Private Recycling Values, Social Norms, and Legal Rules[1]

W. Kip Viscusi[2]
Joel Huber[3]
Jason Bell[4]

This article uses a large, original data set on U.S. recycling behavior and perception of social norms. The data include unique information with respect to personal norms as well as information on both descriptive and injunctive social norms with respect to recycling behavior. The analysis finds that the legal and regulatory environment is strongly related to average county recycling rates and private perceptions of neighbors' attitudes toward recycling. Average community recycling rates, legal regimes, and perceived external norms are correlated with higher individual recycling rates so that both descriptive and injunctive norms are influential. Households that recycle are also more likely to have a private recycling norm. Deposit policies that provide financial incentives and recycling policies that make recycling more convenient are associated with greater recycling rates.

Deposit policies – descriptive norm – environment – injunctive norm – recycling

Valeurs Privées pour le Recyclage, Normes Sociales et Règles Légales

Cet article analyse l'influence des normes sociales sur les comportements de recyclage des ménages à partir d'une base de données américaine originale. Cette base de données unique fournit des informations sur les normes personnelles (ou privées) des ménages, ainsi que sur les normes sociales descriptive d'une part et d'injonction d'autre part. Les normes sociales sont évaluées empiriquement à partir des quatre variables suivantes : les croyances que le recyclage est socialement désirable ; la perception subjective que le voisinage voit défavorablement un manquement au recyclage ; les formes standards de recyclage dans la communauté à laquelle le ménage appartient ; et, l'impact des lois et de la réglementation en matière de consigne. Nous montrons que l'environnement légal et réglementaire est fortement lié aux taux

1. This research was supported in part by a grant from EPA to Vanderbilt University. The authors are solely responsible for all conclusions and policy views expressed. Jake Byl provided excellent research assistance.

2. Corresponding author. University Distinguished Professor of Law, Economics, and Management, Vanderbilt University, 131 21st Avenue South, Nashville, TN 37203, kip.viscusi@vanderbilt.edu. Phone: (615) 343-6835. Fax: (615) 322-5953.
3. Fuqua School of Business, Duke University, 100 Fuqua Drive, Durham, NC 27708, joel.huber@duke.edu. Phone: (919) 660-7785.
4. Fuqua School of Business, Duke University, 100 Fuqua Drive, Durham, NC 27708, jason.bell@duke.edu.

moyens de recyclage ainsi qu'aux perceptions privées des attitudes de son voisinage en matière de recyclage. Ces régimes légaux, ces perceptions, ces taux sont corrélés avec de plus hauts taux de recyclage individuel montrant que les normes sociales descriptive et d'injonction sont d'influence. Les ménages qui recyclent sont probablement ceux qui possèdent des normes privées de recyclage. Les politiques incitatives financièrement en matière de consigne et celles qui rendent le recyclage plus facile d'accès sont associées avec des taux de recyclage plus élevés.

Environnement – norme descriptive – norme d'injonction – politique de consigne – recyclage

Classification JEL : H23, D60, K32, Q30

1. Introduction

Policies can foster pro-environmental behavior in a variety of ways. Standard mechanisms for doing so include the use of financial incentives and command and control requirements.[5] An additional and not entirely distinct avenue of influence to alter behavior is to reinforce social norms for particular kinds of behavior that society finds desirable.[6] If people internalize these norms in a manner that leads to pro-environmental actions, then it may be possible to increase environmental stewardship, either in conjunction with or in lieu of more standard forms of intervention. Social norms have generated academic and policy interest in areas of littering (Cialdini *et al.* [1990]), recycling (Abbot *et al.* [2013]), separation of kitchen waste, purchase of green products, and use of public transit (Thøgersen [2008]). Here we use an original data set to examine how norms are established for households' recycling behavior and demonstrate their powerful effect on pro-environmental behaviors.

The basic model of recycling behavior that provides the framework for our empirical analysis is an extension of our recycling model in Viscusi *et al.* [2011]. The model is general in that it pertains to situations in which there are monetary and nonmonetary incentives. It posits that recycling of household wastes involves time costs with fixed and variable components. Let the recycling time cost for recycling n items be given by $(t_{r0} + t_{r1}\, n)w$, where t_{r0} is the fixed cost, t_{r1} is the unit variable cost per item, and w is the wage rate. If the person instead chooses garbage disposal for the items, the costs are $(t_{g0} + t_{g1}\, n)w$, where t_{g0} is the fixed garbage disposal cost and t_{g1} is the unit variable cost. Recycling may also entail a deposit refund d that is received per item, leading to a monetary benefit dn. A somewhat different but for our

5. Previous studies in this vein include Bohm [1981], Hong et al. [1993], Reschovsky and Stone [1994], Kinnaman and Fullerton [1995, 2000], Fullerton and Kinnaman [1996], Nestor and Podolsky [1998], Sterner and Bartelings [1999], Jenkins *et al.* [2003], Collins *et al.* [2006], Beatty *et al.* [2007], Viscusi *et al.* [2012], and Viscusi *et al.* [2013].

6. The role of norms with respect to recycling is also examined in Schultz *et al.* [2007], Halvorsen [2008], and Viscusi *et al.* [2011].

purposes functionally equivalent analysis frames the recycling benefit as a garbage penalty that is avoided by recycling.

We assume that people receive a warm glow benefit g from recycling each unit and that they also place a value c on the reduced environmental cost associated with recycling. If there is a positive income elasticity of valuation of the environment, c may be a function of the wage w, or $c(w)$ where $c' > 0$. Our survey will elicit a value for the individual's personal norm v with respect to recycling, where the value of $v(g, c)$ depends on both the warm glow benefit and the reduced damage to the environment.

