

ETHICS AND ENVIRONMENTAL ECONOMICS

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The moral problem is a conflict that can never be settled. Social life will always present mankind with a choice of evils. No metaphysical solution that can ever be formulated will seem satisfactory for long. The solutions offered by economists were not less illusory than those of the theologians that they displaced.

All the same, we must not abandon the hope that economics can make an advance toward science, or the faith that enlightenment is not useless. It is necessary to clear the decaying remnants of obsolete metaphysics out of the way before we can go forward [Robinson (1963, p. 146)].

1. Introduction

Welfare economics, one of the foundations of conventional environmental economics, can be thought of as being an enormous elaboration of the utilitarian moral philosophy developed by Bentham, Mill, and others in the eighteenth and nineteenth centuries. There are, however, rival ethical systems that also put forward rules for individual and social moral behavior that are different from those of utilitarianism.

But why be concerned with moral philosophy in a book on environmental economics? There are two main reasons, one having its origins in economics and the other in philosophy. The first stems from the increasingly strained applications of benefit-cost analysis to large environmental issues and the concerns this raises about the adequacy, in these applications, of its conceptual, as well as empirical, basis. From the side of moral philosophy, there has been a great upsurge of interest by philosophers in the ethical implication of man's impacts on the environment. One result has been a spate of writings endeavoring to develop a nontheological, nonhumanistic, environmental ethic. The ideas of these philosophers, if accepted, would have large implications for environmental economics.

*Handbook of Natural Resource and Energy Economics, vol. I, edited by A.V. Kneese and J.L. Sweeney
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which, because of its basis in welfare economics, is intensely humanistic in its orientation.¹

In the next two sections, we elaborate first on the concerns emanating from the economic side and then from the standpoint of the new naturalistic philosophers.

Following that, we discuss several efforts by economists and others to develop criteria of "sustainability" with respect to both particular resources and the whole economic system. These are meant to provide ethical guidance concerning appropriate behavior where resource depletion or environmental degradation threaten to reduce the welfare of future generations. Particularly, we discuss the ideas of the economist Page and their relationship to the writings of the philosopher Rawls.

Then we consider a critique of all the major humanistic ethical ideas in Western philosophy after Aristotle. This critique is contained in an important recent book by the philosopher MacIntyre. This assessment sets the stage for a statement about our own stance concerning the alternative humanistic ethical systems we analyze further on in terms of their implications for environmental economics.

To permit this latter analysis to proceed with some rigor, it is necessary to state the alternative ethical ideas in their simplest possible terms. Therefore, they can in that form be linked only in a loose sense to the writings of any particular philosopher.

Having accomplished this epitomization, we apply several examples of the alternative humanistic ethics we have formalized to some particularly vexing problems in environmental economics. These are the analysis of environmental risks and the problems associated with discounting of environmental benefits and costs over long periods of time. We combine these problems in an illustrative analysis of the problem of storing radioactive nuclear wastes. Because of limitation of information, many questionable assumptions have to be made and the analysis should be taken as being nothing more than an effort to add a certain amount of concreteness to an otherwise very abstract discussion.

We close with a section that, in a sense, takes us back to the opening parts of the chapter. Here we consider a policy issue, the use of economic incentives in environmental policy, that has divided economists who emphasize economic efficiency from many environmentalists who take a different ethical view of environmental policy. This discussion focuses on an important recent book about environmental economics and ethics by political scientist Kelman. It also provides us with a vehicle for a closing statement of perspective on ethics and environmental economics.

¹ It is worth noting, however, in passing, that Bentham's utilitarianism was not anthropocentric. He wrote, "the French have already discovered that the blackness of the skin is no reason why a human being should be abandoned without redress to the caprice of a tormentor. It may come one day to be recognized, that the number of legs... or the termination of the os sacrum are reasons equally insufficient for abandoning a sensitive being to the same fate" [Bentham (1789), quoted in Passmore (1974 p. 14)].

In closing the present section of this chapter, we want to remark that we set out on the tasks just outlined with humility. Neither one of us is a trained philosopher, and we feel sure that professional philosophers reading this chapter would find many of the things we say, at least, simplistic. Still, we think the issues are potentially so important for the future of environmental economics that we feel the attempt must be made.

2. Ethical concerns of benefit-cost analysis

Benefit-cost analysis is discussed in other parts of this Handbook. Our intent here is not to instruct about its application, but rather to provide a brief historical perspective on why some of its newer applications are raising increasingly large ethical concerns among some economists.

Benefit-cost analysis was developed initially to evaluate water resources investment made by the federal water agencies in the United States, principally the United States Bureau of Reclamation and the United States Corps of Engineers. The general objective of benefit-cost analysis in this application was to provide a useful picture of the costs and gains from making investments in water development. The intellectual "father" of the technique is often said to be Jules Dupuit, who in 1844 wrote a frequently cited study "On the Measure of the Utility of Public Works". In this remarkable article, he recognized the concept of consumer's surplus and saw that consequently the benefits of public works are not necessarily the same thing as the direct revenues that the public works projects will generate.

Early contributions to development of benefit-cost analysis generally did not come from the academic or research communities but rather from government agencies. The agencies responsible for water development in this country have for a long time been aware of the need for economic evaluation of projects and the benefit-cost procedure is now embodied in agency policy and in government legislation. In 1808, Albert Gallatin, Jefferson's Secretary of the Treasury, produced a report on transportation programs for the new nation. He stressed the need for comparing the benefits with the costs of proposed waterway improvements. The Federal Reclamation Act of 1902 which created the Bureau of Reclamation, and was aimed at opening western lands to irrigation, required economic analysis of projects. The Flood Control Act of 1936 proposed a feasibility test based on utilitarian welfare economics which requires that the benefits to whomsoever they accrue must exceed costs. This directive told the agencies to ignore the distribution of benefits and costs and give attention only to their total amounts.

In 1946, the Federal Interagency River Basin Committee appointed a subcommittee on benefits and costs to reconcile the practices of federal agencies in making benefit-cost analyses. In 1950, the subcommittee issued a landmark

report entitled "Proposed Practices for Economic Analysis of River Basin Projects". While never fully accepted either by the parent committee or the federal agencies, this report was remarkably sophisticated in its use of economic analysis and laid the intellectual foundation for research and debate which set it apart from other major reports in the realm of public expenditures. This document also provided general guidance for the routine development of benefit-cost analysis of water projects which persists to the present day.

Following this report came some outstanding publications from the research and academic communities. Several books appearing over the past quarter century have gone much further than ever before in clarifying the welfare economics concepts applicable to our water resources development and use and in exploring the fundamental rationale for government activity in the area. Otto Eckstein's (1958) book is particularly outstanding for its careful review and critique of federal agency practice with respect to benefit-cost analysis. While naturally a bit dated, this book is still well worth reading.

A clear exposition of principles together with applications to several important cases was prepared by Jack Hirschleifer and collaborators in 1960. Other reports appeared during the early 1960s. One, which was especially notable for its deep probing into applications of systems analysis and computer technology within the framework of benefit-cost analysis, was published in 1962 by a group of economists, engineers, and hydrologists at Harvard [Maass et al. (1962)]. The intervening years have seen considerable further work on the technique and a gradual expansion of it to areas outside the water resources field.

The most striking development in benefit-cost analysis in recent years has been an increasing application of the technique to the environmental consequences of new technologies and scientific programs. For example, the U.S. Atomic Energy Commission (1972) (before ERDA and the DOE were created) used the technique to evaluate the fast breeder reactor research and development program. It has also been applied to other potential sources of environmental pollution and hazard. Two studies which come to quite contrary conclusions have been made of the Automotive Emissions Control Program. The first was prepared by a Committee of the National Academy of Sciences (1974). The other study is by the research arm of a major automotive producer [Jackson et al. (1976)]. Still other studies have been or are being conducted in the area of water quality analysis, emissions from stationary sources, and toxic substances including nuclear waste disposal.

Even while the benefit-cost technique was limited largely to the relatively straightforward problem of evaluating water resources investments, there was much debate among economists about the proper way of handling both empirical and conceptual difficulties with it. Some of the discussion surrounded primarily technical issues, e.g. ways of computing consumer surplus and how best to estimate demand functions for various outputs. Others were more clearly value and equity issues, e.g. whether the distribution of benefits and costs among

individuals needed to be accounted for or whether it was adequate to consider, as the Flood Control Act directed, only aggregates, and what is the appropriate rate of time discount to use on water projects.

Application of the technique to issues such as nuclear energy development programs, the storage of atomic waste, man-induced climate change, and the regulation of toxic substances aggravate both the empirical and value issues which existed in water resource application. There are several reasons for this.

