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## **On the value of households' recycling efforts**

**Abstract:**

Do households' recycling efforts represent a social cost, which should be taken into account in cost-benefit analyses of alternative waste treatment systems? Some argue that it should not, since recycling efforts are to a large extent voluntary. We demonstrate that if the government can indirectly increase voluntary recycling efforts through appeals to the public or through similar means, then the use of these means does impose a cost on households. This cost can be higher or lower than the environmental gain resulting from the increased recycling. Norwegian data indicates a willingness to pay to let others take over the individual's sorting of household waste corresponding to a cost of about USD 87 per tonne, which is significant compared to the total treatment costs.

**Keywords:** Cost-benefit analysis, norms, recycling, time use

**JEL classification:** D11, D12, D61, D69, Q38

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# 1. Introduction

Voluntary contributions to public goods is a frequently observed phenomenon of everyday life. For example, people volunteer for social work, provide substantial contributions to charity, and it is a common practice to help preserve the nature, e.g. by abstaining from littering in the forest.

While public authorities in many countries place a heavy emphasis on recycling of household waste, the policies used to achieve recycling goals are frequently based neither on direct regulation nor economic incentives. Rather, authorities arrange systems for easy sorting at the source, such as frequent curbside pick-up systems, and then rely on information campaigns to appeal to people's willingness to contribute voluntarily. Thus, appeals to individuals' social responsibility seem to be used as a policy instrument.

Recycling behavior has been extensively studied within different disciplines over the last decades (see Tasaday 1991, Hornik et al. 1995). Most studies have focused on identifying factors which motivate or facilitate recycling. However, few studies discuss whether there is a social cost associated with households' efforts. In most cases, the implicit assumption seems to be that there are no such costs; hence, if the efforts produce environmental benefits, the more effort, the greater the results and the better for social welfare.

Also, some of those analysts who explicitly acknowledge the issue have argued that households' voluntary recycling efforts should not be counted as a social cost in cost-benefit analyses.<sup>1</sup> Within the paradigm of revealed preferences, this argument seems almost tautological: Utility is defined through revealed choice, so if the individual chooses to sort her household waste, this *per definition* yields at least as high utility as abstaining from doing so.

In this paper, however, we will argue that the use of policy instruments which increase norm-motivated recycling efforts may impose a cost on consumers, even in the case where recycling is voluntary. In the cases we study, this cost is strictly positive, and may even be larger than the value of the lost leisure. Whether the cost is outweighed by the environmental benefits resulting from the increased recycling is an empirical issue, which cannot be resolved on *a priori* grounds. However, previous cost-benefit analyses that explicitly value households' time use for recycling have typically based the valuation on labor costs after tax (DeLong 1994, Bruvold 1998, Radetzki 2000). Our analysis implies that the valuation of individual efforts is more complex and depends on the motivation to participate in recycling activities.

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<sup>1</sup> For example, a case is made for this in the report to the Norwegian Ministry of the Environment by Hjeltnes COWI (2001).

Our argument draws on the recent developments in the literature of integrating social and moral norms into neoclassical consumer theory (e.g. Andreoni 1990, Holländer 1990). In particular, we will utilize the idea brought forward by Akerlof and Kranton (2000) and Brekke et al. (2002) that individuals have a preference for keeping a certain type of self-image or identity. A crucial point in our analysis is that policies aimed at increasing voluntary recycling efforts, for example appeals to the public, may increase the effort required to perceive oneself as a "green consumer".

In the impure altruism model proposed by Andreoni (1990), individuals contribute to public goods to obtain "a warm glow of giving". However, within the impure altruism model, the positive feeling of "warm glow" only depends upon the level of contribution, and is not influenced by changes in factors such as public information, social norms, or un-enforced legal requirements. Thus, in the impure altruism model, there is no particular reason why appeals or information campaigns would increase voluntary contributions (or influence people's utility). However, for individuals who are motivated by the desire to keep a self-image as a responsible individual, campaigns aiming to stimulate recycling efforts may make it harder to keep the desired self-image. Thus, such campaigns can influence behavior, but at the same time impose a cost on the individual.

