Reduce, Reuse or Recycle? Household Decisions over Waste Prevention and Recycling

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Abstract

Households have choices when it comes to reducing waste sent to landfills: reduction of consumption or packaging, reuse of goods purchased, or recycling. In this paper, we adopt a holistic approach to the analysis of these choices as separate but related facets of households' waste management behaviour. Theoretically, households produce waste as a by-product of their consumption and must then deal with it either by curbside disposal or by recycling. To the extent that managing additional waste is costly even if only in terms of time, households may also engage in waste prevention, that is, produce less waste by reducing their consumption level and/or changing their consumption patterns in favour of less waste-intensive products. As curbside disposal, waste prevention and recycling relate to the same problem and are linked via several constraints, we employ a three-equation mixed process estimation strategy which allows for the error terms of the three equations to be correlated. For the study, we rely on an original data set that permits defining waste prevention comprehensively from a list of 19 waste prevention activities, that provides for a more balanced policy representation (in terms of presence versus absence of unit pricing), and that covers a wide range of attitudinal elements, values, and norms. Given the richness of the data set, we also examine individuals' decisions over recyclable items that carry a refundable deposit in terms of both purchasing and returning habits, with particular attention to the interaction between a refundable deposit system and unit pricing.

Keywords: Curbside Disposal, Recycling, Waste Prevention, Unit Pricing, Deposit-Refund System, Values, Norms, Attitudes, Mixed-Process Model.

JEL Classifications: D04, H31, Q53, Q58.

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1 Introduction

Household waste constitutes one of the main components of municipal waste: in 2011, for example, households produced over 75% of municipal waste in Australia, Austria, Belgium, France, Germany, Korea, Luxembourg, Mexico, Netherlands, Norway, Slovak Republic, Switzerland, and United Kingdom, and more than 49% in all OECD countries (OECD, 2013b). Although municipal waste represents only a small fraction of the total waste generated (about 10%), its management and treatment tend to be resource-intensive, often requiring more than one-third of the public sector financial efforts earmarked for the abatement and control of pollution (OECD, 2013b).

From 1990 to 2012, the quantity of municipal waste generated in OECD countries increased by 22.5% from over 537 million tonnes to about 658 million tonnes; municipal waste per capita rose instead by 6% from 500 kg per capita to 530 kg per capita. However, this growth was accompanied by a substantial increase in the proportion of waste recovered through recycling and composting, from 19% in 1990 to 34% 2012, and, correspondingly, a substantial decrease in the proportion of waste landfilled from 60% to 45%, while the proportion of incinerated waste increased slightly from 20% to 22% (OECD 2014). Canada experienced the lowest increase in recovery rate from 22% in 1996 to 24% in 2010, while Italy and the United Kingdom experienced the largest increases from 5% and 7% in 1995 to 37% and 42% in 2011; in 2010, (*i*) Japan had the lowest recovery rate (19%), followed by Canada (24%) and the U.S.A. (34%), while Germany had the largest (63%), (*ii*) Canada had the largest proportion of waste landfilled (72%), followed by the U.S.A. (54%), while Germany and Japan had the lowest (0% and 1%), and (*iii*) Japan had the largest proportion of waste incinerated (76%), while Canada had the lowest (4%).[1]

In addition to improvements in recovery rates, waste increased at a lower rate than private final consumption expenditure for most of the OECD countries over the 1990 to 2012 period: only seven experienced a growth rate in per capita municipal waste in excess of the growth rate in per capita private final consumption expenditure, and, in half of the remaining countries, per capita municipal waste actually decreased.[2] This decrease is certainly emblematic of a move towards more environmentally sustainable consumption patterns, but much work is still needed as large amounts of waste continue to be generated and landfill

[1] Although we do not separate between incineration with energy recovery and incineration without energy recovery due to lack of consistent data across the seven countries and over the 12-year period, most of the incineration within the countries for which we have data was carried out with energy recovery, at least in more recent years. In 2012, France incinerated 32% of its municipal waste with energy recovery and 1% without recovery; in 2010, over 93% of Japan's incineration was with energy recovery; all of the incineration in Italy, U.K., and U.S.A. in the last year for which we have data (2011 in the first two cases and 2010 in the last case) was with energy recovery (OECD, 2014).

[2] For the per capita municipal waste growth rates, we use the 1990 and 2012 figures if they are available; otherwise, we use the earliest post-1990 available figure and the latest pre-2012 available figure.

remains the main disposal method in most OECD countries.

Much of the focus of academic and policy work in the household waste area has been on improving upon our understanding of what determines households' waste management decisions, most notably with respect to waste disposal and recycling. Not surprisingly, academic interest in the subject matter has shifted away from theoretical formulations of households' waste management, which have characterized the early literature, to empirical analyses informed by, and consistent with, policy makers' waste reduction efforts in response to increased interest in devising policies to induce greener lifestyles and more environmentally sustainable consumption patterns. A common policy approach has entailed an emphasis on encouraging reduction, reuse of products or packaging, and recycling (i.e., the "three R's"). While reducing, reusing, and recycling are distinct facets of waste management, and often treated as separate policy targets, the decision to engage in one activity (e.g., reducing) is not independent of the decisions to engage in the other activities. Accordingly, we offer a comprehensive study of household waste management by jointly modelling the three decisions, contributing to the empirical literature in the area along several fronts.

First and foremost, we examine the determinants of engagement in *waste prevention* activities. Most of the studies to date focus on waste disposal or recycling or both; the few studies that consider source reduction and, specifically, how it responds to the implementation of unit pricing, draw their conclusions by estimating the effect on a total waste variable, which comprises disposed of and recycled wastes (e.g., Nestor and Podolsky, 1998; Hong, 1999; Van Houtven and Morris, 1999) or includes compostable waste in addition to unsorted and recyclable wastes (e.g., Dijkgraaf and Gradus, 2004), or by comparing the effects on waste disposal and recycling (e.g., Kinnaman and Fullerton, 2000). The only studies that attempt to measure waste prevention directly are Ferrara and Missios (2012 and 2014) but both can only narrowly define waste prevention because of data limitations. However, waste prevention encompasses much more than using refillable containers, reusable bags, paper with recycled content, and products with reduced packaging or toxic content. In this paper, we try to be as comprehensive as possible and include 19 activities, which we list in Table A.1 in the Appendix, in order to gauge waste prevention behaviour more accurately.

A second important contribution of this paper stems from its holistic approach to the study of waste management activities. A common feature of the existing empirical studies of household waste is that they consider waste disposal and reduction activities separately. Due to data constraints, most of these studies examine total discarded waste or recycling and the few that look at more than one activity (e.g., Hong et al., 1993; Fullerton and Kinnaman, 1996; Nestor and Podolsky, 1998; Hong and Adams, 1999; Sterner

and Bartelings, 1999; Van Houtven and Morris, 1999; Kinnaman and Fullerton, 2000; Linderhof et al., 2001; Dijkgraaf & Gradus, 2004; Ferrara and Missios, 2012) treat them as unrelated. The two exceptions are Hong (1999), which adopts a simultaneous equation model to allow for feedback effects between total waste generation and recycling, and Ferrara and Missios (2014), which employs a multivariate binary probit model to estimate the probabilities of specific engagement levels in mixed waste disposal, recycling, and waste prevention jointly but on an individual-specific basis allowing for correlation across the three binary choices. In this paper, we apply a new but extremely flexible procedure that utilizes maximum likelihood estimation (CMP or conditional mixed process) to estimate a three-equation model of household waste management involving a categorical variable for waste disposal, a categorical variable for recycling, and a continuous variable for waste prevention. The flexibility of the CMP module rests upon its ability to deal with a multi-equation system in either a seemingly unrelated regression setup, in which the dependent variables are generated by processes that are independent except for correlated errors, or a simultaneous equation framework, in which endogenous variables influence one another. The most salient features of this tool are that the data-generating processes within the multi-equation system can be mixed, different samples can be used for different models within the system via the inclusion of the Heckman selection model, and switching regressions can be implemented to allow for the modelling of variables to depend on the data.[3]

A third key contribution of this paper relates to the stratified nature of the data collection premised on the requirement that the sample be adequately representative of communities with some sort of unit pricing system to finance garbage collection services; the implication of this policy stratification is that we have a data set which is well balanced in terms of observations from communities with and without unit pricing programs. While the number of communities implementing user fees for garbage collection has increased drastically over the years,[4] the potentially higher administrative burden of unit pricing, likely coupled with monitoring cost concerns associated with the possibility of illegal forms of disposal in response to the program, has resulted in smaller-sized communities favouring the switch to unit pricing. As such communities tend to be under-represented in national and international random sampling of households precisely because of their size, it is challenging to draw conclusive statements about the effectiveness of unit pricing (or lack thereof) when empirical findings do not support the benefits postulated on the basis of theoretical considerations. Of the studies employing household-level data from communities with differing

[3] See Roodman (2011) for a complete description of CMP.

[4] In the U.S.A., 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 U.S. communities (Skumatz and Freeman 2007).

policy regimes to fund the collection of curbside waste (e.g., Sterner and Bartelings, 1999; Jenkins et al., 2003; Ferrara and Missios, 2005, 2012, and 2014), all but Ferrara and Missios (2005) lack strong evidence in support of the hypothesis of positive environmental benefits under user charges via less waste disposal, more recycling, and/or more waste prevention. The data sets in Jenkins et al. and Ferrara and Missios (2012 and 2014) share the feature of being under-represented in terms of observations from communities with unit pricing; on the other hand, the data set in Ferrara and Missios (2005), which is however confined to the study of recycling in a single Canadian province (Ontario), is rather balanced with about 40 percent of the surveyed households paying by the bag.

