INCENTIVES, MCDM, AND ENVIRONMENTAL PROTECTION

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ABSTRACT

The purpose of this article is to show how environmental protection can be facilitated by combining incentives theory and multi-criteria decision making. The article uses alternative ways of dealing with environmental protection for illustrative purposes; the methods are applicable to other socio-economic problems. It proceeds from a simple model to more realistic models, and concludes by noting the great potential that incentives theory and MCDM have for socio-economic planning and environmental policy.

The purpose of this article is to show how environmental protection can be facilitated by the substance of incentives theory and the methods of multi-criteria decision making. The article emphasizes environmental protection, but the ideas are also applicable to other socio-economic problems and natural resources conservation.

The essence of incentives theory in a public policy context is that public policy should seek to encourage socially desired behavior by:

1. Increasing the benefits of rightdoing;
2. Decreasing the costs of rightdoing;
3. Decreasing the benefits of wrongdoing;

4. Increasing the costs of wrongdoing; and
5. Increasing the probability that the benefits and costs will occur [1-3].

The essence of multi-criteria decision making in a public policy context is the idea of systematically processing a set of:

1. Societal goals to be achieved;
2. Alternative public policies for achieving them; and
3. Relations between goals and alternative policies in order to choose or explain the best alternative, combination, allocation, or predictive decision-rule [4-6].

A SIMPLE MODEL

Table 1 applies some of these basic ideas to a relatively simple example involving only two goals and three alternative policies. One goal is pollution reduction, and the other is political feasibility. The three alternative policies are relying on the marketplace, government regulation, and/or pollution taxes. Each alternative is scored on a 0–2 scale on each goal, where 2 means conducive to the goal, 1 means neither conducive nor adverse, and 0 means adverse to the goal. (For further details on alternative ways of dealing with pollution, see [7-10].)

The marketplace receives a zero on pollution reduction because 1) expenses go up as a result of introducing pollution reduction devices, but 2) income does not go up since consumers are generally not influenced by the extent to which a manufacturer pollutes the air, water, or other aspects of the environment. At the opposite end of the scale, pollution taxes (if adopted) receive a 2 on pollution reduction. Pollution taxes are levied in proportion to the amount of pollution which the firm causes. This potentially provides a strong incentive to reduce pollution. If it is less expensive to the firm to pay the taxes, then its tax money can be used for cleanup or other anti-pollution activities. In the middle is regulation. It does better on pollution reduction than the marketplace, since regulation can involve fines and other negative sanctions. It does not do so well

Table 1. Alternative Ways of Dealing with the Problem of Pollution

| | Goals | | |
| | Pollution | Political | |
Policies	Reduction	Feasibility	Sum
Marketplace	0	2	2
Regulation	1	1	2
Pollution Taxes	2	0	2

as pollution taxes because regulation generally lacks strong enough negative sanctions and/or a low probability of their being administratively and judicially enforced.

On the matter of political feasibility, the scoring is in the opposite direction. The marketplace does well with a score of 2, at least when an anti-pollution program is first being proposed. This is so because the marketplace under those circumstances would be the prevailing system. If, however, we are talking about 1988 rather than 1970, reverting back to a marketplace approach might have virtually no political feasibility. Pollution taxes, on the other hand, have been successfully resisted in Congress and state legislatures by business firms and trade associations. They are understandably reluctant to bear the extra costs. They would prefer to have the pollution costs borne by the general taxpayer and those who breathe air, drink water, or otherwise come in contact with pollution. Regulation has political feasibility since it is the prevailing system at different levels of government and for different types of pollution.

Looking at Table 1, one might conclude that there is a three-way tie between these alternative policies. One might then wonder why regulation became the prevailing policy. The answer is partly that there is not a three-way tie since the marketplace falls outside the realm of feasible alternatives by generating virtually no pollution reduction, and possibly even encouraging pollution in order to save expenses. Likewise, pollution taxes fall outside the realm of feasible alternatives by being incapable of mustering sufficient support to overcome the strong opposition. Thus, regulation is the winner, partly through the process of elimination.

A MORE REALISTIC MODEL

Table 1 is unduly simple in only presenting two kinds of incentives to reduce pollution, namely the negative incentives associated with regulation and the somewhat positive incentives associated with pollution tax reductions. Table 1 is also unduly simple is presenting only two goals. Table 2 extends the MCDM analysis to include nineteen policy alternatives and seven societal goals or criteria.