Below, we will use a framework based on neoclassical consumer theory to analyze the implications for normative welfare economics of public policy aimed at changing households' recycling efforts. We will assume that self-image is determined through a comparison of one's own actual effort against an "ideal" effort. The first part of our analysis is concerned with the case where the ideal effort is exogenously determined by the government. This may be the case if individuals have a preference for a self-image as a law-abider (someone who doesn't break the legal rules of society). The government will then be able to change behavior through changing the legal norms, even if these norms are not enforced. The behavior discussed in this case is thus *involuntary* in the sense that effort is required by a legal norm, but *voluntary* in the sense that no external punishment will occur if the requirement is not fulfilled. We then extend the analysis to the case of *morally* motivated recycling efforts, i.e. more truly voluntary behavior, based on the model developed by Brekke et al. (2002). In this case, the government cannot directly control consumers' perception of the "ideal" effort, but policy can still influence voluntary contributions in more indirect ways. Our analysis demonstrates that in both cases, policy changes that increase equilibrium recycling efforts are associated with a social cost which should be included in the cost-benefit analysis, in line with the environmental benefits.

Finally, our theoretical findings are complemented by empirical results from an interview survey. Most of our respondents prefer to leave the recycling to others, if possible without altering the environmental effects. We also find that most respondents are willing to pay a strictly positive amount of

money for this service. However, average WTP per hour is substantially lower than the average after tax wage rate.

## 2. Legal norms

Below, we will assume that consumers' recycling activities are motivated by a desire to keep an image of oneself as a responsible person, in addition to the preference for a good environment. Since we wish to focus on norm-based behavior we will assume that there are no economic incentives for recycling. Such incentives could easily be incorporated into the model.

Consider an individual with the following utility function:

$$(1) \quad U = u(c, l, G, S)$$

where  $c$  and  $l$  represent the individual's consumption of private goods and leisure, respectively, and  $G$  is environmental quality, which is assumed to be a pure public good.  $S$  is the individual's self-image as a responsible person, defined here as a person who conforms to certain norms of responsible behavior (see Brekke et al. 2002). The utility function is increasing and quasi-concave in  $c$ ,  $l$ ,  $G$  and  $S$ .

Environmental quality,  $G$ , equals the quality supplied by others,  $G_{-i}$ , which the individual regards as exogenous, plus the improvement  $g$  due to the individual's own recycling efforts:

$$(2) \quad G = G_{-i} + g$$

The contribution  $g$ <sup>2</sup> is determined by time spent on recycling activities,  $e$ :

$$(3) \quad g = g(e) \quad \text{where } g_e > 0, g_{ee} \leq 0, \text{ and } g(0) = 0 \text{ (subscripts denote derivatives).}$$

The time constraint is given by

$$(4) \quad l + e = T$$

where  $T$  is the total amount of time available for leisure,  $l$ , and recycling activities,  $e$ .<sup>3</sup>

Self-image is assumed to be related to norm compliance: If one does not conform to the norm under consideration, a loss of self-image occurs. Assume now that a law or another direct regulation restricts

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<sup>2</sup> The contribution  $g$  can for example be interpreted as the share of the individual's household waste that is sorted for recycling, assuming that the total amount of waste is fixed. The numeraire of the public good  $G$  must be chosen accordingly.

<sup>3</sup> Labor supply, and thus income (and in Section 2 and 3, even consumption), are exogenously given.

the amount of unsorted waste that should be delivered from each household. This may for example be a rule prohibiting disposal of newspapers and plastic bottles in the unsorted residual waste. Call this a *legal norm*. Assume that to comply to the legal norm, the individual contribution must be at least  $g^*$ .  $S$  depends positively on the individual's own contribution  $g$ , and negatively on the legal norm,  $g^*$ . For simplicity, we will assume that self-image depends on the *difference* between actual behavior and the norm:

$$(5) \quad S = S(g - g^*)$$

The best possible self-image is obtained if  $g \geq g^*$ . We assume that  $S' > 0$  if  $g < g^*$ , and  $S' = 0$  if  $g \geq g^*$ . Further,  $S'' \leq 0$  everywhere (‘’ denotes derivatives).

In accordance with Becker (1968), we will assume that the individual is not literally *forced* to comply with a legal norm. She will choose to comply only if the expected utility of not complying (and possibly being sanctioned) is less than the expected utility of complying.

Sanctions can have a pecuniary and a non-pecuniary part. The former may be a fee for excessive unsorted waste deliveries, or a fixed penalty, where the probability of the penalty being imposed increases with the degree of under-compliance. The non-pecuniary sanction part may be external, i.e. social disapproval, or internal, for example a feeling of shame if one gets caught in doing something illegal, or simply by *knowing* that one does something illegal. Since monetary incentives are thoroughly discussed in the environmental economics literature, and our focus is on norm-based behavior, we will disregard pecuniary sanctions here. Moreover, we will focus on internalized norms, allowing us to abstract from the complications of social interaction. For simplicity, we will also disregard uncertainty, corresponding to the case of a risk-neutral consumer.<sup>4</sup>

Maximizing  $U$  subject to (2) - (5) yields the following first order condition:

$$(6) \quad g_e (u_G + u_S S') = u_l$$

In optimum, the benefits accruing to the individual when she increases her recycling efforts marginally equals the marginal cost to her in terms of lost leisure. The benefits consists of two parts; the environmental benefits accruing to the individual herself, plus the benefits of an improved self-image.

