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Voluntary Emission Reductions, Social Rewards, and Environmental Policy

by

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Abstract

Social norms and intrinsic motivations lead to voluntary environmentally responsible behaviour even in the absence of environmental policy. The paper shows that the introduction of environmental policy may lead to a reduction of voluntary abatement and sometimes may increase emissions and environmental damage. The explanation is that voluntary abatement is socially rewarded and the reward depends on the general attitude of society towards voluntary abatement. So, if the government tightens environmental standards, the voluntary component of abatement is reduced and the social reward is negatively affected. Some considerations concerning optimal environmental policies are discussed towards the end of the paper.

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1. Incentives, Intrinsic Motivation, and Social Norms

The economic analysis of environmental problems and their solution is based on a rather narrow conception of man. Humans are being viewed as egocentric rational utility maximisers. They respond to two types of external stimuli: economic incentives and coercion. The corresponding instruments of environmental policy are emission taxes and tradable pollution permits on the one hand and command and control on the other. There are, however, (at least) two other determinants of environmentally relevant attitudes and behaviour: intrinsic motivation and social norms. Intrinsinc motivation is a part of the preference structure of an individual. There are people who derive utility from behaving in environmentally responsible way. To some extent, this behaviour may also be explained by altruism. Social norms in contrast impose rules on individual behaviour that are socially determined. An individual fulfilling the norm receives some social reward depending on the behaviour of the other individuals in socienty. The larger the number of individuals satisfying the norm, the larger the social reward for each of them.[1] When norms are eroded and stop to exist, there will be no rewards.[2]

Of course, intrinsic motivation and social norms can and do contribute to the solution of the environmental-externality problem. If environmentally sound behaviour is regarded as a value per se (instead of as a mere instrument to achieve environmental quality), this reduces the subjective cost of emission abatement and contributes to the solution of the externality problem. Social norms establish social rewards for behaviour conforming the rule and these rewards replace insufficient economic incentives in the case of externality problems. Economic incentives, intrinsic motivation and social norms are compared in

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1 Whether or not this reinforcement effect is realistic, will be discussed later on.

2 On social norms see Elster (1989) and Coleman (1990), chs. 10-11.

Tables 1a to 1d. The basic situation is a symmetric pollution game with two individuals. Each individual has two strategies, (i) to discharge emissions (*e*) and (ii) to abate emissions (*a*). Abatement costs are 3. Environmental damages in the case of no abatement are 4 and they are shared equally by the individuals. In a situation where both individuals abate emissions, their pay-offs are (2,2).

Table 1a: **The Prisoners' Dilemma**

		Player 1	
		a	e
	a	2,2	0,3
Player 2	e	3,0	1,1

Table 1c: **Intrinsic Motivation**

		Player 1	
		a	e
	a	4,4	2,3
Player 2	e	3,2	1,1

Table 1b: **Solution by Emission Taxes**

		Player 1	
		a	e
	a	2,2	2,1
Player 2	e	1,2	1,1

Table 1d: **Social Norms and the Assurance Game**

		Player 1	
		a	e
	a	4,4	0,3
Player 2	e	3,0	1,1

The following cases are distinguished.

- Unregulated pollution. The equilibrium of the game is a prisoners' dilemma (Table 1a). It is individually rational to pollute, but both players would be better off if they abated their emissions.
- Emission taxes. The polluter pays a tax equalling the environmental damage (4) and the tax revenue is shared by players 1 and 2. The dilemma is solved (Table 1b). The command-and-control approach would enforce abatement by coercion.
- Intrinsic motivation. Players like to behave in an environmentally friendly way and derive additional utility from this. In Table 1c the extra utility is +2 and this suffices to solve the prisoners' dilemma.

