, mandatory recycling may work for some materials (glass, plastic and paper) but not for others (aluminum and food) and may yield smaller benefits than a curbside or drop off program. Under mandatory recycling, the probability of increasing glass, plastic and paper recycling is in fact 0.06, 0.04 and 0.05 higher, respectively, than in the absence of mandatory recycling, compared to 0.11, 0.21 and 0.16 in the presence of a curbside program and to 0.11, 0.15 and 0.11 in the presence of a drop off program. Last, but not least, mandatory recycling may have stronger side effects than recycling programs on whether and how unit pricing impacts recycling intensity. In light of these considerations, mandatory recycling may not be a desirable policy option and policy makers may be able to achieve better results by focusing on improving accessibility of recycling services.

In implementing a collection program for recyclables, policy makers should keep in mind that such a program may only succeed at targeting a particular aspect of waste management. Ideally, a policy-induced behavioral adjustment should include both an increase in recycling and a decrease in waste generation through a shift in consumption patterns in favor of products with less waste content and/or reusable products. The evidence in this study points to the conclusion that the provision of recycling services does not encourage individuals to produce less waste so that, for waste prevention, policy makers may have to resort to additional mechanisms which may involve incentive structures at other stages of the product chain. There is certainly significant variation in waste prevention across the ten countries, as reflected in the country-specific fixed effects, which may be attributable to differences in waste management policies at the production stage.

When a collection program is being contemplated, an important feature to consider is pick-up frequency. While the findings of this study suggest that individuals take into account both the frequency of collection of mixed waste and the frequency of curbside collection of recyclables, the behavioral response to an increase in the latter is inconsistent with theoretical predictions. In fact, individuals tend to recycle less as mixed waste is collected more frequently, as expected, but to recycle less as recyclables are collected more frequently, which is unexpected. To increase recycling, policy makers should thus consider a less frequent collection of mixed waste and, if they implement a door-to-door collection of recyclables, should not necessarily opt for a more frequent collection of recyclables. It is quite possible, although further investigation is necessary to confirm this interpretation, that there exist economies of scale in recycling activities, partly because of the preparation that is required every time recyclables are placed at the curb. Because of this preparation or start up cost, individuals may find the process of getting recyclables ready for collection less time consuming if they have to engage in it every two weeks as opposed to once (or even more than once) a week. Individuals may thus react to a more frequent collection of recyclables simply by recycling less to avoid incurring additional time costs which, from previous discussions in relation to unit pricing, seem to constitute a more relevant factor in recycling decisions than monetary benefits.

In terms of the estimated effects of socio-demographic factors on recycling and waste prevention, there are a few lessons that can be drawn from the analysis which may aid policy makers in the design and targeting of waste management policies. Specifically, in deciding about which areas to target to increase recycling, policy makers may give priority to those which have a high proportion of renters; in fact, not only home-owners tend to recycle more so that intervention is less needed but they also respond negatively to the implementation of a unit pricing system so that, if intervention does occur, measures based on economic incentives may not represent the most effective way of influencing their behavior. Depending on the material, policy makers may target areas with relatively young families more aggressively (for example, for aluminum, paper and food); furthermore, they may be able to achieve better results, in terms of recycling participation and intensity, by focusing on areas with families that have children under the age of 5 and, in terms of waste prevention intensity, on urban/suburban areas where the effect of a unit pricing system on the probability of recycling participation (for some materials, at least) is also stronger.

6 Concluding Remarks

The present study widens the scope of previous analysis and improves upon our understanding of household recycling and waste prevention behavior in a number of ways: (1) by relying upon a survey that builds upon the lessons arising out of the existing literature but also attempts to address questions that remain unanswered; (2) by bringing together key aspects of household behavior, namely, socio-demographic characteristics (for example, income, age, education, household size) and attitudinal variables (for example, environmental concerns, norms, values), thus capturing a broader spectrum of policy influences and allowing for a more accurate assessment of the direct effects of socio-demographic factors and for the investigation of complementary effects among strategies that differ in the assumptions about how behavior can be changed (for example, through incentives, through informational campaigns); (3) by examining the effects of a broad range of policy instruments (pricing, informational and regulatory); (4) by considering the contributions of economic theory as well as of other social sciences, such as psychology and sociology, to household decision-making in order to provide a more accurate and realistic framework for the evaluation of environmental policies; (5) allowing for correlation in behavior between materials in recycling decisions; (6) adding an international dimension to the analysis through households across a cross-section of countries. Although waste prevention is only measured indirectly through a couple of proxies, this study represents the first attempt to assess the effects of socio-demographic and attitudinal characteristics as well as policy instruments (unit pricing, in particular) on activities related to waste prevention.

One of the key insights relates to the presence of strong intrinsic motivations for a more environmentally responsible behavior. There is indeed a positive relation between environmental concern and/or attitude and recycling or waste prevention, which suggests that more environmentally sensitive individuals tend to recognize the environmental deterioration that results from waste production and to exhibit a greater commitment to recycling and waste prevention activities such as taking recycling labels into account when shopping and using/purchasing refillable containers. Correspondingly, individuals who are simply concerned about waste generation do not tend to adjust their recycling and waste prevention efforts. Intrinsic motivations are also present in the form of moral/social considerations as individuals with a stronger sense of civic duty tend to engage more extensively in recycling and waste prevention. On the other hand, individuals who are motivated by a desire to be seen as acting responsibly are not more environmentally responsible. An important implication of these findings is that there may be benefits from sensitizing individuals to environmental problems and educating them about the environmental impact of waste production and the moral dimension of recycling and waste prevention.

The evidence gathered in this study is quite conducive to the conclusion that individuals do respond favorably, in terms of recycling efforts, to the presence of recycling services and that, the more accessible such services are, the more responsive they become. Hence, curbside collection of recyclables yields better results than the other three programs considered in the analysis (drop off, refundable deposit and bring back with no refund). Under curbside collection of recyclables, however, more frequent collection of recyclables is not necessarily desirable contrary to findings in previous studies [10, 23]. The adverse effect of frequency on individuals' recycling behavior also transpires in the collection of garbage as, the more frequently their garbage is collected, the less likely to recycle individuals are and the less they recycle.

The evidence on unit pricing is not as strong as one would expect based upon theoretical predictions and previous empirical findings. Nevertheless, of the three types of unit pricing examined in the study (weight-, volume-, and frequency-based), the volume-based system appears to be the most effective. An important result is that unit pricing may have little to contribute when curbside recycling is in place, especially if weight-based or frequency-based charges are being considered, and curbside recycling may have additional benefits over and above those brought about by unit pricing.

In terms of waste prevention, the presence of unit pricing does not affect the decision about whether to take recycling labels into account in purchasing decisions but does have a positive effect on the decision about how often to use/purchase refillable containers instead of their alternatives. The evidence thus points to some role that user charges may have in inducing individuals to alter their consumption patterns in order to reduce waste as theory predicts.

While the evidence may suggest stronger support for curbside recycling than for unit pricing, there are a few considerations about unit pricing that deserve mention. First, unit pricing does not seem to crowd out intrinsic motivations for recycling but does reduce the positive effect that mandatory recycling has on recycling participation and intensity (equivalently, mandatory recycling reduces the effects of unit pricing). Second, there are specific socio-demographic segments of the population which may respond to unit pricing more or less favorably (for example, the effect of unit pricing on paper recycling is smaller among homeowners; the effect on food recycling is smaller among those living in a house; the effect on aluminum recycling participation is larger among those who have a garden; the effect on glass and plastic recycling participation is larger among those living in an urban or suburban area). Third, the number of observations in the data set which fall under each of the three types of unit pricing (weight- and frequency-based, in particular) is very small and, as a result, the effects of each system may not be fully captured in the analysis.

References

[1] Atri, S. and T. Schellberg (1995), "Efficient Management of Household Solid Waste: A General Equilibrium Model," *Public Finance Quarterly*, 23(1), 3-39.

[2] Berglund, C. and S. Matti (2006), "Citizen and Consumer: The Dual Role of Individuals in Environmental Policy," *Environmental Politics*, 15(4), 550-571.

[3] Brekke, K.A., G. Kipperberg, and K. Nyborg (2010), "Social Interaction in Responsibility Ascription: The Case of Household Recycling," *Land Economics* 86(4), 766-784.

[4] Callan, S.J. and J.M. Thomas (1997), "The Impact of State and Local Policies on the Recycling Effort," *Eastern Economic Journal*, 23, 411-423.

[5] Dijkgraaf, E. and R.H.J.M. Gradus (2004), "Cost savings in unit-based pricing of household waste: The case of The Netherlands," *Resource and Energy Economics*, 26, 353-371.

[6] Dinan, T.M. (1993), "Economic Efficiency Effects of Alternative Policies for Reducing Waste Disposal," *Journal of Environmental Economics and Management*, 25(3), 242-256.

[7] Dobbs, I.M. (1991), "Litter and Waste Management: Disposal Taxes versus User Charges," *Canadian Journal of Economics*, 24(1), 221-227.

[8] Ferrara, I. (2003), "Differential Provision of Solid Waste Collection Services in the Presence of Heterogeneous Households," *Environmental and Resource Economics*, 25(2), 211-226.

[9] Ferrara, I. (2011), "Illegal Disposal and Waste Collection Frequency," *Pacific Economic Review*, November.

[10] Ferrara, I. and P. Missios (2005), "Recycling and Waste Diversion Effectiveness: Evidence from Canada," *Environmental and Resource Economics*, 30, 221-238.

[11] Frey, B.S. (1999), "Morality and Rationality in Environmental Policy," *Journal of Consumer Policy*, 22, 395-417.

[12] Frey, B.S. and F. Oberholzer-Gee (1997), "The Cost of Price Incentives: An Empirical Analysis of Motivation Crowding Out," *American Economic Review*, 87(4), 746-755.

[13] Fullerton, D. and T.C. Kinnaman (1995), "Garbage, Recycling, and Illicit Burning or Dumping," *Journal of Environmental Economics and Management*, 29(1), 78-91.