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<sup>4</sup> The latter assumption is required if loss of self-image occurs only when the individuals is caught violating the norm, but is superfluous if self-image is related to consciousness of one's own actions, not others' knowledge of them.

## 2.1. The social cost of a tightened norm

Of course, in optimum, marginal changes in effort will have no net effect on utility; marginal costs equal marginal benefits. This follows from the fact that effort is endogenous to the consumer. However, the government can increase households' recycling efforts by increasing  $g^*$ , and this will impose a cost on consumers.

Assume that initially  $g \leq g^*$ . Then, the government tightens the legal norm (i.e.  $g^*$  increases).<sup>5</sup> To investigate how this will affect behavior and welfare, we perform a total differentiation of the first order condition (6) with respect to the legal norm  $g^*$ :

(7)

$$\frac{de}{dg^*} = \frac{u_{SG}S'g_e - u_{SL}S' + u_{SS}(S')^2g_e + u_S S''g_e}{2[u_{SG}S'g_e^2 - u_{SL}S'g_e - u_{LG}g_e] + u_{SS}(S'g_e)^2 + u_{GG}(g_e)^2 + u_{ll} + u_S[S''(g_e)^2 + S'g_{ee}] + u_Gg_{ee}}$$

This expression shows that in general, effort may increase or decrease when the norm requirement  $g^*$  increases, depending on whether leisure, environmental quality and self-image are complements or substitutes. However, in the special case that the utility function is separable in its arguments, i.e. that all cross derivatives equal zero, (7) can be specified as:

$$(8) \quad \frac{de}{dg^*} = \frac{g_e}{\eta} [u_{SS}(S')^2 + u_S S''] > 0$$

where  $\eta = u_{SS}(S'g_e)^2 + u_{GG}(g_e)^2 + u_{ll} + u_S[S''(g_e)^2 + S'g_{ee}] + u_Gg_{ee} < 0$ .

In the case of a separable utility function, then, we find that tightening the legal norm unambiguously increases effort.

How does a tightened legal norm affect utility? Differentiating the utility function with respect to  $g^*$ , inserting for (2) - (5) and the first order condition (6), and allowing that a change in  $g^*$  may change others' contributions as well as the individual's own contribution, we get:

$$(9) \quad \frac{dU}{dg^*} = u_G \frac{dG_{-1}}{dg^*} - u_S S'$$

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<sup>5</sup> If  $g > g^*$  initially, nothing would happen if the government increased  $g^*$  marginally:  $S$  would remain unchanged, since  $S' = 0$  for  $g > g^*$ . Since  $g^*$  only enters the model through  $S$ , neither behavior nor utility would change.



Note that (9) does not assume separability. The first term reflects that if *others* recycle more due to the stricter legal norm, the individual will benefit from the environmental effects of this. This term is strictly positive provided that others' aggregate contribution increases in  $g^*$ . The second term,  $-u_s S'$ , is the first order effect on utility - in terms of a reduced self-image - when  $g^*$  increases and the individual thus becomes less in compliance. This term is negative. Thus, the utility impact of a stricter legal norm consists of the environmental benefits of others' effort *minus* a cost associated with the heavier strain on the individual's self-image.

Another and perhaps more familiar way to write (9) is<sup>6</sup>

$$(10) \quad \frac{dU}{dg^*} = u_G \frac{dG}{dg^*} - u_l \frac{de}{dg^*} - u_s S' (1 - g_e \frac{de}{dg^*})$$

This expression shows that the individual's benefit of a marginally tightened legal norm consists of the individual's *environmental gain* (including that resulting from her own effort), less the cost in terms of *lost leisure*, less the total *self-image* costs. If  $de/dg^* > 0$ , and others' aggregate recycling effort weakly increases in  $g^*$ , the environmental gain contributes positively to the individual's utility, while the cost in terms of lost leisure contributes negatively.