First, while water resource applications often involve the evaluation of public goods (in the technical economic sense of goods exhibiting jointness in supply) the bulk of outputs pertain to such things as irrigation, navigation, flood control, and municipal and industrial water supplies which usually could be reasonably evaluated on the basis of some type of market information. In the newer applications, we are dealing almost entirely with public goods where market surrogates are much more difficult to establish.

Secondly, such matters as nuclear radiation and toxic materials relate to exposure of the whole population or large subpopulations to very subtle influences of which they may entirely unaware. It is difficult to know what normative value individual preferences have under these circumstances.

Thirdly, the distributional issues involved in these applications entail not only monetary benefits and costs, but the distribution of actual physical hazard. While it is not out of the question that monetary equivalents to these risks could be developed, the ethical issues appear to be deeper than just the economic returns which are involved. This is especially so if compensation is not actually paid to losers, as it is in practice unlikely to be.

Fourthly, we are in some cases dealing with long-lived effects which could extend to hundreds of thousands of years and many, many human generations. This raises the question of how the rights and preferences of future generations can be represented in this decision process. Realistically, the preferences of the existing generation must govern. The question is whether simple desires of existing persons are to rule or whether it is necessary to persuade the present generation to adopt some ethical rule or rules of a constitutional nature in considering questions of future generations.

The new applications of benefit-cost analysis bristle with ethical and value issues. These are the concerns raised from the side of economics.

3. The new naturalistic ethics

Some philosophers have recently chosen to address the difficult issues of ethics and policy presented by environmental concerns by abandoning humanistic philosophy altogether. These have been referred to as the "new naturalistic philosophers" [Marietta (1982)]. This group is rapidly producing a large new literature.

Actually, in many cases the discussion starts with the question of what is the nature and extent of man's obligation to nonhuman creatures – there is by now a large "animal rights" literature. From there, by some, extensions are made to nonliving entities, and by yet others, ideas having originated in humanistic philosophy are abandoned entirely and a purely naturalistic view of the ethical aspects of man in nature is advocated.

In a few instances the writing is rather hysterical and reminiscent of the more extreme kind of environmentalist prose of the later 1960s and early 1970s. For example, the main themes of a book, *Why the Green Nigger? Re-mything Genesis* [Gray (1979)] is stated by a reviewer [Shute (1980)] as follows:

In *Why the Green Nigger?* Elizabeth Dodson Gray attempts to show that it has been the use of a male-constructed, hierarchical picture of the world (with men at the top) that has been responsible for making nature a "green nigger." Possessing no rights, feminine and inferior nature is mastered, manipulated and oppressed by superior men. This male-constructed hierarchical picture of reality, Gray says, is posing a threat to the survival of life on the planet Earth. But Gray sees hope for changing the status and treatment of nature if we understand that reality is not hierarchical, but is a "complex and dynamic web of energy" (p. 67) which men are not only dependent upon, but in which they are inextricably enmeshed as beings with value no greater than that of anything else.

Most of the writing, however, has been a sober and well-intentioned attempt by the pertinent group of moral philosophers to tussle with some hard issues. There is no hope in the scope of a chapter to comprehensively survey all the contributions to this literature, but the interested reader can find a concentrated supply of articles from it in the journal *Environmental Ethics*. We choose a few of what we take to be among the best efforts of this genre and try to state the main ideas succinctly. We start with one that is a "slight" extension of some typical humanistic type arguments, then go through one that tries to extend man's obligations to all living things, a possible rationale for Albert Schweitzer's famous "respect for life", to a further one that extends ethical standing even to nonliving things, and finally to a set of writing that abandons the humanistic anchors altogether.

The first piece is by philosopher Richard A. Watson (1979). The idea of reciprocity is frequently invoked in the philosophical discussion of morality, and Watson uses a reciprocity framework to try to explain and justify the attribution of moral rights and duties.

We pause to note that the reciprocity is used in two separate senses in the literature under consideration. In the first it refers to the possibility of *actual* reciprocal action between or among agents. In the second it is used more in the "golden rule" sense of doing to others of what you would have them do unto you.

A related idea is Kant's categorical imperative that views ethical behavior as being that which the acting party believes should be universalized into a rule so that it would apply to everyone else, including their actions toward him. The second version does not necessarily imply that real reciprocal action is possible and therefore, as can be seen in the paper following Watson's, may apply to a broader range of phenomena.

Another pause is merited to explain a further distinction. In the pertinent literature, "right" (as in "animal rights") is taken to have at least two meanings. There can be "legal rights", and there can be moral rights or "inherent rights". That nonhuman entities can have legal rights is, of course, manifest. Corporations have rights in the legal sense as do wilderness areas and laboratory animals, although in the last case, enforcement is virtually nil. The real issue is whether nonhuman entities can have intrinsic rights inherent in the thing itself (*das Ding an sich*).

Now to return to Watson. He claims that to say that an entity has rights makes sense only if that entity can fulfill reciprocal duties, i.e. can act as a moral agent. To be such, again he claims, an entity must be (1) self-conscious, (2) understand general principles, (3) have free will, (4) understand the given principles, (5) be physically capable of acting, and (6) intend to act according to or against the given principles. So far, this line of argument would not be surprising to a conventional ethical philosopher even though he might not necessarily agree with it. It could be taken to define a human milieu which is moral as contrasted with a nonhuman one which is not.²

But Watson goes on to argue that a few animals besides humans, especially chimpanzees, gorillas, dolphins, and dogs, "...which, in accordance with good behavioral evidence, are moral entities, and sometimes moral agents. On the grounds of reciprocity, they merit, at a minimum, intrinsic or primary rights to life and to relief from unnecessary suffering" [Watson (1979, p. 99)].

Again, an interpretive note. Having heard an argument of this nature, it seems that many, if not most, economists would be puzzled as to why the philosopher making it should expect anyone else to believe him. By what authority can you, the philosopher, tell me what is morally right or morally wrong? A theological explanation, which is not invoked in humanistic philosophy, might not be believed, but it would probably be regarded as an understandable argument. But this attitude misunderstands the point of view of at least some, perhaps most, ethical philosophers. They do not appeal to higher authority, but believe that if they are clever enough and think hard enough about a moral problem, they should be able to come up with principles or rules that will persuade anyone else,

² It should be noted, however, that those who argue from *real* reciprocity seem to have a lot of trouble with the rights of very young children, the insane, hopeless idiots, and the helpless old.

or at least those who have an informed and sensitive moral intuition, of their validity.

With this background, and a set of arguments that gives "moral standing" to a few chimps and such, let us turn to a set of arguments that opens a much wider field of beings to moral claims. In a widely respected, which is not necessarily the same as to say widely agreed with, article, philosopher Kenneth E. Goodpaster (1978) approaches the question of man's responsibility to nature in a different way. Instead of addressing questions raised by the inherent rights concept, he asks the question, what makes a being morally "considerable"? The issue is one raised in an earlier book by philosopher G.J. Warnock (1971). Warnock asks what is the condition of having a claim to be "considered" by rational agents to whom moral principles apply. Goodpaster rephrases Warnock's question, "...for the terminology of R.M. Hare (or even Kant) the same questions might be put thus: In universalizing our putative moral maxims, what is the scope of the variable over which universalization is to range?", and a little further on, "For all A , X deserves moral considerations from A where A ranges over rational moral agents and moral 'consideration' is construed broadly to include the most basic forms of practical respect (and so is not restricted to 'possession of rights by X ')" [Goodpaster (1978, pp. 308–309)].

Still further on, he states the conclusion to which his thoughts about this question have led him. "Neither rationality nor the capacity to experience pleasure and pain seem to me necessary (even though they may be sufficient) conditions of moral considerability. And only our hedonistic and concentric forms of ethical reflection keep us from acknowledging this fact. Nothing short of the condition of being alive seems to me to be a plausible and nonarbitrary criterion" [Goodpaster (1978, p. 310)].

Having as he said, "put his cards on the table", and having further introduced distinctions and terminology we do not have space to explain (thus our characterization will necessarily do offense to the richness of his arguments and ideas), he begins with a critique of how Warnock answered his own question. As a matter of deserving moral consideration, Warnock rejects the reciprocity argument used by Watson, as explained above, at least partly based on the "infants and imbeciles" argument suggested in Watson (1979, p. 99). Instead, Warnock proposes that the criterion of moral considerability arises from the capacity to suffer.

Or stated in the more formal manner introduced earlier: for all A , X deserves moral considerations from A if and only if X is capable of suffering pain (or experiencing enjoyment).

Note that this may sound utilitarian, but unlike utilitarianism, it does not provide a criterion for action, but merely for consideration, by moral agents. While according to Goodpaster, Warnock in some places writes as though he is only including humans, but by the end of the book, he has broadened his scope to include nonhumans. Still, the operative idea is sentience.