There are also two costs incurred by failing to recycle. The first of these costs e is the cost experienced by violating the perceived external norm for recycling as reflected in adverse reactions from one's neighbors or policy requirements. The second related cost component is the cost s associated with failing to conform with standard modes of recycling behavior in the community irrespective of whether one's neighbors would be upset by failing to recycle. In our empirical analysis we will distinguish these two different types of social norms adopting the terminology in the norms literature, which distinguishes injunctive norms and descriptive norms.[7] Injunctive norms pertain to garbage disposal behavior that is morally or legally disapproved. Thus, if neighbors are upset if you don't recycle or if there are legal sanctions for not recycling, such influences are injunctive social norms. Descriptive norms with respect to recycling pertain to the patterns of behavior reflected in what other people do. We will capture the influence of these norms through average community recycling rates. It can be difficult to disentangle the effects of injunctive and descriptive norms because of their strong positive correlation (Thøgersen [2008]). In addition, the presence of pro-environmental behaviors such as recycling or not littering may remind people of the presence of an injunctive norm (Cialdini *et al.* [1990]). We seek to distinguish these effects as much as is feasible by controlling for two sets of variables reflecting injunctive norms – perceptions of the attitudes of one's neighbors toward recycling as well as information on the characteristics of recycling and deposit laws.

If we assume that the household already engages in both recycling and garbage disposal so that the fixed costs associated with recycling can be ignored, the condition that a household will recycle is given by

$$(g + c)n - (t_{r0} + t_{r1}\, n)w + dn > -en - sn - (t_{g0} + t_{g1}\, n)w,$$

which reduces to

$$g + c + d + e + s > (t_{r1} - t_{g1})w$$

Thus, if the sum of the warm glow benefit, the value of the reduced environmental damage, the deposit refund, the avoided injunctive norm costs,

7. Cialdini *et al.* [1990], Thøgersen [2008] and Abbott *et al.* [2013].

and the avoided descriptive norm costs exceed the time costs, the household will recycle.[8]

The data we analyze on recycling behavior affords us a detailed assessment of the role of these components. Higher values of w have conflicting effects in terms of raising both the environmental benefits and the perceived costs of recycling. We find a positive dominant influence of the value of time wage effect w as captured empirically by household income.

Thus, we will assess empirically the role of the four norm-related variables – personal beliefs that recycling is desirable, perception that others will view a failure to recycle unfavorably, standard recycling patterns in the community, and differences in recycling and deposit laws. The empirical analysis will embody all these effects, which all have the expected relationship to recycling behavior.

Our empirical analysis utilizes a rich individual data set on recycling behavior for glass, paper, cans, and plastic, as well as data on perception of social norms. After describing the data and providing an overview of the empirical analysis in Section II, we examine the factors influencing the external social norm variables in Section III. These norms and the regulatory environment are linked to both the household's recycling decisions and private recycling norms, which we analyze in Section IV. The concluding Section V summarizes the powerful role of norms-related factors with respect to recycling behavior.

2. Data and Structure of Empirical Analysis

This paper uses two original data sets drawn from a random sample of the U.S. population. Each of these cross-sectional data sets is based on the Knowledge Networks panel, which provides a demographically matched sample of the United States should read States household population (see Appendix Table A1).

Our core data set that we analyze consists of 1.047 respondents whom Knowledge Networks recruited specifically for this study in 2009. Each respondent completed a survey that we developed, which included questions on bottled water recycling and attitudes toward recycling generally. Respondents also provided detailed information on household recycling behavior as well as information pertaining to social norms, in particular, how they view the recycling decisions of others and how they think others view their recycling behavior. Such norms perception information is unique in

8. The simple formulation above reflects the general manner in which the norms variables will be captured empirically. Theoretical models of norms may be more complex by, for example, including a reference-dependent loss $\lambda(n^* - n)$ if the social norm for recycling is n^* and the respondents recycles $n < n^*$. The empirical formulation is quite general in that community recycling rates and both private and external norm variables enter the model.

that there is no other published survey with comparable information. Appendix Table 2A provides the means and standard deviations of the relevant data from this data set.

The second data set provides county-level data that permits an analysis of the local demographics and recycling conditions for the respondent's county. These data were generated by taking data, grouped by county, from approximately 250.000 responses to demographic and recycling questions asked of Knowledge Networks panel members. These data include some responses covering 2009 and three years before and after. This sample, which we refer to as the county data set, includes demographic and recycling information for 2.799 counties (about 90% of all counties in the United States), but does not include data on the two social norm perception variables except for the 1.047 observations that are a subset of this data set.

Table 1 shows how recycling laws in the United States vary by state. Using information on the state of residence we constructed a series of variables to characterize the state regulatory regimes that respondents face. The incentives provided by these laws are of two types – financial incentives that pertain to deposit policies and legislative requirements designed to regulate behavior. Deposit policies establish financial incentives for recycling through deposits on plastic and glass bottles and aluminum cans. As of 2009, when data in the core data set were collected, five states had such deposit policies in place including bottles other than plastic water bottles.[9] In some cases, there are also monetary deposits for plastic water bottles. Six states had instituted deposits for plastic water bottles.[10] All the states that impose deposits for plastic water bottles also have deposits for other bottles and cans. As a result, we distinguish three types of deposit policy regime: those with no deposits, those with deposits on bottles, cans and bottled water, and those with deposits not including bottled water.

In addition, there are various recycling laws that the states have enacted. Following Viscusi *et al.* [2013] we categorize these laws based on their stringency. The most stringent laws are *mandatory* recycling laws. Six states and the District of Columbia have these types of laws, which require residents to recycle certain materials, sometimes enforced through official warnings or increasing fines for repeated violations.[11] The next most stringent type is *opportunity* laws, implemented by eight states. These laws require local governments to ensure that residents have an opportunity to recycle, generally through curbside pickup or dedicated locations where recyclable materials can be taken. The next most stringent legal regime consists of *planning* laws enacted in fifteen states, whereby the state has enacted a detailed recycling plan, such as establishment of a provision for curbside pickup and recycling drop-off centers. The least stringent form of legislation

9. New York added water to its deposit law, but this law had not been implemented when the core data were collected bottles.