Regarding self-image effects, however, the impact on utility is ambiguous: The first term,  $-u_s S'$ , is negative, and reflects the direct negative effect on self-image when  $g^*$  increases, making it harder to keep a good self-image. The second term,  $u_s S' g_e \frac{de}{dg^*}$  is positive as long as  $de/dg^* > 0$ , reflecting that the individual at least partially compensates the direct effect on self-image by increasing effort. In general, it is not possible to determine a priori which of these effects dominate. However, in the special case of a separable utility function, the self-image effects on utility will be strictly negative, and the individual will never increase her effort so much that her self-image in fact improves.<sup>7</sup>

In conclusion, tightening an un-enforced legal norm imposes a private cost on the individual. More specific assumptions about the shape of the utility function are needed to determine whether the self-image cost is positive or negative. With a separable utility function, however, this term is strictly negative, and the total private cost is strictly larger than the value of lost leisure time.

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<sup>6</sup> (10) is obtained by inserting (2) - (5) into (1), differentiating with respect to  $g^*$ , and rearranging terms.

To perform a complete cost-benefit analysis of a tightening of the legal norm  $g^*$ , we must aggregate costs and benefits for all individuals in society.<sup>8</sup> To allow us to focus on our main argument rather than the many complications of utility aggregation, let us simply assume that society consists of  $N$  identical individuals, and that the social welfare function is utilitarian:

$$(11) \quad W = NU$$

The change in social welfare  $W$  due to a tightened legal requirement can then be found by aggregation of (9), using (11):

$$(12) \quad dW / dg^* = N \left[ u_G \frac{dG_{-1}}{dg^*} - u_S S' \right] = (N-1)u_G dG / dg^* - Nu_S S'$$

Just like (9), this expression may be positive or negative, but the latter term is unambiguously negative.<sup>9</sup> Hence, there is a net social cost associated with increased norm-induced effort, which should be accounted in cost-benefit analysis of alternative waste treatment systems.

We could alternatively base the aggregation on (10), in which case we get an expression that can be interpreted as consisting of aggregate environmental benefits, time costs and self-image costs. Social welfare increases in  $g^*$  if and only if the net welfare loss from reduced leisure and reduced self-image is outweighed by the environmental benefits. The model does not ensure *a priori* that this will hold. Consequently, even in the absence of sanctions, the change in a legal norm can be perceived as a regulation which imposes a cost on individuals.<sup>10</sup>

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<sup>7</sup> By inserting (8), the last two terms in (10) can be written

$$-u_S S' (1 - g_e \frac{de}{dg^*}) = -u_S S' \frac{1}{\eta} [u_{GG} (g_e)^2 + u_{ll} + (u_G + u_S S') g_{ee}] < 0.$$

<sup>8</sup> Below, the system costs of collection, transportation and industrial processing of sorted household waste are not taken into account. In an applied analysis, all costs should of course be considered.

<sup>9</sup> The “minus one” part comes from the fact that in utility optimum, the private benefits from the individual’s own effort is exactly outweighed by the cost of leisure as noted in (6). Thus, neither time costs nor non-external benefits of effort are counted explicitly in (12).

<sup>10</sup> This may seem to contradict conclusions from the simple Homo Economicus model of undergraduate textbooks. However, Homo Economicus would not increase recycling behavior at all due to changed un-enforced legal norms, so if changing the norm in fact leads to changed behavior, the Homo Economicus model is unsatisfactory.

### 3. Moral responsibility

In the previous section, we assumed that the government had direct control over the norm individuals compare their performance against. However, since we assumed that self-image was related to a legal norm, it is not obvious that effort can be regarded as voluntary. Below we will analyze the case where the "the ideal contribution" is determined endogenously by individuals' own moral judgment, but where this judgment is influenced by public policy in more indirect ways. In this version of the model, recycling effort is clearly voluntary. Interestingly, the conclusion that there is a social cost associated with public policy aimed at stimulating recycling efforts still holds.

The analysis below is based on Brekke et al. (2002). They model self-image in a similar fashion as above. However, now  $S$  is interpreted as a self-image as a morally responsible person, while  $g^*$  is the individual's own perception of the morally ideal contribution.

Brekke et al. model  $g^*$  as determined endogenously, through the individual's own moral judgment, as *that contribution which the individual would wish everyone to make*: Before deciding on how much to recycle, the individual considers what would happen to social welfare if all other  $N-1$  individuals acted like she plans to do herself. Then, morally ideal action is the choice which would yield the highest social welfare if chosen by everyone. When making this judgment, the individual considers public policy as exogenous. If policy changes the social welfare effects of a given individual action, policy can indirectly change the morally ideal contribution, and thereby also actual effort provided by individuals.