Goodpaster is not convinced. He writes, "Biologically, it appears that sentience is an adaptive characteristic of living organisms that provides them with a better capacity to anticipate, and so to avoid threats to life. This at least suggests, though of course it does not prove, that the capacities to suffer and to enjoy are ancillary to something more important rather than tickets to considerability in their own right" [Goodpaster (1978, p. 316)]. He continues, "Nor is it absurd to imagine that evolution might have resulted (indeed might still result?) in beings whose capacities to maintain, protect and advance their lives did not depend upon mechanisms of pain and pleasure at all" [Goodpaster (1978, p. 317)].

Following this line of thinking, he proposes, but does not claim to have proved, that the quality of being alive is a better claim to moral considerability than sentience.

He then considers some possible objections, especially on the part of those who have claimed that sentience is the key and therefore moral considerability should be limited to humans and a few of the higher animals. In particular, he discusses a paper by Feinberg (1974) which he takes to be the best representative of that point of view. The main point argued by Feinberg is that a being cannot intelligibly be said to deserve moral considerability unless it satisfies the "interest principle". Feinberg notes,

The sorts of beings who can have rights are precisely those who have (or can have) interests. I have come to this tentative conclusion for two reasons: (1) because a rightholder must be capable of being represented and it is impossible to represent a being that has no interests, and (2) because a rightholder must be capable of being a beneficiary in his own person, and a being without interests is a being that is incapable of being harmed or benefited, having no good or "sake" of its own [Feinberg (1974, p. 51)].

Goodpaster objects to the claim that "interests" logically presupposes desires or wants or aims, the equipment for which is not available to plants. He states that there is no absurdity or unintelligibility in imagining the representation of the needs of a tree for sun and water in the face of a proposal to cut it down or pave its surrounding space for a parking lot. Because of plants' clear tendencies to maintain and heal themselves, he finds it very difficult to reject the idea of interests on their part in staying alive. This he contrasts with "mere things" that are not alive and therefore have no interests.

But in commenting on Goodpaster's article, philosopher W. Murray Hunt (1980) claims that even the condition of living is too narrow a criterion for moral considerability, and that "being in existence" is *at least* as plausible and nonarbitrary a criterion as is life. Hunt's argument rests on two main bases. The first is the "continuity" between living and nonliving things. The second is a counter-example to the proposition that the consideration of "being alive" is sufficient for moral considerability. His example is the problem of fulfilling the wishes of a

person who has died. The being alive criterion would imply that such wishes have no moral standing, an implication that Hunt says would not be acceptable to most ethicists. He argues that if the response is that this is because he once was alive, then the criterion would have to be amended to "being alive or once having been alive". In this case, moral consideration would have to be given to "mere things", like coal, since the material composing it was once alive. Essentially, Hunt argues that having started on the "slippery slope" of abandoning strict adherence to humanism, there is no stopping point short of according moral considerability to everything in existence.

Finally, we turn to a very brief discussion of the work of some philosophers who do not even start with humanistic traditions. These are the true "new naturalistic philosophers". Aldo Leopold (1949) is the father of naturalistic ethics, and his famous statement from *A Sand County Almanac*, "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise", is frequently quoted in this literature. The Summer 1982 (vol. 4, no. 2) of *Environmental Ethics* is a symposium issue, "Environmental Ethics and Contemporary Ethical Theory". In it are contained several papers of this genre. We quote the succinct description of them given in the introduction to the volume by the journal editor:

In the first paper, Peter Miller argues that psychologically based environmental ethics are ill suited to characterize natural intrinsic value. To solve this problem Miller proposes the acceptance of a metaphysical or metaethical category of richness. In the next paper, Donald Scherer argues that natural value need not depend on psychologically based judgments of human beings. Scherer imagines a series of planets with ever more highly organized levels of life, each of which yield new forms of value. These values are, Scherer argues, neither anthropocentric nor holistic. Holmes Rolston, III develops a position similar to Scherer's, but he finds value in nature beyond life: in geological, tectonic and entropic nature as well. Rolston is concerned with establishing the objective existence of nonpsychological values although he allows that there is a subjective (psychological) component as well, and finds a place for it in his view.

In closing this section, we must reiterate that we have been able to give the reader no more than a glimpse at the new literature in environmental ethics. But we trust it will give the economist reader a feel for the types of arguments made. Whether one is inclined to accept them or not, it is clear that these ideas are much too abstract, or insufficiently formed, to mesh tightly with actual public policy issues or with economic concepts. For the remainder of this chapter, with the exception of the last section, we return to the humanistic fold, and explore some of the implications for environmental economics of ideas stemming from that tradition. But first we develop a perspective on Western humanistic moral philosophy to which we hold for the remainder of this chapter.

4. A plague on all your houses, and a perspective

As our discussion so far should indicate, unanimity of view is not one of the stronger characteristics of environmental ethicists. One might think that might be true primarily of those whom their more orthodox brethren would take to be on the fringe of the discipline, such as the new naturalistic philosophers. But this is not the case. Disagreement abounds among those who espouse utilitarian views on the one hand and libertarian views on the other. The one looks to actions that maximize the good of the whole, and the other to individual rights. Others still are Kantians or Rawlsians, both emphasizing universality, but in different contexts. Other views exist in addition. In an important recent book, philosopher Alasdair MacIntyre (1981) has performed a critical evaluation of all of the major ethical views in Western philosophy over the last few centuries and found them all wanting. To him they are a combination of fragments of the "older" (aristotelean) tradition and certain modern "novelties". He writes,

It follows that our society cannot hope to achieve moral consensus. For quite non-Marxist reasons Marx was in the right when he argued against the English trade unionists of the 1860s that appeals to justice were pointless, since there are rival conceptions of justice formed by and informing the life of rival groups. Marx was of course mistaken in supposing that such disagreements over justice are merely secondary phenomena, that they merely reflect the interests of rival economic classes. Conceptions of justice and allegiance to such conceptions are partly constitutive of the lives of social groups, and economic interests are often partially defined in terms of such conceptions and not vice versa. None the less Marx was fundamentally right in seeing conflict and not consensus at the heart of modern social structure. It is not just that we live too much by a variety and multiplicity of fragmented concepts; it is that these are used at one and the same time to express rival and incompatible social ideals and policies *and* to furnish us with a pluralist political rhetoric whose function is to conceal the depth of our conflicts [MacIntyre (1981, p. 235)].

We share MacIntyre's skepticism about man's efforts to find principles of morality through the exercise of his powers of reason and, in his detailed analyses, he makes a convincing case that expressions of ethical views are intertwined with other less minded interests. At the same time, we find his own prescriptions, which would require re-establishment of something like an Athenian city state, equally unconvincing.

If this is the case, one may well ask, why bother with this ethical exercise at all? There are reasons. First, it is indisputably true that most people have moral beliefs and concerns. Perhaps that is what distinguishes them most from even the other higher animals. We think it is very much worthwhile to examine what implementation of those beliefs would imply for environmental economics and

decisions on environmental problems – a task to which we turn in succeeding sections. Second, we have a different view of pluralistic society and the function of political processes than expressed in the quotation from MacIntyre. We believe that the pluralism of modern society is simply a fact and that the development of political processes to peacefully and reasonably fairly resolve value conflicts is a high achievement. We also believe that economic-ethical analysis can make an important contribution to informing those processes about implications of viewing things from different moral perspectives. Finally, the philosophical foundation of modern neoclassical economic thought is the ethical doctrine of utilitarianism, albeit in considerably amended form from classical utilitarianism (as we will explain subsequently). We feel that it is worthwhile to try to understand what implications other competing ethical ideas might have for the economic analysis of environmental problems. On this we also hope to make some progress in succeeding sections. Before proceeding, however, to the comparative analysis of several competing ethical systems in the context of some large questions in environmental economics, we turn briefly to the ideas of a few economists who have stepped partly out of the utilitarian framework to consider one such large question. That is our obligation to future generations in the face of resource depletion and potential environmental degeneration.

5. Sustainability

The idea of managing resources in such a way as to maintain a sustainable yield has had appeal to many conservationists. The concepts they have put forward have often drawn the criticism of economists as is explained in Chapters 2, 12 and 14 of this Handbook. However, some economists have been drawn to close relatives of the sustainable yield concept in considering questions about our obligations to the “further future”, as some philosophers put it. An early instance was S.V. Ciriacy-Wantrup. In a classical book [Ciriacy-Wantrup (1952)] he advocated the idea of requiring a “safe minimum standard of conservation” as a matter of resources and environmental policy. He wrote “a safe minimum standard of conservation is achieved by avoiding the critical zone – that is those physical conditions, brought about by human action, which would make it uneconomical to halt and reverse depletion” [Ciriacy-Wantrup (1952, p. 253)].