10. Delaware repealed its deposit law in 2010.

11. Violations of mandatory state recycling laws vary by locality but take the form of warnings or relatively small fines followed by increasing fines for repeated offenses. For example, the Waste Management and Recycling Ordinance #08-02 of Pine Lake, Wisconsin specifies a fine of at least $25 for the second offense and $100 for the third and all subsequent offenses.

consists of policies in six states that simply establish a recycling *goal*. Finally, there are fifteen states that have enacted no state-wide recycling policies.

The starting point for our analysis of a household's recycling behavior consists of the demographic characteristics of the area and the various recycling laws and policies in place where the respondent lives. This recycling environment is associated with the average recycling rate in the locale where the respondent lives, where the unit of observation is the respondent's county. The county level within a state is a refined locational measure, as there are 2.799 counties represented in our data set. We use the county level recycling variable as a descriptive norms measure in that it captures average recycling behavior in the locale.[12] Additionally, the data include an explicit indicator of injunctive social norms, measured by agreement with the statement: "Other people in my neighborhood would be upset if they noticed someone putting recyclable materials into the garbage." Thus, the respondent's recycling decision can be related to social norms in three ways. First, injunctive norms may be directly established through current laws and regulations. Second, beliefs that others view a failure to recycle negatively create an injunctive norm. Third, the recycling behavior of others may establish a descriptive norm if households want to be in step with their neighbors.

The final norms variable relates to whether the respondent projects recycling norms on to others and is reflected in agreement or disagreement to the statement: "I would be upset if I noticed someone in my neighborhood putting recyclable materials into the garbage." We refer to this as the personal norms perception variable.

Table 2 shows the interrelationship between the two norm perception variables. There is a substantial correspondence between the respondent's personal norms and perception of the neighbor's norm. Further, the injunctive norm is less common than the personal norm. While 30% of the sample would be upset if their neighbors did not recycle, they believe that only 15% of their neighbors would be upset with people who put recyclable materials in the garbage. It may be that because the failure to recycle by including the material in one's garbage is generally hidden so that unobservable violations of this type cannot be monitored, the relative concern with respect to views of one's neighbors is not as great. Recycling behavior is likely to be unobservable except for curbside collection, where the visibility of recycling serves to create a social norm (Abbot *et al.* [2013]). The dominant combination of beliefs in Table 2 is that there is only a modest role of perceptional recycling norms. Two-thirds of the respondents believe that neither they nor their neighbors would be upset by a failure to recycle, so that concerns of this type are not prominent. In contrast, only 12% of the sample members both express concern with neighbors who do not recycle and also believe that their neighbors would be upset by a failure to recycle.

The relationship of the norms perception variables to recycling behavior follows the expected pattern. External and personal norms are more promi-

12. For 20 observations in 14 states, the county identifier was missing. For these observations, the state average is used.

nent for those who engage in relatively high amounts of recycling activity. Table 3 lists the respondent's self-assessed recycling rates and their relationship to the norm perception variables. The first two rows of norm variables pertain to the individual survey question responses. The subsequent four rows reflect the different combinations of responses based on responses to both of the survey questions. The columns in Table 3 pertain to the reported degree of recycling behavior by the respondent's household relative to the respondent's neighbors. Respondents who believe they recycle a relatively greater amount than their neighbors are more likely to be upset seeing a neighbor not recycling. By contrast, the difference in recycling behavior when a neighbor might be upset is less. Indeed, in the relatively rare case $(n = 39)$ where the respondent would not be concerned but believes the neighbor would, then respondents are most likely to indicate recycling less than their neighbors among all categories of norms.

Overall, the averages at the bottom row of Table 3 are consistent with a positive self-assessment bias. When people are asked comparative questions such as whether they recycle more, less, or the same amount as their neighbors, they typically do not wish to find fault with themselves and consequently rate themselves as being average or above average in their recycling behavior. Such framing effects are evident in a variety of other survey contexts. It also may be the case that because disposing of recyclable materials in one's trash is not observable, people underestimate how much recycling their neighbors do. Thus, across norm conditions, 39% of the sample believes that they recycle more than their neighbors, 44% believe that the amount is the same, and only 18% believe that they recycle less than their neighbors.

Although the relative recycling assessments may be upwardly biased because of the framing effect of the relative recycling question, the relationship of the relative assessments to the norms perception variables indicates many plausible patterns. In most of our analysis below we focus on specific recycling behaviors, but the relative recycling amount is a useful summary index that is consistent with the reported specific behaviors. The highest beliefs that the respondent's household recycles more than the neighbors' are for the situation in which the respondent would be upset if the neighbors did not recycle but where there is not also a comparable injunctive norms perception, which is presumably the result of a low perceived recycling rate by one's neighbors. At the other extreme, respondents are least likely to believe that they are relatively greater recyclers if they don't care about recycling, but they believe their neighbors do or, more specifically, if there is a perceived injunctive norm for recycling that is not accompanied by a personal norm in favor of recycling.

So far we have shown a relationship between perceived relative recycling and social norms. Now we turn to reported recycling behavior. For each respondent, information is available on whether the respondent indicated that they recycled glass, plastic, cans, and paper. Table 4 summarizes the overall recycling rates for these materials and their relationship to the household's perceived relative recycling rate. For each recycling material, the percentage of households who recycle the material steadily increases as one moves from the first row to the third row in the table, consistent with a

positive self-assessment bias as shown earlier. Respondents' relative beliefs concerning their recycling behavior are consistent with their reported recycling rates. The percentage across all households for recycling the different materials ranges from 52% to 71%. The highest recycling rates are for cans, while the lowest recycling rates are for glass. The lower recycling rate for paper may be attributable in part to the decrease in newspaper circulation coupled with the general absence of any financial incentives for newspaper recycling.

On average across the four materials, the sample recycles 62% among the four materials. This is similar though slightly lower than the 69% rate reported by all responses from all panelists in the counties where members of the sample live. We will use this average of the four-material recycling rate for the respondent's county of residence as a measure of the descriptive recycling norm that stems from the standard recycling behavior of others.