[14] Fullerton, D. and T.C. Kinnaman (1996), "Household Responses to Pricing Garbage by the Bag," *American Economic Review*, 86, 971-984.

[15] Fullerton, D. and W. Wu (1998), "Policies for Green Design," *Journal of Environmental Economics and Management*, 36(2), 131-148.

[16] Halvorsen, B. (2008), "Effects of Norms and Opportunity Cost of Time on Household Recycling," *Land Economics*, 84(3), 501-516.

[17] Hong, S. (1999), "The Effects of Unit Pricing System upon Household Solid Waste Management: The Korean Experience," *Journal of Environmental Management*, 57, 1-10.

[18] Hong, S. and Richard M. Adams (1999), "Household Responses to Price Incentives for Recycling: Some Further Evidence," *Land Economics*, 74(4), 505-514.

[19] Hong, S., R.M. Adams and H.A. Love (1993), "An Economic Analysis of Household Recycling of Solid Wastes: The Case of Portland, Oregon," *Journal of Environmental Economics and Management*, 25, 136-146.

[20] Hornik, J., J. Cherian, M. Madansky and C. Narayana (1995), "Determinants of Recycling Behavior: A Synthesis of Research Results," *The Journal of Socio-Economics*, 24(1), 105-127.

[21] Jenkins, R.R. (1993), The Economics of Solid Waste Reduction, Aldershot, UK: Edward Elgar.

[22] Jenkins, R.R., S.A. Martinez, K. Palmer and M.J. Podolsky (2003), "The Determinants of Household Recycling: A Material-Specific Analysis of Recycling Program Features and Unit Pricing," *Journal of Environmental Economics and Management*, 45, 294-318.

[23] Judge, R. and A. Becker (1993), "Motivating Recycling: A Marginal Cost Analysis," *Contemporary Policy Issues*, 11, 58-68.

[24] Kinnaman, T.C. and D. Fullerton (2000), "Garbage and Recycling with Endogenous Local Policy," *Journal of Urban Economics*, 48, 419-442.

[25] Linderhof, V., P. Kooreman, M. Allers and D. Wiersma (2001), "Weight-Based Pricing in the Collection of Household Waste: The Ooostzaan Case," *Resource and Energy Economics*, 23, 359-371.

[26] Nestor, D.V. and M.J. Podolsky (1998), "Assessing Incentive-Based Environmental Policies for Reducing Household Waste Disposal," *Contemporary Economic Policy*, XVI, 401-411.

[27] OECD (2008), OECD Environmental Data COMPENDIUM 2006-2008, Paris, France: OECD.

[28] Palmer, K., H. Sigman and M. Walls (1997), "The Cost of Reducing Municipal Solid Waste," *Journal of Environmental Economics and Management*, 33, 128-150.

[29] Podolsky, M.J. and M. Spiegel (1998), "Municipal Waste Disposal: Unit Pricing and Recycling Opportunities," *Public Works Management and Policy*, 3, 27-39.

[30] Reschovsky, J.D. and S.E. Stone (1994), "Market Incentives to Encourage Household Waste Recycling: Paying for What You Throw Away," *Journal of Policy Analysis and Management*, 13, 120-139.

[31] Skumatz, L.A. and D.J. Freeman (2007), Pay as you Throw (PAYT) in the US: 2006 Update and Analyses, report prepared for US EPA and SERA (Skumatz Economic Research Associates), SERA, Superior (CO).

[32] Statistics Canada (2008), Households and the Environment Survey, Catalogue No. 11-526-X, ISSN 1913-5270, 2006.

[33] Sterner, T. and H. Bartelings (1999), "Household Waste Management in Swedish Municipality: Determinants of Waste Disposal, Recycling and Composting', *Environmental and Resource Economics*, 13, 473-491.

[34] Thørgeson, J. (2003), "Monetary Incentives and Recycling: Behavioral and Psychological Reactions to a Performance-Dependent Garbage Fee," *Journal of Consumer Policy,* 26(2), 197-228.

[35] Van Houtven, G.L. and G.E. Morris (1999), "Household Behavior under Alternative Pay-as-You-Throw Systems for Solid Waste Disposal', *Land Economics*, 75(4), 515-537.

7 Appendix

Binary and ordinal regression models can be derived from a latent-variable model which relates a latent or unobserved variable y^* ranging from $-\infty$ to ∞ to the observed independent variables according to the structural equation

$$y_i^* = \boldsymbol{\beta}'\mathbf{x}_i + \varepsilon_i,$$

where $\boldsymbol{\beta}'$ is the vector of coefficients estimated by maximum likelihood estimation (MLE), $\mathbf{x}$ is the vector of independent variables, ε is a random term,[7] and i denotes the observation. The idea of a latent y^* is that the underlying propensity (for example, to recycle or to recycle a particular proportion) generates the observed state; although the propensity itself cannot be observed, a change in what is observed is triggered by a change in y^*. The probability of an event occurring is thus given by the cumulative density function (cdf) of ε evaluated at given values of the independent variables.

[7] The error term could be distributed normally (probit specification) or logistically (logit specification). The two distributions differ only in spread with the latter having thicker tails: $var(\varepsilon) = \pi^2/3$ with the logistic cdf and $var(\varepsilon) = 1$ with the normal cdf. The two distributions can give different results if the sample is unbalanced (that is, most of the outcomes are similar with only few differences).

A simple measurement equation is then used to link the observed y with the latent y^*. In the binary case,

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases}$$

so that positive values of y^* are observed as $y = 1$ while negative values of y^* are observed as $y = 0$ and the probability of the event occurring is given by

$$\Pr\left(y_i = 1 \mid \mathbf{x}_i\right) = \Phi\left(-\boldsymbol{\beta}'\mathrm{x}_i\right),$$

where Φ denotes the normal cdf. In the ordinal case,

$$y_i = \begin{cases} 1 & \text{if } -\infty = \mu_0 \leq y_i^* < \mu_1 \\ 2 & \text{if } \mu_1 \leq y_i^* < \mu_2 \\ 3 & \text{if } \mu_2 \leq y_i^* < \mu_3 \\ \vdots & \vdots \\ J & \text{if } \mu_{J-1} \leq y_i^* < \mu_J = \infty, \end{cases}$$

where J is the number of categories and μ_j is the cutpoint for $j = 0, \ldots, J$, and the probabilities of household i falling into the J categories are given by

$$\begin{aligned} &\Pr\left(y_i = 1 \mid \mathbf{x}_i\right) = \Phi\left(\mu_1 - \boldsymbol{\beta}'\mathrm{x}_i\right) - \Phi\left(-\boldsymbol{\beta}'\mathrm{x}_i\right) \\ &\Pr\left(y_i = 2 \mid \mathbf{x}_i\right) = \Phi\left(\mu_2 - \boldsymbol{\beta}'\mathrm{x}_i\right) - \Phi\left(\mu_1 - \boldsymbol{\beta}'\mathrm{x}_i\right) \\ &\Pr\left(y_i = 3 \mid \mathbf{x}_i\right) = \Phi\left(\mu_3 - \boldsymbol{\beta}'\mathrm{x}_i\right) - \Phi\left(\mu_2 - \boldsymbol{\beta}'\mathrm{x}_i\right) \\ &\ldots \\ &\Pr\left(y_i = J \mid \mathbf{x}_i\right) = \Phi\left(\mu_{J-1} - \boldsymbol{\beta}'\mathrm{x}_i\right) - \Phi\left(\mu_J - \boldsymbol{\beta}'\mathrm{x}_i\right), \end{aligned}$$

that is, the areas under the normal cdf between pairs of cutpoints.

Table 1. Explanatory variables: definitions and descriptions

Variable	Description	Variable	Description
AUSTRALIA	Australia indicator	INCOME_CONT	Mid-point income in euros
CANADA	Canada indicator	ROWNR	Ownership indicator
CZECHREP	Czech Republic indicator	RESTYPE_HOUSE	House indicator
FRANCE	France indicator	RESDROOMS	Number of bedrooms
ITALY	Italy indicator	GARDEN	Garden indicator
KOREA	Korea indicator	AREADESC_URBAN	Urban indicator
MEXICO	Mexico indicator	AREADESC_SUBURBAN	Suburban indicator
NETHERLANDS	Netherlands indicator	RESDYRS_CLASS_1	Less than 2 years living in residence indicator
NORWAY	Norway indicator	RESDYRS_CLASS_2	2 to 5 years living in residence indicator
STATUS_MARRIED	Married/living as a couple indicator	RESDYRS_CLASS_3	6 to 15 years living in residence indicator
GENDER_MALE	Male indicator	ENVRANK	Rank of environmental concerns
AGE_CLASS_1	Age 18 to 24 indicator	WSTE_CNCRN	Indicator for waste generation concern
AGE_CLASS_2	Age 25 to 34 indicator	ENVCNCRN_INDX	Environmental concern index
AGE_CLASS_3	Age 35 to 44 indicator	ENVATTIT_INDX	Environmental attitude index
AGE_CLASS_4	Age 45 to 54 indicator	WSTCHRG_WEIGHT	Indicator for weight-based fee
ADULTS	Number of adults	WSTCHRG_VOL	Indicator for volume-based fee
UNDER5	Number of children under 5	WSTCHRG_FREQ	Indicator for frequency-based fee
BETWEEN5AND18	Number of children between 5 and 18	COLLFREQ_CLASS_1	More than once a week mixed waste pick-up
EDUC_CLASS_1	Indicator for no high school	COLLFREQ_CLASS_2	Once a week pick-up of mixed waste indicator
EDUC_CLASS_2	Indicator for high school	RCYCLCOLDTD_X	Door-to-door service for material X indicator
EDUC_CLASS_3	Some post-secondary education indicator	RCYCLFREQ_X_1	More than once a week pick-up of X indicator
EDUC_CLASS_4	Bachelor’s degree indicator	RCYCLFREQ_X_2	Once a week pick-up of X indicator
EMPL_FULLTIME	Full-time employment indicator	RCYCLCOLDOF_X	Drop-off service for X indicator
EMPL_PARTTIME	Part-time employment indicator	RCYCLCOLRFD_X	Return with refund service for X indicator
EMPL_RETIRED	Retired indicator	RCYCLCOLBBK_X	Return with no refund service for X indicator
EMPL_HOMEMAKER	Homemaker indicator	UF_INCOME	Interaction between user fee and income
EMPL_STUDENT	Student indicator	UF_RESROWNR	Interaction between user fee and ownership
EMPL_LEAVE	In employment but not working indicator	UF_HOUSE	Interaction between user fee and house
OCCUP_1	Liberal profession indicator	UF_RESDROOMS	Interaction between user fee and number of rooms
OCCUP_2	Middle/senior executive indicator	UF_GARDEN	Interaction between user fee and garden
OCCUP_3	Self-employed indicator	UF_URSUB	Interaction between user fee and urban/suburban
OCCUP_4	Salaried employee indicator	UF_SERVICE_X	Interaction between user fee and any service for X
OCCUP_5	Manual worker indicator	UF_MANDATED	Interaction between user fee and mandatory recycling
MTVRCYLDUTY_LKT	Importance of belief that recycling is a civic duty	UF_MTVRCYLDUTY_LKT	Interaction between user fee and importance of civic duty
MTVRCYLRESP_LKT	Importance of desire to be seen as a responsible citizen	UF_MTVRCYLRESP_LKT	Interaction between user fee and responsible citizen
MTVRCYLMAND	Mandatory recycling as recycling motive indicator	MTVRCYLENVR_LKT	Importance of environmental benefits in motivation
MTVRCYLMAND_LKT	Importance of mandatory recycling in motivation		

