Environmental Economics

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For eight years, I have taught environmental economics at California State University, Long Beach and the University of California, Irvine. The majority of the students in this course are taking majors other than economics. About 10% of them are interested in attending law school. The course provides a background in applications of economic theory to public policy issues relating to environmental and land-use law and regulation. In particular, societal goals, as they are revealed through legislation, administrative regulations and court decisions, are given considerable weight throughout the course. Students also gain an understanding of what is likely to result from striving to attain economic efficiency, how attempting to attain economic efficiency can impact the environment, and the principal limitations of the economic efficiency criterion.

This paper provides a survey of the principal applications of economic theory to public policy issues relating to environmental and land-use law and regulation. The first section describes the scope of the policy issues treated by environmental economics. The second section provides a discussion of the maximize wealth goal and the concepts of economic efficiency that are derived from that goal. The third section contains a survey of five critiques of the maximize wealth goal as a reasonable basis for rational social policy. One or more of these critiques generally form the basis of attacks by environmentalists upon the relevance of the economic efficiency criterion for evaluating environmental policy options. The fourth section is concerned with the general problem of market failure resulting from the existence of public goods and externalities, and raises the issue of whether attempting to reduce the impacts of market failure will result in an even greater "government failure." The last section deals with the problem of whether technological changes and the depletion of natural resources have made the maximize wealth goal an obsolete standard for measuring economic efficiency.

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I.

THE SCOPE OF ENVIRONMENTAL ECONOMICS

Economic theory is primarily concerned with the production and consumption of private goods and services, the operation of markets where goods and services are exchanged, and the institutions governing the production, consumption, and exchange of private goods and services. Under the stimulus of increasingly widespread and serious environmental problems which have resulted from energy-intensive technologies, agricultural and industrial technologies based on synthetic organic chemicals, unprecedented levels of urbanization, and suburban sprawl by middle-class whites, economists became increasingly interested in externalities, public goods, market failure and collective decision making.[1] Environmental economics grew out of these concerns. It is primarily concerned with the analysis of externalities and involuntary exchanges[2] that do not take place on markets, the impact of economic activity on the natural environment, and how societal goals relating to the use of capital, labor, and natural resources change over time in response to changes in a broad range of economic, environmental, political, social and technological factors.

The most widely analyzed and discussed environmental problems involve situations in which the actions of one person affect, either positively or negatively, the well-being of one or more other persons, without a market transaction taking place that compensates for the loss or gain in well-being. A discussion of this classic

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1. Externalities occur when the actions of one person affect the well-being of other persons and there is no compensating market transaction between the persons. Public goods are jointly supplied to two or more persons in the sense that one person can use the public good without reducing the amount available for other persons to use. Market failure exists when, given existing institutions, the operation of the market does not result in maximizing the value of capital, labor and natural resources. Collective decision making occurs when decisions about the use of resources are made by some governmental body, rather then private individuals seeking their self-interest. Formal analyses of the externalities problem can be found in MARSHALL'S, PRINCIPLES (1908) or A. PIGOU'S, ECONOMICS OF WELFARE (1920), both of which were widely used textbooks in their day. However, they both felt that externalities problems were of relatively little importance—a point of view that most economists retained until the late 1960s.

2. Involuntary exchanges occur when the action of one individual reduces the wealth or well-being of another person, as when a neighbor's new home blocks the view of the ocean of an existing home.

externality problem is one of the primary topics of my environmental economics course. Much of the law of torts is devoted to deciding how to compensate damaged persons for a loss in well-being inflicted by the actions of others. However, many important externalities cannot be handled under the law of torts because the specific persons responsible for inflicting a loss of health, property, or well-being cannot be precisely identified or their share of the damages determined in any reasonable way. Thus, the creation of an externality can be viewed as an involuntary exchange between persons, which contrasts sharply with the voluntary exchanges that characterize market transactions. Moreover, not all involuntary exchanges result in damages of a nature or extent whereby their prohibition or the payment of compensation is necessarily in the public interest.