As before, assume that there are  $N$  identical individuals, and let subscript  $i$  denote variable values for individual  $i$ . To keep the analysis simple, assume that all individuals share the utilitarian view of social welfare represented by

$$(13) \quad W = \sum_i U_i$$

The individual determines  $g_i^*$  by maximizing  $W$  with respect to  $e_i$ , subject to (1) - (5) and  $e_i = e_j$  for all individuals  $i, j$ . The morally ideal contribution  $g_i^*$  is then found as  $g_i^* = g_i(e_i^*)$ , where  $e_i^*$  is the solution to the welfare maximization problem<sup>11</sup>:

$$(14) \quad \text{Max}_{e_i} [N u_i(c_i, T - e_i, Ng(e_i), S_i(0))].$$

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<sup>11</sup> Note that since  $g^*$  is defined as the contribution that maximizes welfare if made by everyone,  $g_i = g_i^*$  is by definition the solution to the problem. Hence, in optimum  $S_i = S_i(g_i - g_i^*) = S_i(0)$ , which is a constant, unaffected by the solution for  $g_i^*$ .

This gives the first order condition for a social welfare maximum

$$(15) \quad u_{il} = N u_{iG} g_{ie}$$

which is the condition for a Pareto optimal supply of public goods: In optimum, the marginal cost of effort (in terms of lost leisure) equals its marginal benefits (in terms of aggregate environmental benefits). We will assume that this problem does have an interior solution, implying that  $g_i^* > 0$ . Once  $g_i^*$  is determined, actual behavior is determined through ordinary utility maximization, where  $g_i^*$  can be regarded as exogenous.<sup>12</sup> Actual effort  $e_i^0$  and the share recycled  $g_i^0$  are then determined by maximizing utility (1), subject to (2) – (5), just like in the section on legal norms. An interior utility maximum will be characterized by (6). Due to the tradeoff between self-image and leisure, consumers will always choose to contribute somewhat less than the ideal (see Brekke et al. 2002), so  $g_i < g_i^*$ .

### 3.1. The social cost of moral responsibility

How can policy affect recycling efforts within this model, and how will such changes affect social welfare? To illustrate this, imagine that new technology becomes available, facilitating centralized sorting of household waste. As a consequence of the new opportunities, the government abandons its curbside collection system for different household waste fractions, and invests instead in a waste separation plant with mechanical separation of waste components. All household waste will now be collected without separation of fractions, thus personal sorting effort will no longer affect the environment. Hence, the responsibility for sorting of waste is shifted from consumers to the government. Relation (2) is replaced by

$$(2') \quad G = G^p$$

where  $G^p$ , which is exogenous to consumers, is the level of environmental quality resulting from the central sorting process.

Within the model of moral motivation outlined above, the consumer must first determine  $g^*$ . Let superscripts 0 denote variable values in the initial situation (with source separation in households) and superscript 1 denote variable values after the central sorting system is implemented. Maximizing (13) subject to (1), (2') and (3) - (5) and  $g_i = g_j$  for all individuals  $i, j$ , now yields  $g_i^{*1} = 0$  (which is a corner solution): When effort is not useful for society any more, the individual will no longer feel a moral

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<sup>12</sup> Note that it now might be reasonable to assume  $S_i' \leq 0$  if  $g_i > g_i^*$ , rather than  $S_i' = 0$  if  $g_i > g_i^*$  as was assumed in the section on legal norms: Social welfare will in fact go down if people contribute too much, so if self-image is determined by the wish to contribute to a good society, self-image should have a global maximum at  $g_i = g_i^*$ . In Brekke et al. (2002) it is assumed that  $S_i' < 0$  if  $g_i > g_i^*$ .

obligation to sort her household waste. Since effort is costly in terms of lost leisure, the socially optimal effort is zero. Consequently, the change in the system for collection of household waste changes the morally ideal behavior.

This implies, however, that the individual can reduce her effort, and still her self-image will improve: She will no longer suffer a loss of self-image from not complying completely with her moral ideal.<sup>13</sup> Reduced individual responsibility increases utility, *ceteris paribus*.

This conclusion may appear to be at odds with the intuition of the impure altruism model of Andreoni (1990). In Andreoni's model, the loss of the opportunity to contribute voluntarily would imply a loss of "warm glow" benefits. Note, however, that in the impure altruism model warm glow depends only on the actual contribution; while in our model, self-image depends on the *difference* between actual contribution and the moral requirement. Hence, as long as the moral requirement is kept fixed, the two models yield the same conclusions. It is when the moral requirement changes that conclusions may differ. The individual obtains a kind of "warm glow" by contributing in both models; but in Andreoni's model, there is no loss of self-image due to failure to fulfill legal or moral obligations.