The alternatives are grouped in terms of increasing the benefits of rightdoing, reducing the costs of rightdoing, reducing the benefits of wrongdoing, increasing the costs of wrongdoing, and increasing the probability of the benefits and costs occurring. Such a five-part list is useful for generating policy alternatives in a variety of different policy problems.

Goals

The goals can be grouped in terms of the "three E's" of effectiveness, efficiency, and equity, and the "three P's" of public participation, predictability, and procedural due process. Pollution reduction is especially relevant to

Table 2. Comparing Alternative Incentives for Reducing Pollution

Alternatives	Political Feasibility	Effectiveness in Reducing Pollution	Cleanup Funds	Cost to General Taxpayers	Cost to Consumers or Workers	Public Participation	Predictability and Due Process	Sum
I. Increase Benefits of Rightdoing								
1. Reward subsidies to cities	2	5	3	1	3	3	4	21
2. Reward subsidies to businesses	1	5	3		3	3	4	20
3. Pollution tax reduction	1	4	4	3	2	3	4	21
4. New government contracts	3½	4	3	2½	3	3	4	23
5. Selling marketable pollution rights	3½	4	3	3	2	3	4	22½
II. Reduce Costs of Rightdoing								
6. Tax deductions	4	3½	3	2	3	3	4	22½
7. Cost subsidies to cities	4	3½	3	2	3	3	4	22½
8. Cost subsidies to businesses	2	3½	3	2	3	3	4	20½
III. Increase Costs of Wrongdoing								
9. Damage suits	4	4	3	3	2	4	2	22
10. Publicize wrongdoers	3½	4	3	2½	3	4	2	22
11. Pollution tax	1	5	4	4	2	3	4	23
12. Fines	4	3	3	3	2	3	2	20
13. Jail	2	3	3	2	3	3	2	18
14. Loss of government contracts	2½	4	3	2½	3	3	2½	20½
15. Buying marketable pollution rights	3½	4	3	3	3	3	4	23½
16. Padlock injunction	2	4	3	3	2	3	2	19
IV. Reduce Benefits of Wrongdoing								
17. Confiscate profits	2	5	3½	3	3	3	2	21½
V. Increase Probability of Benefits and Costs								
18. Improve monitoring	4	4	3	2	3	3	2	21
19. Bounties for reporting	4	4	3	3	3	4	2	23

effectiveness. Cleanup funds are also relevant. In this context, an ounce of cleanup cure can be more meaningful than a pound of prevention if prevention is far more expensive. A water filtration plant to make the water drinkable might be an example, rather than have every factory on the river re-tool to generate only sterile water into the river. Efficiency or monetary cost relates both to the general taxpayer and to consumers or workers. A third set of goals are the "three F's," or constitutional feasibility, political feasibility, and administrative feasibility. Political feasibility is especially important in this context. Related to political feasibility are a fourth set of goals, the "two S's," which stand for liberal symbolism and conservative symbolism. Satisfying those goals is important for bipartisan support.

Alternatives

There are a number of ways of increasing the benefits of *rightdoing* in this context, such as providing reward subsidies to cities or businesses. Those are subsidies that go beyond reducing the costs of pollution devices. They are bonuses for rightdoing, as in a cost-plus contract. Other benefits can include a reduction in the pollution tax rate, new government contracts, and the income to business firms which can come from selling marketable pollution rights, with which the Reagan and Bush administrations have been experimenting. Receiving a tax deduction to cover anti-pollution expenses reduces the cost of rightdoing. So does a cost subsidy to cities or businesses whereby the government pays part or all of the cost of anti-pollution devices. Cities are treated separately from businesses on alternatives 1-2 and 7-8 because the politics of passing a subsidy is quite different depending on whether municipalities or business firms are involved. Cities are especially guilty of water pollution through bad sanitation systems or through the failure to adopt the latest anti-pollution methods and hardware.

The costs of *wrongdoing* can be facilitated by damage suits, publicizing wrongdoers, levying heavy pollution taxes, fines, jail, and the loss of existing government contracts. Being in a position where one has to buy marketable pollution rights in order to satisfy an anti-pollution standard may put a business firm at the mercy of its competitors who have some extra rights to sell. The ultimate cost is a padlock injunction which closes a business firm until it complies. The benefits of wrongdoing can be reduced by confiscating profits which result from not complying with anti-pollution rules, analogous to the confiscation of profits from drug dealing and other forms of socially undesirable behavior.