Note: Materials (X): GLAS = glass; PLST = plastic; MTAL = aluminum; PAPR = paper; FOOD = food.

Table 2. Summary statistics for independent variables

Variable	Mean (SD) All observations	Mean (SD) Unit Pricing*
Socio-demographic characteristics		
Married Indicator	0.62 (0.49)	0.52 (0.50)
Male Indicator	0.48 (0.50)	0.44 (0.50)
Age 18 to 24 Indicator	0.14 (0.34)	0.22 (0.42)
Age 25 to 34 Indicator	0.21 (0.41)	0.26 (0.44)
Age 35 to 44 Indicator	0.22 (0.41)	0.21 (0.40)
Age 45 to 54 Indicator	0.19 (0.39)	0.15 (0.36)
Number of Adults	2.24 (1.02)	2.48 (1.16)
Number of Children under 5	0.20 (0.50)	0.23 (0.55)
Number of Children between 5 and 18	0.45 (0.80)	0.51 (0.84)
No High School Indicator	0.12 (0.33)	0.09 (0.29)
High School Indicator	0.26 (0.44)	0.28 (0.45)
Some Post-Secondary Education Indicator	0.27 (0.45)	0.26 (0.44)
Bachelor's Degree Indicator	0.24 (0.43)	0.28 (0.45)
Employed Full-Time Indicator	0.48 (0.50)	0.44 (0.50)
Employed Part-Time Indicator	0.12 (0.33)	0.13 (0.34)
Retired Indicator	0.14 (0.34)	0.07 (0.25)
Housewife Indicator	0.07 (0.26)	0.10 (0.30)
Student Indicator	0.08 (0.27)	0.13 (0.33)
In Employment but Not Working Indicator	0.12 (0.33)	0.02 (0.13)
Liberal Profession Indicator[1]	0.17 (0.37)	0.17 (0.37)
Middle/Senior Executive Indicator[1]	0.16 (0.37)	0.12 (0.33)
Self-Employed Indicator[1]	0.07 (0.26)	0.07 (0.26)
Salaried Employee Indicator[1]	0.36 (0.48)	0.38 (0.48)
Manual Worker Indicator[1]	0.11 (0.31)	0.10 (0.30)
Income	30258 (21633)	26747 (18561)
Ownership Indicator	0.65 (0.48)	0.61 (0.49)
House Indicator	0.55 (0.50)	0.50 (0.50)
Number of Rooms	4.88 (2.31)	4.40 (2.15)
Garden Indicator	0.87 (0.34)	0.84 (0.36)
Urban Indicator	0.45 (0.50)	0.50 (0.50)
Suburban Indicator	0.32 (0.47)	0.28 (0.45)
Less than 2 Years Tenure Indicator	0.21 (0.41)	0.29 (0.45)
2 to 5 Years Tenure Indicator	0.25 (0.43)	0.26 (0.44)
6 to 15 Years Tenure Indicator	0.27 (0.45)	0.26 (0.44)
Attitudinal Characteristics (including Motives for Recycling)		
Waste Generation Concern Indicator	0.93 (0.25)	0.92 (0.27)
Environmental Concern Index	3.03 (0.66)	3.05 (0.68)
Environmental Attitude Index	0.41 (0.68)	0.36 (0.68)
Beneficial for the Environment Indicator	0.96 (0.19)	0.94 (0.23)
Money Saving Indicator	0.47 (0.50)	0.51 (0.50)
Civic Duty Indicator	0.88 (0.32)	0.87 (0.33)
Responsible Citizen Indicator	0.52 (0.50)	0.55 (0.50)
Mandatory Recycling Indicator	0.88 (0.32)	0.90 (0.30)
Relevance of Mandatory Recycling[2]	2.40 (0.96)	2.53 (0.93)

* Unit pricing comprises weight- and volume-based programs.

[1] Means and standard deviations computed for subsample comprising respondents who reported to be employed (full or part time), in employment but not currently working, or retired.

[2] Means and standard deviations computed for subsample excluding respondents who reported mandatory recycling not be an applicable motive for recycling.

Variable	Mean (SD) All observations	Mean (SD) Unit Pricing*
Pricing Methods		
Weight-based Fee Indicator	0.03 (0.16)	N/A
Volume-based Fee Indicator	0.12 (0.33)	N/A
Frequency-based Fee Indicator	0.04 (0.21)	N/A
Fee based on Household Size Indicator	0.15 (0.36)	N/A
Flat Fee Indicator	0.49 (0.50)	N/A
No Fee Indicator	0.13 (0.33)	N/A
Other Form of Charging Indicator	0.04 (0.20)	N/A
Services Available		
More than Once a Week Pick-up of Mixed Waste Indicator	0.36 (0.48)	0.39 (0.49)
Once a Week Pick-up of Mixed Waste Indicator	0.46 (0.50)	0.42 (0.49)
Door-to-Door Service for Glass Indicator	0.27 (0.44)	0.32 (0.47)
More than Once a Week Pick-up of Glass Indicator[1]	0.17 (0.37)	0.34 (0.48)
Once a Week Pick-up of Glass Indicator[1]	0.44 (0.50)	0.43 (0.50)
Door-to-Door Service for Plastic Indicator	0.33 (0.47)	0.36 (0.48)
More than Once a Week Pick-up of Plastic Indicator[2]	0.15 (0.36)	0.32 (0.47)
Once a Week Pick-up of Plastic Indicator[2]	0.46 (0.50)	0.46 (0.50)
Door-to-Door Service for Aluminum Indicator	0.31 (0.46)	0.36 (0.48)
More than Once a Week Pick-up of Aluminum Indicator[3]	0.16 (0.37)	0.31 (0.46)
Once a Week Pick-up of Aluminum Indicator[3]	0.45 (0.50)	0.45 (0.50)
Door-to-Door Service for Paper Indicator	0.45 (0.50)	0.47 (0.50)
More than Once a Week Pick-up of Paper Indicator[4]	0.12 (0.33)	0.27 (0.45)
Once a Week Pick-up of Paper Indicator[4]	0.36 (0.48)	0.36 (0.48)
Door-to-Door Service for Food Indicator	0.39 (0.49)	0.44 (0.50)
More than Once a Week Pick-up of Food Indicator[5]	0.25 (0.43)	0.41 (0.49)
Once a Week Pick-up of Food Indicator[5]	0.40 (0.49)	0.35 (0.48)
Drop Off for Glass Indicator	0.58 (0.49)	0.48 (0.50)
Drop Off for Plastic Indicator	0.40 (0.49)	0.35 (0.48)
Drop Off for Aluminum Indicator	0.44 (0.50)	0.38 (0.48)
Drop Off for Paper Indicator	0.45 (0.50)	0.40 (0.49)
Drop Off for Food Indicator	0.31 (0.46)	0.28 (0.45)
Bring Back with Refund for Glass Indicator	0.18 (0.39)	0.17 (0.38)
Bring Back with Refund for Plastic Indicator	0.18 (0.38)	0.18 (0.39)
Bring Back with Refund for Aluminum Indicator	0.08 (0.26)	0.08 (0.28)
Bring Back with Refund for Paper Indicator	0.02 (0.15)	0.04 (0.20)
Bring Back with Refund for Food Indicator	0.01 (0.11)	0.03 (0.17)
Bring Back with No Refund for Glass Indicator	0.03 (0.18)	0.05 (0.21)
Bring Back with No Refund for Plastic Indicator	0.03 (0.17)	0.05 (0.21)
Bring Back with No Refund for Aluminum Indicator	0.03 (0.16)	0.05 (0.21)
Bring Back with No Refund for Paper Indicator	0.02 (0.15)	0.05 (0.21)
Bring Back with No Refund for Food Indicator	0.02 (0.12)	0.03 (0.18)

* Unit pricing comprises weight- and volume-based programs.
[1] Summary statistics computed for respondents with access to curbside recycling of glass.
[2] Summary statistics computed for respondents with access to curbside recycling of plastic.
[3] Summary statistics computed for respondents with access to curbside recycling of aluminum.
[4] Summary statistics computed for respondents with access to curbside recycling of paper.
[5] Summary statistics computed for respondents with access to curbside recycling of food.