In recent writings, economist Talbot Page (1977, 1982) has elaborated a related idea. He argues that preserving *opportunities* for future generations is a common sense minimal notion of intergenerational justice. He writes,

It seems sensible to focus on the limit our responsibility to what we can foresee and control. As future opportunity is more in our control than future utility, it would seem that opportunity is a more sensible object of intergenerational

justice. With some effort we can control the form of the heritage to be passed on to the next generation. It is beyond the control of the present generation to ensure that the next one will be happy or hardworking. It is beyond our control to increase their welfare; we can only assure them of certain opportunities for happiness that we foresee will be essential. But we *can* preserve certain essentials, such as the valuable parts of the cultural and natural resource base. If we cannot ensure that these will in fact be passed on to future generations, we can at least keep from ensuring that they will not be passed on.

From his writings, it is clear that Page includes environmental resources in his concept of the "resource base".

While appealing to common sense, Page, however, also makes appeal to the ideas of two moral philosophers John Locke and John Rawls. Locke's ideas, especially that of "just acquisition" are also incorporated into modern libertarian thought. Page writes:

The most absolute claim of just acquisition is an individual's claim to work wholly created by himself. Thus, Byron had a right to burn his books, but his wife did not, without his permission. (The classical utilitarian would not see the point of this distinction and might deny Byron the right to burn his own books.) The next strongest claim of just acquisition is by an individual who "produces" an object by mixing his labor with a resource of which there is "enough and as good" left for others. The last claim, in fact no claim at all, of just acquisition [for it] concerns the resource base passed into the hands of the present generation by the mere passage of time.

By this argument, the present generation does not have a right to deplete the opportunities afforded by the resource base since it does not "own" it. This is not to say that the resource base, including environmental resources, must be held physically intact, but that when there is depletion, it must be compensated for by technological development or capital investment.

The other ethical philosopher to whose ideas Page appeals is John Rawls (1971). Rawls' book, *A Theory of Justice*, has been exceptionally widely noted and commented upon.

Rawls' just society is based on principles contracted with the mutual consent of all society in an "original position", behind what he calls a "veil of ignorance". Behind the veil, everyone has the general knowledge for determining what principles of justice will regulate society, but lacks knowledge about his own individual case. Rawls writes:

No one know his place in society, his class position or social status; nor does he know his fortune in the distribution of natural assets and abilities, his intelligence and strength, and the like. Nor, again, does anyone know his conception of the good, the particulars of his rational plan of life, or even the special

features of his psychology such as his aversion to risk or liability to optimism or pessimism. More than this, I assume that the parties do not know the particular circumstances of their own society. That is, they do not know its economic or political situation, or the level of civilization and culture it has been able to achieve. The persons of the original position have no information as to which generation they belong [Rawls (1971, p. 139)].

Rawls goes on to formulate principles of justice that he thinks would be chosen by society behind the veil of ignorance so that: (1) "each person is to have an equal right to the most extensive basic liberty compatible to similar liberty for others"; (2) "social and economic inequalities are to be arranged so that they are both: (a) reasonably expected to be to everyone's advantage, and (b) attached to offices and positions open to all" [Rawls (1971, p. 68)].

These are principles for intragenerational justice. To the extent that he treats the intergenerational question at all, and his treatment is very limited, he views it primarily in terms of the present generation's duty to save. Page finds this argument unsatisfactory. To him, one of the important ideas of the original position is that it links all generations together with a common perspective [Page (1977, p. 203)]. In the original position, there is no shift in time perspective from one generation to another. It seems plausible that if those in the original position did not know which generation they were going to be part of, they would emphasize intergenerational equity for the same reasons that Rawls supposed that they would do in developing principles of intragenerational justice.

We now proceed to the task of taking five humanistic criteria, utilitarian, benefit-cost analysis (which is an application of a special case of neo-utilitarianism), egalitarian, libertarian, and elitist, and simplifying and defining them in such a way that they can be used in a reasonably rigorous manner for analyzing large problems in environmental economics. This is not an exhaustive list of possible criteria, but they do reasonably span the range of the essence of ideas advocated by humanistic philosophers in the last few centuries. Later we will show how three of these (utilitarian and libertarian as compared to benefit-cost analysis) can be applied to the problem of storing radioactive wastes.

6. Comparative analysis of ethical systems

6.1. Introduction

As we have already said, developing these criteria for analysis involves some radical simplification of the complex frameworks developed by actual moral philosophers. We turn first to utilitarianism. We discuss it somewhat more fully than our other systems. There are two reasons for this: (1) a highly evolved

(neo-classical) utility theory is the basis for modern welfare economics and, to an extent, its applied arm, benefit-cost analysis, and (2) the other ethical systems we present are in our version much less complex.

6.2. Utilitarian

In *classical utilitarianism*, individual or collective actions were to be taken in such a manner as to maximize the good of the whole society. Thus, it is quite possible that a person would be called upon to take an action injurious to himself for the good of the whole. *Neoclassical utilitarianism* requires that the individual maximize only his own utility. Neoclassical welfare economics demonstrates that, *under certain very restrictive conditions*, this results in a welfare maximum for the whole economic system, *for a given distribution of claims to assets*. Therefore, neo-classical utilitarianism must take the distribution of income as fixed in proving its welfare theorem and admit that there is also a similar welfare maximum that corresponds to every conceivable income distribution and, as such, it cannot choose among them. Choice of income distribution must be based on concepts other than utility, e.g. justice. Page comments on these matters in an illuminating way:

To state the matter a little more soberly, many economists rejected classical utilitarianism in favor of its neoclassical version when they decided that utility was entirely nonobservable. At the same time it became clear that most of the structure in economics could be preserved by thinking in terms of preference orderings instead of quantitative utilities. Preference orderings have the advantage of being, at least in principle, observable by choices actually made. This rejection of classical, quantitative utility has two repercussions noteworthy for our purposes.

First, if interpersonal comparisons of utility are impossible, then we are no longer able to maximize the sum of utilities across people. So the neoclassical utilitarian defends a weaker kind of maximization process in which each one maximizes his own utility. The classical utilitarian's moral principle, which says to maximize the sum of utilities, is strong in the sense that it sometimes directs people to act against their own selfish interests. The corresponding, weaker neoclassical utilitarian's moral principle says that we should move toward Pareto optimality. This principle is weaker in not requiring individuals to act against their own selfish interests. It is also weaker because in many situations it does not tell us what to do (it is a partial ordering).

Second, the rejection of observable utilities leads toward a behaviorist or black-box theory of the mind. The only evidence allowed for inferences about happiness or satisfaction is observable behavior: for example, actual purchases

in markets. Evidence from introspection is looked upon with suspicion, as are surveys of stated preferences. The situation is a little like trying to infer the structure of a car's motor by observing the car's operation. With this black-box approach it is not surprising that we might be limited to simple concepts of the motor [Page (1982)].

Thus, the most modern versions of economic welfare theory are said to be *ordinal* utility theories while the classical utility theories assume measurable or cardinal theory. It is now possible to see where benefit-cost analysis sits in all this. Actually, it is an amalgam of classical and neo-classical ideas. It is neo-classical in that it assumes the maximization of individual utilities rather than the utility of the whole, but it is classical in that in actual quantitative application it must, contrary to the neo-classical tradition, assume both measurable and comparable utility. However, it cannot *actually* measure utility, and to get around this fact, to exclude considerations of income distribution, and to maintain its logical integrity, it must make some very strong assumptions; for example, that the marginal utility of income is constant and equal for everyone.³ Under this assumption, in terms of maximizing net total utility, it does not matter who gets a dollar's worth of benefit or who bears a dollar's worth of costs.

But before turning to our next ethical system, which emphasizes the *justice* of income distribution rather than the maximization of utility (although the principle can, as we shall see, be interpreted in utility terms), it will be a useful lead in to discuss the income distribution question a little more formally. Here we assume, as does benefit-cost analysis, that utility is cardinal and maximized by individuals. However, we assume, consistent with the classical utilitarian view, that marginal utility diminishes with increased income for each individual and may differ between individuals.

First, we will examine the case, consistent, for example, with the view of Pigou (1920), where all individuals have (about) the same relationship between utility and income. Thus, for example, if two individuals, A and B, have utility U_A and U_B , respectively, derived from incomes Y_A and Y_B , respectively, and if Mr. B is initially wealthier than Mr. A., $Y_B^0 > Y_A^0$, then B has a higher total utility level than A. But given the traditional utilitarian assumption of diminishing marginal utility, that the utility curves in Figure 5.1 flatten out as income increases, it is easy to show that society's total utility could be enlarged by giving A and B the same income, \bar{Y} . This follows because, by raising A's income from Y_A^0 to \bar{Y} , we get a gain in utility of ΔU_A compared to the loss in utility ΔU_B to B, resulting from lowering B's incomes from Y_B^0 to \bar{Y} . Note that $Y_B^0 - \bar{Y} = \bar{Y} - Y_A^0$, so we take income away from B to give to A to get a gain in total utility, $U_A + U_B$, since $|\Delta U_A| > |\Delta U_B|$, or A's gain exceeds B's loss.