As a final contribution in the empirical analysis of the three waste management strategies, we utilize the most comprehensive survey to date in that it not only covers all aspects of household waste management behaviour (curbside disposal, recycling, and waste prevention) and all factors previously considered in the literature (in separate and independent studies) but it also includes additional elements to capture a range of influences most consistent with a complete view of decision-making and conducive to the study of possible complementarities or substitutabilities across different behavioural motivators.[5]

There are two other themes related to waste management which we consider in this paper as we exploit the richness of the data set. One of the two themes concerns the recycling of different types of materials (glass, plastic, newspapers and magazines, cardboard, aluminum, and food waste); the other theme pertains to the buying and returning of recyclables under a refundable deposit system, two waste management activities which largely remain unexplored in household-level studies. In the former case, the contributions to the literature amount, for the most part, to the same contributions as those above detailed in relation to the three waste management options, namely, (1) a holistic approach that allows to capture possible correlation possibilities between the intensities of recycling different materials, (2) a sample that is more balanced in terms of representation of communities with and without unit pricing resulting from the sample stratification strategy adopted for the data collection, and (3) a comprehensive data set that covers a wide range of behavioural influences. In the latter case, the main contribution to the literature rests upon the questions themselves which, ultimately, should aid in our objective to shed some light on the

[5]More recent empirical studies in the area explore the relevance of attitudinal characteristics (e.g., Ferrara and Missios, 2012), the effects of social and moral motives (e.g., Berglund and Matti, 2006; Halvorsen, 2008; Brekke et al., 2010; Ferrara and Missios, 2012 and 2014), and whether policy tools such as unit pricing and mandatory recycling tend to crowd in or crowd out intrinsic motivation for environmentally sound waste management choices (e.g., Ferrara and Missios, 2012 and 2014). The inclusion of attitudinal factors such as environmental concerns, norms, and values as determinants of behaviour reflects the realization that a better understanding of how people formulate judgements and make decisions in the waste area and, more generally, in any environment-related consumption area necessitates approaching decisions from a broader mindset that accounts for the sociological and psychological dimensions of decision making, in addition to the economic dimension, and for the interplay among different types of motivations.

effectiveness of refundable deposit systems at encouraging recycling and how it interacts with the presence of unit pricing.

In the section that follows, we detail the empirical framework in terms of our data and variables. We provide the results in section 3. Finally, in section 4, we present concluding remarks.

2 Empirical Framework

In this paper, we adopt a holistic approach to the study of the determinants of households' waste management behaviour. Theoretically, households produce waste as a by-product of their consumption and must then deal with it either by curbside disposal or by recycling. To the extent that managing additional waste is costly even if only in terms of time, households may also engage in waste prevention, that is, produce less waste by reducing their consumption level and/or changing their consumption patterns in favour of less waste-intensive products (such as choosing products with less packaging). Households then entertain three options: (1) curbside disposal, (2) recycling, and (3) waste prevention. As these options relate to the same problem and are, in fact, linked via several constraints,[6] it is reasonable to hypothesize that, although we can express the level of engagement in each option in reduced form and thus only as a function of exogenous variables, any unsystematic factor affecting the decision over a particular aspect of waste management has implications for the other aspects: a labour dispute in garbage collection services which affects waste disposal through the error term in the waste disposal equation is likely to affect recycling and waste prevention activities through the error terms in the recycling and waste prevention equations; a technological shock that increases the recyclability of the waste content of consumption goods translates into a positive random effect on waste prevention but is also likely to result into a positive random effect on recycling and a negative random effect on waste disposal.

Hence, the three waste management equations combine into a seemingly unrelated (SUR) system in the sense that no endogenous variable appears on the right-hand side of the other equations; however, their errors are correlated and share a multivariate normal distribution. While estimating the three equations separately would produce consistent estimates of parameters, results would tend to be less efficient as their generating process would ignore the full covariance structure of the multi-equation system. Needless to say, on matters of policy, the ability to predict accurately is particularly relevant as policy adjustments are

[6] Constraints linking the various waste management options are: (1) a waste constraint according to which waste production, which is a positive function of consumption, is equal to the sum of waste discarded (legally or illegally) and waste recycled; (2) a time constraint according to which an individual's total time endowment is equal to the sum of amounts of time spent at work, on leisure activities, and on waste management activities (e.g., sorting recyclables); (3) an income constraint according to which total income earned is equal to the sum of expenditures on consumption and waste management (e.g., use fee).

administratively costly and politically unwelcoming, especially for large-scale projects.

In addition to estimating the intensity of engagement in curbside disposal, recycling, and waste prevention, we explore the recycling decision more thoroughly by considering behavioural similarities and differences across various recyclables, namely, glass, plastic, newspapers and magazines, cardboard, aluminum cans, and food waste. For the same reasons as those above highlighted in support of the existence of linkages between any two waste management options via unsystematic effects, we postulate that a random event affecting the probability of recycling more of a particular recyclable item triggers random effects in the recycling intensity decisions over the other recyclable materials. We thus estimate the six recycling intensity decisions simultaneously with ordered probit models linked via their error terms.[7]

Finally, given the richness of the data set, we are able to examine individuals' decisions over recyclable items that carry a refundable deposit (that is, glass and plastic bottles and aluminum cans) in terms of both purchasing and returning habits. To the best of our knowledge, this is the first attempt at exploring the interaction between a refundable deposit system for particular recyclables and unit pricing and, specifically, the effects of unit pricing on individuals' decisions over (1) whether to buy containers with refundable deposits and (2) the proportion of containers with refundable deposits returned for partial or full refund (i.e., return intensity).

In estimating the parameters of the regression model for the return intensity decision, we recognize that our sample of individuals who buy containers with refundable deposits may suffer from selection on unobservables as the errors that determine the likelihood of buying containers with refundable deposits may be correlated with the errors determining the proportion of containers returned for refund: individuals may make a decision to buy containers with refundable deposits based on the proportion of containers they would return for refund. To account for said correlation, we estimate the parameters of an ordered probit sample-selection model for the return intensity outcome with selection on buying containers with refundable deposits. Even though our interest is on the ordinal outcome, the model involves two dependent variables as we need to model the sample selection process. We thus have the ordinal outcome (i.e., the return intensity) and a binary variable that indicates whether buying containers with refundable deposits is observed. We model the two dependent variables jointly as functions of the same covariates and normally distributed error terms which may be correlated. Based on the estimation results, however, we can only find support for the hypothesis of correlated error terms for glass containers. We then model the two decisions for

[7] We recognize that it would be more accurate to refer to the food waste recycling decision as the composting decision. However, for ease of exposition given the estimation strategy we employ and in accordance with the phrasing of the relevant survey questions with food waste treated as a type of recyclable, we adopt the convention of labelling composting as food waste recycling.

plastic containers and aluminum cans separately but also provide the results of the disjoint estimation of the buying and returning probabilities for glass containers.

2.1 Data

The collection of the data for our study was funded by SSHRC (Social Sciences and Humanities Research Council) and carried out by GMI (Global Market Insite), now Lightspeed GMI, in 2013 through a web-based panel that involved 11,013 respondents living in target municipalities across the U.S.A. and Canada.[8] One of the major shortcomings of previous studies is the limited number of observations from municipalities with unit pricing. Although user charges are more common nowadays, their use remains rare compared to the flat-fee alternative (e.g., through property taxes) and is often restricted to small municipalities. In order to ensure a well represented sample from communities with some sort of pay-as-you-throw programme for garbage pick-up and disposal, we constrained the data collection to a selected sample of municipalities both in the U.S.A. and in Canada which we chose according to (1) presence/absence of unit pricing and (2) size. In the U.S.A., for each community without unit pricing (NO PAYT), we attempted to identify a community with unit pricing (PAYT) within the same state and, to the extent possible, of comparable size; we could not apply a similar pairing strategy in Canada where communities with unit pricing remain concentrated in the provinces of British Columbia and Ontario, but we did ensure a balance between the PAYT and NO-PAYT communities in terms of number of communities and number of respondents within each group. Finally, to retain the possibility of accounting for community-specific effects in the empirical analysis, we tried the ensure that we would have at least 100 observations per community; in all but four cases, which fall under the PAYT category in Canada, we met the threshold.[9]

In determining the target communities, we did not attempt to differentiate across different types of unit pricing mechanisms out of practical considerations, that is, to avoid an additional layer of target restrictions which would have complicated and likely incapacitated the data collection, but we did include in the survey a question about garbage collection financing mechanism in one's community and provided the following options: (1) property taxes, (2) volume-based unit charge/price (per bag, container/cart, etc.), (3) weight-based unit charge/price (per kilogram, pound, etc.), (4) frequency-based charge/price, (5) other, and (6) don't know. Interestingly, 28% of the respondents do not know how they pay for their

[8] See Table A.2 in the Appendix for summary information about the selected municipalities.

[9] We provide the list of communities by country (U.S.A. or Canada) and type (PAYT or NO PAYT) in Table A.2. We have four regions, each consisting of 14 communities: regions 1 and 2 include PAYT and NO-PAYT communities from the U.S.A.; regions 3 and 4 include PAYT and NO-PAYT communities from Canada. Of the 11,013 responses collected, 25% are from region 1, 28% from region 2, 23% from region 3, and 24% from region 4; 48% of the responses are thus from PAYT communities. For the Canadian panel, a French version of the questionnaire was available and 5% of the 5,128 Canadian participants, mostly from Montreal and Quebec City, opted for it (see Table A.5).

garbage collection and disposal, 10% indicate other types of mechanisms, 44% list property taxes, 9% pay by volume, 1% pay by weight, and 10% pay according to frequency. It is clear that, aside from a large number of uncertain individuals, there is quite a bit of discrepancy between how garbage collection is financed and how individuals perceive it to be financed. This discrepancy provides us with an additional opportunity to examine the effectiveness of unit pricing by separating between the informed and uninformed respondents within the same policy region through the inclusion of a variable interacting the policy region with the perceived garbage collection financing mechanism; this discrepancy also gives us a chance to consider the relevance of the information dimension of waste management.

Based on the figures in Table A.4 in the Appendix, which gives a cross-tabulation of respondents by region and answer to the question about garbage collection financing mechanism, we note that (1) U.S. respondents are more likely to be unaware of how their garbage collection is financed than Canadian respondents are (32% and 34% in regions 1 and 2 versus 20% and 22% in regions 3 and 4), (2) respondents from PAYT communities are as likely to be unaware as those from NO-PAYT communities are, (3) respondents from PAYT communities are more likely to be misinformed about how their garbage collection is financed than respondents from NO-PAYT communities are (15% versus 6% in the U.S.A. and 66% versus 2% in Canada),[10] (4) U.S. respondents are more likely to suggest paying for garbage collection through a mechanism other than one based on property taxes, volume, weight, or frequency than Canadian respondents are (13% and 14% in regions 1 and 2 versus 4% and 6% in regions 3 and 4), and (5) Canadian respondents are more likely to report paying for garbage collection through property taxes when their communities rely on unit pricing but less likely to report paying user fees when their communities rely on property taxes than U.S. respondents are (66% versus 15% and 2% versus 6%). The last point may relate to the age difference between U.S. and Canadian unit pricing programs, with the latter relatively new compared to the former; as we can expect a time lag between the implementation of a new program and the realization of its implementation through experience, respondents with less experience are more likely to be misinformed.