3. Determinants of External Recycling Norms

The external influences of laws and demographic characteristics are hypothesized to influence average recycling rates. Thus, our next matter of interest is the correspondence between the recycling environment and recycling rates. The legal and regulatory environment not only may influence recycling directly as an injunctive norm, but also may have an indirect effect on recycling through the descriptive norms.

Table 5 presents regression results for the average reported recycling rate in the county for each of the four materials—glass, plastic, cans, and paper. The final column reports regression results for the average recycling rates across the four materials. Because average recycling rates may affect the support for different kinds of laws, these regressions are correlational not causal. However, in Viscusi *et al.* [2012] and Viscusi *et al.* [2013], we present results for two natural experiments involving the introduction of plastic water bottle deposit policies, each of which had the expected effect of boosting recycling behaviors. The explanatory variables in Table 5 usually affect each of the types of recycling behavior similarly. Recycling rates are 12% higher in states in which there are deposits required for bottles and cans but not for plastic water bottles, and are 19% higher in states that also require deposits on plastic water bottles. The presence of the plastic water bottle deposit law in part reflects a more vigorous recycling regime, which may account for the greater recycling rates for cans and glass bottles in states with plastic water bottle deposit policies. In addition, there may be substantial interdependencies in recycling activities so that policies that encourage recycling of one type of material boost other recycling rates as well. If there are fixed costs to recycling behavior then people will have a greater incentive to recycle any particular material once they are already engaged in some type of recycling behavior.

The role of the recycling laws follows the expected pattern where more stringent laws are associated with greater recycling rates than less stringent laws. The omitted category that serves as the reference point is that of states that have no recycling laws in place. It is puzzling that states with no general statewide recycling laws would have greater recycling levels than those with goal laws. That may be due to a number of causes. First, laws pertaining to the general recycling policy are not the only mechanisms for creating incentives to recycle. Some states with no recycling laws (Vermont, Massachusetts, and Delaware) have relatively high recycling rates, but have state laws that require bottle deposits, thus creating a financial incentive to recycle. Respondents in these three states reported an average recycling rate of 71% compared to 48% for the other states with no recycling laws. Deposit regimes are more stringent than goal laws for the materials requiring deposits, as there is a monetary penalty for failing to recycle equal the amount of the deposit. In those cases, the state has demonstrated willingness to act through deposit laws so state mandated recycling levels might be redundant, as residents already recycle.[13] Second, even if a state has no recycling law, many of its municipalities and counties may have recycling policies, decreasing the need for state-wide legislation. Conversely, some states without such active municipalities or with poor recycling rates might have legislatures that pass goal laws to encourage local governments to aspire to higher recycling rates. Finally, rural states with few large cities may have effective municipal recycling laws in urban areas where statewide goals would be less realistic in sparsely populated areas. And in fact, states with goal laws have a population density over one and a half times greater than states with no laws, even though states with no laws have almost twice the average population.

The mandatory laws incentivizing citizen participation have the largest effect in Table 5 on all categories of recycling, followed by those requiring local municipalities to provide recycling opportunities to its citizens. The coefficients for mandatory or opportunity laws do not differ significantly from that for the most vigorous financial incentives, which are those that are in place in states with deposits for plastic water bottles as well as other bottles and cans.[14] The next most rigorous laws are planning laws, and these laws likewise boost average recycling rates relative to having no state recycling laws. Across all four recycling materials, the role of the planning laws is consistently less than half than the role of the mandatory or opportunity laws. The states with goals are associated with significantly lower recycling rates compared to states with no recycling laws. This effect supports our past research on other recycling behavior in which we found that states that enact legislation with only exhortations and goals that lack concrete recycling plans are making a symbolic commitment that appears to be reflecting concern about state recycling performance but a lack of commit-

13. These three states also pursued recycling laws after the survey date, with Delaware passing a law in 2009, Vermont in 2012, and Massachusetts with a bill pending in its legislature.

14. $F = 0.56$, $Prob > F = -0.455$.

ment to recycling efforts.[15] They reflect an understanding of the problem but a lack of political will to act.[16]

Together, the results for the laws and the deposit policies indicate that formal interventions are in fact closely related to recycling rates. It is likely that causality runs in both directions. States in which people are committed to recycling may pass stringent recycling laws. Both the regulatory regime and the county recycling rates are part of the general recycling environment that establishes a behavioral norm for recycling.[17] Our intent here is not to disentangle these influences but instead to focus on how these factors are jointly related to perceptions of social norms and individual recycling behavior. Including both the legal variables and the county recycling rates as explanatory variables in subsequent equations creates no problematic econometric issues, as there is no requirement that explanatory variables in a regression be independent.

Another noteworthy implication of the regressions in Table 5 is that counties with higher average income engage in more recycling of all kinds. Although higher income households have higher opportunity costs of recycling, they may place a higher value on environmental quality if protecting the environment through recycling policies is a normal economic good. We have found a positive income effect for recycling in previous research and have estimated a positive income elasticity for the value of water quality, each of which is consistent with the types of valuations evidenced here.

The recycling environment will also establish an injunctive norm. The injunctive norm variables in the analysis are the various recycling law variables as well as the respondent's belief that neighbors would be upset if their household did not recycle. The probit estimates in Table 6 examine the determinants of whether respondents are more likely to believe their neighbors would be upset when recycling rates are high and recycling laws are stringent. There is a strong relationship of the county recycling rate to the perception of an injunctive norm, but the impact of mandatory laws is not statistically significant unless the county recycling rate variable is excluded. Legal regimes do not have an additional effect on perceptions after accounting for average recycling rates, and only the most stringent legal regime is influential. The magnitude of the relationship based on the results in the first column of Table 6 is such that for each 0.10 increase in the fraction of people in the county who are recycling, the probability that the respondent believes neighbors would be upset by a failure to recycle is 0.027 higher, whereas the presence of a mandatory recycling law increases the fraction of people who recycle by 0.15 in column 2 of Table 6.

In addition, higher income respondents are more likely to believe their neighbors would be upset by their failure to recycle, even after controlling for the county recycling rate and other factors. This result is consistent with the positive relationship of income with recycling behavior generally.