Table 3a. Recycling: univariate (binary) and multivariate probit estimation results

Variable	Glass		Plastic		Aluminum		Paper		Food	
	Binary	Multi	Binary	Multi	Binary	Multi	Binary	Multi	Binary	Multi
AUSTRALIA	0.19 (0.15)	0.16 (0.15)	0.25* (0.14)	0.25* (0.14)	0.20* (0.12)	0.18 (0.12)	0.28** (0.14)	0.26* (0.14)	-0.44*** (0.09)	-0.46*** (0.09)
CANADA	-0.05 (0.14)	-0.13 (0.14)	0.27* (0.14)	0.28* (0.16)	0.11 (0.11)	0.18 (0.11)	-0.19 (0.12)	-0.13 (0.12)	-0.32*** (0.09)	-0.32*** (0.09)
CZECHREP	-0.70*** (0.12)	-0.73*** (0.13)	-0.08 (0.13)	-0.25* (0.14)	-1.25*** (0.11)	-1.31*** (0.12)	-0.22* (0.12)	-0.28** (0.13)	-0.37*** (0.11)	-0.38*** (0.11)
FRANCE	-0.66*** (0.11)	-0.66*** (0.12)	-0.37*** (0.12)	-0.38*** (0.12)	-0.37*** (0.09)	-0.44*** (0.10)	-0.31*** (0.11)	-0.27** (0.12)	-0.28*** (0.09)	-0.28*** (0.09)
ITALY	-0.39*** (0.12)	-0.33*** (0.12)	-0.23** (0.12)	-0.20 (0.12)	-0.21** (0.09)	-0.19** (0.10)	-0.38*** (0.11)	-0.34*** (0.11)	0.13 (0.08)	0.15* (0.08)
KOREA	0.24 (0.15)	0.27* (0.16)	0.36** (0.16)	0.45*** (0.17)	0.74*** (0.13)	0.76*** (0.13)	0.13 (0.15)	0.10 (0.15)	1.20*** (0.11)	1.19*** (0.12)
MEXICO	-1.09*** (0.14)	-0.95*** (0.14)	-0.51*** (0.14)	-0.43*** (0.14)	-0.26** (0.12)	-0.25** (0.12)	-0.79*** (0.14)	-0.74*** (0.14)	0.02 (0.11)	0.05 (0.11)
NETHERLANDS	-0.20* (0.11)	-0.23** (0.11)	-1.23*** (0.10)	-1.34*** (0.10)	-1.19*** (0.09)	-1.20*** (0.09)	0.01 (0.11)	-0.03 (0.12)	0.11 (0.08)	0.10 (0.08)
NORWAY	-0.56*** (0.12)	-0.64*** (0.12)	-0.71*** (0.11)	-0.77*** (0.12)	-0.49*** (0.09)	-0.52*** (0.10)	0.28** (0.13)	0.17 (0.14)	0.27*** (0.09)	0.28*** (0.09)
STATUS_MARRIED	0.10* (0.05)	0.14*** (0.05)	0.18*** (0.05)	0.22*** (0.05)	0.08* (0.05)	0.13*** (0.05)	0.10* (0.05)	0.09* (0.06)	0.00 (0.04)	-0.00 (0.04)
GENDER_MALE	0.01 (0.05)	0.04 (0.05)	-0.08* (0.05)	-0.06 (0.05)	0.11*** (0.04)	0.10** (0.04)	-0.09* (0.05)	-0.04 (0.05)	-0.03 (0.04)	-0.04 (0.04)
AGE_CLASS_1	0.03 (0.10)	0.00 (0.11)	0.34*** (0.10)	0.27*** (0.11)	-0.29*** (0.09)	-0.28*** (0.10)	-0.16 (0.11)	-0.20* (0.11)	-0.09 (0.08)	-0.15* (0.09)
AGE_CLASS_2	-0.04 (0.09)	-0.04 (0.09)	0.33*** (0.08)	0.25*** (0.08)	-0.16** (0.07)	-0.16** (0.07)	-0.16* (0.09)	-0.20** (0.09)	-0.05 (0.06)	-0.08 (0.07)
AGE_CLASS_3	0.12 (0.09)	0.11 (0.09)	0.27*** (0.08)	0.25*** (0.08)	-0.00 (0.07)	-0.00 (0.07)	-0.08 (0.09)	-0.08 (0.09)	-0.06 (0.06)	-0.07 (0.06)
AGE_CLASS_4	-0.04 (0.08)	-0.07 (0.08)	0.12* (0.07)	0.05 (0.07)	0.04 (0.06)	0.04 (0.07)	-0.11 (0.08)	-0.09 (0.08)	-0.01 (0.06)	-0.01 (0.06)
ADULTS	-0.00 (0.03)	-0.01 (0.03)	-0.01 (0.03)	-0.02 (0.03)	0.01 (0.02)	0.00 (0.02)	0.00 (0.03)	0.01 (0.03)	-0.01 (0.02)	-0.01 (0.02)
UNDER5	-0.09* (0.05)	-0.13*** (0.05)	-0.11** (0.05)	-0.15*** (0.05)	0.04 (0.04)	-0.01 (0.04)	-0.08* (0.05)	-0.10** (0.05)	-0.01 (0.04)	-0.01 (0.04)
BETWEEN5AND18	-0.04 (0.03)	-0.06* (0.03)	-0.00 (0.03)	-0.03 (0.03)	0.03 (0.03)	0.03 (0.03)	-0.01 (0.03)	-0.01 (0.03)	-0.01 (0.02)	-0.01 (0.02)
EDUC_CLASS_1	-0.20* (0.11)	-0.16 (0.11)	-0.02 (0.10)	-0.02 (0.10)	-0.09 (0.09)	-0.01 (0.10)	-0.20** (0.11)	-0.22** (0.11)	0.12 (0.08)	0.13 (0.08)
EDUC_CLASS_2	-0.19** (0.09)	-0.21** (0.10)	-0.00 (0.08)	-0.01 (0.09)	-0.13* (0.08)	-0.11 (0.08)	-0.09 (0.09)	-0.13 (0.10)	0.01 (0.07)	0.00 (0.07)
EDUC_CLASS_3	-0.27*** (0.09)	-0.29*** (0.09)	-0.03 (0.08)	-0.03 (0.08)	-0.06 (0.07)	-0.05 (0.08)	0.00 (0.09)	-0.09 (0.10)	0.07 (0.07)	0.07 (0.07)
EDUC_CLASS_4	-0.11 (0.09)	-0.15* (0.09)	-0.03 (0.08)	-0.06 (0.08)	-0.03 (0.07)	-0.04 (0.08)	0.08 (0.09)	0.02 (0.09)	0.02 (0.07)	0.03 (0.07)
EMPL_FULLTIME	0.04 (0.11)	0.03 (0.11)	0.19* (0.10)	0.18 (0.11)	0.15 (0.09)	0.24*** (0.10)	0.12 (0.11)	0.12 (0.11)	0.08 (0.08)	0.06 (0.09)