- Social norms. Environmentally friendly behaviour is rewarded - albeit only if all players behave in this way. The reward is +2. The resulting game is an assurance game. See Sen (1973). It has two Nash equilibria where either both players discharge emissions or both of them abate. The outcome of the game depends on the solution concept. In the case of mixed strategies, anything is possible but the cooperative equilibrium is the most probable one. One may, however, also argue that none of the players has an incentive to unilaterally deviate from the solution which offers the highest pay-offs. Thus, one should expect that the abatement equilibrium is chosen although (*e, e*) is a Nashequilibrium as well.

There are different ways in which cooperative behaviour can be achieved. When economists analyse environmental problems, they usually consider two of them: economic incentives and the command-and control approach. Intrinsic motivation and social norms are regarded as being non-economic and are, therefore, neglected. However, such a limitation of the analysis may lead to an erroneous view of the real world and to misleading policy implications. The economic instruments and the non-economic ones are not independent of each other. It has been argued by Weck-Hannemann/Frey (1995) that economic instruments of environmental policy may undermine intrinsic motivation. The main reasons are that external coercion and incentives erode self-determination and that they are often applied in a way perceived as being unfair by the regulatees.[3]

The present paper is devoted to an analysis of the interdependence of environmental policy and social norms. Is it likely that socially desirable behaviour is undermined by the implementation of the standard instruments of environmental policy? The paper is organised as follows. Section 2 establishes a simple model of socially rewarded environmental behaviour. Section 3 studies the effects of changes in environmental policy on this behaviour. In section 4, optimal environmental policies are analysed. Section 5 provides some final thoughts.

[3] See Frey (1986, 1992, 1993) for a more general discussion of this idea. In Frey (1992), a simple formalisation of the phenomen of intrinsic motivation is given in the framework of a utility maximisation model.

2. The Model

Consider a society consisting of a large number of individuals of two types. One type responds to social rewards and the other does not. The latter group may be viewed as the competitive sector of the economy. In a perfect-competition framework, firms react to monetary incentives only. Ethical considerations cannot play a role: a firm spending resources on activities that are socially but not individually beneficial will be driven out of the market.[4] Ethical behaviour and voluntary contribution to public goods are feasible only for the non-competitive part of the economy and for the agents involved in non-market activities. The shares of the two groups in the population are assumed to be constant: s and $(1-s)$.

The first part of the analysis will be devoted to the socially concerned part of the population mainly. Assume that each individual discharges e if no abatement is undertaken. The abatement level is a. Thus, an abating agent discharges $e-a$ into the environment. Moreover, there is an abatement level a^* which is the minimum abatement required by the environmental regulation. a^* is implemented to induce environmentally sound behaviour by the other part of the population, which does not respond to social rewards. Moreover, a^* is to be interpreted as that part of the abatement of socially concerned agents which is involuntary. Thus, $a-a^*$ is the voluntary abatement level. Each individual is infinitely small compared to the society as a whole. Thus, no one takes external effects into account. It is useful to introduce the representative individual in this society. Its behaviour is denoted by upper-case letters. Thus, $E-sA-(1-s)A^*$ is the average emission level in society and $s(A-A^*)$ is the average voluntary abatement.

Abatement of emissions is costly. Let $c(.)$ be a convex cost function. Then, if environmental regulation takes the shape of emission taxes or tradable permits, then the tax rate or the price of the permit is determined by $t=c'(a^*)$. Environmental damages are measured by a strictly convex function $z(E-sA-(1-s)A^*)$.

It is assumed here that the social norm is to contribute to the supply of public goods. I.e., voluntary emission reductions are socially rewarded. The social reward accruing to a single individual depends on the voluntary emission reductions by the rest of society. If everyone behaves in an environmentally friendly way, such a behaviour is socially accepted and rewarded. Someone who is the only one abating more emissions than he or she is

[4] See Siebert (1992) for this argument.

required to by law is viewed as being a fool and does not receive social rewards.[5] Let social rewards be measured by a twice differentiable and strictly concave utility function $u(a\text{-}a^*, s(A\text{-}A^*))$, where

$$u_1 > 0, \quad u_2 > 0, \quad u_{11} < 0, \quad u_{22} < 0, \quad u_{12} > 0$$

and a subscript denotes the partial derivative of this function with respect to the first and second arguments, respectively. The positive cross-derivative implies that social norms reinforce individual behaviour. Similar utility functions to model socially determined behaviour have been used by Schelling (1978), Naylor (1990), and Myles/Naylor (1996). The main difference between their models and the present one is that they look at a dichotomous decisision whether or not to contribute to a public good. The shares of contributors and non-contributers is variable. This model in contrast assumes that the shares of the two types of individuals in society are given but that the degree of contribution may change.