2.2 Variables

As we consider separate but related decisions in this paper, to avoid cluttering the exposition, we structure the discussion in this subsection under two headings: one about the dependent variables corresponding to the three waste management decisions (garbage disposal, overall recycling, and waste prevention), the

[10] These figures simply reflect the proportions of respondents reporting paying for garbage collection through property taxes in PAYT communities and through volume- or weight-based fees in non-PAYT communities.

six material-specific recycling decisions (glass, plastic, newspapers and magazines, cardboard, aluminum cans, and food waste), and the purchase and return decisions of returnable containers under a refundable deposit system; the other about independent variables broken down by type and whether they matter in all or a subset of the decisions.

2.2.1 Dependent Variables

In designing the questionnaire, we made sure to include a fairly comprehensive set of questions that would provide a good measure of waste prevention efforts. To date, very little is known about household waste prevention; due to data limitations, household waste management studies have in fact focused on waste disposal and recycling. To our knowledge, the only studies that try to address the waste prevention dimension of household waste management are Ferrara and Missios (2012) and Ferrara and Missios (2014). However, in both instances, waste prevention can only be narrowly defined based on two questions: in the 2012 paper, participation in waste prevention is proxied by the act of taking recycling logos into account during purchasing decisions, while extent of participation in waste prevention is proxied by how regularly (from never to always) refillable containers are purchased/used; in the 2014 paper, engagement in quantitative waste prevention is equated with regularly using refillable containers and reusable bags, while engagement in qualitative waste prevention is equated with regularly using paper with recycled content and products with reduced toxic content.

In this paper, we employ a list of 19 questions covering a wide range of waste prevention activities and can thus measure waste prevention more comprehensively and accurately. In deciding about whether and how to combine the 19 statements to measure engagement in waste prevention, we use the Cronbach's α to determine the degree to which the 19 statements measure the same construct. With an α value of 0.92, there is excellent internal consistency which does not improve but falls slightly if we remove one at the time each of the 19 items (see Table A.5 in the Appendix);[11] we are thus confident that we can combine the 19 items into a single index and do so by employing weighting based on factor analysis (W_PREV_FA).

Given the ordinal nature of the variables associated with the 19 statements, we carry out factor analysis using the matrix of polychoric correlations as opposed to the matrix of Pearson correlations which assume interval measurement scales and are thus not suitable for studying the degree of association between categorical variables. If we think of two ordinal variables as resulting from discretizing or categorizing continuous random variables, the polichoric correlation between two ordinal variables is then the maximum likelihood estimate of the correlation between the two unobserved continuous variables that underlie the

[11] As a rule of thumb, internal consistency is acceptable if $0.7 \leq \alpha < 0.8$, good if $0.8 \leq \alpha < 0.9$, and excellent if $\alpha \geq 0.9$.

two observed ordinal variables under the assumption that the two unobserved continuous variables follow a bivariate normal distribution. Although we reject the hypothesis of normally distributed data based on both the likelihood ratio test, with $\chi^{2(15)} = 981.9$, and the Pearson goodness of fit test, with $\chi^{2(15)} = 1016.43$, we justify the use of the polychoric coefficient matrix by relying on the discussion in Pearson and Heron (1913) which demonstrates that, even with markedly skewed distributions, the Gaussian theory gives first approximations of the correlation coefficients within ± 0.05 of their true values; hence, for the purpose of computing polychoric correlation coefficients, and particularly for large samples, whether the actual joint distribution differs from the normal distribution is practically inconsequential.

To construct a waste prevention index using the factor analysis results, we adopt the same methodology as in Nicoletti et al. (2000), cited in OECD/JRC (2008), which involves weighting at two levels: (1) the intermediate weighting of the detailed items associated with each of the extracted factors according to their contributions to the variance explained by the factor and (2) the final weighting of the extracted factors according to their contributions to the variance in the data. In extracting the number of factors to retain upon applying the principal-component factor method to the analysis of the matrix of polychoric correlation coefficients,[12] we follow the standard practice of focusing on factors that (1) are associated with eigenvalues larger than unity, (2) individually contribute to the overall variance of the data by more than 10 percent, and (3) cumulatively contribute to the overall variance of the data by more than 60 percent. After identifying the number of factors necessary to represent the data, we rotate the factors in an attempt to minimize the number of basic items that have a high loading on the same factor, thus simplifying the interpretation of the results as, after rotation, each item is associated with only one factor and each factor represents only a small number of items. From the initial (pre-rotation) factor solution, we identify three factors to retain which satisfy the first and third of the above three requirements;[13] we then rotate these factors via the orthogonal "varimax" rotation method (with Kaiser normalization), the most common of the rotation methods, which maximizes the sum of the variances of the squared loadings across the factors. Upon rotation, we compute squared loadings and scale them to unity sum, we assign items to factors based on the magnitude of their scaled squared loadings and thus associate items C, J, K, L, N, and S with factor

[12] There are several methods to analyze the correlation matrix: principal factor, principal-component factor, iterated principal-component factor, and maximum-likelihood factor methods. By the principal-component factor method, linear combinations of the basic indicators are formed such that the first component (combination) accounts for the largest amount of variability in the data, the second component, which is uncorrelated with the first, for the next largest amount, and so on so forth. As noted in OECD/JRC (2008), factor extraction by the principal-component factor method is the most common approach, preferred in the development of composite indicators because it is simple and allows for the construction of weights reflecting the information content of individual indicators.

[13] In the initial factor solution, the eigenvalues of the first three factors are 8.9513, 1.53351, and 1.01216, respectively; the corresponding proportions of variance accounted for individually are 47.11 percent, 8.07 percent, and 5.33 percent, so that the first three factors explain 60.51 percent of the overall variance of the data.

1, items A, B, D, E, F, and G with factor 2, and items H, I, M, O, P, Q, and R with factor 3, and, finally, we re-scale the relevant squared loadings within each factor to unity sum and multiply the re-scaled squared factor loading of each item by the proportion of the variance explained by the factor representing the item. We provide a summary of the computational steps on the post-rotation results in Table A.6, with the last column containing the weights corresponding to the various items which we use in constructing an index measuring the extent of engagement in waste prevention.

For the garbage disposal and recycling decisions, the construction of the dependent variables is much more straightforward as we only have to deal with two questions in the former case and with one question in the latter case. For the garbage disposal decision, we define the dependent variable ($GARBAGE$) as the interval within which the average number of full standard-sized bags disposed of at each collection falls. In constructing this variable, we rely on two questions: one question pertains to how garbage is placed at the curb, that is, whether by bag or by container/cart and, if by the latter option, in which size; the other question relates to the number of full or partially full standard-sized bags or containers/carts placed, on average, at the curb per collection.[14,15]

For the recycling decision, we construct an ordinal variable (REC_PROP) which gives the proportion of recyclables that is recycled, excluding containers returned for refunds of deposits. This variables takes on values from 1, which denotes zero recycling, to 5, which denotes 100 percent recycling, with 2, 3, and 4 thus representing 25 percent, 50 percent, and 75 percent, respectively. We adopt the same value assignment strategy for the material-specific recycling decisions: an ordinal variable giving the proportion of recyclable Y actually recycled ($PROP\_Y$), where $Y =$ glass, plastic, newspapers and magazines, cardboard, aluminum cans, and food waste, respectively, which we employ in the joint estimation of the recycling decisions across the six types of recyclables.

The last two dependent variables we construct relate to our analysis of refundable deposit systems: the proportion of type-Z (glass containers, plastic containers, or aluminum cans) containers/cans returned for refund ($PROP\_Z\_RET$), and an indicator for buying type-Z containers/cans ($PROP\_Z\_BUY$).

[14] We conjecture that a partially full bag/container/cart, other than the last one reported, is equivalent to 75 percent of a full bag/container/cart and the last partially full bag/container/cart is equivalent to 50 percent of a full bag/container/cart. For respondents disposing of garbage in containers/carts, we convert the number of containers/carts into standard-sized bags using that a standard bag corresponds to a 16 gallon container/cart and that the size of a container/cart is equal to the mid-point of its size range. For the few cases in which respondents report using containers/carts of different sizes, we derive the equivalency in terms of standard-sized bags based on the average size of the containers/carts used.

[15] In Table A.7, we provide a visual of the interaction possibilities between the two questions (one about disposal option, that is, whether by bag or container/cart; the other about quantity of bags or containers/carts). In some cases, there exist discrepancies (e.g., reporting to place bags at the curb but providing the quantity only in terms of containers/carts). In the Table, we include the number of cases for each interaction possibility and indicate how we determine quantity of bags in each case.

2.2.2 Independent Variables

In understanding the various household waste decisions we consider in this paper, we account for different types of determinants, from the typical individual, household, and contextual characteristics, which are common across the three waste management strategies under scrutiny (i.e., garbage disposal, recycling, and waste prevention), to attitudinal factors, to policy instruments.[16] Beginning with the common variables, we have gender and age of respondent as the only individual characteristics. For household characteristics, we have: household age distribution, highest level of formal education achieved in household, and household income. For contextual characteristics, we have: number of years spent in neighborhood, ownership of residence, and type of residence. To the extent that the contextual characteristics are more about the local context, they are not as likely to be relevant in the waste prevention decision as they are in the garbage disposal and recycling decisions which have more of a local dimension than waste prevention does.

In terms of attitudinal factors, we include some generic statements about trust in key bodies and the environment and some specific to waste prevention and recycling, each measuring the extent of agreement on a scale from 1 to 5, with 1 indicating strong disagreement and 5 strong agreement. For trust, we have: (1) governments are trustworthy, (2) environmental non-governmental organizations (NOGs) are trustworthy, and (3) producers and retailers are trustworthy, with the latter variable likely to be of greater influence in the waste prevention decision which, in many respects, is a consumption decision and thus reliant on information from producers and retailers. For the environment, we have: (1) the state of the environment is of concern ($ENVCNCRN$), (2) individuals can contribute to a better environment ($BETTRENV$), (3) environmental impacts are frequently overstated ($OVRSTATE$), (4) environmental issues should be dealt with primarily by future generations ($FUTRGNRS$), (5) environmental issues will be resolved primarily through technological progress ($TECHPROG$), and (6) environmental policies introduced by the government to address environmental issues should not cost extra money ($NOTCOSTS$). Combining the 5 statements about the environment into an environmental attitude index is not an option with a Cronbach's α value of 0.59, which improves only marginally increasing to 0.61 when we omit the last statement and decreases when we omit anyone of the other statements, and an average inter-item covariance of 0.21.[17]

Additional attitudinal factors we account for in the empirical analysis relate to a single activity, which we refer to, in what follows, as activity X, where X can be either recycling or waste prevention. Hence, we have:

[16] See Table A.8 in the Appendix for a complete listing of the variables by type.