15. See Viscusi *et al.* [2011, 2012, 2013].
16. Most of the states with goal laws are poorer than the country overall and/or more rural.
17. While legal regimes may take time before they bolster or establish norms for recycling, the natural experiments mentioned above from Viscusi *et al.* [2012, 2013] demonstrate that recycling rates can be seen to increase measurably in a short period of time.

4. Individual Household Recycling Rates

One would expect that the regulatory and legal regimes, descriptive norms, and perceptions of external norms should influence the household's recycling behavior. We begin with an analysis of the household's total recycling behavior based on the number of different materials that are recycled, where the responses can range from 0 to 4 (among glass, plastic, cans, and paper). We run Poisson regressions to account for the count aspect of the data. Table 7 reports two regressions, one that includes the average county recycling rate and one that does not. The data used in this analysis consist of the 1.047 observations for which we have recycling norm perception information, but we include recycling data on these households from multiple years from 2005 through 2011. Respondents provided recycling information an average of 3.9 times over that period, ranging from one to five times. To account for the effect of including multiple observations per household on the estimated standard errors, all reported standard errors are robust and clustered for the respondent household.

Consider Table 7's first column of regression results for the number of materials that are recycled where the county recycling rate is not included. The perception variable for the neighbors' norms and various regulatory variables are associated with greater recycling rates. If the respondent believes that one's neighbors care about recycling, this belief is associated with a larger number of materials that the respondent's household recycles. Relative to the absence of state laws, both mandatory and opportunity laws have a positive impact, while as before goal laws have a negative effect. Also, the presence of deposits for cans and bottles other than plastic water bottles, deposit policies that also include water bottle deposits have relatively weak effects.

However, matters are quite different for the second equation in Table 7 in which the average reported county recycling rate among all panelists is included. The county average recycling rate has a strong and significant positive effect. Even controlling for a large set of variables designed to characterize injunctive norms, the descriptive norm variable for average recycling rates has a strong influence. The perception of external social norms variable remains influential, though with a smaller magnitude than when the county average recycling rates is not included. The greatest change is with respect to the various deposit and regulatory regime variables. After the county recycling rate is included in the analysis, these variables no longer have substantial influence on the number of materials that the respondent's household recycles. The negative effect of the goal laws remains, and respondents in states with water bottle deposit laws actually recycle fewer materials in this equation after accounting for the county rate. The negative effect of deposit laws, including water bottle deposits, may arise because a comprehensive bottle deposit policy may lead respondents to visit recycling locations that only recycle bottles and cans for which there are deposits.

The demographic effect of greatest interest remains the income level of the household. Even after accounting for the county average recycling rate, household income has a positive effect on recycling behavior as measured by the number of materials that the household recycles.

To explore whether these various effects are borne out for specific materials, Table 8 reports the separate probit regressions for whether the respondent recycles glass, plastic, cans, and paper. Even though there is overall variability in the recycling rates for the different materials, the patterns of influence for each of the four regressions are remarkably similar to those exhibited in the total number of materials recycled regressions and are consistent across all types of recycling behavior. Both the county average recycling rates and perceptions that one's neighbors care about the household's recycling efforts each have a positive coefficients in an equation for the probability that the respondent recycles each of the four materials listed. Moreover, income has a positive effect on recycling rates, consistent with the previous results.

How all these factors affect the household's personal perceived recycling norms with respect to the recycling activities by others is the final linkage to be examined. The variables that we include in the probit regressions in Table 9, for whether the respondent would be upset if others did not recycle, include the main effects identified in the previous analyses.[18] We capture the household's recycling behavior with two indicator variables for whether the household recycles more or less than the household's neighbors. The omitted category consists of those who recycle the same amount as their neighbors. Being a diligent recycler is more strongly associated with personal recycling norms than does being a below average recycler, as the increased probability of 0.25 from above average recycling is more than twice the 0.10 decrease in being upset that occurs for respondents who recycle less than their neighbors. There is an asymmetry in that others' failure to recycle is more likely to upset a person if their household recycles. Such failures to recycle are violations of the norm that the household has established for itself and do not contribute to the constructive actions that the household has undertaken to protect the environment. The negative effect for the below-average recyclers is smaller because these households have not incurred recycling costs that in any way are being offset by the failure of others to recycle.

The two measures of external social norms are positively related to the household's belief that they would be upset if others did not recycle. A 0.10 increase in the county average recycling rate would increase the probability that the respondent would be upset if others did not recycle by 0.035. Respondents who believe they recycle more than their neighbors see a 0.25 increase in the probability of being upset if others do not recycle. Further, among those in states with the strongest recycling laws there is a 0.17 increase in the probability of being upset with a non-recycling neighbor. This makes sense, since the strictest recycling laws reflect a society's commitment to protecting the environment, in addition to the fact that a non-

18. Exploratory runs that also included political party registration of the respondent did not indicate any statistically significant effects.

recycling neighbor would be breaking the law. Finally, an increase in respondent income of $100.000 increases the probability of being upset by 0.08.

5. Conclusion

Policy makers can manipulate different policy instruments to foster greater recycling rates. Chief among these are financial incentives and regulations that mandate different kinds of recycling behavior and establish mechanisms by which people can recycle various materials. In previous studies we have found that the presence of such interventions boosts recycling rates. These policies additionally affect descriptive norms by establishing standards of behavior and affect injunctive norms by fostering incentives for recycling behavior.

A particularly powerful variable is the average recycling rate in the respondent's area, which is higher in locales with stringent recycling regimes. The average recycling rate of others is positively related to the household's recycling rate, both directly and by influencing the household's perception that neighbors would be concerned with the household's failure to recycle. Similarly, the respondent is more likely to be upset if neighbors do not recycle if the county recycling average is high.

After accounting for the average recycling behaviors and the role of perceived recycling norms, the deposit policies and regulatory efforts have little independent role to play. This is not to say that such efforts are inconsequential. In their absence, the average recycling rates in the area would not be as great. However, if it is possible to alter average protective behaviors, then doing so may have additional impacts on perceived norms and households' efforts to take actions that are protective of the environment.