Nevertheless, our assumption that self-image is determined by the *difference* between actual contributions and the morally ideal contribution is crucial for the above conclusion. If self-image depends positively on the actual contribution and negatively on the morally ideal contribution, but in other ways that assumed above, the loss of warm glow when waste sorting becomes centralized may outweigh the exceed the benefits of decreased individual responsibility.

#### 4. A measure of the cost of effort

To enable us to analyze the costs of norm motivated efforts, while disregarding environmental benefits, assume that the environmental quality level after the central sorting plant investment equals exactly the level provided voluntarily by individuals initially, i.e.  $G^0 = G^P$ . The utility change for individual  $i$  can then be written as

$$(16) \quad \Delta U_i = u_i(c_i, T - e_i^0, G^0, S_i^0) - u_i(c_i, T, G^P, S_i(0)) < 0$$

With the investment, consumption is unchanged (disregarding any financing of the investment through tax payments); leisure increases by  $e_i^0$ ; environmental quality is unchanged, while self-image, accord-

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<sup>13</sup> Recall from (5) that  $S(0)$  is the maximal value of the self-image function, regardless of the value of  $g_i^*$ . Hence, when  $g_i^* = 0$ , the individual can keep a maximally positive self-image, even if she does not contribute at all.

ing to our model, has increased. Consequently, when we disregard the investment and operation costs of the central sorting system, there is a welfare gain when recycling is done by central sorting rather than by voluntary efforts. If we take extra investment and operation costs of the waste sorting plant into account, the investment would be welfare improving if  $\sum_i \Delta U_i > C$ , where  $C$  is the present value of extra investment and operation costs of the investment alternative as compared to the alternative of household sorting of waste.

This illustrates that moral responsibility imposes a burden on individuals, even if they are not *forced* to act on this responsibility. In other words, less personal responsibility reduces effort and increases utility; conversely, increasing the individual's effort by increasing individual responsibility implies a cost.

A monetary measure of the individual utility difference caused by the shift of responsibility is given by willingness to pay,  $WTP_i$ , defined implicitly by the following:

$$(17) \quad u_i(c_i, T-e_i^0, G^0, S_i^0) = u_i(c_i - WTP_i, T, G^p, S_i(0))$$

where  $WTP_i$  equals the loss of consumption which leaves the individual at the same level of utility as in the initial situation (i.e.  $WTP_i$  is the compensating surplus of the shift). Since  $c_i$  and  $G$  are unchanged, and  $I_i$  and  $S_i$  both increase,  $WTP_i$  must be positive. In principle,  $WTP_i$  can be measured through a contingent valuation survey, or even through market experiments.

As discussed above, the unambiguous sign of the welfare change depends on the particular form of the self-image function. Although we do find it reasonable that the ideal contribution enters the self-image function, it is not evident that the specific functional form we have employed here is the most plausible one.<sup>14</sup> Further, it is also possible that self-image depends on other variables than actual and ideal contributions. For example, for some people moral satisfaction appears to be associated not with how useful their effort is to society, but to how large burdens they bear; the more suffering, the better self-image. Self-image may also be related to others' social acceptance, although our model has focused on sanctioning mechanisms that are internal to the individual. Social approval may require that one is actually observed performing recycling activities, and if a recycling company takes over, this opportunity to derive social approval vanishes.

Also, we have assumed that recycling activities are not fun or meaningful *in themselves*. Nevertheless, the data presented below indicates that the latter assumption may not hold for some individuals. For those who find pleasure in the time use as such,  $e$  should be included in the utility function as a kind of

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<sup>14</sup> For example,  $S = s(g/g^*)$  would be one alternative;  $S = f(ag - bg^*)$ , where  $a \neq b$  are constants, is another.

leisure. Since central sorting takes away the opportunity to participate in an appreciated activity, this may imply a loss of welfare.

In general, all the above-mentioned modifications of the self-image function may change conclusions regarding the sign of the welfare change of introducing central waste sorting. Thus, in the next section, we provide empirical estimates of willingness to pay to let others do the sorting of household waste. If individuals are not willing to pay for such a service, our model must be rejected.