³ Although it must be pointed out that benefit-cost analysis may be defensible in logically looser ways.

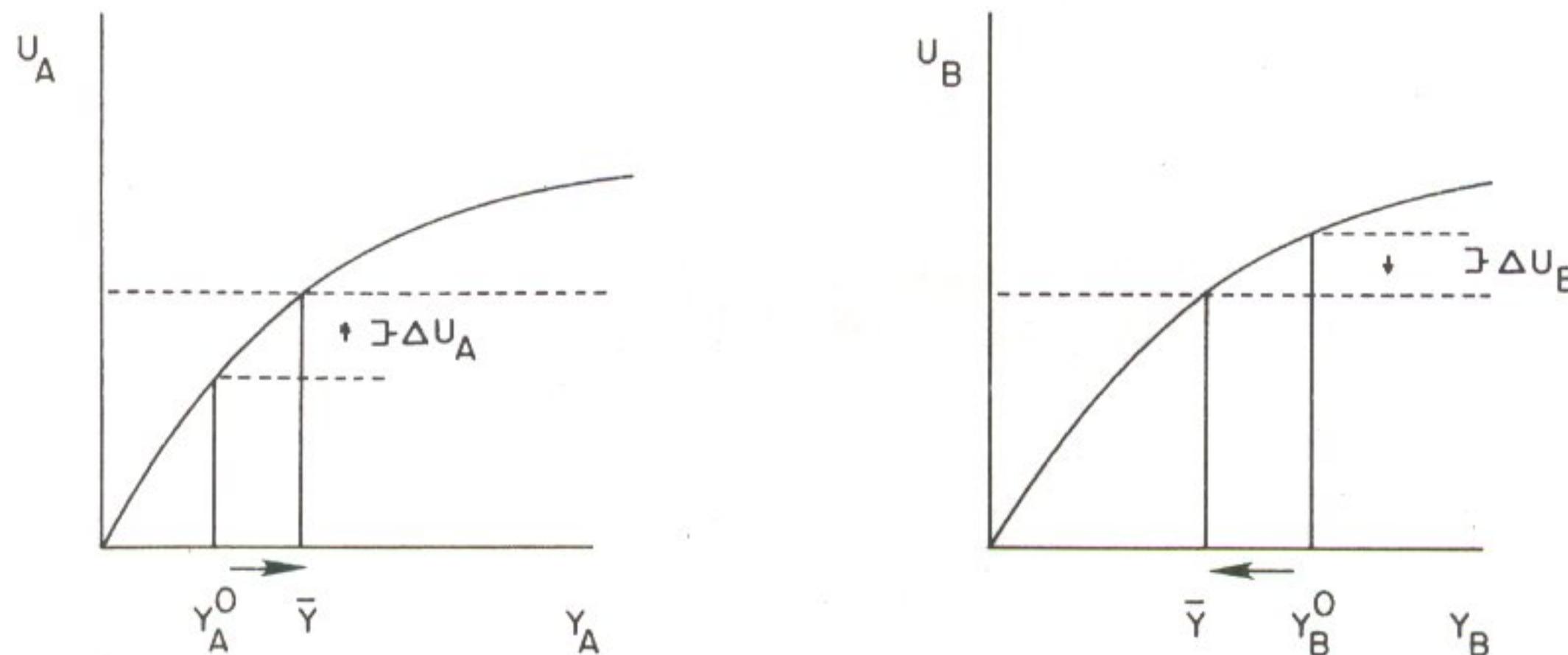


Figure 5.1. Utility as a function of income for two hypothetical individuals.

The same solution results from solving the following problem:

$$\begin{aligned} & \max U_A(Y_A) + U_B(Y_B) \\ & \text{s.t.} \\ & Y_A + Y_B = Y_A^0 + Y_B^0, \end{aligned}$$

which implies at the optimum that $\Delta U_A / \Delta Y_A = \Delta U_B / \Delta Y_B$, or that the rate of increase of utility with income (marginal utility) must be equal for the two individuals. Since the two individuals in our example have similar utility functions, marginal utilities are equated where incomes are the same, $Y_A = Y_B = \bar{Y}$.

But, on the other hand, we can assume different individuals have different utility functions. For example, Edgeworth (1967), in *Mathematical Psychics* (first published in 1881) argues that the rich have more sensitivity and can better enjoy money income than the poor. We then end up with a situation like that shown in Figure 5.2. Y_A^* and Y_B^* are utility maximizing incomes for A and B because the marginal utilities of income are equated. Mr. A gets more income than Mr. B because he obtains more utility from income than B does. In Edgeworth's view, Mr. A by his sensitivity should have more money to be used in appreciating fine wine than Mr. B who is satisfied with common ale. In the extreme case, Mr. A might be a "utility monster", i.e. his marginal utility of money income might everywhere exceed Mr. B's marginal utility of income, in which case all of society's income should go to Mr. A.

Clearly, then, in the utilitarian framework, depending on beliefs about the particular nature of utility functions, any distribution of income can be justified, ranging from an egalitarian viewpoint (Pigou) to an elitist viewpoint (Edgeworth).

There do exist ethical systems which are totally egalitarian on the one hand, and totally elitist on the other. These diametrically opposed ethical systems are described next. We realize that probably very few people, if pushed to the wall,

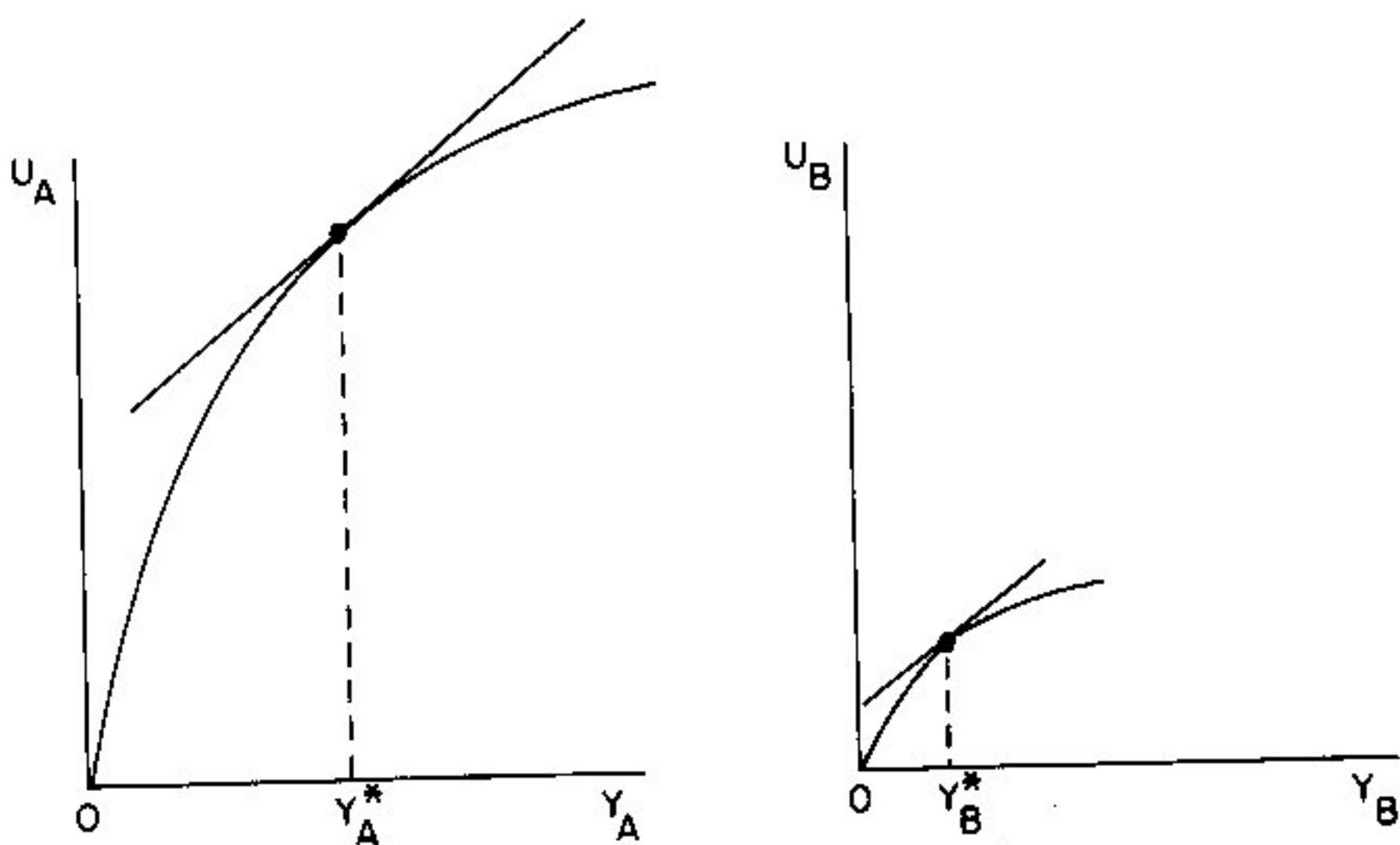


Figure 5.2. Society maximizes total utility by giving more income to A than to B.

would actually support the implementation of either of these extreme systems in its pure form. But it is useful to analyze them as representing the ends of the spectrum.