Environmental economics is also concerned with the impact of human actions on the extent, quality and stability of the natural eco-system. In this type of case, the parties to any litigation generally include persons interested in preserving and protecting natural habitats and government agencies responsible for protecting endangered species from extinction, fresh water and marine habitats from pollution, and national parks and wilderness areas from overuse. Environmental economics is concerned with these problems because they generally result from actions by persons to increase their wealth, or governmental actions to provide a "needed" service to the community (such as a new road, dam or powerline).

Since the immediate and principal beneficiaries often include other organisms besides humans, legal actions protecting wildlife and natural habitats tend to be relatively controversial. In some cases, the principal beneficiaries may be future generations who are unable to present their case or protect their interests through the traditional judicial or legislative process. The benefits to contemporary society often cannot be readily or unequivocably determined on the basis of existing scientific knowledge. Thus, it may be difficult to establish a constituency for this type of environmental legislation and regulation. Yet, courts, Congress, and state legislatures generally perceive a need to protect the natural environment from actions that are likely to be irreversible.

The third principal concern of environmental economics is with the evolution of the various economic, political, and social goals and institutions which control individual and collective use of the natural environment. Dynamic changes in political institutions,

private property rights, availability of natural resources, urbanization, and the religious and moral views of society all interact, slowly over one or more human generations, to yield various social goals and institutions. These same factors also interact to determine the agricultural and industrial technologies appropriate to each historical epoch, with the rate and nature of technological change basically resulting from trends in the relative costs of capital, labor, and natural resources. The environmental and land-use problems resulting from the new technologies of the past 50 years ultimately gave rise to the need for the legal system to reflect the realities of air, water, and noise pollution, natural resource depletion, and the loss of many of life's amenities.[3] It is these technological changes that have played an important role in initiating the integration of law and economics over the past two decades and makes the opposition of some legal scholars to the integration of law and economics seem anachronistic to economists.

These three general classes of problems that characterize the scope of environmental economics are presented at the beginning of the course to indicate to the students the wide range of issues which arise where the environment, technology, economics and law interact. The objective of this initial discussion is to provide an overall framework into which the various elements of economic analysis are fitted. Economic analysis can then be presented as a methodology for understanding the nature and sources of complex problems confronting human societies. It also provides a framework for understanding the evolution of cultural, legal and political traditions in response to changing economic and technological conditions.

II.

ECONOMIC EFFICIENCY AND THE MAXIMIZE WEALTH GOAL

In order to discuss or measure "efficiency," one must specify the goal that is to be attained as a result of "efficient" decisions by courts or administrative agencies. The social goal implied by contemporary concepts of economic efficiency is that of maximizing the market value of the nation's capital, labor and natural resources.[4] In the remainder of this article, this goal will be re-

3. A recommended reading for my course which provides an extended analysis of the relationship between contemporary technologies and environmental quality is E. J. MISHAN, TECHNOLOGY AND GROWTH: THE PRICE WE PAY (1969).

4. This goal is sometimes confused with maximizing the nation's gross national product ("GNP"). GNP considers only the estimated value of final goods and

ferred to as the "maximize wealth goal." Since the amount of capital, labor, and natural resources available to society cannot be significantly changed over short periods of time, the maximize wealth goal generally implies that it is efficient to adopt policies and regulations, and to make court decisions that increase the value of the goods and services produced and consumed by society. On the level of individual decision making units, such as households and business firms, efficiency requires that they strive to maximize the value of the resources they own and that households consume those goods and services that make them as well-off as possible given their preferences for alternative goods and services. In both cases, the market prices of goods and services are assumed to be unaffected by the decisions made by individual firms or households.[5]

A special case of the maximize wealth goal is called Pareto optimality.[6] Pareto optimality exists whenever any change in the allocation of resources will result in at least one person being made worse off. A Pareto efficient change or decision is one that makes at least one person better off without making any other person worse off. Although it is obvious that Pareto efficient changes are consistent with the maximize wealth goal, courts and government agencies are rarely presented with the opportunity to make decisions which make one person better off and no one else any worse off. Most cases involve situations where making one person better off involves some other person becoming worse off, and there exists no practical or low cost way of having the "winners" compensate the "losers." Thus, Pareto efficiency has rather limited applicability to the problems generally encountered in environmental economics.