Finally, note that in a model with endogenous labor supply, the marginal value of a unit of time would equal the after tax wage rate. However, using the wage rate as an estimate for the value of time requires that all individuals are faced with a fully flexible labor market, which may not be the case. Thus, not only self-image benefits, but even the benefits of changed leisure time may be difficult to estimate based on market data only.

## 5. Empirical illustrations

As discussed above,  $WTP_i$  provides a measure of individual  $i$ 's utility change, and can in principle be elicited through contingent valuation. Below, we will report results from a CVM study concerning the hypothetical introduction of central sorting of household waste. One should note, however, that while the model presented above assumes that everybody is identical, this is of course no plausible assumption when considering empirical evidence (if so, we would not have to ask more than one individual). Further, as discussed above, if our self-image function is mis-specified, there is a possibility of negative utility effects, and the survey unfortunately did not allow negative WTP responses. The data presented below should therefore be interpreted with caution.<sup>15</sup>

### 5.1. Data

Our data were collected in 1999, using Statistics Norway's Omnibus Survey. A representative sample of 2000 respondents in the age group 16-79 years was drawn from the Norwegian population in two stages, in accordance with Statistics Norway's standard sampling procedure. The net sample, for which we report the results, consists of 1162 respondents, i.e. the response rate was slightly less than 60 per cent. For 76 per cent of the sample, the respondents were interviewed in-person in their own home, while the remainders of the interviews were conducted by telephone.

Individuals were asked to report their sorting of different waste components, the time used for recycling activities, including time spent on sorting and transportation, their motives for sorting waste, the

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<sup>15</sup> A more thorough econometric analysis of the data will be provided in a companion paper.

attitude towards expanding sorting systems and towards leaving the sorting to others, and about the willingness to pay for having others to take over the job. The survey also includes routine questions about several background variables such as age, gender, family status, income, etc. The reader who is interested in more information on the survey, including results on time and energy use and sorting of different waste fractions, is referred to Bruvoll, Halvorsen and Nyborg (2000).

## 5.2. Motivation

On average, respondents estimated that they spend half an hour extra each week on recycling activities. Those who reported to sort household waste were asked to what degree they agreed with different statements concerning their motivation, see Table 1.

**Table 1. Motives for sorting household waste. Per cent. (Figures add up to 100 for each of the statements, deviations due to rounding.)**

I sort partly because....	Agree	Partly agree	Partly disagree	Disagree	Don't know
I consider it a requirement of the authorities	38	25	11	26	1
I want to think of myself as a responsible person	42	31	8	18	1
I should do what I want others to do	65	23	5	6	1
I want others to consider me a responsible person	22	19	12	46	2
It is a pleasant activity in itself	16	22	18	44	1

Number of respondents: 1102 (excluding those who do not sort at the source)

The first three motivation factors in Table 1 are closely related to the type of norm-based motivation discussed in this paper. The first question relates to *legal norms*, and the results indicate that the authorities' impositions are important to recycling behavior. 63 percent agreed or partly agreed to the statement that they sort partly because they perceive it as a requirement imposed by the authorities. The next two statements relate to *moral norms*: "I want to think of myself as a responsible person" and "I should do what I want others to do". A majority of the respondents, 73 and 88 percent, respectively, agreed or partly agreed that this was part of the reason why they recycle.

We also find that *social approval*, which was disregarded in the theoretical analysis above, to some extent is a motive for recycling. Nevertheless, a majority of respondents (58 percent) disagreed or partly disagreed that they recycled partly because "I want others to think of me as a responsible person". Finally, we asked whether the respondents perceive it a *pleasant activity* in itself. Although such



a motive did seem to be present for some people, most respondents - 62 percent - entirely or partly disagreed in this statement.

### 5.3. Willingness to pay

Those who reported to sort household waste also received the following question:

*"Assume that a recycling company can make use of your waste. New technology makes it possible to sort waste centrally so that the environmental effect will be the same. The company collects the unsorted waste from your home. Would you make use of the offer if this did not increase your expenses, or would you prefer to sort yourself?"*

This corresponds to the hypothetical investment project discussed in section 3.1. Environmental benefits are assumed to be kept unchanged, but the individual effort required goes down to zero if the respondent makes use of the offer. 72 percent replied that they would make use of the offer, while 27 percent would prefer to sort themselves. This indicates that the actual process of sorting is perceived as a burden for most people – but not for everyone. Of those who disagreed completely that their sorting was motivated by legal requirement, i.e. "voluntary" contributors, 71 per cent reported that they would accept the offer.