[17] Poor internal consistency across statements 2 through 6 is also found in Ferrara and Missios (2014) based on a different data set which was put together in 2008 as part of an international study of household environment-related consumption.

(1) X is an essential part of our culture ($CULT\_X$), (2) X is the right thing to do ($RIGHT\_X$), (3) X protects the environment ($ENVIR\_X$), and (4) there is social pressure to engage in X ($PRESSURE\_X$). In addition to variables that reflect how activity X is viewed, we include a number of variables that measure on a scale from 1 (no influence) to 5 (extremely influential) the level of influence of social ($SOCIAL\_MOT\_X$) and moral ($MORAL\_MOT\_X$) motives and of several triggers, namely, local government's support, local government's requirement, consumer organization's involvement, and local media education programs. To our knowledge, there are no studies, including the two mentioned above (Ferrara and Missios, 2012; Ferrara and Missios, 2014), that look at the cultural, moral, and social dimensions of waste prevention and address the questions of how the perception that waste prevention is a cultural, moral, or social phenomenon plays out in waste prevention decisions, how moral and social considerations influence the level of engagement in waste prevention, and how effective public/community support and education are as triggers of waste prevention behaviour. Although there are studies that consider the impact of social and moral motivations on recycling behaviour (e.g., Berglund, 2006; Halvorsen, 2008; Ferrara and Missios, 2012 and 2014), the questions around the cultural, moral, and social dimensions of recycling and the effectiveness of public/community support and education as triggers of recycling behaviour are novel.

The availability of data on both motivations and triggers allows us to introduce interaction variables to determine whether the effectiveness of triggers hinges upon the presence of motivations. According to Fogg's behaviour model (Fogg, 2009), for individuals to take target actions, they must have sufficient motivation, sufficient ability, and an effective trigger. These three factors must be present at the same instant for a target behaviour to occur; however, while there is some sort of trade-off between motivations and abilities in the sense that the target behaviour can occur when ability is low provided that motivation is high and vice versa, although both factors must be at some non-zero level, triggers are needed even when both ability and motivation are high. Fogg speaks of a behaviour activation threshold, corresponding graphically to the locus of the combinations of motivation and ability levels above (below) which triggers can (cannot) induce the target behaviour, and of three types of triggers with functions linked to different combinations of motivation and ability levels. When individuals are motivated but lack (or perceive to lack) the ability to accomplish a task, a facilitator trigger is needed to emphasize the ease with which the task can be carried out; when individuals are able but lack motivation, a spark trigger is needed which includes a motivational element; when individuals are both able and motivated, a signal trigger is needed to remind them of the task.

In his discussion of motivation, Fogg identifies three core motivators, each with two sides: the plea-

sure/pain motivator, the hope/fear motivator, and the social acceptance/rejection motivator; hence, people may act to feel pleasure or avoid pain, in the hope that something good is going to happen or out of fear that something bad is going to happen, and/or to gain social approval or avoid social disapproval. In the context of our study, we can capture these three motivators through a moral motivation variable which measures the importance of feeling good about oneself (thus, pleasure), an environmental motivation variable which relates to the anticipation of environmental benefits (thus, hope), and a social motivation variable which measures the importance of neighbours (thus, social approval). Of the four triggers we are able to define with the data collected, we can think of local government's support and citizen/consumer organization's involvement as signal triggers if their function is to remind individuals of why activity X is important or as spark triggers if their function is to motivate individuals to engage in X, likely through the social acceptance/rejection motivator; as well, we can think of local media education programs as facilitator triggers if they serve to simplify the task of engaging in X by highlighting ways in our daily lives in which we can support X or as spark triggers if they serve to motivate through any of the three above mentioned motivators. If, for a given ability level, triggers are more effective among highly motivated individuals, we expect the signs of the coefficients associated with the variables interacting the three motivators with the three triggers to be positive.

Two additional interaction variables we construct and include into the analysis address the question of whether beliefs translate into motivations as we would expect: for individuals who believe that X is the right thing to do, moral motives are likely to matter more in decisions about X; similarly, for individuals who believe that there are social pressures to engage in X, social motives are likely to be of greater relevance. Related to the above variables, we also consider the interaction between the belief that X is the right thing to do and social motives and the interaction between the belief that there are social pressures to engage in X and moral motives; the relevance of these interactions extends beyond the scope and focus of this paper, which is about understanding waste management activities, to encompass a broader question about whether moral and social considerations are consistent with one another, that is, whether we are more or less likely to be socially (morally) motivated to take an action if we believe this action to be the right thing to do (what society expects of us).

Although the local government requirement variable, which measures the importance of the fact that the local government requires X, does not perfectly fit the definition of trigger and, thus, does not fall into any of the three trigger categories Fogg describes, we include it into the analysis as a quasi-policy instrument with an emphasis on whether being or feeling obliged to undertake specific tasks enhances or

corrodes intrinsic motives to perform the tasks. Hence, we interact both the moral and social motivation variables with the local government requirement variable to derive the effects of requiring X on moral and social motivations and determine whether external intervention is perceived to be acknowledging, in which case there is a crowding in of intrinsic motivation, or controlling, in which case there is a crowding out of intrinsic motivation (Frey, 1999). As we detail below, the inclusion in the survey questionnaire of a question about whether recycling is mandatory or voluntary allows us to explore the impact of mandating recycling and the crowding in/out effects of the policy on intrinsic motivation for recycling directly, and we thus do away with inferring the effect from whether and the extent to which the policy is believed to matter in recycling decisions.

Finally, to complete the list of explanatory variables, we have policy or quasi-policy instruments which include indicators for the presence of (real or perceived) unit pricing (UF_REG and UF_PER), a collection program for recyclables (REC_COLL), a drop-off program for recyclables (REC_DROP), and mandatory recycling (REC_MAN), indicators for different frequencies of recyclables' collection (REC_FREQ), indicators for different frequencies of garbage collection (GAR_FREQ), and the proportions of the six recyclable/compostable materials included in the questionnaire (glass, plastic, newspapers/magazines, cardboard, aluminum cans, and food waste) which are collected at the curb (N_CURB), dropped off for cash refund (N_REF), dropped off without payment (N_UNREF), and collected through occasional special drives (N_DRIVE).

Apropos of different recycling programs, we construct material-specific variables for inclusion in the empirical modelling of recycling behaviour across different types of recyclables to capture the presence of curbside collection, drop off for cash, drop off without cash, and special drive. For glass and plastic containers and for aluminum cans with refundable deposits, we add a binary variable indicating whether the refund for returning the container is full as opposed to partial; this variable only appears in the analysis of refundable deposit systems.

In the recycling equations (both overall and material-specific), we include additional policy-like factors to explore and comment on the time dimension of recycling and its impact on recycling behaviour to a far greater extent than existing studies allow because of data limitations. In particular, we have indicators for whether recycling requires (*i*) washing out containers, (*ii*) separating recyclables, (*iii*) bundling newspaper, and/or (*iv*) cutting and bundling cardboard. We also have the length of time (in minutes) it takes to reach the drop-off centre if available and the average amount of time (in minutes), excluding the time to reach the drop-off centre if available, spent on recycling activities each week.

To estimate the effect of unit pricing, we rely on the unit pricing variable which reflects locational information, taking on a value of 1 if respondents are from PAYT regions (i.e., region 1 in the U.S.A. and region 3 in Canada) and a value of zero otherwise; this variable identifies the actual presence of unit pricing. On the other hand, the perceived presence of unit pricing, which is typical of household-level waste management studies, is based on a question about how garbage collection is financed with several options to choose amongst: property taxes, volume–based fee, weight-based fee, frequency-based fee, other, and uncertain. As above noted, there is clearly a disconnect between how individuals actually pay for their garbage collection and how they believe or perceive to be paying, and we thus have the opportunity to engage in a more thorough investigation of the effects of unit pricing by separating between individuals who are well informed and those who are not and, within the latter group, between individuals who are misinformed and those who are uncertain. To this end, we introduce fixed effects to identify individuals in (*i*) PAYT and non-PAYT communities who do not know how they pay for garbage collection, (*ii*) PAYT communities who believe to be paying for garbage collection through property taxes, and (*iii*) non-PAYT communities who believe to be paying for garbage collection through volume- or weight-based fees. Focusing on being misinformed as opposed to being informed permits greater flexibility in how we consider and classify individuals who report paying for garbage collection with frequency-based fees or through some other mechanism. In defining the state of being misinformed, we need in fact only consider instances in which property taxes represent the reported option in PAYT communities and volume- or weight-based fees are the reported option in non-PAYT communities, thus allowing for the possibility that the "frequency-based charge/price" and "other" options result from imperfect reporting, which may relate to a particular reading of the relevant survey question, as opposed to misinformation.[18] If there are obvious differences across the various groups with regard to the effectiveness of unit pricing, we expect them to have important policy implications. Finally, in order to comment on possible crowding in/out effects of unit pricing, we rely on variables interacting unit pricing with moral and social motivations.

At last, to the list of explanatory variables, we add country-specific fixed effects to separate between Canadian and U.S. responses as there may be institutional differences between the two countries not captured in the other independent variables that amount to differences in waste management practices.

[18] Using the figures in Table A.6, we can easily compute the proportion of misinformed individuals among those who do not report being unaware as 0.22, 0.09, 0.83, and 0.02 in regions 1, 2, 3, and 4, respectively. In Canada, the high proportion of individuals in PAYT communities who believe to be paying for garbage collection through property taxes is troubling but, as we note elsewhere, may result from less experience with unit pricing as well as from the presence of free bags in many of the PAYT communities.