Policies to increase the *probability* of the benefits and costs occurring include improved monitoring systems and bounties for reporting of wrongdoing. An important aspect of increasing the probability of the benefits and costs occurring is arranging for the benefits and costs to be legislated and then effectively

administered. Legislative embodiment and effective administration affect the assessment of political feasibility and effectiveness in reducing pollution, respectively, in Table 2.

Relations

The relations in Table 2 are scored on a more sophisticated 1-5 scale, rather than a 0-2 scale. In a 1-5 scale, a 5 means highly conducive to the goal, a 4 means mildly conducive, a 3 means neither conducive nor adverse, a 2 means mildly adverse, and a 1 means highly adverse. There are nineteen alternatives times seven criteria, or 133 cells, in the table, too many to discuss in detail. One might, however, look at the top row as an example.

Reward subsidies to cities are not very politically feasible. It is difficult enough to obtain subsidies that cover costs without an incentive bonus. It is especially difficult for a legislature to pass reward subsidies to businesses, rather than cities. On the other hand, reward subsidies are highly effective in reducing pollution. If a city or business firm can reduce pollution to 0 for $100,000, and a legislature is willing to pay $120,000, both cities and businesses are likely to accept the offer. Doing so is neutral with regard to providing cleanup funds. The cost to the taxpayer is very high, but there is no cost to consumers of the firm's products or to the workers. Such a system does not rely upon active public participation (unlike damage suits, publicity-related boycotts, or bounties). Reward subsidies tend to have high predictability or objectivity as to who is going to receive them and to what extent. They are not likely to result in innocent firms being wrongfully accused, which is an important part of due process.

Results

The column at the far right sums the 1-5 scores in each of the seven criteria columns for each of the nineteen policy alternatives. The alternatives that score relatively high (meaning 23 points or higher) include:

1. Giving government contracts to business firms that satisfy or excel on meeting pollution requirements;
2. Pollution taxes (although they may not be able to meet a minimum political feasibility level);
3. The buying and selling of marketable pollution rights as a cost to polluters and an income-reward to non-polluters; and
4. Bounties for reporting wrongdoing whereby the general public shares in fines that are levied.

The alternatives that score relatively low (meaning 20 or below) include:

1. Reward subsidies to business which are opposed as being too expensive to the taxpayer;

2. Fines which tend to be treated as petty business expenses to be passed on to the consumer;

3. Jail sentences that are unlikely to be imposed and thus relatively ineffective; and

4. Padlock injunctions that are opposed because they result in loss of employment and production.

EXPANDING THE MODEL

If the criteria are going to be weighted differently, political feasibility can be considered a constraint. Any alternative which scores only a 1 on political feasibility can be considered unfeasible. Of the other criteria, effectiveness in reducing pollution is probably the most important, followed by costs to the general taxpayer. Scores on those criteria might be doubled, say, to accord them greater weight in determining the overall sum for each alternative.

One can analyze a variety of policy alternatives in addition to the nineteen forms of incentives and disincentives listed here. It might be interesting, for example, to analyze alternatives involving the division of labor among national, state, and local government, and among legislatures, administrative agencies, and courts. One could also analyze structures that focus upon the division of labor between the public and private sectors, and between the government and the general public. One could even assess educational programs that might lead people to regard certain forms of pollution as unthinkable. They then never come to a decision "fork" where they have to decide whether the benefits minus the costs of pollution outweigh the benefits minus the costs of not polluting.

This kind of analysis can be extended to other fields of public policy and may help formulate broader principles concerning incentives and multi-criteria decision making. A broader "incentives principle" might be that rewards for rightdoing generate more socially desired behavior than penalties for wrongdoing. A broader "MCDM principle" might be that better conclusions are likely to be reached if one expands one's deliberations by thinking in terms of many alternatives and many criteria, while keeping the total quantity manageable and nonredundant.

The incentives approach can be contrasted with the unplanned marketplace, which may often be ineffective in or inimical to encouraging socially desired behavior. It can also be contrasted with a regulation approach, which may over-emphasize seeking to encourage desired behavior by fiat and penalties. The MCDM approach can be contrasted with traditional operations research and management science, which may overemphasize single objective functions and working with less important variables that happen to be measurable. The combination of incentives theory and multi-criteria decision making has great potential for facilitating environmental planning in a more systematic way. The combination can be useful in treating important goals, alternatives, and relations in order to reach better decisions.

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