Table 1. Recycling Laws and Deposit Regimes by State in 2009

Deposit Regimes	
Deposit law excluding water bottles	Iowa, Massachusetts, Michigan, New York, Delaware
Deposit law including water bottles	California, Connecticut, Hawaii, Maine, Oregon, Vermont
Legal Regimes, in Descending Stringency	
Mandatory recycling	Connecticut, District of Columbia, New Jersey, New York, Pennsylvania, West Virginia, Wisconsin
Opportunity to recycle	Arizona, Arkansas, Florida, Minnesota, Nevada, Oregon, South Carolina, Washington

State requires recycling plan	Alabama, California, Hawaii, Illinois, Iowa, Maine, Maryland, Michigan, Nebraska, New Mexico, North Carolina, Ohio, Tennessee, Texas, Virginia
State requires a recycling goal	Louisiana, Mississippi, Montana, New Hampshire, Rhode Island, South Dakota
No recycling law	Alaska, Colorado, Delaware, Georgia, Idaho, Indiana, Kansas, Kentucky, Massachusetts, Missouri, North Dakota, Oklahoma, Utah, Vermont, Wyoming

Source: Statutory documentation for the legal regimes is provided in Tables A1, A2, and A3 of Viscusi *et al.* [2013]. Connecticut and Oregon adopted plastic water bottle recycling policies that took effect in 2009. Vermont's laws addressing recycling (10 V.S.A. § 6604 and § 6622, 24 V.S.A. § 2202a) were not considered stringent enough to qualify it as a plan law state. New York passed a deposit law covering plastic bottles, but it had not been implemented when the survey was administered. Delaware repealed its deposit law in 2010, after the survey was administered.

Table 2. Perceptions That Respondent and Neighbors Would Be Upset by Failure to Recycle

	Neighbor Not Upset	Neighbor Upset	Total
Respondent Not Upset	65.8% (689)	3.7% (39)	69.5% (728)
Respondent Upset	18.8% (197)	11.7% (122)	30.5% (319)
Total	84.6% (886)	15.4% (161)	1.047

Note: The number of observations in each cell is listed in parentheses.

Table 3. Relation of Norm Perceptions to Recycling Behavior: Percent of Respondents Who Think They or Neighbors Would Be Upset by Not Recycling

	Recycle More than Neighbors	Recycle Same as Neighbors	Recycle Less than Neighbors
Respondents Upset ($N = 319$)	62.7	30.7	6.6
Neighbor Upset ($N = 161$)	42.2	43.5	14.3
Respondent Upset but Neighbor Not ($N = 197$)	71.6	24.4	4.1
Neighbor Upset but Respondent Not ($N = 39$)	23.1	51.3	25.6
Both Upset ($N = 122$)	48.4	41.0	10.7
Neither Upset ($N = 689$)	28.9	48.9	22.2
Total ($N = 1.047$)	39.0	43.5	17.6

Table 4. Percent of Four Material Types Recycled by Respondent by Relative Recycling Rate

	N	Glass	Plastic	Cans	Paper	Average of Four Materials
Recycle Less than Neighbors	184	20.2	29.8	40.3	29.8	30.0
Recycle Same as Neighbors	455	44.2	54.4	66.4	56.7	55.4
Recycle More than Neighbors	408	75.6	83.8	89.6	84.7	82.7
Total	**1.047**	**52.2**	**61.6**	**70.8**	**61.7**	**61.6**

Notes: The final column is the average of the four 0-1 recycling scores for glass, plastic, cans, and paper for respondents.

Table 5. Regressions of County Recycling Averages for Different Materials

	Glass County Average	Plastic County Average	Cans County Average	Paper County Average	Total County Average
Deposit Laws Excluding Water	0.153** (0.018)	0.154** (0.019)	0.086** (0.018)	0.099** (0.019)	0.120** (0.016)
Deposit Laws Including Water	0.283** (0.027)	0.256** (0.027)	0.151** (0.026)	0.097** (0.028)	0.191** (0.023)
Mandatory Laws	0.254** (0.021)	0.197** (0.022)	0.124** (0.020)	0.144** (0.022)	0.179** (0.018)
Opportunity Laws	0.200** (0.016)	0.177** (0.016)	0.115** (0.015)	0.154** (0.017)	0.165** (0.014)
Planning Laws	0.061** (0.012)	0.068** (0.013)	0.044** (0.012)	0.054** (0.013)	0.058** (0.010)
Goal but No Planning Laws	– 0.046* (0.018)	– 0.057** (0.019)	– 0.030* (0.018)	– 0.050* (0.019)	– 0.043** (0.016)
Income / 10.000	0.029** (0.003)	0.029** (0.003)	0.008** (0.003)	0.031** (0.003)	0.024** (0.002)
Top Income Category (over $175.000)	0.184* (0.087)	0.177* (0.090)	0.198* (0.085)	0.135 (0.091)	0.172* (0.074)
Northeast	0.091** (0.024)	0.076** (0.025)	0.022 (0.023)	0.072** (0.025)	0.069** (0.021)
South	– 0.153** (0.011)	– 0.142** (0.012)	– 0.139** (0.011)	– 0.140** (0.012)	– 0.144** (0.010)
West	– 0.074** (0.017)	– 0.062** (0.017)	– 0.061** (0.016)	0.008 (0.018)	– 0.043** (0.014)
Constant	0.169** (0.018)	0.264** (0.018)	0.603** (0.017)	0.309** (0.018)	0.337** (0.015)
Observations	2.799	2.799	2.799	2.799	2.799
R-squared	0.36	0.31	0.17	0.24	0.34

Notes: Dependent variables are the fraction of those in the county who recycle (from 0 to 1). Standard errors are in parentheses: * significant at 5%; ** significant at 1%. County Average, Ranging from 0 (0%) to 1 (100%).