6.3. *Egalitarian*

The egalitarian view holds that the well-being of a society is measured by the well-being of the worst off person in that society. This criterion would, if fully adopted, lead to a totally equal distribution of utility.⁴

The egalitarian criterion can be expressed mathematically in economic terms as follows: for two individuals A and B, where utility is denoted U , if $U_A < U_B$, we maximize U_A subject to $U_A \leq U_B$; if $U_B < U_A$, then we maximize U_A subject to $U_B \leq U_A$. If we reach a state where $U_A = U_B$, then we maximize U_A subject to $U_A = U_B$. The implication of this for redistribution of income is that we begin by adding income to the worst off individual (taking income away from wealthier individuals) until he catches up with the next worst-off individual. We then add income to both individuals until their utility levels (well-being) have caught up to the third worst off, etc. Eventually, this process must lead to a state where $U_A = U_B = U_C = U_D \dots$ for all individuals in a society, where all utilities are identical, or to a state where further redistributions will make everyone worse off, e.g. through negative impacts on incentives. This criterion can be written more

⁴ Contemporary egalitarianism is often associated with the writing of John Rawls but it should be clear from even our brief earlier discussion of his ideas that his theory of just distribution is much more complex than the simple egalitarian criterion we analyze here.

compactly for a two-person society as $\max \min \{U_A, U_B\}$, so we are always trying to maximize the utility of the individual with the minimum utility. Implicit also in the argument is the assumption that the individuals' utility functions with respect to income are about the same. Thus, this ethical criterion would work toward a relatively equal distribution of income among individuals in a single generation or, in an intergenerational situation, across generations.

6.4. Elitist

An elitist criterion can be derived as the precise opposite of the egalitarian criterion. The well-being of society is measured by the well-being of the best off individual. Every act is "right" if it improves the welfare of the best off and "wrong" if it decreases the welfare of the best off.⁵

We discuss this criterion primarily to display the polar opposite of the egalitarian case. But it should be mentioned elitist arguments are sometimes made and action taken on them even in our society. The gasoline shortage of the summer of 1979 moved Senator Hiyakawa of California to comment: "The important thing is that a lot of the poor don't need gas because they're not working." Economic productivity can in this sense rationalize a defined "elite". Thus, concepts of merit can be elitist in nature, e.g. those who produce the most "should" have the largest merit increases in salary (even though they may already have the highest salaries).

The income distribution implied by this criterion is not simply to give all of society's wealth to the best off. This is true because, if between two individuals A and B we are attempting to

$$\max \max \{U_A, U_B\},$$

or to maximize the utility of the individual who can attain the greatest utility, we must first find the solution for $\max U_A$, and then separately for $\max U_B$, and then pick whichever solution gives the greatest individual utility. Obviously, it will usually be better to keep B alive to serve A, i.e. to contribute to his well-being than to give B nothing if A is to be best off. Thus, subsistence (which in a broader context might include minimal education, health care, etc.) is typically required for B. Similarly, if we have two succeeding generations, it may well be "best" for the first generation to save as much as possible to make the next generation better off. This attitude has been manifest among many immigrants to the United States with respect to their children. Thus, an elitist viewpoint may support altruistic behavior.

⁵ The elitist view is often associated with the writing of Fredrich Nietzsche, *Beyond Good and Evil* (1886). But, as noted in connection with Rawls, Nietzsche's ideas are much more complex than the simple criterion adopted here.

The ethical systems we have considered so far have been in one way or another concerned with the welfare or the "goodness" of the whole society. There is another class of ethical systems that concerns itself not with society at large, but with protecting individual rights. In regard to public policy issues, as we will see, the two are usually in conflict.

6.5. Pareto criterion

The fourth ethical system is an amalgam of a number of ethical principles embodied in part in a Christian ethic (the Golden Rule) as well as in the U.S. Constitutional viewpoint that individual freedoms prevail except where others may be harmed. These views which emphasize individual rights have been formalized by Nozick (1974) in a strict libertarian framework. We are not here concerned with changing the initial position of individuals in society to some ideal state, as were all the ethical systems discussed earlier, but rather in benefiting all or at least preventing harm to others, even if those others are already better off. This ethic has been embodied often by economists in the form of a criterion requiring "Pareto superiority", that is, an unambiguous improvement in welfare requires that all persons be made better off by a change in resource use or at least as well off as before. Any act is then immoral or wrong if anyone is worse off because of it. Any act which improves an individual's or several individuals' well-being and harms no one is then moral or "right".

If, for example, Mr. A and Mr. B initially have incomes Y_A^0 and Y_B^0 , then we require for any new distribution of wealth (Y_A , Y_B) – for example, if more wealth becomes available and must be distributed – that

$$U_A(Y_A) \geq U_A(Y_A^0)$$

and

$$U_B(Y_B) \geq U_B(Y_B^0),$$

or each individual must be at least as well off as he initially was. Any redistribution, e.g. from wealthy to poor or vice versa, is specifically proscribed by this criterion. Thus, this criterion, while seemingly weak – i.e. it does not call for redistribution – can block many possible actions if they do as a side effect redistribute income to make *anyone* worse off, however slight the effect may be. Often, then, to satisfy a libertarian or Pareto criterion requires that gainers from a particular social decision must *actually* compensate losers. In practice, in public policy decisions, this rarely occurs, at least fully, and there are some important situations where it is technically impossible.

7. An application to the problem of nuclear waste storage

This section is an attempt to look beyond traditional benefit-cost analysis to consider long-term nuclear waste storage from both an ethical and an economic perspective. The problem of nuclear waste storage exemplifies the type of problem where benefit-cost analysis has most often been criticized. We conjecture that the dual problem of valuing risk to life of future generations motivates these criticisms. To address these issues, we develop formal economic models of alternative decision criteria for nuclear waste storage which are based, at least loosely, on alternative ethical positions. In particular, two of the alternative ethical positions outlined above are contrasted with each other and then with standard benefit-cost analysis.

First, the utilitarian ethic is used to explore the notion that the proper goal for society is to pursue the good of the whole both across individuals and more importantly across time. Second, we focus on the Pareto or libertarian criterion where the protection of individual rights both across individuals and across generations is more important than the good of the whole. It should be noted that these criteria share two characteristics. First, in each, man is the measure of all things. Thus, in contrast to the naturalistic ethic the only value of the natural environment is the value human beings place on it, and so nonhuman objects have no intrinsic value. Second, these criteria are consistent with the neo-classical notion of economic efficiency and are consequentialist in nature – focusing on outcomes of the decision process. It should be noted that philosophers view any consequentialist analysis to be at least utilitarian in spirit as opposed to other humanistic ethics which focus on procedures or due process.

Given the formalization of the Utilitarian and Pareto ethics presented in the previous section, we can model the choice to store nuclear wastes using an expected utility framework as follows: we assume that there are only two generations. Generation one, the current generation, has to decide whether or not to develop nuclear facilities. Utility of generation one, $U_1(Y_1)$ depends on generation one's income, Y_1 , which initially is \bar{Y}_1 . For this illustrative example we assume that generation one's income can be augmented by utilizing nuclear power which adds B dollars in net to income (net benefits to generation one of nuclear power) but in turn depends on generating nuclear wastes of w tons. Thus, B is an increasing function of w , $B(w)$. Income to generation one is then $\bar{Y}_1 + B(w)$. However, generation one may decide to compensate the future generation, generation two, for the hazards of nuclear waste storage imposed on them. Thus, generation one might reduce their income by C dollars to be invested for the benefit of generation two, leaving a net income of $Y_1 = \bar{Y}_1 + B(w) - C$. Generation two, with an initial income of \bar{Y}_2 , may then receive an income of $Y_2 = \bar{Y}_2 + (1 + r)C$ if generation one invests C dollars at a rate of return r for the period of time between the two generations. If, however, the two generations are

separated by 10 000 years, it is highly doubtful that compensation is possible, i.e. the odds are zero that a financial institution will survive over such a period to accumulate compound interest at rate r . Of course, we still may properly assume that risk of death to individuals in generation two, $\Pi_2(w)$, is a function of the quantity of nuclear wastes created by generation one, since nuclear wastes will still be radioactive even after 10 000 years have passed. We assume, to focus just on the intergenerational risk issue, that risks to generation one are fixed at Π_1^0 . Utilizing the two ethical criteria, we will now explore under what decision rule nuclear power should be pursued by generation one, thus transferring nuclear waste to generation two.