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services produced during some period of time. The maximize wealth goal is broader in that it also considers entities that are not produced during the current period (*e.g.*, a Rembrandt painting) or exist in the natural world (*e.g.*, a redwood forest or a scenic vista). Maximizing GNP, for example, may not maximize the value of the redwood forest because people may value the forest in its natural state more than they value the lumber that could be produced by cutting the forest.

5. This assumption characterizes what economists call a competitive market structure. Where individual economic units believe that they can influence market prices, determining efficient economic policy becomes relatively complex. For the basic theory of such policies, which requires a considerable background in formal economics, *see* Lipsey & Lancaster, *The General Theory of Second Best*, 24 REV. ECON. STUD. 11 (1956).

6. For discussions of Pareto optimality *see* K. LANCASTER, INTRODUCTION TO MODERN MICROECONOMICS 299-300 (2d ed. 1974) *and* J.P. QUIRK, INTERMEDIATE MICROECONOMICS, chs. 13, 17 (1976).

Economists have observed how persons behave under a wide range of economic and social conditions. On the basis of these observations, they have developed a number of theories of the behavior of the managers of business firms, consumers, government administrators, and various types of special interest groups. The theories which are most widely used in environmental economics include the law of diminishing value (the more a person has of a good, the less he values another unit of that good, holding constant the quantities of other goods), the law of rising marginal cost (each additional unit of a good will cost more to produce than the preceeding unit, holding constant the quantities of capital goods used in the production process), the law of mass production (when all factors of production are variable, a larger output can generally be produced at a lower average cost), and the law of substitution (consumers and producers are willing to substitute one good or factor of production for another if their relative prices change). The law of rising marginal cost results from either a rise in the value of the activity that must be reduced when the activity under consideration is increased (thus, this is the reverse of the law of diminishing value) or the law of diminishing returns, which states that the productivity of a variable factor of production (such as labor) falls as more of the variable factor of production is used with fixed amounts of other factors of production (such as capital).

Since economic efficiency involves maximizing the value or minimizing the cost of an activity, it is necessary to measure marginal changes in values and costs when one additional unit of the activity is to be undertaken. If the value of the last (marginal) unit is greater than its (marginal) cost, then it is economically efficient to undertake one more unit of the activity and to make a corresponding reduction in the level of some other activity. There is a reduction in some other activity because resources are always scarce and the budget of every economic decision maker is, therefore, limited. The values and costs involved in these calculations may be measured in terms of dollars or some physical unit, or they may be purely subjective evaluations in the mind of the decision maker. In any event, from the point of view of the decision maker, expanding one activity reduces its marginal value and increases its marginal cost, ultimately leading to the level of the activity where its marginal value equals its marginal cost, at which point an efficient allocation of resources has been obtained and the value of the resources involved is maximized.

When only private goods with uncontested property rights are involved, decision makers can generally make an unambiguous choice between two or more alternative uses of their resources. Economic analysis is based on the assumption that people are rational in that they will choose the alternative that maximizes their well-being; the business decision maker will maximize the firm's profits or wealth, and the government administrator or decision maker for a nonprofit entity will maximize the value of the services provided from their budget. However, where externalities or public goods are involved, the decision making process involves considerable ambiguities with respect to the proper values (benefits) and costs to assign to changes in the level of the activities under consideration.