Those respondents who would make use of the company's recycling arrangements reported an average *WTP* of USD 30 per year<sup>16</sup>. This *WTP* is the individual's compensating surplus of not having to exert effort, but still keep the environmental quality at the status quo level. Individual *WTP* to have others sort the household's waste can thus be regarded as a monetary measure for the value of this individual's disutility of recycling activities, taking both the value of leisure and self-image effects into account.

If we divide the average *WTP* by the hours individuals claim to spend on recycling activities, we get a *WTP* per hour of only about 45 cent.<sup>17</sup> This is substantially lower than average hourly wages after tax. This relatively low value may be caused by an inflexible labor market, or by some or all of the modifying factors discussed in Section 4.2. In addition, it may be very difficult to estimate how much time one spends on recycling activities. When compared to other data sources, the time use reported by our respondents seems to be fairly high (see Bruvold et al. 2000). If the time use is overestimated,

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<sup>16</sup> When the survey was conducted, USD1  $\approx$  NOK 8.

<sup>17</sup> However, those who spend a lot of time sorting waste tend to have substantially lower *WTP* per hour than those who spend little time. This can reflect that people with a high time cost recycle less, or it can simply be caused by measurement errors in the time variable.

respondents seems to be fairly high (see Bruvoll et al. 2000). If the time use is overestimated, this will lead to a corresponding underestimation of willingness to pay per hour.

A more fundamental cause might be that our theoretical model underrates the identity gains from sorting waste. Environmentally concerned individuals might perceive waste sorting as a symbolic act, which cannot simply be substituted by central systems without reducing the feeling of acting morally, regardless of the environmental effect of the act.

The moment we relax the assumption of identical individuals, interpersonal aggregation of *WTP*-data requires strict assumptions. To interpret the unweighed sum of individual willingness to pay as a measure of the aggregate welfare costs of individual recycling efforts, we must assume that the social benefits of an extra dollar is the same, regardless of whom it is given to. Hence, aggregate *WTP*-data cannot uncritically be interpreted as measuring welfare.

Still, even if we regard aggregate *WTP* as measuring the total sum of money people are willing to pay to let others do the job, neither more nor less, this sum may be interesting to compare to other costs of alternative waste treatment. The responses to our survey implies an average willingness to pay per tonne of sorted household waste of about USD 87, see Bruvoll et al. (2000). This cost is considerable compared to estimated total waste treatment costs.<sup>18</sup>

## 6. Conclusions

If governments have direct or indirect means to increase consumers' feeling of individual responsibility, and if this in turn increases individual recycling efforts, then using these means will impose costs on individuals. This holds even if efforts are voluntary, not backed by enforced legal rules or monetary incentives. These costs may or may not outweigh the environmental benefits resulting from the effort. In the special case of separable utility functions, the costs imposed on individuals are strictly larger than the value of the lost leisure time. Hence, in cost-benefit analyses of alternative waste treatment programs, the social costs of individuals' voluntary or norm-based recycling efforts need to be acknowledged.

These results may appear to conflict with the intuition that morally motivated efforts produce a feeling of warm glow and thus makes effort less costly. However, it is important to keep in mind that we discuss the effect of exogenous shifts in policy instruments, not changes in individual's morale per se;

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<sup>18</sup> Estimates from Bruvoll (1998) and Radetzki (2000) indicate that total social costs (also including conventional and environmental costs) of waste treatment range from USD 30 to USD 520 per tonne.

preferences are fixed in our analysis. There is a private benefit associated with voluntary recycling efforts in our model, and in equilibrium the marginal private benefit of effort equals exactly its private cost. *Increasing* voluntary efforts from the status quo equilibrium, however, requires changes in exogenous variables, and it is these changes that impose costs on individuals. We have assumed that individuals have preferences for a self-image as a responsible person, i.e. someone who conforms to legal or moral norms. Imposing *more* responsibility on such an individual is to lay a heavier burden upon her, because it makes it more difficult to keep her good self-image.

Our interview survey confirms that many individuals' recycling efforts are motivated by a preference to conform to norms; including legal, social and moral norms. The analysis also shows that a majority of those who recycle would prefer others to take over their effort if this was possible without reducing the environmental impact. This confirms that the recycling effort is in fact considered as a burden for most respondents. For those respondents who did recycle and who would accept an offer to let others do the job at a zero price, average willingness to pay was USD 30 per year. Comparing to Norwegian data on total amounts of sorted household waste, this corresponds to a cost of individual effort of USD 87 per tonne, which is not insubstantial compared to other cost components in waste treatment.

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