We can summarize the notation outlined above as follows:

Π_i = probability of death in generation i ,

U_i = utility in generation i where $U_i' > 0$; $U_i'' < 0$,

Y_i = income in generation i ,

$B(w)$ = net benefits (additional income) of having nuclear power,
an increasing function of the quantity of nuclear waste (w),

r = interest rate,

C = compensation from generation one to generation two: $C \geq 0$.

For generation one, expected utility (E_1) is equal to the probability of death times the utility obtained from initial income (\bar{Y}_1) plus the benefits associated with nuclear power, minus compensation paid (if any) to the future generation:

$$E_1 = (1 - \Pi_1^0)U_1(\bar{Y}_1 + B(w) - C). \quad (1)$$

The second generation's expected utility is dependent upon the probability of death as a function of the amount of nuclear waste times the utility from initial income (\bar{Y}_2) plus compensation paid (if any) compounded at the rate of interest, r :

$$E_2 = (1 - \Pi_2(w))U_2(\bar{Y}_2 + (1 + r) \cdot C). \quad (2)$$

The Utilitarian criterion states that the sum of the total expected utilities of both generations, T , should be maximized;

$$\max_{w, C} T = E_1 + E_2, \quad (3)$$

where the choice variables are the levels of compensation (C) and generation of nuclear waste (w). We make the following assumptions of symmetry between generations: (1) $U_1(Y) \equiv U_2(Y)$ or both generations have the same utility functions; (2) $\bar{Y}_1 = \bar{Y}_2$ or both generations have the same initial income; and (3) $\Pi_1^0 = \Pi_2^0$ or both generations have the same initial risk. Thus, we explore an

egalitarian formulation of the Utilitarian ethic similar to that associated with Pigou in the preceding section.

The first-order conditions are:

$$\frac{\partial T}{\partial C} = -(1 - \Pi^0)U'_1 + (1 - \Pi_2)U'_2(1 - r) \leq 0 \quad (4)$$

and

$$\frac{\partial T}{\partial w} = (1 - \Pi^0)U'_1B' - \Pi'_2U_2 \leq 0. \quad (5)$$

The decision of whether or not to build nuclear power plants thus generating nuclear wastes can be analyzed in two contexts. The first situation is that where compensation between generations is impossible or undesirable ($C = 0$) so (4) holds with inequality. The second case is where compensation is possible and desirable ($C > 0$) so (4) holds with equality. We will evaluate whether or not nuclear facilities should be built, generating waste, by evaluating $\frac{\partial T}{\partial w}$ at the point where $w = 0$. Rearranging (5) yields:

$$B'(0) \geq \frac{\Pi'_2U_2}{(1 - \Pi_1^0)U'_1}, \quad \text{for } \left. \frac{\partial T}{\partial w} \right|_{w=0} \geq 0. \quad (6)$$

Let us consider the case where compensation between generation one and two is impossible. Utilizing the assumptions of symmetry between generations, the assumption of no compensation and $w = 0$ implies that utility in each generation is the same, or $U_2(\bar{Y}_2) = U_1(\bar{Y}_1)$. This implies the marginal utility of generation one (U'_1) is equal to marginal utility of generation two (U'_2). Additionally, evaluating the decision at $w = 0$ implies the same risk levels or $\Pi_1^0 = \Pi_2(0)$. Thus, (6) can be rewritten by substituting U'_2 for U'_1 and $\Pi_2^0(0)$ for Π_1^0 yielding:

$$B'(0) \geq \frac{\Pi'_2U_2}{(1 - \Pi_2(0))U'_2}, \quad \text{for } \left. \frac{\partial T}{\partial w} \right|_{w=0} \geq 0. \quad (7)$$

(7) states that generation one can evaluate whether or not to build a nuclear facility by determining whether the marginal benefits of nuclear power are greater than, less than, or equal to the incremental risk (Π'_2) times the marginal compensation for increased risk of death or value of safety $U_2/(1 - \Pi_2(0))U'_2$ for generation two which, given our assumptions, is the same as the marginal value of safety for generation one. Assuming that compensation is impossible results in no discounting of future damages (the cost of risk to generation two). Thus, in order to pursue nuclear power (so optimally $w > 0$) the marginal benefits to generation one must be greater than the associated incremental risk to generation two times the marginal value of safety of generation two both evaluated at $w = 0$. The discount rate where no compensation is possible under an egalitarian specification of the Utilitarian ethic is thus equal to zero.

Let us now consider the decision for generation one under the Utilitarian criterion where compensation is possible and desirable. In this scenario, condition

(4) holds with equality and the assumption of equal initial income does not hold: $U_1(\bar{Y}_1) \neq U_2(\bar{Y}_2)$. Rearranging condition (4) and solving for U'_1 yields:

$$B'(0) \geq \left[\frac{1}{1+r} \right] [\Pi'_2] \left[\frac{U_2}{(1-\Pi_2)U'_2} \right]. \quad (8)$$

If the marginal benefits of nuclear power are greater than or equal to the discounted value, $[1/(1+r)]$, of the incremental risk (Π'_2) to generation two, times the marginal value of safety $[U_2/(1-\Pi_2)U'_2]$ for generation two, then a policy of nuclear power should be pursued under the Utilitarian criterion. Thus, if compensation is possible under an egalitarian specification of the Utilitarian ethic the discount rate should be equal to the rate of interest.

The Pareto or Libertarian criterion can be stated as follows. If generation one's well-being is improved by using nuclear power and production of nuclear waste, then generation two must be at least as well off as before. The expected utilities for generations one and two defined in (1) and (2) can be used to state the Libertarian criterion:

$$\begin{aligned} & \max_{w, c} (1 - \Pi_1^0) U_1(Y_1 + B(w) - C) \\ & \text{s.t.} \quad (a) \\ & (1 - \Pi_2^0(w)) U_2(Y_2 + (1+r)C) \geq (1 - \Pi_2(0)) U_2(\bar{Y}_2). \\ & \quad (b) \quad (c) \end{aligned} \quad (9)$$

We maximize the expected utility of generation one [term (a)] subject to the condition that the expected utility of generation two [term (b)] is greater than or equal to the initial utility of generation two [term (c)] where no nuclear waste is produced. Thus, the rights of generation two are defended by the constraint. The first-order conditions are

$$\partial L / \partial C = -(1 - \Pi_1^0) U'_1 + \lambda (1 - \Pi_2) U'_2 (1 + r) = 0 \quad (10)$$

and

$$\partial L / \partial w = (1 - \Pi_1^0) U'_1 B' - \lambda \Pi'_2 U_2 \leq 0. \quad (11)$$

Again, assuming an egalitarian symmetry between generations, the condition for evaluating the decision to build a nuclear facility from the perspective that initially $w = 0$, is obtained by rearrangement of (11) which yields:

$$B'(0) \geq \frac{\lambda \Pi'_2 U_2}{(1 - \Pi_1^0) U'_1}. \quad (12)$$

Only one situation relating to compensation is available for analysis in the Libertarian case due to the structure of the constraint. That is, if no compensation is possible then the amount of nuclear waste must be zero or the Pareto criterion is violated. This is, the term (b) in eq. (9) would be less than term (c) and

generation two would not be at least as well off as before. Thus the only situation of interest for the decision to build a nuclear facility is where compensation for generation two due to the existence of nuclear waste is possible. Solving for λ in condition (10) assuming compensation is possible yields:

$$\lambda = \frac{(1 - \Pi_1^0)U'_1}{(1 - \Pi_2)U'_2(1 + r)}. \quad (13)$$

Substituting into (13) yields:

$$B'(0) \geq \frac{1}{1 + r} \frac{U_2}{(1 - \Pi_2)U'_2}. \quad (14)$$

A policy of nuclear power should be pursued under the Libertarian ethic only when compensation is possible and the marginal benefits to generation one are greater than the discounted marginal value of risk to generation two.