In his path-breaking article on the analysis of externalities,[7] Coase noted that to prevent person *A* from taking an action that would harm person *B* would have the effect of permitting person *B* to inflict harm on *A*. For example, requiring a rancher to fence in his cattle so they will not eat the crops of a nearby farmer does prevent the rancher from harming (*i.e.*, reducing the wealth) of the farmer; however, requiring the rancher to build the fence is to permit the farmer to impose a wealth loss on the rancher. Clearly, in neither case do we have the opportunity to make a Pareto efficient decision, since someone will be made worse off. Moreover, commonly held views of equity would have us require the rancher to build the fence or give up raising cattle; yet, this is not necessarily the decision that the maximize wealth goal would have us make.

As Coase points out, with several examples drawn from court decisions, the proper principle to use in these cases is that of preventing the greater harm, which amounts to making the decision which maximizes the net economic value of the resources used by the farmer *and* the rancher. If, each year, the cattle were to eat crops with a market value of, say, $500, and erecting and maintaining the fence would cost $800 per year, the greater harm would be imposed on the rancher.[8] Moreover, society would suffer a reduction in the value of its capital, labor, and natural resources

7. Coase, *The Problem of Social Cost*, 1 J.L. ECON. 1, 1–44 (1960). For a summary article on Coase's model presented in terms of standard economic analysis *see* Turvey, *On Divergencies between Social Cost and Private Cost*, 30 ECONOMICA 309 (1963).

8. The structure of this example is simplified to illustrate its essentials. Normally, problems of this type would be subjected to marginal analysis.

since $800 would be expended to eliminate the loss of only $500 in crops; thus, requiring the rancher (or the farmer) to build the fence would be inefficient relative to the maximize wealth goal.

A better solution would be to require the rancher to compensate the farmer for his losses, since that would force the rancher to treat the value of the crops eaten by his cattle as a cost of production. This would force the rancher to recognize the social cost of his production activities as well as the private costs (such as labor, feed, etc.) that he routinely incurs in raising cattle. This is precisely the result that would occur if one person were to own both parcels of land[9] or if the two parties were to bargain with each other under conditions where bargaining costs were zero and the private property of the farmer could not be trespassed upon by the rancher's cattle. Rather than incur a cost of $800, the rancher would be willing to pay the farmer $500 to compensate for the crops that his unfenced cattle would eat. Depending upon the relative bargaining skills of the farmer, he may be able to get more than $500 from the rancher, but no more than $800. However, as practicing lawyers are well aware, bargaining costs, the costs of preparing the contract that results from the bargaining process, and the costs of policing performance of the terms of the contract are not zero and may be substantially greater than the benefits to be obtained from the bargaining process.[10] Finally, given the relatively high cost of bargaining, it may cost the rancher less to buy the farmer's land (or the right to raise crops on the land) at its market value than to incur the cost of the fence.[11]

Any decision to force the rancher to build the fence, to compensate the farmer for crop damage, or to buy the farmer's land is not Pareto efficient. However, from a societal point of view, the fact that one party gains and the other loses is relatively unimportant if the goal is to maximize wealth. What is important is that both parties take into consideration all of the benefits and costs resulting from their activities. Thus, where externalities are concerned, the objective is to develop statutes, administrative

9. This is generally referred to as "internalizing the externality."

10. The costs of bargaining rise at an increasing rate as the number of parties to the bargaining process rises, generally making bargaining impractical where more than a very small number of parties are involved. In addition, there are the strategic bargaining and "free-rider" problems—*see* J. M. BUCHANAN, THE DEMAND AND SUPPLY OF PUBLIC GOODS, ch. 5 (1968).

11. For a discussion of this approach to solving environmental problems posed by externalities *see* T. D. CROCKER & A. J. ROGERS, ENVIRONMENTAL ECONOMICS, chs. 4, 5 (1971).

regulations and court decisions that force persons making decisions with respect to the use of capital, labor, and natural resources to consider all of the costs resulting from the particular decisions that they make. Where the decision involves creation of benefits which the decision maker cannot capture through a market transaction, the objective becomes one of developing institutions that result in the decision maker taking into consideration the benefits to others resulting from his or her decision. If all of the economic costs and benefits of each potential decision are taken into consideration, then the efficient decision which maximizes the value of the capital, labor, and natural resources involved can be determined and put into effect.