The utility function of a socially concerned individual is

$$w = -c(a) + u\big(a - a^*, s(A - A^*)\big) - z\big((E - sA - (1-s)A^*\big) - Dt(e - a) \tag{1}$$

where D is a dummy variable taking the values 1 if emissions are taxed and 0 if the command-and-control approach is chosen. If the government charges an emission tax it collects the rent resulting from the scarcity of environmental resources. If it applies command and control, the rent goes to the private sector.

3. The Effect of Environmental Policy on Voluntary Emission Reductions

The optimal abatement level is determined by differentiation of equation (1) with respect to a:

$$-c' + u_1 + Dt = 0. \tag{2}$$

The second-order condition is satisfied. Two cases may be distinguished depending on whether or not market instruments of environmental policy are used. Total differentiation of

[5] It should be noted that this is just one view of the functioning of social rewards. Alternatively, one may argue that an individual obeying the norm creates externalities for others. Everyone who tries to fulfil the norm drives the standard up for other people. For them it is now more difficult to fulfil the norm. This implies that the larger the average abatement, the less socially rewarded is an individual agent who abates. Such a model will be discussed briefly at the end of this paper.

equation (2) gives the desired result. It has to be taken into account, however, that in equilibrium $a=A$ and $a^*=A^*$. Thus,

$$\left(-c''(a)+u_{11}+su_{12}\right)da=\left(u_{11}+su_{12}\right)da^* \qquad \text{if} \quad D=0, \tag{3}$$

$$\left(-c''(a)+u_{11}+su_{12}\right)da=\left(-c''(a^*)+u_{11}+su_{12}\right)da^* \qquad \text{if} \quad D=1. \tag{4}$$

In equation (4), it has been used that $dt=c''(a^*)da^*$. It is seen that da/da^* can be less or greater that 1 depending on the parameters of the model. Thus, we have

$$\frac{d\left(a-a^*\right)}{da^*}=\frac{c''(a)}{u_{11}+su_{12}-c''(a)} \qquad \text{if} \quad D=0, \tag{5}$$

$$\frac{d(a-a^*)}{da^*}=\frac{c''(a)-c''(a^*)}{u_{11}+su_{12}-c''(a)} \qquad \text{if} \quad D=1. \tag{6}$$

This implies

Proposition 1

In the case of a command-and-control approach voluntary emission reductions will be reduced (reinforced) by tighter mandatory abatement requirements if $\left(u_{11}+su_{12}-c''\right)$ *is positive (negative). In the case of emission taxation, the shape of the cost function is also important.*

Social norms of voluntary emission reductions tend to be undermined by environmental policy if the reinforcing component of the social-rewards function is strong. This can be explained as follows. For a given level of a, an increase in a^* reduces voluntary abatement by both each single individual as well as the average individual in society. The reduction in a single individual's voluntary abatement leads to increased marginal utility and thus to an increase in abatement. The reduction in average voluntary abatement, reduces a single individual's marginal utility and, therefore, the incentive to abate.

The effect on total emissions is

$$\frac{d\left((E-sA-(1-s)A^*\right)}{da^*} = s\frac{c''(a)-u_{11}-su_{12}}{u_{11}+su_{12}}-(1-s) \qquad \text{if} \quad D=0, \tag{7}$$

$$\frac{d\left((E-sA-(1-s)A^*\right)}{da^*} = s\frac{c''(a)-u_{11}-su_{12}}{u_{11}+su_{12}-c''(a^*)}-(1-s) \qquad \text{if} \quad D=1 \tag{8}$$

and it can be seen that the overall effect of tighter environmental policies may be negative.