3 Results

The significance of the estimated coefficients of correlation associated with the three dual combinations of waste management strategies supports the methodological approach we adopt in this paper which takes into account that an unsystematic effect on one activity may be accompanied by unsystematic effects on the other activities. As one would expect, a random increase in waste disposal tends to correspond to random decreases in both recycling and waste prevention while a random increase in recycling corresponds to a random increase in waste prevention (see Table 1). We also find evidence of error correlation between equations modelling different but related decisions in the simultaneous estimation of the recycling intensity decisions over different recyclables, with results pointing to the tendency for unobservables that increase recycling intensity for a particular recyclable to occur with unobservables that increase recycling intensity for any of the other recyclables considered in the multi-equation model (see Table 2).

Across all areas, Canada tends to do better than the United States: Canadians, on average, dispose of less waste, recycle more, and engage more in waste prevention. Canadians also do better in the recycling of each of the items considered in the analysis (glass, plastic, newspapers/magazines, cardboard, aluminum cans, and food waste), in the buying of containers that carry refundable deposits (glass and plastic containers and aluminum cans), and in the returning of containers for refund. Based on marginal effects computed at covariates' mean values, Canadians are between 7 to 17 percentage points more likely to recycle 100 percent of specific items, with the most significant difference in the recycling of newspapers and magazines and cardboard, 6 percentage points more likely to engage in complete general (no material-specific) recycling, and 16 percentage points more likely to curbside dispose of no more than one standard-sized bag. But Canadians also tend to behave in a more environmentally sound manner in the purchase of containers/cans returnable for refund and in the 100 percent return of containers/cans that carry refundable deposits; Canadians are, in fact, 15, 19, and 25 percentage points more likely to buy returnable plastic containers, aluminum cans, and glass containers, respectively, and they are 22, 24, and 28 percentage points more likely to return for refund 100 percent of aluminum cans, plastic containers, and glass containers, respectively.

As we specifically control for the impact of environmental attitudes, we cannot attribute the systematic difference in waste management behaviour between the two countries to differences in environmental consciousness. The environmental attitudes we cover in the study are however general, that is, about the environment and, thus, not specific to waste and/or its environmental effects. It is then possible for the systematic differences between the two countries to result from differences in the extent to which waste

is perceived to contribute to environmental deterioration. Insofar as this perception is informed by how actively governments engage with the problem of the waste associated with a product throughout the entire life cycle of the product, differences in the two countries' policy initiatives to tackle the environmental cost of waste at the production stage may help explain why Canada tends to do better in handling its waste problem at the household level. Whichever the reasons may be, including institutional and cultural elements unrelated to the environment and/or waste, it goes without saying that, given the strength and consistency of the results across the three waste management areas, the material-specific recycling decisions, the decisions to buy containers/cans with refundable deposits, and the decisions to return containers/cans for refunds, there is significant policy value in exploring these reasons more thoroughly and systematically in order to identify key factors which, if accounted for, may contribute to formulating more effective policy directions.

3.1 Waste Disposal, Recycling, and Prevention

3.1.1 Individual and Household Characteristics

Of the few individual characteristics we include in the analysis, the results in relation to the respondent's gender and age suggest that, on average, female individuals tend to recycle less but engage more in waste prevention while age has a consistently positive environmental effect in that it results in less waste disposal, more recycling, and more waste prevention.

At the household level, the number of individuals in any age group has a clearly positive effect on waste disposal but not on the other waste management areas. For recycling, however, there is some evidence that age-driven differences in the value of time may be at play in determining the extent of engagement in the activity: having more members between 20 and 34 years of age reduces recycling while having more members over 65 years of age increases recycling. For waste prevention, the only statistically significant finding is that the number of children between 5 and 19 years of age has a positive effect on waste prevention, likely stemming from the presence of a wider range of consumption products households must purchase in order to meet the needs of this age cohort and the greater opportunities to engage in waste prevention they then face when making their purchases. In households with more children, it is also possible for educational motives to be present, which may explain the greater intensity in waste prevention, although one would expect such motives to also translate in greater recycling efforts; however, in the recycling decision, there may be some offsetting element at work as households with children are likely to have greater marginal valuations of time which would negatively affect recycling intensity.

Education seems to matter systematically only in the waste disposal decision with more education

amounting to less waste disposal, but there is some evidence that very high educational attainments (e.g., a university degree) trigger greater waste prevention. Income plays no clear role in the curbside disposal and waste prevention decisions but has some systematic positive effect on recycling, at both the low and high ends of the income distribution, which may be counter-intuitive based on the notion that recycling is time-intensive and that high-income households face a higher opportunity cost of time and would thus invest less time in recycling activities. The results about the controls that capture the time dimension of recycling are however unconvincing: (1) even if there is some evidence that recycling intensity is increasing in the amount of time devoted to recycling activities and decreasing in the amount of time required to reach the drop-off centre, the estimated marginal effects are negligible; (2) of the various activities required for recycling (e.g., washing, separating, bundling, and cutting), only bundling newspaper reduces recycling and washing out containers actually increases recycling. Combined, the above two points suggest a weaker role for time considerations in recycling decisions than theory would predict. The second point also stresses that it is not the amount of time necessary to recycle that matters much but how convenient or immediate the activity required for recycling is: while, during a given week, washing out containers may involve more time than bundling newspapers, the former is immediate and permits recycling to take place as soon as the product becomes disposable, but the latter requires some planning and prevents recycling from occurring upon the product becoming disposable (newspapers need to be stored and piled up before bundling applies and recycling can take place).

Finally, there is strong evidence, both in terms of the statistical significance of the estimated coefficients and in terms of the consistency of their implications across the three waste-related activities, that those who own their current residence have environmentally healthier waste management habits, that is, they engage in less waste disposal, more recycling, and more waste prevention. We take this result to reflect and stress the local or neighbourhood aspect of waste which derives from its more tangible features and associated direct or private effects: waste is simply unpleasant to look at and smell, and individuals owning their current residence are more likely to exhibit an attachment to their residence and area of residence and be concerned with anything that threatens to devalue them. Living in a house (attached or detached) has a statistically significant positive effect only on recycling, likely because of the storage requirements that the activity entails and that a house is better equip to satisfy than an apartment.

3.1.2 Attitudinal Factors

In the empirical analysis, we account for several attitudinal factors, some of which are common across the three activities while others are area-specific. Of the common factors, trust in various bodies (governments,

environmental NGOs, and producers/retailers) plays no role in the waste disposal decision but affects both recycling and waste prevention activities, the reason being likely related to the greater relevance of product characteristics in the recycling and waste prevention decisions. A summary of the effects of attitudinal variables in provided in Table 1a. Interestingly, the belief that governments are trustworthy tends to lower both recycling and waste prevention, a result which may suggest some substitutability in, or shifting of, social responsibilities when it comes to matters involving indirect costs/benefits: if individuals have trust in governments, they may have confidence in the policy framework in place to tackle the waste problem and may then be less concerned about altering their behaviour to alleviate the problem.

Being concerned about the environment only conditions waste prevention, and this result likely exploits the timing differences across the three waste management activities and the informational disconnect between different disposal options and their environmental implications. Waste prevention is a pre-production stage decision, that is, it occurs before waste is produced; curbside disposal and recycling take place after waste production. It is then rather natural to expect that a concern for the environment kicks in as a motivating factor when it can have the greatest impact, when it can matter the most. At the same time, unless there is a clear understanding that waste has a profound detrimental effect on the environment and that recycling is a less environmentally damaging disposal option than curbside disposal, a concern for the environment is not likely to be of relevance at the disposal stage. These points underscore the importance of perceiving to have the ability to make a difference: we may be concerned about the environment but, unless we perceive that we contribute to a better environment, we may not be willing to alter our behaviour. This message comes up quite pronouncedly when we look at the effect of individuals' belief that they can contribute to a better environment: the stronger the belief is, the more engaged in recycling and waste prevention but the less engaged in curbside disposal people are.

	Garbage	Recycling	Prevention
ENVCNCRN	0.0128	0.0008	0.0713***
BETTRENV	-0.0461***	0.0358*	0.0901***
CULT_X		0.0782***	0.0388***
RIGHT_X		0.2393***	0.1899***
ENVIR_X		0.0309	0.0787***
PRESSURE_X		-0.0898**	0.0193
MORAL_MTV_X		-0.0543	0.1263***
SOCIAL_MTV_X		0.1391*	-0.005

Table 1a. Summary of coefficients of attitudinal variables of interest. See full Table 1.

Consistently with the above line of reasoning, negative environmental attitudes, as reflected in individuals' belief that environmental impacts are overstated, that environmental issues are for future generations to address or for technological progress to resolve, or that environmental policies should not involve a

monetary cost, tend to intensify participation in curbside disposal while weakening participation in recycling but not to negatively alter waste prevention practices. The apparent oddity in the response (or lack thereof) of waste prevention intensity to negative environmental attitudes when we take their effects on recycling and curbside disposal into account warrants some discussion. A key intrinsic difference between waste prevention and waste disposal is that the former is an ex-ante activity about preventing a problem while the latter, which comprises both curbside disposal and recycling, is an ex-post activity about dealing with the problem. The implication of this difference is that individuals are the only players in the waste prevention decision and thus retain full control; on the contrary, they share responsibility with governments (or disposal service providers) in dealing with the waste problem at the disposal stage. Negative environmental attitudes can then trigger a shift in responsibility away from the individuals when responsibility sharing occurs, thus increasing curbside disposal and decreasing recycling, and may motivate greater engagement in the fully controlled activity (i.e., waste prevention), as the case when there is strong belief that environmental policies should be costless.

The second set of attitudinal variables we consider pertains solely to recycling and waste prevention. For both activities, the cultural and moral dimensions are quite significant: the extent to which each activity is believed to be part of our culture or the right thing to do increases its intensity. However, the belief that there is social pressure to engage in the activity has no impact on waste prevention and actually reduces recycling. Nevertheless, social motives (via the influence of neighbours) matter in the recycling decision, and more so when social pressure is high, but not in the waste prevention decision, and moral motives (via the influence of feeling good about oneself) impact waste prevention but not recycling. In addition to emphasizing the social aspect of recycling versus the individual aspect of waste prevention, these results underscore a couple of peculiar features of social pressure, namely, that an action must be observable for the impact of social pressure to materialize and that social pressure undermines or does away with our ability to function as individuals and can therefore lead to undesirable outcomes. Elaborating on the second feature, what we have here is a situation in which the antipodal relationship between the "social" and the "individual" embodied in the concept of social pressure clearly comes up: people are influenced by neighbours but still feel in control of their actions (in a sense, it is their choice to be influenced by neighbours); however, people react negatively to the idea that they must behave in a particular way because it is what society desires.