Variable	Glass		Plastic		Aluminum		Paper		Food	
	Binary	Multi	Binary	Multi	Binary	Multi	Binary	Multi	Binary	Multi
EMPL_PARTTIME	-0.04 (0.12)	-0.06 (0.12)	0.13 (0.11)	0.12 (0.12)	0.19* (0.10)	0.26*** (0.10)	0.07 (0.12)	0.12 (0.12)	0.10 (0.09)	0.09 (0.09)
EMPL_RETIRED	-0.00 (0.13)	0.01 (0.13)	0.19* (0.12)	0.13 (0.12)	0.18* (0.11)	0.24** (0.11)	-0.01 (0.13)	-0.04 (0.13)	0.18** (0.09)	0.16* (0.10)
EMPL_HOMEMAKER	-0.06 (0.12)	-0.02 (0.12)	0.05 (0.11)	-0.04 (0.12)	0.19* (0.11)	0.17 (0.11)	0.21* (0.12)	0.30** (0.13)	0.08 (0.09)	0.08 (0.09)
EMPL_STUDENT	-0.18 (0.12)	-0.14 (0.13)	-0.07 (0.13)	0.02 (0.13)	0.17 (0.11)	0.24** (0.12)	0.05 (0.13)	0.12 (0.14)	0.00 (0.10)	0.02 (0.11)
EMPL_LEAVE	-0.03 (0.18)	-0.11 (0.19)	-0.10 (0.17)	-0.04 (0.18)	-0.02 (0.17)	0.06 (0.18)	-0.05 (0.18)	-0.07 (0.19)	-0.26* (0.15)	-0.21 (0.15)
OCCUP_1	-0.07 (0.10)	-0.09 (0.10)	-0.09 (0.10)	-0.13 (0.11)	0.00 (0.09)	-0.05 (0.09)	-0.04 (0.10)	-0.07 (0.11)	-0.08 (0.08)	-0.06 (0.08)
OCCUP_2	-0.07 (0.10)	-0.10 (0.10)	-0.14 (0.10)	-0.18* (0.10)	-0.19** (0.09)	-0.24*** (0.09)	-0.07 (0.10)	-0.07 (0.11)	-0.12 (0.08)	-0.11 (0.08)
OCCUP_3	0.04 (0.12)	0.02 (0.12)	-0.08 (0.12)	-0.09 (0.13)	-0.07 (0.10)	-0.11 (0.11)	0.02 (0.12)	0.00 (0.13)	0.02 (0.09)	0.01 (0.09)
OCCUP_4	0.02 (0.09)	-0.01 (0.09)	-0.14* (0.08)	-0.18** (0.09)	-0.12 (0.07)	-0.18** (0.08)	0.08 (0.09)	0.05 (0.09)	-0.13** (0.06)	-0.14** (0.07)
OCCUP_5	-0.00 (0.11)	0.02 (0.11)	-0.14 (0.11)	-0.12 (0.11)	-0.03 (0.09)	-0.07 (0.10)	0.05 (0.11)	0.08 (0.12)	-0.07 (0.08)	-0.08 (0.08)
INCOME_CONT	0.00** (0.00)	0.00*** (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
RESOWNR	0.06 (0.06)	0.11* (0.06)	-0.03 (0.06)	0.00 (0.06)	0.04 (0.05)	0.08 (0.05)	0.08 (0.06)	0.11* (0.06)	0.02 (0.05)	0.03 (0.05)
RESTYPE_HOUSE	-0.12* (0.07)	-0.17** (0.07)	-0.10 (0.06)	-0.12* (0.06)	0.06 (0.06)	0.06 (0.06)	-0.17*** (0.07)	-0.19*** (0.07)	0.23*** (0.05)	0.21*** (0.05)
RESDROOMS	0.04*** (0.01)	0.03** (0.01)	0.01 (0.01)	0.01 (0.01)	0.00 (0.01)	-0.00 (0.01)	0.04*** (0.01)	0.04** (0.01)	0.02* (0.01)	0.02* (0.01)
GARDEN	0.13* (0.08)	0.12 (0.08)	0.19*** (0.08)	0.08 (0.08)	0.03 (0.07)	-0.01 (0.07)	0.03 (0.08)	0.00 (0.08)	0.11* (0.06)	0.10 (0.07)
AREADESC_URBAN	-0.01 (0.07)	-0.05 (0.07)	0.03 (0.06)	-0.05 (0.07)	-0.01 (0.06)	-0.02 (0.06)	0.08 (0.07)	0.06 (0.07)	-0.19*** (0.05)	-0.20*** (0.05)
AREADESC_SUBURBAN	-0.05 (0.07)	-0.06 (0.07)	0.03 (0.06)	-0.03 (0.07)	-0.04 (0.06)	-0.04 (0.06)	0.03 (0.07)	0.05 (0.07)	-0.16*** (0.05)	-0.15*** (0.05)
RESDYRS_CLASS_1	-0.12* (0.08)	-0.09 (0.08)	-0.19*** (0.07)	-0.21*** (0.08)	-0.15** (0.07)	-0.11 (0.07)	-0.12 (0.08)	-0.10 (0.08)	-0.12** (0.06)	-0.09 (0.06)
RESDYRS_CLASS_2	-0.11* (0.07)	-0.12* (0.07)	-0.08 (0.07)	-0.11 (0.07)	-0.11* (0.06)	-0.10 (0.06)	-0.06 (0.07)	-0.09 (0.07)	-0.12** (0.05)	-0.09* (0.05)
RESDYRS_CLASS_3	-0.12* (0.06)	-0.13** (0.06)	-0.15*** (0.06)	-0.18*** (0.06)	-0.11** (0.05)	-0.10* (0.06)	-0.13** (0.06)	-0.14** (0.07)	-0.04 (0.05)	-0.02 (0.05)
ENVRANK	-0.01 (0.02)	-0.01 (0.02)	-0.00 (0.01)	-0.01 (0.02)	-0.03*** (0.01)	-0.04*** (0.01)	-0.04*** (0.02)	-0.04*** (0.02)	-0.02 (0.01)	-0.02* (0.01)
WSTE_CNCRN	0.10 (0.10)	0.14 (0.10)	-0.08 (0.10)	-0.05 (0.10)	-0.15 (0.09)	-0.20** (0.10)	0.15 (0.10)	0.13 (0.10)	0.06 (0.08)	0.07 (0.08)
ENVCNCRN_INDX	0.13*** (0.05)	0.14*** (0.05)	0.14*** (0.04)	0.08* (0.04)	0.14*** (0.04)	0.12*** (0.04)	0.01 (0.05)	0.05 (0.05)	0.06* (0.03)	0.06* (0.04)
ENVATTIT_INDX	0.10*** (0.04)	0.11*** (0.04)	0.08** (0.03)	0.11*** (0.04)	0.13*** (0.03)	0.15*** (0.03)	0.04 (0.04)	0.03 (0.04)	-0.04 (0.03)	-0.05* (0.03)

Variable	Glass		Plastic		Aluminum		Paper		Food	
	Binary	Multi	Binary	Multi	Binary	Multi	Binary	Multi	Binary	Multi
WSTCHRG_WEIGHT	0.02	-0.02	-0.10	0.10	0.55	0.37	0.33	0.18	0.64*	0.69*
	(0.44)	(0.46)	(0.44)	(0.45)	(0.42)	(0.42)	(0.46)	(0.46)	(0.36)	(0.37)
WSTCHRG_VOL	0.47	0.50	0.29	0.55	0.52	0.40	0.81*	0.79*	0.54	0.60*
	(0.44)	(0.46)	(0.42)	(0.43)	(0.41)	(0.41)	(0.45)	(0.44)	(0.35)	(0.36)
WSTCHRG_FREQ	0.09	0.09	0.05	0.34	0.26	0.11	0.44	0.41	0.47	0.54
	(0.44)	(0.46)	(0.43)	(0.44)	(0.42)	(0.42)	(0.45)	(0.45)	(0.35)	(0.36)
COLLFREQ_CLASS_1	-0.11	-0.12	-0.14*	-0.08	-0.19***	-0.16**	-0.09	-0.12	-0.30***	-0.29***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.07)	(0.07)	(0.08)	(0.08)	(0.06)	(0.06)
COLLFREQ_CLASS_2	-0.21***	-0.21***	-0.17***	-0.13**	-0.18***	-0.17***	-0.13*	-0.16**	-0.29***	-0.26***
	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.05)	(0.05)
RCYCLCOLDTD_X	0.99***	1.22***	1.49***	1.55***	1.70***	1.60***	1.15***	1.26***	0.98***	0.99***
	(0.14)	(0.14)	(0.12)	(0.12)	(0.10)	(0.10)	(0.11)	(0.11)	(0.06)	(0.07)
RCYCLFREQ_X_1	-0.11	-0.13	-0.54***	-0.48***	-0.53***	-0.36***	-0.31**	-0.31**	-0.01	-0.02
	(0.17)	(0.17)	(0.15)	(0.15)	(0.13)	(0.13)	(0.13)	(0.13)	(0.09)	(0.09)
RCYCLFREQ_X_2	-0.01	-0.05	-0.16	-0.06	-0.25***	-0.09	-0.17*	-0.22**	-0.08	-0.09
	(0.14)	(0.14)	(0.12)	(0.12)	(0.10)	(0.10)	(0.10)	(0.10)	(0.06)	(0.07)
RCYCLCOLDOF_X	0.72***	0.79***	0.94***	1.01***	1.08***	1.07***	0.79***	0.87***	0.67***	0.68***
	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)	(0.06)	(0.09)	(0.08)	(0.05)	(0.05)
RCYCLCOLRFD_X	0.42***	0.61***	1.06***	1.21***	0.95***	1.07***	0.51***	0.79***	0.42***	0.51***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.10)	(0.10)	(0.14)	(0.15)	(0.16)	(0.15)
RCYCLCOLBBK_X	0.30**	0.37***	0.59***	0.69***	0.55***	0.48***	0.25*	0.53***	0.71***	0.75***
	(0.15)	(0.14)	(0.16)	(0.16)	(0.15)	(0.14)	(0.15)	(0.15)	(0.14)	(0.15)
MTVRCYLENVR_LRKT	0.28***	0.26***	0.18***	0.19***	0.20***	0.22***	0.28***	0.29***	0.10***	0.11***
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)
MTVRCYLDUTY_LRKT	0.12***	0.10***	0.10***	0.10***	0.05	0.03	0.12***	0.11***	0.05	0.05
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
MTVRCYLRESP_LRKT	-0.01	0.01	0.03	0.04	-0.01	-0.01	0.02	0.01	-0.02	-0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
MTVRCYLMAND	0.36***	0.30***	0.20**	0.11	0.11	0.03	0.28***	0.27***	0.00	0.01
	(0.10)	(0.10)	(0.10)	(0.10)	(0.09)	(0.09)	(0.10)	(0.10)	(0.08)	(0.08)
MTVRCYLMAND_LRKT	-0.04	-0.04	0.01	0.04	-0.00	0.02	-0.00	0.00	0.08***	0.08***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
UF_INCOME	0.00	0.00	0.00	0.00*	-0.00	0.00	0.00	0.00	0.00*	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
UF_RESOWNR	0.01	-0.11	-0.03	-0.10	-0.19	-0.28**	-0.31**	-0.36**	0.13	0.11
	(0.13)	(0.14)	(0.13)	(0.13)	(0.12)	(0.12)	(0.14)	(0.15)	(0.11)	(0.11)
UF_HOUSE	0.33***	0.35***	0.22*	0.25*	-0.13	-0.17	0.05	0.07	-0.42***	-0.39***
	(0.13)	(0.14)	(0.13)	(0.13)	(0.12)	(0.13)	(0.13)	(0.14)	(0.10)	(0.11)
UF_RESDROOMS	-0.04	-0.03	-0.01	0.00	0.03	0.03	-0.04	-0.03	-0.04*	-0.04*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)
UF_GARDEN	-0.19	-0.13	-0.11	0.02	0.18	0.33*	0.05	0.13	-0.09	-0.09
	(0.19)	(0.20)	(0.19)	(0.19)	(0.17)	(0.18)	(0.18)	(0.18)	(0.16)	(0.16)
UF_URSUB	0.30**	0.25*	0.25*	0.19	-0.04	-0.06	-0.06	-0.09	0.12	0.17
	(0.13)	(0.13)	(0.13)	(0.13)	(0.12)	(0.12)	(0.14)	(0.14)	(0.11)	(0.11)
UF_SERVICE_X	-0.12	-0.07	-0.19	-0.28**	-0.28**	-0.21	0.09	0.08	-0.26**	-0.27***
	(0.17)	(0.17)	(0.14)	(0.14)	(0.14)	(0.13)	(0.17)	(0.17)	(0.11)	(0.11)
UF_MANDATED	-0.46**	-0.41*	-0.17	-0.38*	-0.29	-0.37*	-0.33	-0.39	-0.15	-0.21
	(0.22)	(0.24)	(0.20)	(0.22)	(0.20)	(0.21)	(0.24)	(0.24)	(0.18)	(0.19)