Table 6. Probit Regression on Whether Neighbors Would Be Upset if Respondent Did Not Recycle

	Marginal Effect (Standard Error)	Marginal Effect (Standard Error)
Home County Recycling Average	0.274**	
	(0.082)	
Deposit Laws, Excluding Water	– 0.021	– 0.008
	(0.035)	(0.036)
Deposit Laws, Including Water	0.006	0.043
	(0.040)	(0.043)
Mandatory Laws	0.098	0.152*
	(0.067)	(0.073)
Opportunity Laws	– 0.013	0.039
	(0.042)	(0.046)
Planning Laws	0.007	0.027
	(0.037)	(0.037)
Goal but No Planning Laws	0.118	0.108
	(0.103)	(0.099)
Income / 10.000	0.007**	0.009**
	(0.003)	(0.003)

Notes: Robust standard errors are in parentheses: * significant at 5%; ** significant at 1%. Regression also included variables for top income category, MSA status, and geographical region.

Table 7. Poisson Regressions on Number of Materials Recycled

	Coefficient (Standard Error)	Coefficient (Standard Error)
Home County Recycling Average		1.694**
		(0.133)
Neighbor Would Be Upset	0.154**	0.089*
	(0.038)	(0.035)
Deposit Laws, Excluding Water	0.109*	0.017
	(0.052)	(0.052)
Deposit Laws, Including Water	0.081	– 0.111*
	(0.053)	(0.053)
Mandatory Laws	0.230**	– 0.043
	(0.078)	(0.072)
Opportunity Laws	0.288**	– 0.019
	(0.071)	(0.069)
Planning Laws	0.093	– 0.025
	(0.068)	(0.067)
Goal but No Planning Laws	– 0.225	– 0.214
	(0.174)	(0.156)
Income / 10.000	0.033**	0.026**
	(0.004)	(0.004)
Constant	0.427**	– 0.378**
	(0.078)	(0.102)
Observations	4.058	4.058

Notes: Standard errors are adjusted for 1.047 clusters: * significant at 5%; ** significant at 1%. Regressions also included variables for top income category, MSA status, and geographical region.

Table 8. Probit Regressions for Different Materials Recycled

	Glass	Plastic	Cans	Paper
Home County Recycling Average	1.403**	1.124**	0.686**	0.966**
	(0.115)	(0.099)	(0.089)	(0.100)
Neighbor Would Be Upset	0.137**	0.100**	0.061*	0.112**
	(0.037)	(0.035)	(0.030)	(0.033)
Deposit Laws, Excluding Water	0.043	0.060	0.008	– 0.002
	(0.049)	(0.043)	(0.038)	(0.048)
Deposit Laws, Including Water	– 0.066	– 0.072	– 0.057	– 0.172**
	(0.056)	(0.054)	(0.048)	(0.054)
Mandatory Laws	0.068	0.031	0.064	0.034
	(0.067)	(0.061)	(0.052)	(0.060)
Opportunity Laws	0.023	– 0.019	– 0.008	– 0.048
	(0.056)	(0.051)	(0.045)	(0.051)
Planning Laws	– 0.014	– 0.012	– 0.006	– 0.065
	(0.047)	(0.042)	(0.036)	(0.042)
Goal but No Planning Laws	– 0.115	– 0.052	– 0.042	– 0.157*
	(0.082)	(0.091)	(0.075)	(0.080)
Income / 10.000	0.024**	0.024**	0.015**	0.024**
	(0.004)	(0.004)	(0.003)	(0.004)
Observations	4.058	4.058	4.058	4.058

Notes: Standard errors are adjusted for 1.047 clusters: * significant at 5%; ** significant at 1%. Regressions also included top income category, MSA status, geographical region, and dummy variables for year the survey was taken, 2005-2011. Excluded date variable is 2005.

Table 9. Probit Regression on Whether Respondent Would Be Upset if Others Did Not Recycle

	Marginal Effect (Std. Err.)	Marginal Effect (Std. Err.)	Marginal Effect (Std. Err.)
Home County Recycling Percent	0.345**		0.484**
	(0.108)		(0.105)
Recycles More than Neighbors	0.245**	0.252**	
	(0.032)	(0.032)	
Recycles Less than Neighbors	– 0.095*	– 0.108**	
	(0.042)	(0.040)	
Deposit Laws, Excluding Water	0.058	0.079	0.064
	(0.053)	(0.053)	(0.052)
Deposit Laws, Including Water	– 0.074	– 0.032	– 0.079
	(0.049)	(0.050)	(0.049)
Mandatory Laws	0.167*	0.226**	0.154*
	(0.074)	(0.075)	(0.071)
Opportunity Laws	0.035	0.101	0.031
	(0.059)	(0.059)	(0.058)
Planning Laws	0.026	0.048	0.036
	(0.049)	(0.048)	(0.048)
Goal but No Planning Laws	0.008	4.0E-4	– 0.044
	(0.112)	(0.109)	(0.108)

	Marginal Effect (Std. Err.)	Marginal Effect (Std. Err.)	Marginal Effect (Std. Err.)
Income / 10.000	0.008* (0.004)	0.009* (0.004)	0.011** (0.004)

Notes: $N = 1.047$ Robust standard errors are in parentheses: * significant at 5%; ** significant at 1%. Regressions also included variables for top income category, MSA status, and geographical region.

Appendix Table A1. Comparison of Knowledge Networks Sample to the National Adult Population[a]

Demographic Variable	US Adult Population	2009 Survey Participants (n=1.047)
	Percent	Percent
Gender		
Male	48.7	48.2
Female	51.3	51.8
Age		
18 – 24 years old	13.1	7.3
25 – 34 years old	17.9	11.8
35 – 44 years old	17.9	17.5
45 – 54 years old	19.2	21.2
55 – 64 years old	15.0	23.0
65 – 74 years old	8.9	13.2
75 years old or older	8.1	6.0
Educational Attainment (25 and older)		
Less than HS	13.3	11.1
HS Diploma or higher	57.2	59.5
Bachelor or higher	29.5	29.4
Race / Ethnicity		
White	80.9	81.6
Black/African-American	12.2	11.9
Other	6.9	6.6
Hispanic	13.6	13.6
Marital Status		
Married	57.4	58.1
Single (never married)	26.0	22.5
Divorced	10.2	13.8
Widowed	6.3	3.8
Household Income		
Less than $15.000	12.9	11.8
$15.000 to $24.999	11.8	8.8
$25.000 to $34.999	10.9	10.7
$35.000 to $49.999	14.0	16.5
$50.000 to $74.999	17.9	20.7
$75.000 to $99.999	11.9	14.8
$100.000 or more	20.5	16.6

[a] *U. S. Census Bureau (http://www.census.gov/)*. 2009 adult population (18 years+) except as noted, income uses 2008 data.