When we examine the effects of the various interaction terms involving moral and social factors, we find a supporting relationship between the belief that an activity is the right thing to do and moral motives

and between the belief that there is social pressure to engage in an activity and social motives. The tendency is, in fact, for the effect of social motives to be stronger in both the recycling decision and the waste prevention decision when there is social pressure to engage and for the effect of moral motives to be stronger, but only in the recycling decision, when engagement is viewed as the right thing to do. For both recycling and waste prevention, however, the belief that engagement is a civic duty (i.e., the right thing to do) erodes social motivation while the belief that engagement is what society expects does not affect moral motivation.

As we delve into the social and moral dimensions of waste management decisions, a general message we can draw from our findings is that social pressure is a more complicated channel through which we can modify behaviour because it is (or is perceived to be) controlling and thus requires that it be managed subtly in a manner that does not challenge or undermine the individuality of decision making. Although individuals are sensitive and responsive to the views of their peers (e.g., recyclers in the neighbourhood), especially when such views are resonant of social expectations, they react negatively to the notion of social conformity. Furthermore, in motivating behaviour, the relevance of the desire to feel good about ourselves (i.e., moral motivation) is unlikely to be conditioned by whether we believe that our actions meet social norms; conversely, the relevance of the desire to gain our peers' approval or avoid their disapproval (i.e., social motivation) is likely intertwined with the belief that our actions meet moral norms but in a non-supporting type of association which highlights the negative connotation of societally influenced acting stemming from its relativity and instability.

The remaining results are consistent with the view that waste prevention is inherently an individualistic activity which underpins the individual's ability to have an impact, while recycling is inherently a collectivist activity which underpins the collective's ability to make a difference. As such, recycling responds to factors that involve multiple agents in society (i.e., social considerations) in ways waste prevention does not. Hence, while having a government supporting an activity, which we treat as a signal or reminder of the importance of the activity, has a significant and positive effect on both recycling and waste prevention, the extent of agreement with the belief that the activity protects the environment increases waste prevention but has no effect on recycling whose environmental benefits through individual efforts are likely to be viewed as negligible. And while having a government requiring an activity or having a citizen/consumer organization involved in the activity does not matter in waste prevention for which the decision-making unit has or perceives to have full control of the activity's impact, it does reduce recycling possibly because of the negative reaction to imposition or to the idea of imposition or because of the opportunity of shifting

responsibility from the individual to the citizen/consumer organization or because of some negative signal the involvement of the citizen/consumer organization sends if there is, for example, limited trust in such organization.

As a final note in this sub-section, none of the three triggers (government's support, citizen/consumer organization's involvement, and local media education programs) appears to be more effective at encouraging recycling among highly motivated individuals. On the contrary, there is some statistically significant interaction between the social acceptance motivator and the three triggers in the waste prevention decision; specifically, citizen/consumer organization's involvement and local media education programs correlate positively, whereas government's support correlates negatively, with social motives, a result which indicates that, the more socially motivated individuals are, the less likely it is for their waste prevention efforts to respond positively to government's support and negatively to citizen/consumer organization's involvement and local media education programs.

In general, the evidence around triggers highlights that having a government supporting recycling and waste prevention can be a more effective signal than citizen/consumer organization's involvement or local media education programs, possibly because of the pertinency of the "leading by example" message given the leadership role the government plays; however, when individuals feel pressured to act in a particular way, they are less prone to view such support through positive lenses.

3.1.3 Policy Variables

The last set of variables we include in the analysis comprises policy or quasi-policy instruments. A summary of the effects of the policy variables in provided in Table 1b.The primary policy tool is unit pricing which turns out to be statistically significant in all decisions. Specifically, the presence of user fees decreases curbside waste and increases both recycling and waste prevention; this effect holds independently of how we define the presence of unit pricing, that is, using the locational information we have (see Table 1) or based on the responses to the question about the type of financing mechanism in adoption in the community of residence, although the marginal effect of the perceived presence of unit pricing is consistently stronger across the three areas (see Table 5). Furthermore, in the latter case, that is, when we rely on the stated presence of unit pricing and thus add to the analysis covariates to explore the effects of uncertainty and misinformation,[19] we find that uncertainty about the financing of garbage collection reduces curbside

[19]To avoid redundancy, we do not include the entire set of results from the estimation involving individuals' responses in the construction of the indicator for the presence of unit pricing. Instead, we focus on key factors (e.g., unit pricing and its interactions with other covariates) and sum up the corresponding marginal effects in Table 5. Included in Table 5, we also have relevant findings, when the presence of unit pricing is based on individuals' responses, from the material-specific analysis of recycling and from the analysis of refundable deposit systems.

disposal and increases recycling only in PAYT communities but lowers waste prevention in both PAYT and non-PAYT communities. On the other hand, households in PAYT communities who believe to be paying for garbage collection services out of property taxes tend to dispose of less garbage at the curb but do not exhibit a systematically different behaviour in recycling and waste prevention; correspondingly, households in non-PAYT communities who believe to be paying for curbside garbage by volume or weight tend to engage in more curbside disposal and less recycling but exert a similar level of engagement in waste prevention.

	Garbage	Recycling	Prevention
UF_REG	-0.2163***	0.3018***	0.0801*
REC_COLL		0.4970***	
REC_DROP		0.0505*	
REC_MAN		0.2796***	
N_CURB		0.9936***	
N_REF		-0.032	
N_UNREF		0.2561***	

Table 1b. Summary of coefficients of policy effects of interest. See full Table 1.

In exploiting the implications of the estimated effects associated with the uncertainty and misinformation variables, we come to four reflections worthy of mention: (1) uncertainty and misinformation about the payment structure in place to finance garbage collection affect waste management persistently only in areas directly linked to the structure, namely, curbside disposal and, to a lesser extent, recycling; (2) uncertainty and misinformation do not prevent the realization of the intended immediate benefit of unit pricing (i.e., a decrease in curbside disposal); (3) uncertainty serves as a cautionary stimulus in the decision of how much garbage to discard; (4) misinformation is more about what financing mechanisms mean conceptually than practically. An important innuendo of the above reflections is that economic incentives can and do work, and are thus powerful tools to modify behaviour, even when individuals are uncertain about, or unaware of, their existence, although they may not be able to fully internalize how these incentives affect activities related to the policy target; in the waste management context, uncertain/misinformed individuals do account for unit pricing when choosing their curbside disposal level but fall short of considering its implications in the recycling decision and/or in the waste prevention decision.

The evidence on the possible crowding out of intrinsic (moral or social) motivation resulting from the implementation of unit pricing is not particularly compelling. In fact, the presence of unit pricing based on locational information reduces the effect of moral motives in the recycling decision but such motives do not appear to affect recycling behaviour; the presence of unit pricing based on survey responses reduces the effect of social motives in the waste prevention decision which is, however, independent of social motives.

Also unconvincing is the evidence in support of the hypothesis that requiring an activity crowds out intrinsic motivation: the interaction between the strength of influence of having a governmental mandate in place and intrinsic motivation (moral or social) is of no relevance in recycling decisions, although mandatory recycling does increase recycling, but the effect of moral motives on waste prevention tends to be lower among individuals for whom the requirement is more influential.

Having either a collection program or a drop-off program for recycling promotes recycling but the former has a stronger effect ($\chi^{2(1)} = 56.82$). Consistently, as the proportion of recyclables which are collected at the curb or dropped off without payment increases, recycling intensifies, again with the effect under the curb option dominating ($\chi^{2(1)} = 135.82$); on the other hand, recycling is decreasing in the proportion of recyclables which are collected through occasional special drives. Indeed, regularity in the collection of recyclables matters in encouraging recycling but the impact exhibits a non-monotic relationship with frequency, increasing as frequency decreases from weekly to every two weeks ($\chi^{2(1)} = 2.88$) and eventually becoming statistically insignificant for monthly collections. A similar result holds for curbside garbage but the impact of pick-up frequency, while also increasing initially as collection becomes less frequent (from twice a week to weekly), does not vanish at the monthly option; on the contrary, the impact remains constant, statistically speaking, at the weekly level as frequency decreases to every two weeks to once per month.[20] When testing for impact equivalence between the two waste management options, we find that the effect of the most frequent collection is statistically the same between curbside disposal and recycling ($\chi^{2(1)} = 0.03$) but the largest effect on curbside disposal at the once per week pick up exceeds that on recycling at the every two weeks pick up ($\chi^{2(1)} = 4.45$).

Finally, in terms of the cross effects of collection frequency, we find that (1) curbside disposal intensity is unresponsive to weekly collection of recyclables but increases at an increasing rate as collection becomes less frequent, (2) recycling intensity only decreases if curbside waste is collected twice a week, and (3) waste prevention does not respond to how often curbside waste is collected but increases when recyclables are collected once per week or every two weeks. For both frequencies, indirect effects do not necessarily align with direct effects, which suggests that, from a policy perspective, the frequency choice would require a weighing of the two types of effects according to their magnitudes and environmental implications. Notwithstanding, the evidence does highlight that how frequently recyclables are collected is a more consequential decision both in terms of the scale and the scope of its effects and, as a result, the decision has

[20] The χ^2 values associated with the hypotheses that the effects of the four frequency options are equal, that the effects of all frequency options but the twice per week option are equal, and that the effect of the twice per week option is equal to that of the once per week option are $\chi^{2(3)} = 31.58$, $\chi^{2(2)} = 0.33$, and $\chi^{2(1)} = 30.78$, respectively, so that we cannot accept the first and third hypotheses.

a more salient strategic dimension.

3.2 Material-Specific Recycling

The results from the material-specific analysis of recycling are mostly consistent with those from the analysis of overall recycling, although there are some differences across recyclables, especially between food waste and the other recyclables (see Table 2). In what follows, we focus on these differences as well as on notable discrepancies between overall recycling and material-specific recycling, particularly when marginal effects are sizable.

We begin by emphasizing that Canada's stronger commitment to recycling carries over to the full range of individual recyclables considered in the analysis but is particularly noticeable in the recycling of newspapers/magazines and cardboard, with Canadians being 16 and 15 percentage points more likely to recycle 100 percent of the items whereas the gap in likelihood for overall recycling sits at 6 percentage points. Attitudinal effects for material-specific recycling are in provided in Table 2a and policy effects in Table 2b.