Variable	Glass		Plastic		Aluminum		Paper		Food	
	Binary	Multi	Binary	Multi	Binary	Multi	Binary	Multi	Binary	Multi
UF_MTVRCYLDUTY_LRKT	0.05	0.07	0.05	0.00	0.06	0.03	-0.00	0.00	-0.06	-0.06
	(0.08)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.07)	(0.07)
UF_MTVRCYLRESP_LRKT	-0.04	-0.07	-0.08	-0.07	0.02	0.06	-0.01	-0.01	0.11**	0.12**
	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.05)	(0.05)
Intercept	-1.15***	-1.20***	-1.42***	-1.16***	-1.49***	-1.33***	-1.15***	-1.23***	-1.41***	-1.39***
	(0.29)	(0.31)	(0.27)	(0.29)	(0.26)	(0.27)	(0.29)	(0.31)	(0.23)	(0.24)
$\hat{\rho}_{21}$		0.56***		0.56***		0.56***		0.56***		0.56***
		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)
$\hat{\rho}_{31}$		0.45***		0.45***		0.45***		0.45***		0.45***
		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)
$\hat{\rho}_{41}$		0.37***		0.37***		0.37***		0.37***		0.37***
		(0.03)		(0.03)		(0.03)		(0.03)		(0.03)
$\hat{\rho}_{51}$		0.15***		0.15***		0.15***		0.15***		0.15***
		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)
$\hat{\rho}_{32}$		0.52***		0.52***		0.52***		0.52***		0.52***
		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)
$\hat{\rho}_{42}$		0.42***		0.42***		0.42***		0.42***		0.42***
		(0.03)		(0.03)		(0.03)		(0.03)		(0.03)
$\hat{\rho}_{52}$		0.17***		0.17***		0.17***		0.17***		0.17***
		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)
$\hat{\rho}_{43}$		0.38***		0.38***		0.38***		0.38***		0.38***
		(0.03)		(0.03)		(0.03)		(0.03)		(0.03)
$\hat{\rho}_{53}$		0.21***		0.21***		0.21***		0.21***		0.21***
		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)
$\hat{\rho}_{54}$		0.23***		0.23***		0.23***		0.23***		0.23***
		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)
Number of Observations	6918	6250	6887	6250	6699	6250	6894	6250	6569	6250
Log Likelihood	-2025	-11000	-2261	-11000	-2901	-11000	-1927	-11000	-3693	-11000
Wald χ^2 Statistic	880.7	4736.2	1252.1	4736.2	1646.4	4736.2	784.8	4736.2	1365.3	4736.2

Notes: (1) *, **, and *** indicate significance at the 10%, 5%, and 1%, respectively; (2) figures in brackets are robust standard errors.

Table 3b. Recycling: marginal effects from the binary probit estimation

Variable	Glass	Plastic	Aluminum	Paper	Food
AUSTRALIA	0.02	0.04**	0.06*	0.03***	-0.17***
CANADA	-0.01	0.04**	0.04	-0.03	-0.13***
CZECHREP	-0.15***	-0.01	-0.47***	-0.03	-0.15***
FRANCE	-0.13***	-0.08***	-0.13***	-0.05**	-0.11***
ITALY	-0.07***	-0.05*	-0.07**	-0.06***	0.05
KOREA	0.03*	0.05***	0.19***	0.02	0.40***
MEXICO	-0.27***	-0.12***	-0.09**	-0.17***	0.01
NETHERLANDS	-0.03*	-0.35***	-0.44***	0.00	0.04
NORWAY	-0.11***	-0.17***	-0.18***	0.03***	0.11***
STATUS_MARRIED	0.01**	0.03***	0.03*	0.01*	0.00
GENDER_MALE	0.00	-0.01*	0.04***	-0.01*	-0.01
AGE_CLASS_1	0.00	0.05***	-0.10***	-0.02	-0.03
AGE_CLASS_2	-0.01	0.05***	-0.05**	-0.02*	-0.02
AGE_CLASS_3	0.02	0.04***	-0.00	-0.01	-0.02
AGE_CLASS_4	-0.01	0.02*	0.01	-0.02	0.00
ADULTS	-0.00	0.00	0.00	0.00	0.00
UNDER5	-0.01**	-0.02**	0.01	-0.01*	0.00
BETWEEN5AND18	-0.01	-0.00	0.01	-0.00	0.00
EDUC_CLASS_1	-0.03*	-0.00	-0.03	-0.03*	0.05
EDUC_CLASS_2	-0.03**	-0.00	-0.04*	-0.01	0.00
EDUC_CLASS_3	-0.04***	-0.00	-0.02	-0.00	0.03
EDUC_CLASS_4	-0.02	-0.01	-0.01	0.01	0.01
EMPL_FULLTIME	0.01	0.03*	0.05	0.02	0.03
EMPL_PARTTIME	-0.01	0.02	0.06**	0.01	0.04
EMPL_RETIRED	-0.00	0.03*	0.06**	0.00	0.07**
EMPL_HOMEMAKER	-0.01	0.01	0.06**	0.02**	0.03
EMPL_STUDENT	-0.03	-0.01	0.05	0.01	-0.00
EMPL_LEAVE	-0.00	-0.02	-0.01	-0.01	-0.10*
OCCUP_1	-0.01	-0.02	0.00	-0.01	-0.03
OCCUP_2	-0.01	-0.03	-0.06**	-0.01	-0.05*
OCCUP_3	0.01	-0.01	-0.02	0.00	0.01
OCCUP_4	0.00	-0.03*	-0.04	0.01	-0.05**
OCCUP_5	-0.00	-0.03	-0.01	0.01	-0.03
INCOME_CONT	0.00**	0.00	0.00	0.00	0.00
RESOWNR	0.01	-0.01	0.01	0.01	0.01
RESTYPE_HOUSE	-0.02*	-0.02*	0.02	-0.02***	0.09***
RESDROOMS	0.01***	0.00	0.00	0.00***	0.01*
GARDEN	0.02	0.04**	0.01	0.00	0.04*
AREADESC_URBAN	-0.00	0.00	0.00	0.01	-0.07***
AREADESC_SUBURBAN	-0.01	0.00	-0.01	0.00	-0.06***
RESDYRS_CLASS_1	-0.02	-0.04***	-0.05**	-0.02	-0.05**
RESDYRS_CLASS_2	-0.02	-0.01	-0.04*	-0.01	-0.05**
RESDYRS_CLASS_3	-0.02*	-0.03***	-0.04**	-0.02*	-0.01
ENVRANK	-0.00	-0.00	-0.01***	-0.01***	-0.01
WSTE_CNCRN	0.01	-0.01	-0.05*	0.02	0.02
ENVCNCRN_INDX	0.02***	0.02***	0.05***	0.00	0.02*
ENVATTIT_INDX	0.01***	0.01**	0.04***	0.01	-0.02

Variable	Glass	Plastic	Aluminum	Paper	Food
WSTCHRG_WEIGHT	0.00	-0.02	0.15*	0.04	0.24**
WSTCHRG_VOL	0.05	0.04	0.15	0.07***	0.21*
WSTCHRG_FREQ	0.01	0.01	0.08	0.04	0.18
COLLFREQ_CLASS_1	-0.02	-0.03*	-0.06***	-0.01	-0.12***
COLLFREQ_CLASS_2	-0.03***	-0.03***	-0.06***	-0.02**	-0.12***
RCYCLCOLDTD_X	0.11***	0.21***	0.43***	0.16***	0.37***
RCYCLFREQ_X_1	-0.02	-0.13***	-0.19***	-0.05**	-0.00
RCYCLFREQ_X_2	-0.00	-0.03	-0.09**	-0.03	-0.03
RCYCLCOLDOF_X	0.11***	0.15***	0.34***	0.11***	0.26***
RCYCLCOLRFD_X	0.05***	0.12***	0.22***	0.05***	0.16***
RCYCLCOLBBK_X	0.03***	0.07***	0.15***	0.03**	0.26***
MTVRCYLENVR_LRKT	0.04***	0.03***	0.06***	0.04***	0.04***
MTVRCYLDUTY_LRKT	0.02***	0.02***	0.02	0.02***	0.02
MTVRCYLRESP_LRKT	-0.00	0.01	0.00	0.00	-0.01
MTVRCYLMAND	0.06***	0.04*	0.04	0.05***	0.00
MTVRCYLMAND_LRKT	-0.01	0.00	-0.00	-0.00	0.03***
UF_INCOME	0.00	0.00	-0.00	0.00	0.00*
UF_RESOWNR	0.00	-0.01	-0.06	-0.05**	0.05
UF_HOUSE	0.04***	0.03*	-0.04	0.01	-0.16***
UF_RESDROOMS	-0.01	-0.00	0.01	0.00	-0.02*
UF_GARDEN	-0.03	-0.02	0.06	0.01	-0.04
UF_URSUB	0.04***	0.04**	-0.01	-0.01	0.05
UF_SERVICE_X	-0.02	-0.04	-0.10**	0.01	-0.10**
UF_MANDATED	-0.08*	-0.03	-0.10	-0.05	-0.06
UF_MTVRCYLDUTY_LRKT	0.01	0.01	0.02	0.00	-0.02
UF_MTVRCYLRESP_LRKT	-0.01	-0.01	0.01	-0.00	0.04**
Probability	0.9243	0.8983	0.7340	0.9289	0.5189

Note: *, **, and *** indicate significance at the 10%, 5%, and 1%, respectively.