Proposition 2

Tighter environmental standards may reduce abatement effort.

It may happen that the reduction in voluntary abatement is so severe that it dominates the increase in mandatory abatement. In this case, the introduction of environmen-tal policy would be counter-productive.

Finally, we obtain a result concerning the effect of the environmental-policy instrument on voluntary abatement. Let us assume that the mandatory abatement level, a^*, remains unchanged. Then the introduction of a small tax component would have the following effect on emissions.

$$\left(-c''(a) + u_{11} + su_{12}\right)da = -d(Dt) \qquad \text{for given } a^*. \tag{9}$$

Proposition 3

The level of voluntary abatement is changed if a small emission tax is introduced at a given minimum abatement level.

In standard economic models without socially determined behaviour, the quantity constraint of the command-and-control regulation is a binding constraint and the introduction of a small tax rate has no allocative effect at all. It merely shifts rents from the producers to the government. If social rewards play a role, then the quantity constraint is not binding for socially concerned people. Thus, the tax has an effect and its direction again depends on the relative sizes of the second derivatives of the utility function.

4. Optimal Environmental Policies

If environmental policies influence social norms that determine voluntary emission reductions, then this should have effects on policy suggestions. The social welfare function can be written by adding up the utilities of the two sub-groups of society and taking into account that tax revenues are redistributed.

$$W = -sc(A) - (1-s)c(A^*) + su\big(A - A^*, s(A - A^*)\big) - z\big((E - sA - (1-s)A^*\big) \tag{10}$$

The optimal environmental policy can be derived by differentiation with respect to A^*. The first-order condition is

$$z' = \frac{(1-s)c'(a^*) + sc'(a) + \dfrac{d(a-a^*)}{da^*}\big(Dt - u_2\big)}{1 + s\dfrac{d(a-a^*)}{da^*}} \tag{11}$$

where the private sector's first-order condition, (2), has been used. In the case of no social rewards, the marginal environmental damage would equal the marginal cost of abatement, $(1-s)c'(a^*) + sc'(a)$. If abatement behaviour is socially determined, then this is no longer so. It follows that

Proposition 4

If voluntary abatement is socially rewarded, the optimal pollution level may be larger or smaller than the pollution level corresponding to a Pigouvian solution in the case without social rewards.

The interpretation of equation (11) is not straightforward. However, is plausible that the optimality result is ambiguous to some extent given that the previous comparative statics were ambiguous as well.

5. Final Remarks

The paper has shown that in the presence of voluntary abatement activities that are determined by social norms effects of environmental policy become ambiguous. Neither is it sure that emissions are reduced if tighter environmental regulations are introduced, nor is the Pigouvian tax rate optimal any more. Given these ambiguities, some of the limitations of the underlying model are not that severe anymore. The utility function has been assumed to be additively separable. Usually, this is an assumption that helps to avoid paradox results like Giffen-good effects. Here, however, we obtain a wide range solutions already with this simplistic assumption. Thus, it has to be expected that more general models produce additional ambiguities instead of unambiguous results.

The really critical assumption of this model is that social norms reinforce voluntary abetement in the way described here: social rewards increase with the general attidute towards voluntary abatement in society. The alternative view is that high levels of voluntary abatement by my neighbours make it difficult for me to meet the standard and to obtain the social reward. In this case, the derivatives of the utility function with respect to its second argument would change their signs: $u_2 < 0$ and $u_{12} < 0$.This would change some of the main results. In the case of command and control, voluntary abatement will unambignously be reinforced by tighter environmental standards. It cannot happen that tighter regulation leads to higher emission levels. However, the effect on the optimal environmental policy would remain ambiguous.

On the whole, it has been shown that the purely economic approach to human behaviour can lead to misleading results. It would be worthwile to consider social determinants of individual behaviour in other models involving the private provision of public goods as well.

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