	Glass	Plastic	Newspaper	Cardboard	Cans	Food
ENVCNCRN	0.007	-0.024	-0.013	-0.008	-0.002	-0.092***
BETTRENV	0.004	0.01	0.009	0.009	-0.001	-0.002
CULT_ REC	0.058***	0.092***	0.074***	0.077***	0.062***	0.041
RIGHT_ REC	0.321***	0.267***	0.326***	0.286***	0.245***	0.241**
ENVIR_ REC	-0.02	0.005	-0.005	-0.008	0.069	-0.03
PRESSURE_ REC	-0.107**	-0.067	-0.029	-0.039	-0.059	-0.180**
MORAL_MTV_ REC	-0.086	0.028	0.079	0.015	-0.009	-0.038
SOCIAL_MTV_ REC	0.169**	0.061	-0.026	0.042	0.05	-0.004

Table 2a. Summary of attitudinal effects of interest on material-specific recycling. See full Table 2.

The household's age distribution matters only sporadically: in addition to the negative effect of age 20 to 34 on the recycling of newspapers/magazines and to the positive effect of being over 65 on composting, both of which mirror the effects on overall recycling, there is some evidence that a thicker left tail representing the under 4 and between 5 and 19 years of age groups lowers the recycling of certain items (cardboard and cans for both groups; glass and newspapers/magazines for the latter group).

Of the household characteristics, income is the most relevant across all recyclables but food waste whose recycling, unlike overall recycling, is income-invariant. That recycling efforts are increasing in income seems at odds with the notion that, as income increases, the opportunity cost of time increases, and we should thus observe less engagement in a time-consuming activity like recycling. But, as for overall recycling, the marginal effects of the covariates that capture more directly the time dimension of recycling (i.e., time spent on recycling activities and time required to reach the drop center) are negligible when they

are statistically significant, suggesting that the opportunity cost of time reflected in the income level may not be an important consideration in recycling decisions. Given the insignificance of all of the education categories, income, which tends to be highly correlated with education, may be reflective of the likely positive influence of education.

The relevance of the time dimension of recycling also comes into question on account of the effects of such requirements as washing (for glass, plastic, and aluminum cans), bundling (for newspapers/magazines and cardboard), and cutting (for cardboard), effects which are either positive (e.g., washing) or statistically insignificant (e.g., bundling and cutting). Separation, on the other hand, while it has no impact on overall recycling, does reduce the recycling of every type of recyclable but leaves composting, or the recycling of food waste, unchanged; arguably, however, the impact of separation may be capturing more than just a time investment concern but a storage concern in that several bins would need to be available for the separated items. How important the concern for storage is likely rests upon space availability which is a less pressing consideration if living in a house. Now, having storage requirements may not always be a driving force in the recycling decision as other factors, such as safety and odours, may prevail. Indeed, in the material-specific analysis of recycling, the statistically significant positive effect of living in a house does not show up in the recycling of glass, for which safety may be a greater concern, and of food waste, for which odours may represent a more relevant concern.

For many of the remaining covariates, the recycling of food waste exhibits some unique features which set it apart from the recycling of the other recyclables as well as from overall recycling. What underpins the uniqueness of food waste is the likely perception that it has a lower recyclability potential than the other waste materials because of the absence of tangible reusable items or that the environmental benefit of recycling it, as opposed to landfilling it, is of smaller scale than for the other recyclables because of its higher biodegradation rate. For instance, the belief that governments are trustworthy does not tend to reduce composting, presumably because the possibility of shifting environmental responsibilities to reliable governments is less meaningful when environmental impacts are perceived to be modest. Consistently, negative environmental attitudes (i.e., the belief that environmental policies should not entail a monetary cost, that environmental issues are for future generations to address or technological progress to resolve, or that environmental impacts are overstated) have no impact on food waste recycling but reduce the recycling of the other waste items even if unsystematically across the four convictions (e.g., plastic recycling is not responsive to how firmly individuals believe in environmental impacts being overstated or future generations being responsible for addressing environmental issues). The possibility of sharing the responsibility of

environmental mitigation we discuss above in our attempt to explain response differences between ex-post activities (i.e., waste disposal and recycling) and ex-ante activities (i.e., waste prevention) is thus less likely to be a relevant consideration in the food waste recycling decision which has a stronger personal dimension than the recycling decision over any other recyclable.

	Glass	Plastic	Newspaper	Cardboard	Cans	Food
UF_REG	0.176*	0.269***	0.12	0.263***	0.224**	0.02
REC_COLL	0.175**	0.136**	0.114*	0.163**	0.226***	0.048
REC_DROP	-0.033	-0.012	0.005	-0.004	-0.013	0.081**
REC_MAN	0.050*	0.087***	0.081***	0.068**	0.053*	0.342***
CURB_Y	0.246***	0.169***	0.196***	0.193***	0.015	0.138
DP_C_Y	0.120***	0.258***	0.044	0.027	0.359***	0.069
DP_NC_Y	-0.037	-0.071**	-0.001	-0.065**	-0.048	0.076

Table 2b. Summary of policy effects of interest on material-specific recycling. See full Table 2.

But the more individualistic peculiarity of composting also surfaces in its invariance to the belief that composting is part of our culture or to the involvement of a citizen/consumer organization and in its negative responsiveness to local media education programs or to the belief that there is social pressure to engage in the activity even if the peer effect via neighbours' influence is absent. In regard to social pressure and social motives (via the influence of neighbours), glass is the only recyclable for which the results from the analysis of overall recycling hold, namely, that individuals respond negatively to the imposition of pressure but are influenced positively by their neighbours; in all of the other cases, with the exception of food waste, social pressure and social motives are inconsequential. In spite of the differences, the conclusion that social pressure may not be an effective tool to modify behaviour still stands.

Other salient features of food waste recycling which separates it from the recycling of the other waste items concern the effects of policy instruments, most notably of unit pricing, pick-up frequencies, curbside collection, and drop-off programs. The key result is that the presence of unit pricing does not condition the decision over the intensity of food waste recycling, although, interestingly, the perceived presence of unit pricing does, with a marginal effect on the probability of recycling 100 percent of recyclable food waste equal to 17 percentage points (see Table 5). While we are not able to explain the reason for this discrepancy, we do note that food waste is the only recyclable for which the belief that garbage collection is financed out of property taxes when a unit pricing system is in place increases recycling, contrary to our theoretical expectations. But the effect of misinformation in recycling decisions seems to be at odds with our theoretical priors more generally in that the overall recycling intensity is lower when individuals not subjected to user fees believe to be paying user fees for garbage collection, a result which we obtain in the material-specific analysis only for the decision about recycling cans. A common feature between

aluminum can recycling and food waste recycling, which may be linked to their theory-inconsistent reaction to misinformation, is the discrepancy in impact between actual unit pricing and perceived unit pricing, with aluminum can recycling increasing in the former but unresponsive to the latter and food waste recycling unresponsive to the former but increasing in the latter.

Having a collection program for recyclables has no bearing on food waste recycling but increases the recycling of any other type of recyclables; on the contrary, having a drop-off program for recyclables increases food waste recycling but has no effect on the recycling of everything else. When we consider material-specific collection programs, we find composting to be consistently unresponsive to the presence of any program (curbside, drop off for cash, drop off without cash, and special drive) while recycling intensity tends to be increasing in the presence of curbside collection for all of the other waste items but cans, increasing in the presence of a drop-off program for cash for all of the other waste items but newspapers/magazines and cardboard, and decreasing in the presence of a drop-off program without cash for plastic and cardboard. In no specific instance, the presence of special drives matters, although overall recycling does decrease with the number of recyclables collected through occasional special drives.

Finally, a striking difference between composting and the recycling of the other waste items emerges in the impact of collection fequencies, with more frequent collections (weekly and every two weeks) having no effect on composting and less frequent collections (monthly) increasing composting, whereas the response of material-specific recycling to variation in collection frequency for any other waste material mirrows that of overall recycling which amounts to a positive effect at high frequency and no affect at low frequency.

3.3 Refundable Deposit Systems

In the analysis of refundable deposit systems, which covers glass and plastic containers and aluminum cans, we include a much smaller set of covariates for two reasons: (1) many of the covariates we have at our disposal relate to a specific waste management option (recycling or waste prevention) and are thus not applicable to the buying and returning decisions over containers/cans with refundable deposits; (2) some covariates (e.g., gender, household age distribution, education) turn out to have consistently statistically insignificant effects across all returnable-for-refund items, and we thus omit them altogether in the final estimation iteration. To be clear, the covariates we initially consider in this section, before omission due to consistent statistical insignificance, are the same as those we include in the curbside disposal equation with the exception of the pick-up frequency indicators but with the addition of an indicator for a curbside recycling program being available and an indicator for the deposit being fully, as opposed to partially, refundable. Attitudinal effects for refundable deposit systems are in summarized in Table 3a and policy

effects in Table 3b.

	Ordered Probit			Binary Probit		
	Return Glass	Return Plastic	Return Cans	Buy Glass	Buy Plastic	Buy Cans
ENVCNCRN				0.0344*	0.0483**	0.025
BETTRENV	0.0639**	0.0774***	0.0842***	0.0457**	0.0403*	0.0379*

Table 3a. Summary of attitudinal effects of interest under refundable deposit systems. See full Table 3.

In terms of methodology, we initially apply an ordered probit procedure for the return intensity decision with sample selection involving the choice of whether to buy containers/cans with refundable deposits. As noted in an earlier section, we conjecture that the decision of whether to buy containers/cans with refundable deposits may be influenced by the proportion of containers individuals would return for refund, in which case we would expect the error term in the buying decision equation to be correlated with the error term in the return intensity decision equation. The estimation results from the ordered probit model with sample selection do, however, support our hypothesis only for glass containers and suggest a negative correlation between the outcome errors and the selection errors; specifically, unobservables that increase the proportion of glass containers returned for refund tend to occur with unobservables that decrease the likelihood of buying glass containers with refundable deposits. Hence, we retain the ordered probit sample-selection model only for glass containers (see Table 3) and model the purchase and return intensity decisions over plastic containers and aluminum cans separately, that is, via a binary probit model for the purchase decision and an ordered probit model for the return intensity decision, but we also provide the disjoint estimation of the participation and intensity probabilities for glass containers (see Table 4).