Table 4. Recycling: ordered probit estimation results

Variable	Glass	Plastic	Aluminum	Paper	Food
AUSTRALIA	-0.24 (0.09)***	-0.21 (0.08)***	0.08 (0.08)	-0.21 (0.08)***	-0.49 (0.09)***
CANADA	-0.29 (0.08)***	-0.23 (0.08)***	0.02 (0.08)	-0.24 (0.08)***	-0.41 (0.09)***
CZECHREP	-1.20 (0.08)***	-0.74 (0.08)***	-1.46 (0.10)***	-0.78 (0.08)***	-0.50 (0.10)***
FRANCE	-0.44 (0.08)***	-0.18 (0.08)**	-0.28 (0.08)***	-0.26 (0.08)***	-0.28 (0.08)***
ITALY	-0.41 (0.08)***	-0.30 (0.08)***	-0.18 (0.08)**	-0.29 (0.07)***	0.17 (0.08)**
KOREA	-0.65 (0.09)***	-0.55 (0.09)***	0.02 (0.09)	-0.57 (0.09)***	0.54 (0.09)***
MEXICO	-1.46 (0.09)***	-1.04 (0.09)***	-0.47 (0.09)***	-1.11 (0.09)***	-0.18 (0.10)*
NETHERLANDS	-0.24 (0.07)***	-1.24 (0.08)***	-1.22 (0.08)***	0.07 (0.07)	0.08 (0.07)
NORWAY	-0.48 (0.08)***	-0.78 (0.08)***	-0.44 (0.08)***	-0.03 (0.08)	0.19 (0.08)**
STATUS_MARRIED	0.05 (0.03)	0.07 (0.03)**	0.05 (0.04)	0.03 (0.03)	0.02 (0.04)
GENDER_MALE	0.02 (0.03)	-0.01 (0.03)	0.10 (0.03)***	-0.02 (0.03)	0.00 (0.03)
AGE_CLASS_1	-0.07 (0.07)	0.12 (0.07)*	-0.31 (0.07)***	-0.23 (0.07)***	-0.18 (0.07)**
AGE_CLASS_2	-0.04 (0.05)	0.16 (0.05)***	-0.16 (0.06)***	-0.16 (0.05)***	-0.12 (0.06)**
AGE_CLASS_3	0.05 (0.05)	0.17 (0.05)***	0.01 (0.06)	-0.08 (0.05)	-0.07 (0.06)
AGE_CLASS_4	-0.03 (0.05)	0.08 (0.05)*	0.04 (0.05)	-0.03 (0.05)	-0.06 (0.05)
ADULTS	-0.00 (0.02)	0.00 (0.02)	-0.01 (0.02)	-0.01 (0.02)	-0.00 (0.02)
UNDER5	-0.08 (0.03)***	-0.06 (0.03)*	-0.01 (0.03)	-0.05 (0.03)	-0.02 (0.03)
BETWEEN5AND18	-0.04 (0.02)**	-0.01 (0.02)	-0.02 (0.02)	0.00 (0.02)	0.00 (0.02)
EDUC_CLASS_1	-0.30 (0.07)***	-0.11 (0.07)*	-0.16 (0.07)**	-0.16 (0.07)**	0.08 (0.08)
EDUC_CLASS_2	-0.18 (0.06)***	-0.03 (0.06)	-0.11 (0.06)*	-0.04 (0.06)	0.00 (0.06)
EDUC_CLASS_3	-0.19 (0.06)***	-0.03 (0.06)	-0.09 (0.06)	-0.05 (0.05)	0.08 (0.06)
EDUC_CLASS_4	-0.08 (0.06)	-0.05 (0.05)	0.00 (0.06)	0.03 (0.05)	0.04 (0.06)
EMPL_FULLTIME	0.05 (0.07)	0.09 (0.07)	0.14 (0.07)*	0.04 (0.07)	-0.01 (0.08)
EMPL_PARTTIME	0.05 (0.08)	0.05 (0.08)	0.18 (0.08)**	0.08 (0.08)	0.03 (0.08)
EMPL_RETIRED	0.03 (0.08)	0.09 (0.08)	0.22 (0.09)***	0.05 (0.08)	0.08 (0.09)
EMPL_HOMEMAKER	-0.02 (0.07)	-0.04 (0.07)	0.16 (0.08)**	0.07 (0.07)	0.04 (0.08)
EMPL_STUDENT	-0.03 (0.08)	-0.03 (0.08)	0.17 (0.09)**	-0.08 (0.08)	-0.02 (0.09)
EMPL_LEAVE	-0.06 (0.12)	-0.11 (0.12)	0.01 (0.13)	-0.06 (0.13)	-0.24 (0.15)
OCCUP_1	-0.08 (0.07)	-0.06 (0.07)	-0.02 (0.07)	-0.08 (0.06)	-0.03 (0.07)
OCCUP_2	-0.07 (0.07)	-0.08 (0.07)	-0.14 (0.07)**	-0.08 (0.06)	-0.11 (0.07)*
OCCUP_3	0.04 (0.08)	-0.02 (0.08)	-0.02 (0.08)	0.09 (0.08)	0.04 (0.08)
OCCUP_4	-0.08 (0.06)	-0.10 (0.06)*	-0.12 (0.06)**	-0.03 (0.05)	-0.10 (0.06)*
OCCUP_5	0.00 (0.07)	-0.07 (0.07)	0.02 (0.07)	-0.04 (0.07)	-0.01 (0.07)
INCOME_CONT	0.00 (0.00)***	0.00 (0.00)**	0.00 (0.00)*	0.00 (0.00)	0.00 (0.00)
RESOWNR	0.14 (0.04)***	0.08 (0.04)**	0.09 (0.04)**	0.08 (0.04)**	0.06 (0.04)
RESTYPE_HOUSE	-0.00 (0.04)	0.01 (0.04)	0.07 (0.05)	-0.01 (0.04)	0.23 (0.05)***
RESDROOMS	0.03 (0.01)***	0.01 (0.01)	0.00 (0.01)	0.02 (0.01)*	0.02 (0.01)**
GARDEN	0.04 (0.05)	0.05 (0.05)	-0.04 (0.06)	-0.04 (0.05)	0.12 (0.06)*
AREADESC_URBAN	0.04 (0.05)	-0.01 (0.05)	-0.01 (0.05)	0.04 (0.04)	-0.20 (0.05)***
AREADESC_SUBURBAN	0.02 (0.05)	-0.01 (0.04)	-0.02 (0.05)	0.00 (0.04)	-0.16 (0.05)***
RESDYRS_CLASS_1	-0.13 (0.05)***	-0.12 (0.05)**	-0.12 (0.05)**	-0.09 (0.05)*	-0.12 (0.05)**
RESDYRS_CLASS_2	-0.11 (0.04)***	-0.10 (0.04)**	-0.11 (0.05)**	-0.06 (0.04)	-0.15 (0.05)***
RESDYRS_CLASS_3	-0.13 (0.04)***	-0.12 (0.04)***	-0.08 (0.04)*	-0.07 (0.04)*	-0.06 (0.04)
ENVRANK	-0.03 (0.01)***	-0.01 (0.01)	-0.03 (0.01)***	-0.04 (0.01)***	-0.02 (0.01)

Variable	Glass	Plastic	Aluminum	Paper	Food
WSTE_CNCRN	0.18 (0.07)***	-0.03 (0.07)	-0.12 (0.08)*	0.10 (0.07)	0.05 (0.08)
ENVCNCRN_INDX	0.02 (0.03)	0.07 (0.03)**	0.10 (0.03)***	0.03 (0.03)	0.06 (0.03)**
ENVATTIT_INDX	0.12 (0.02)***	0.06 (0.02)***	0.11 (0.02)***	0.03 (0.02)	-0.02 (0.02)
WSTCHRG_WEIGHT	0.27 (0.28)	0.11 (0.28)	0.47 (0.30)	0.30 (0.31)	0.77 (0.30)***
WSTCHRG_VOL	0.49 (0.28)*	0.34 (0.27)	0.52 (0.30)*	0.56 (0.30)**	0.71 (0.30)**
WSTCHRG_FREQ	0.33 (0.29)	0.23 (0.27)	0.45 (0.31)	0.33 (0.31)	0.70 (0.30)**
COLLFREQ_CLASS_1	-0.09 (0.05)*	-0.12 (0.05)**	-0.15 (0.05)***	-0.09 (0.05)*	-0.31 (0.05)***
COLLFREQ_CLASS_2	-0.09 (0.04)**	-0.12 (0.04)***	-0.14 (0.04)***	-0.08 (0.04)**	-0.29 (0.05)***
RCYCLCOLDTD_X	0.71 (0.07)***	0.91 (0.06)***	1.30 (0.07)***	0.76 (0.06)***	0.90 (0.06)***
RCYCLFREQ_X_1	-0.32 (0.08)***	-0.39 (0.08)***	-0.44 (0.08)***	-0.13 (0.08)*	0.02 (0.07)
RCYCLFREQ_X_2	-0.15 (0.07)**	-0.18 (0.06)***	-0.21 (0.06)***	-0.08 (0.05)	-0.03 (0.06)
RCYCLCOLDOF_X	0.43 (0.05)***	0.52 (0.05)***	0.82 (0.05)***	0.48 (0.05)***	0.60 (0.05)***
RCYCLCOLRFD_X	0.23 (0.04)***	0.75 (0.05)***	0.67 (0.07)***	0.23 (0.10)**	0.38 (0.12)***
RCYCLCOLBBK_X	0.10 (0.09)	0.23 (0.09)**	0.47 (0.11)***	0.18 (0.10)*	0.61 (0.11)***
MTVRCYLENVR_LRKT	0.29 (0.03)***	0.24 (0.03)***	0.21 (0.03)***	0.27 (0.03)***	0.15 (0.03)***
MTVRCYLDUTY_LRKT	0.13 (0.03)***	0.11 (0.03)***	0.09 (0.03)***	0.16 (0.03)***	0.07 (0.03)**
MTVRCYLRESP_LRKT	-0.03 (0.02)	0.01 (0.02)	-0.03 (0.02)	-0.01 (0.02)	-0.03 (0.02)*
MTVRCYLMAND	0.28 (0.07)***	0.18 (0.07)***	0.09 (0.07)	0.19 (0.07)***	0.01 (0.08)
MTVRCYLMAND_LRKT	-0.06 (0.02)***	-0.03 (0.02)	0.01 (0.02)	-0.02 (0.02)	0.08 (0.02)***
UF_INCOME	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
UF_RESOWNR	-0.16 (0.08)**	-0.11 (0.08)	-0.23 (0.08)	-0.19 (0.08)***	-0.00 (0.08)
UF_HOUSE	0.01 (0.08)	-0.06 (0.08)	-0.13 (0.08)	-0.04 (0.08)	-0.36 (0.08)***
UF_RESDROOMS	0.00 (0.02)	0.01 (0.02)	0.05 (0.02)	0.00 (0.02)	-0.02 (0.02)
UF_GARDEN	-0.09 (0.11)	-0.01 (0.11)	0.06 (0.12)	-0.02 (0.11)	-0.18 (0.12)
UF_URSUB	0.02 (0.08)	0.01 (0.09)	-0.08 (0.09)	-0.03 (0.08)	0.08 (0.09)
UF_SERVICE_X	0.06 (0.12)	0.08 (0.10)	-0.20 (0.11)	0.12 (0.13)	-0.29 (0.10)***
UF_MANDATED	-0.42 (0.15)***	-0.16 (0.14)	-0.33 (0.15)	-0.31 0.16)**	-0.12 (0.16)
UF_MTVRCYLDUTY_LRKT	0.01 (0.05)	0.01 (0.05)	0.08 (0.06)	0.01 (0.05)	-0.06 (0.06)
UF_MTVRCYLRESP_LRKT	0.00 (0.04)	-0.05 (0.04)	-0.03 (0.04)	-0.03 (0.04)	0.08 (0.04)**
Number of Observations	6681	6722	6498	6732	6338
Log Likelihood	-8293.4	-8622.4	-7758.2	-8567.7	-7292.1
χ^2 Statistic	1822.1	1692.1	2066.5	1565.5	1461.5