We can summarize our results as follows. The Utilitarian ethic, in the case where identical initial incomes and utility functions are assumed, would require discounting only if compensation can actually be paid. Otherwise a zero discount rate is appropriate. The Libertarian case would reject nuclear waste storage outright if compensation cannot be paid, but accepts the discounting procedure if compensation between generations is possible. Since it is unreasonable to assume that compensation can be paid to generations 10 000 years or more in the future for the storing of nuclear waste, this analysis leads under the assumption of an egalitarian specification of the Utilitarian ethic, to the use of a zero discount rate or, under the assumption of a Libertarian ethic, to the outright rejection of nuclear waste storage. Traditional benefit-cost analysis, on the other hand, would almost certainly lead to the conclusion that nuclear waste storage is unimportant in the nuclear power decision since future damages would, at any usual positive rate of interest, be discounted to near zero.

8. Conclusion: Ethics and a policy debate

In discussing environmental policy, economists have tended to favor approaches that emphasize economic incentives (e.g. effluent charges) in contrast to command and control regulation (e.g. effluent standards). Many environmentalists have also supported economic incentives as part of environmental policy. A large and influential group of environmentalists have, however, been adamantly opposed to the use of charges to help manage environmental quality. This group of environmentalists and economists who advocate charges have not found it possible (or perhaps desirable) to communicate with each others positions and therefore have been unable to understand each other properly. In an important recent book political scientist Kelman (1981) attempts to interpret each group to the other.

We close this chapter with a brief discussion of that book and a statement of our own perspective on ethics and environmental economics.

In the first chapter, Kelman presents the economists' rationale for charges in a highly simplified form. The argument is that charges will be more efficient than uniform emission standards in the sense that a given level of ambient environmental quality can be attained by their use at less cost than by the implementation of standards. Theory and several quantitative case studies support this view, but the issue is a lot more complex than one would gather from this chapter. This is no real complaint, however, because, for the sake of understanding the differences between economists who support effluent charges and those environmentalists who oppose them, the relative efficiency of charges can be taken as given, for the argument is not primarily about that.

The second chapter presents a discussion of ethical theory and the case for concern about charges. This is the chapter that is most salient to our present concerns, and we will dwell mostly upon it in this discussion. We note in passing that if one only read this chapter, one would get the impression that on ethical grounds, *all* environmentalists are opposed to charges. This, as we just noted, is not true. The interviews reported in the third chapter of Kelman's book show that the community of environmentalists is divided on the question. Indeed, for a time in the 1970s, there existed a group of environmental organizations called the "Coalition to Tax Pollution". In particular, they supported a charge on sulfur compounds emitted to the atmosphere. Once again though, for the sake of ethical discussion, this split among the environmentalists does not matter. A large number of environmentalists are opposed to charges. Also, the ethical positions described in Kelman's chapter two do probably fairly characterize the group of environmentalists, both inside and outside of government, who drafted and lobbied through Congress the basic national air and water pollution legislation in the early 1970s. This legislation rejected charges and established effluent standards based on concepts of "best available technology".

The remaining chapters of the book are not of particular pertinence to the present discussion. Let us therefore return to the presentation in Chapter 2 of the ethical ideas that in Kelman's view are held by those hostile to charges. This chapter proved to us, as economists, extremely revealing and insightful. As noted in earlier discussion, in the normal course of things, economists take people's preferences as given. They do not inquire into people's motives except, also as previously discussed, that they assume people are guided mostly by their self-interest, at least in economic matters. This assumption of self-interest is at the heart of the efficiency case for charges.⁶ To capture the essence of the idea, if public policy specifies that emissions to the atmosphere be reduced by a certain amount, say in a metropolitan area, this could be accomplished in alternative ways. All discharges could be cut back by a certain fraction by enforcing

⁶ Charges and standards are discussed in detail in Chapter 10 of this Handbook.

emissions standards. Alternatively, a charge could be levied on each unit of discharge and each emitter could be left to decide how much to control and how much to discharge. Acting in his own best interest, he would reduce discharge until the cost of another unit of discharge reduction is equal to the charge. This is because up to that point, his overall costs will be lower if he curbs the discharge than if he pays the emissions fee. If cost of reducing discharge are different for different dischargers, as in practice they are, much control will be induced at points where control costs are low and little control where costs are high. Thus, if the charge is set at the appropriate level, the combination of the economic incentive provided by it and the self-interest of the dischargers will produce a situation where the same amount of overall discharge reduction can be achieved as with emission standards, but at lower (possibly much lower) overall cost. This means that the real cost to society is lower with charges than with standards to achieve the same social objective.

But according to Kelman's analysis, the environmentalist hostile to charges would not find the results of applying the charges technique acceptable even if he agreed that the outcome just indicated would really happen. He would object that discharging substances to the environment that put others at risk or harm them economically is ethically wrong. As we saw in the discussion above, the Pareto or Libertarian ethical system could provide a foundation for this view of the matter.

The environmentalist in question then *does* care about motives, and he *does not* want to create a situation in which discharges to the environment appear to those doing them to be legitimate. This, apparently, is what is behind the cliche "license to pollute" that some environmentalists have so long used to inveigh against charges and which has so long baffled economists. The economist tends to see emissions standards that do not forbid discharges entirely (and for practical reasons, few do) as the real license to pollute. This is because once the standard is met, remaining discharges to the environmental commons can occur with no penalty at all to the polluter. In other words, they are free gifts to the polluter.

Again, here economists and environmentalists sail past each other in the night. According to Kelman, even though environmentalists are realistic enough to see that zero discharges is, in most cases, an impossible dream, they feel that polluting activity should be stigmatized by making it illegal and by persuading others to share their ethical view of the matter. If the emitter cannot realistically stop entirely, then he should want to "do his best" to do so. This appears to be the ethical foundation, at least in those particular environmentalists' minds, for using discharge permit systems that require "best available technology" somehow defined. If the discharger is within his permit requirements, he is by definition doing his best. Regulatory systems incorporating economic incentives are not acceptable because they do not ensure that everyone will be doing his best, even if they result in lower costs to society, of meeting the same environmental goals, or in meeting higher environmental goals at the same cost.

This environmental policy stance is only apparently oriented to results. In fact, it does not care about the overall efficiency of the system, it neglects opportunities for improving environmental quality other than by discharge reduction (for example, by reservoir operations in a river system), and in its extreme sense, it does not even care about environmental quality as long as everyone is doing his best.

It seems clear to us that the ethical attitude described by Kelman has left us with environmental policies that produce both higher costs and less environmental quality than an approach that would have paid attention to efficiency. That situation in itself presents an interesting ethical dilemma.

As discussed in Chapter 1 the first law of thermodynamics requires that the mass of materials extracted from nature and used in man's production and consumption activities must be returned in some manner to the natural environment because matter is not destroyed in these activities. All that can be altered is the form and location of these residuals discharges or the total throughput can be altered somewhat by recycling of used materials. It strikes us as distinctly odd to regard a socially necessary activity, residuals generation, dictated by natural law, as being *inherently* immoral in the same way that most people, including economists, regard rape or murder as immoral. Much more appropriate, in our opinion, is to regard it as an important societal problem that requires collective choices and public management as part of which a variety of policy instruments may be employed.

In closing, it may be interesting to discuss briefly how the ethical ideas put forth in the preceding parts of this chapter would view polluting activity. A utilitarian would presumably conclude that if the utility to the polluter outweighed the utility to the damaged parties, polluting would be all right. To an egalitarian, presumably whether the activity led to a more or less equal distribution of utilities or opportunities would be the dominant consideration.

In cases where damaged parties cannot be, or are not, compensated, i.e. almost always, two other ethical rules are unequivocal and, in result, agree with the environmental fundamentalism described by Kelman if the status quo point is taken to be a condition of no pollution. A libertarian presumably would reject any polluting activity because it infringes on the rights of others. Interestingly, a rule derived from economic theory, the Pareto principle discussed earlier, also leads to the environmentalists' result. This criterion, as the reader will recall, holds that an action can only be regarded as an unambiguous economic improvement if it makes at least one person better off and no one else worse off. In the absence of compensation, application of this criterion would foreclose any polluting activity. However, if the status quo is taken to be the actual state of pollution, the criterion would counsel us to do nothing or else compensate the polluters. Economists interested in public policy almost always reject the Pareto criterion because it enshrines the status quo and would prevent virtually any

public action. This is the trouble with absolutist criteria of any kind. Their application would either hang up any possibility of action or otherwise muck up the functioning of the economic and social system in an unacceptable manner.

A more suitable way to think about ethical aspects of public policy might be to view it in terms of combinations of criteria. An appropriate ethical, as contrasted to political, goal or public policy might be a utilitarian one (since we do care about the good of the whole), but constrained by Libertarian considerations (limits on how much individual interests may be intruded upon) and egalitarian considerations (permit differences of income based primarily on productivity incentive objectives). Should one view the matter in this way, economic theory and method might make some interesting contributions to philosophical discourse, for the stuff of microeconomics is optimization under multiple constraints. Intriguing thought!

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