That individuals tend to take into account their return intensity plan when deciding whether to buy glass containers but not when deciding whether to buy plastic containers or aluminum cans has likely to do with the peculiar characteristics of glass which make its disposal a more restrictive process than the disposal of plastic and aluminum and/or with the type of content/drink which typically comes in glass containers. Unlike unreturned plastic containers and aluminum cans, unreturned glass containers cannot be easily crushed and placed in a garbage bag for curbside disposal and the buying of glass when non-glass options exist is thus more likely to entail a commitment to recycling or returning the glass item. More coordination between the buying and the returning decisions involving glass containers, which would underlie the presence of correlation between unobservables affecting the two decisions, may also arise if the use of glass containers tends to be confined to specific types of content/drink that require special but regular trips to the point of purchase (e.g., liquor stores). Interestingly, having a curbside recycling program has no effect on the purchase and return decisions over glass containers but does impact the two decisions

for plastic containers and aluminum cans, reducing the purchase propensity in both cases but encouraging the return of plastic containers while discouraging the return of aluminum cans. The ineffectiveness of a curbside recycling program in the decisions over glass containers is symptomatic of the correlation between the buying and the returning decisions over glass containers likely due to the specificity of their content.

From the results we report in Table 4, aside from the previously noted high statistical significance of the coefficients associated with the country indicator which is indicative of Canadians' greater disposition towards buying containers/cans with refundable deposits and returning them for refund, the four factors which we find to be consistently relevant in the two decisions and, within each decision, across different types of returnable item are the respondent's age, the presence of unit pricing, whether the deposit is fully refundable, and the extent to which individuals believe that they can contribute to a better environment. Both the presence of a full refund and the belief that individual pro-environmental practices can make a difference encourage the purchase and return for refund decisions, but the former covariate's marginal effect on the purchase decision tends to be larger than that on the 100 percent return decision: in comparison to a partial refund, a full refund increases the buying probability by 58 to 74 percentage points while increasing the 100 percent returning probability by 15 to 21 percentage points. The respondent's age, however, affects the two decisions differently, decreasing the probability of purchasing items with refundable deposits but increasing their return intensity.

	Ordered Probit			Binary Probit		
	Return Glass	Return Plastic	Return Cans	Buy Glass	Buy Plastic	Buy Cans
UF_REG	-0.1413***	-0.1711***	-0.1282***	-0.1260***	-0.2212***	-0.1898***
CURB_Z	0.0697	0.1279***	-0.2035***	0.0065	-0.0989***	-0.1922***
RD_TYPE_Z	0.4064***	0.5652***	0.4835***	1.5725***	2.0608***	1.7760***

Table 3b. Summary of policy effects of interest under refundable deposit systems. See full Table 3.

The presence of unit pricing, however, has a perverse impact on both decisions but the significance of this result is not at all clear as, unlike in the other two empirical analyses, there is noticeable inconsistency in impact between actual presence and perceived presence of unit pricing. In fact, from Table 5, we note that the reported presence of unit pricing is irrelevant in both the decision of whether to buy items with refundable deposits and the decision over the proportion of returnable items to return. At the same time, uncertainty about the payment structure has a consistently negative effect only on the buying decision and in PAYT communities while misinformation has a negative effect on both decisions in PAYT communities and a positive effect only on the buying decision in non-PAYT communities. Hence, based on the effects of the misinformation variables, individuals who believe to be paying user fees for curbside garbage are more likely to buy items with refundable deposits while individuals who believe to be paying for garbage

collection through property taxes are less likely to buy such items and, if they do buy them, are less likely to return them in large proportions.

What is driving the negative effect of the actual presence of unit pricing is then uncertainty and misinformation, both of which consistently sway residents of PAYT communities away from items with refundable deposits. Although the perceived presence of unit pricing is statistically insignificant, the effects of the two misinformation variables may suggest a role for unit pricing in encouraging individuals to resort to items with refundable deposits, possibly through a strengthening of the understanding of the inherent interconnection between waste prevention and waste production. In line with the results about managing waste through curbside disposal, recycling, and waste prevention, uncertainty and misinformation tend to work against the realization of the potential benefits of unit pricing in aspects of waste management not directly linked to unit pricing (i.e., waste prevention and, to a lesser extent, recycling). Arguably, uncertainty and misinformation may reflect a lack of appreciation of the holistic nature of the waste problem and of the complementaries and substitutabilites that may exist among different strategies available to tackle it.

4 Concluding Remarks

In this paper, we pursue a comprehensive analysis of household waste management, consistent with the "three R's" approach of policy bodies, by considering all at once the three channels (i.e., waste disposal, recycling, and waste prevention) through which households can address their waste problem, particularly in response to policy initiatives targetting one or more of such channels. To the best of our knowledge, this is the first study that, owing to the data set at its disposal, examines level (or intensity) decisions in the three waste-related areas simultaneously and allows for the possibility of linkages through unobservables. While we can express the level of engagement in each activity in reduced form and thus only as a function of exogenous variables, it is reasonable to expect unsystematic factors affecting one activity to have ramifications for the other two activities. Our empirical specification thus involves (*i*) a system of three equations, corresponding to the three waste management activities, which are related to one another through jointly normally distributed errors, (*ii*) data-generating processes which are mixed as we have two kinds of dependent variables (categorical for waste disposal and recycling and continuous for waste prevention), and (*iii*) determinants which vary by equation. We adopt a similar specification, but within a six-equation model with the same kind of dependent variables, when we examine the recycling decision across six different types of recyclables. In both instances, the results do provide strong support for the

presence of error correlation in each pairing of activities and resonate with the expectation that a shock boosting environmental engagement in one area has pro-environment implications in the other areas.

Aside from the empirical strategy and the holistic approach to the investigation of household waste management activities, which encompass waste prevention, an area not adequately explored in previous studies because of a lack of direct measures of engagement in source reduction, we contribute to the related literature by extending the analysis to the decisions of buying and returning recyclables that carry refundable deposits. Key findings here are that individuals tend to take into account their return intensity plan only when deciding whether to buy glass containers and engage more actively with the purchase and return of items with refundable deposits when a full refund is in place or if they believe that their pro-environmental practices can make a difference but do not respond favorably to the presence of user fees. But a finding worth emphasizing because of its robustness and consistency across the three empirical analyses is that Canada's environmental performance as reflected in households' waste management practices exceeds the corresponding environmental performance in the United States. While we cannot attribute the systematic difference in waste management behaviour between the two countries to differences in environmental consciousness, which we specifically account for in our empirical specifications, we recognize the policy relevance of isolating the reasons for such a stark result and speculate that differences in the extent to which waste is perceived to contribute to environmental deterioration or differences in policy initiatives to tackle the environmental cost of waste at the production stage may be at play.

Employing a data set from a household survey specifically designed to address data limitations in the literature, we also provide a more robust assessment of unit pricing systems, which represent the one market-based policy instrument available to municipal governments in their efforts to manage household waste more efficiently and effectively, by working with a more policy-balanced sample and with actual, as opposed to perceived, presence of user charges. In the absence of sample stratification by policy, existing household-level studies find no support for the hypothesis that user charges yield positive environmental effects by inducing households to opt for more environmentally friendly waste management options (e.g., recycling), a finding that is likely attributable to the fact that said studies rely on samples that are underrepresented in terms of observations from communities with some sort of pay-as-you-throw programme (about 10 percent). On the contrary, our evidence suggests that economic incentives can and do work, with no clear-cut crowding out implications for intrinsic motivations, and are thus powerful tools to modify behaviour, even when individuals are uncertain about, or unaware of, their existence.

Furthermore, without policy stratification, studies to date gather information about user fees via a

survey question, the answer to which can only give whether the respondent believes to be paying user fees for garbage bags/cans placed at the curb. With policy stratification, coupled with a survey question about the type of payment scheme in place for garbage collection services, we are able to measure the actual presence of user fees and compare its effects to those of the perceived presence of user fees; based on this comparison, we can then arrive at a couple of interesting policy-relevant statements which stress the importance of information, namely: (*i*) there is quite a bit of discrepancy between how garbage collection is financed and how individuals perceive it to be financed, but being misinformed about the presence of user fees is likely a function of time, expected to decline in frequency as more experience with the unit pricing program accumulates; (*ii*) uncertainty and misinformation about how garbage collection is financed do not have negative repercussions in the curbside disposal decision and, to a lesser extent, in the recycling decision, but uncertain/misinformed individuals may not always account for the implications of unit pricing in the broader waste management context, a result which we may interpret as underscoring the need for information diffusion investments to highlight the substitutability possibilities that exist across waste management options.

Being more policy-balanced and including actual information about user fees are not the only important features of the data set. The richness of the data set stems, in fact, from its comprehensive coverage of non-economic elements/influences which stress the social, moral, and cultural facets of environmental decisions and allow us to provide an empirical examination of Fogg's behaviour model (Fogg, 2009) according to which any target behaviour requires sufficient motivation and ability and an effective trigger but, while there is a trade off between motivation and ability, a trigger must always be present. Of the three core motivators Fogg defines, we find pleasure and hope to affect waste prevention decisions and social approval to affect recycling decisions and speculate that the difference in impact reflects the more individualistic nature of waste prevention and more collectivist nature of recycling. Ability, or the belief of being able to contribute to a better environment, matters across all waste management options, and the one trigger that works in promoting engagement in recycling and waste prevention is government's support which we treat as a signal or reminder of the importance of the supported activity.

Other interesting results in our analysis of the three waste management options corresponding to the three "R's" which deserve consideration in policy design exercises include: (*i*) the greater role of trust in recycling and waste prevention decisions seemingly attributable to the greater relevance of product characteristics; (*ii*) the possible negative connotation of governmental trust as individuals may choose to engage less extensively in recycling and waste prevention if they can rely on (or trust) the policy

framework in place; (*iii*) timing differences across the three waste management activities, with waste prevention occuring before waste production (when individuals have control over the environmental impact of their choices) and recycling and curbside disposal occuring after waste production (when individuals can partially shift to governments the responsibility of dealing with their waste problem), and their more favorable implications for the effects of environmental attitudes on waste prevention; (*iv*) the controlling aspect of social pressure which manifests itself in individuals being responsive to the views of their peers but reacting negatively to the notion of social conformity as it undermines the individuality of decision making; (*v*) the weaker role of time considerations in recycling decisions coupled with the greater emphasis on convenience and immediacy of activities in support of recycling (e.g., washing out containers may require more time but is more immediate than bundling newspapers).

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