Notes: (1) *, **, and *** indicate significance at the 10%, 5%, and 1%, respectively; (2) figures in brackets are robust standard errors.

Table 5. Waste prevention: probit and ordered probit estimation results

Variable	Binary Probit		Ordered Probit
	Coefficient	Marginal Effect	
AUSTRALIA	-1.57 (0.10)***	-0.48 (0.02)***	0.31 (0.07)***
CANADA	-0.65 (0.09)***	-0.25 (0.03)***	0.19 (0.07)***
CZECHREP			0.06 (0.08)
FRANCE	-1.30 (0.10)***	-0.43 (0.02)***	0.12 (0.07)*
ITALY	-1.42 (0.09)***	-0.47 (0.02)***	0.04 (0.06)
KOREA	-2.08 (0.11)***	-0.55 (0.01)***	0.12 (0.07)*
MEXICO	-0.21 (0.12)*	-0.08 (0.05)*	0.27 (0.08)***
NETHERLANDS	-1.26 (0.10)***	-0.42 (0.02)***	0.01 (0.07)
NORWAY	-1.01 (0.10)***	-0.36 (0.03)***	0.41 (0.07)***
STATUS_MARRIED	-0.02 (0.04)	-0.01 (0.02)	0.03 (0.03)
GENDER_MALE	0.12 (0.04)***	0.05 (0.02)***	-0.05 (0.03)*
AGE_CLASS_1	0.38 (0.08)***	0.15 (0.03)***	0.11 (0.06)*
AGE_CLASS_2	0.29 (0.06)***	0.12 (0.02)***	0.09 (0.05)*
AGE_CLASS_3	0.19 (0.06)***	0.08 (0.02)***	0.01 (0.05)
AGE_CLASS_4	0.10 (0.06)*	0.04 (0.02)*	0.04 (0.04)
ADULTS	0.02 (0.02)	0.01 (0.01)	0.01 (0.02)
UNDER5	0.02 (0.04)	0.01 (0.02)	-0.01 (0.03)
BETWEEN5AND18	0.01 (0.02)	0.00 (0.01)	0.01 (0.02)
EDUC_CLASS_1	-0.14 (0.08)*	-0.06 (0.03)*	-0.06 (0.06)
EDUC_CLASS_2	-0.15 (0.07)**	-0.06 (0.03)**	-0.03 (0.05)
EDUC_CLASS_3	-0.03 (0.07)	-0.01 (0.03)	-0.03 (0.05)
EDUC_CLASS_4	-0.02 (0.07)	-0.01 (0.03)	-0.05 (0.05)
EMPL_FULLTIME	-0.21 (0.07)***	-0.08 (0.03)***	0.00 (0.05)
EMPL_PARTTIME	-0.17 (0.08)**	-0.07 (0.03)**	-0.00 (0.06)
EMPL_RETIRED	-0.13 (0.08)	-0.05 (0.03)	0.01 (0.06)
EMPL_HOMEMAKER	-0.22 (0.09)**	-0.09 (0.04)**	0.09 (0.07)
EMPL_STUDENT	-0.16 (0.11)	-0.06 (0.04)	-0.03 (0.08)
EMPL_LEAVE	-0.02 (0.15)	-0.01 (0.06)	0.04 (0.11)
INCOME_CONT	-0.00 (0.00)*	-0.00 (0.00)*	0.00 (0.00)
RESTYPE_HOUSE	-0.04 (0.04)	-0.02 (0.02)	-0.03 (0.03)
GARDEN	0.11 (0.06)*	0.04 (0.02)*	0.11 (0.04)***
AREADESC_URBAN	-0.02 (0.05)	-0.01 (0.02)	-0.09 (0.04)**
AREADESC_SUBURBAN	-0.01 (0.05)	0.00 (0.02)	-0.13 (0.04)***
ENVRANK	-0.05 (0.01)***	-0.02 (0.00)***	-0.01 (0.01)
WSTE_CNCRN	0.08 (0.09)	0.03 (0.04)	-0.06 (0.06)
ENVCNCRN_INDX	0.14 (0.04)***	0.06 (0.01)***	0.26 (0.03)***
ENVATTIT_INDX	0.12 (0.03)***	0.05 (0.01)***	-0.01 (0.02)
USERFEE	0.05 (0.06)	0.02 (0.02)	0.11 (0.04)***
COLLFREQ_CLASS_1	-0.13 (0.06)**	-0.05 (0.03)**	
COLLFREQ_CLASS_2	-0.06 (0.05)	-0.03 (0.02)	
RCYCLCOLDTD_GLAS	-0.02 (0.11)	-0.01 (0.05)	-0.05 (0.06)
RCYCLFREQ_GLAS_1	-0.31 (0.18)*	-0.12 (0.07)*	
RCYCLFREQ_GLAS_2	-0.06 (0.12)	-0.03 (0.05)	
RCYCLCOLDOF_GLAS	-0.11 (0.07)	-0.04 (0.03)	-0.04 (0.05)
RCYCLCOLRFD_GLAS	0.00 (0.06)	0.00 (0.02)	0.05 (0.04)
RCYCLCOLBBK_GLAS	-0.30 (0.13)**	-0.12 (0.05)**	-0.06 (0.09)

Variable	Binary Probit		Ordered Probit
	Coefficient	Marginal Effect	
RCYCLCOLDTD_PLST	0.04 (0.10)	0.02 (0.04)	0.10 (0.06)
RCYCLFREQ_PLST_1	-0.33 (0.22)	-0.13 (0.08)	
RCYCLFREQ_PLST_2	-0.06 (0.13)	-0.02 (0.05)	
RCYCLCOLDOF_PLST	0.02 (0.07)	0.01 (0.03)	0.02 (0.05)
RCYCLCOLRFD_PLST	0.04 (0.07)	0.02 (0.03)	0.03 (0.05)
RCYCLCOLBBK_PLST	0.08 (0.14)	0.03 (0.06)	0.07 (0.10)
RCYCLCOLDTD_MTAL	0.18 (0.11)*	0.07 (0.04)*	0.09 (0.06)
RCYCLFREQ_MTAL_1	0.37 (0.22)*	0.15 (0.08)*	
RCYCLFREQ_MTAL_2	-0.14 (0.13)	-0.06 (0.05)	
RCYCLCOLDOF_MTAL	0.16 (0.06)***	0.06 (0.02)***	0.08 (0.04)**
RCYCLCOLRFD_MTAL	0.07 (0.09)	0.03 (0.03)	0.11 (0.06)**
RCYCLCOLBBK_MTAL	0.13 (0.15)	0.05 (0.06)	0.10 (0.10)
RCYCLCOLDTD_PAPR	-0.04 (0.09)	-0.02 (0.04)	
RCYCLFREQ_PAPR _1	0.06 (0.17)	0.03 (0.07)	
RCYCLFREQ_PAPR _2	0.10 (0.09)	0.04 (0.04)	
RCYCLCOLDOF_PAPR	-0.02 (0.08)	-0.01 (0.03)	
RCYCLCOLRFD_PAPR	-0.08 (0.14)	-0.03 (0.06)	
RCYCLCOLBBK_PAPR	0.03 (0.16)	0.01 (0.06)	
MTVRCYLENVR_LRKT	0.20 (0.04)***	0.08 (0.02)***	0.19 (0.03)***
MTVRCYLDUTY_LRKT	0.09 (0.03)***	0.03 (0.01)***	0.11 (0.02)***
MTVRCYLRESP_LRKT	0.01 (0.02)	0.01 (0.01)	0.05 (0.02)***
MTVRCYLMAND	0.22 (0.08)***	0.09 (0.03)***	0.09 (0.06)
MTVRCYLMAND_LRKT	-0.07 (0.02)***	-0.03 (0.01)***	0.00 (0.02)
Intercept	-0.42 (0.23)*		
Number of Observations	6225		7027
Log Likelihood	-3460.4		-7866.2
Wald χ^2 Statistic	1396.8		616.9
Probability		0.4865	

Notes: (1) *, **, and *** indicate significance at the 10%, 5%, and 1%, respectively; (2) figures in brackets are robust standard errors.