Appendix Table A2. Summary Statistics of Analysis Variables

Analysis Variable	Mean	Std.Dev.
Respondent Upset if Neighbors Trash Recyclables	0.305	0.460
Neighbors Upset if Someone Trashes Recyclables	0.154	0.361
Respondent Believes Recycles More than Neighbors	0.390	0.488
Respondent Believes Recycles Same as Neighbors	0.435	0.496
Respondent Believes Recycles Less than Neighbors	0.176	0.381
Does Respondent Recycle Glass	0.522	0.433
Does Respondent Recycle Plastic	0.616	0.414
Does Respondent Recycle Cans	0.708	0.378
Does Respondent Recycle Paper	0.617	0.415
Home County Recycling Average	0.647	0.189
Deposit Laws, Excluding Water	0.140	0.348
Deposit Laws, Including Water	0.181	0.386
Mandatory or Opportunity Laws	0.350	0.477
Mandatory Laws	0.192	0.394
Opportunity Laws	0.158	0.365
Planning Laws	0.466	0.499
Goal but No Planning Laws	0.027	0.161
No Laws	0.158	0.365
Income / 10.000	6.121	4.219
Top Income Category ($175.000)	0.023	0.150
Lives in Metropolitan Statistical Area (MSA)	0.845	0.362
Region: Northeast	0.188	0.391
Region: South	0.322	0.467
Region: West	0.233	0.423
Region: Midwest	0.257	0.437

References

ABBOTT A., NANDEIBAM S. and O'SHEA L. [2013], "Recycling: Social Norms and Warm-Glow Revisited." *Ecological Economics*, 90(6): 10–18.

BEATTY T. K. M., BERCK P. and SHIMSHACK J. P. [2007], "Curbside Recycling in the Presence of Alternatives." *Economic Inquiry*, 45(4): 739–755.

BOHM P. [1981], *Deposit Refund System: Theory and Applications to Environmental, Conservation, and Consumer Policy*. Baltimore: Johns Hopkins Press for Resources for the Future.

CIALDINI R. B. and KALLREN C. A. [1990], "A Focus Theory of Normative Conduct: Recycling the Concept of Norms to Reduce Littering in Public Places." *Journal of Personality and Social Psychology*, 58(6): 1015–1026.

COLLINS A., O'DOHERTY R. and SNELL M. C. [2006], "Household Participation in Waste Recycling: Some National Survey Evidence from Scotland." *Journal of Environmental Planning and Management*, 49(1): 121–140.

FULLERTON D. and KINNAMAN T. C. [1996], "Household Responses to Pricing Garbage by the Bag." *American Economic Review*, 86(4): 971–983.

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

HONG S., ADAMS R. M. and LOVE H. A. [1993], "An Economic Analysis of Household Recycling of Solid Waste: The Case Study of Portland, Oregon." *Journal of Environmental Economics and Management*, 25(2): 136–146.

JENKINS R. R., MARTINEZ S. A., PALMER K. and PODOLSKY M. J. [2003], "The Determinants of Household Recycling: A Material-Specific Analysis of Recycling Program Features and Unit Pricing." *Journal of Environmental Economics and Management*, 45(2): 294–318.

KINNAMAN T. C. and FULLERTON D. [1995], "How a Fee Per-Unit Garbage Affects Aggregate Recycling in a Model with Heterogeneous Households." In *Public Economics and the Environment in an Imperfect World*, eds. Lans Bovenberg and Sijbren Cnossen, 135–159. Boston: Kluwer Academic Publishers.

____. [2000], "Garbage and Recycling with Endogenous Local Policy." *Journal of Urban Economics*, 48(3): 419–442.

NESTOR D. V. and PODOLSKY M. J. [1998], "Assessing Incentive-Based Environmental Policies for Reducing Household Waste Disposal." *Contemporary Economic Policy*, 16(4): 401–412.

RESCHOVSKY J. D. and STONE S. E. [1994], "Market Incentives to Encourage Household Waste Recycling: Paying for What you Throw Away." *Journal of Policy Analysis and Management*, 13(1): 120–139.

SCHULTZ P. W., NOLAN J. M., CIALDINI R. B., GOLDSTEIN N. J. and GRISKEVICIUS V. [2007], "The Constructive, Destructive, and Reconstructive Power of Social Norms." *Psychological Science*, 18(5): 429–434.

STERNER T. and BARTELINGS H. [1999], "Household Waste Management in a Swedish Municipality: Determinants of Waste Disposal, Recycling and Composting." *Environmental and Resource Economics*, 13(4): 473–491.

THØGERSEN J. [2008], "Social Norms and Cooperation in Real-Life Social Dilemmas." *Journal of Economic Psychology*, 29(4): 458–472.

VISCUSI W. K., HUBER J., and BELL J. [2011], "Promoting Recycling: Private Values, Social Norms, and Economic Incentives." *American Economic Review*, 101(3): 65–70.

____. [2012], "Alternative Policies to Increase Recycling of Plastic Water Bottles in the United States." *Review of Environmental Economics and Policy*, 6(2): 190–211.

VISCUSI W. K., HUBER J., BELL J, and CECOT C. [2013], "Discontinuous Behavioral Responses to Recycling Laws and Plastic Water Bottle Deposits." *American Law and Economics Review*, 15(1): 110–155.