Students in the environmental economics class readily accept economic efficiency and the implied maximize wealth goal as reasonable bases for rational economic policy when economic conditions are such that incomes can grow without significant environmental pollution or rapid rates of natural resource depletion. Making the pie as large as possible is unquestionably appealing in a world of scarcity relative to peoples' demands for goods and services. But, like law students, they are also concerned with the distribution of income and wealth—who gets what share of the pie and who is to decide how to divide up the pie. Pointing out that economics has no generally accepted theories of how income or wealth ought to be distributed is hardly satisfactory. Taking the existing distribution of property rights (and thus, income and wealth) as a given generally does not satisfy the students, even when the incentives towards economic efficiency provided by a stable system of guaranteed property rights is explained. Most students seem to believe that relatively high incomes and wealth are the result of immoral or unethical behavior and that people are poor because they are oppressed or, at least, are the product of a deficient social environment. Short of totally abandoning cooperative production activities, there are political solutions to these concerns which require varying degrees of coercion by government. At least the free market system and its dispersal of private property rights allows a substantial degree of individual liberty and minimal governmental coercion.

Analyzing alternative public policy options using the economic efficiency criterion is one of two principal approaches utilized by economists. The second is based on the premise that public policy changes result primarily from political action initiated by those individuals who will benefit. Thus, according to the "public

choice" economists,[12] land-use policies intended to preserve open space or protect public access to beaches do not result from government agencies' seeking efficient use of the nation's resources, but rather from the efforts of some group of individuals to obtain goods collectively at a lower cost than they would be able to obtain them through private purchase. The individuals who will benefit from the public policy change may argue that what they desire will increase economic efficiency and improve the overall quality of life. However, it is pursuit of their narrow self-interest at the expense of the disorganized and ill-informed majority that leads these special interest groups to seek public policy changes. This approach is of value in understanding why particular environmental laws and regulations are proposed and adopted. It is not treated to any significant degree in my course because it does not provide widely accepted standards for making collective decisions about resource use.

III.

CRITIQUES OF ECONOMIC EFFICIENCY AND THE MAXIMIZE WEALTH GOAL

Before discussing the institutional implications of the existence of externalities and social costs where use of the environment is involved, my course digresses into a discussion of whether the maximize wealth goal provides an appropriate basis for social decision making given recent trends in the rate of technological change and the relative prices of capital, labor and natural resources. Based on the experiences of others, I have the impression that law students are as skeptical of economic efficiency and the implied maximize wealth goal as a social decision criterion as are my environmental economics students. To focus their concerns on matters that have a fair degree of relevance for the social decision process, I discuss five general topics drawn from economic history, information theory[13] and philosophy. These topics may be of par-

12. The name "public choice" economists comes from the title of their principal journal, *Public Choice*. A brief statement of the general position of public choice economists is:

> The actions of groups, organizations, communities, nations and societies can best be understood by focusing attention on incentives and actions of the members. When we speak of the goals and actions of the United States, we are really referring to the goals and actions of the *individuals* in the United States . . . group actions are still the results of decisions of individuals.

A. A. ALCHIAN & W. R. ALLEN, UNIVERSITY ECONOMICS at 19 (3d ed. 1972).

13. Information theory essentially involves the study of whether specific data

ticular interest to lawyers wishing to question the general applicability of the maximize wealth goal as the basis for social decision making.

The first topic involves a review of the history of economic thought for discussions of social goals other than the maximize wealth goal. At least two are discernable—(1) the "social justice" goals of such philosophers as Plato, Aristotle and Aquinas, and (2) those of mercantilism. These social goals were not irrational given the economic conditions from the Middle Ages to the middle of the 19th century. They evolved during a period when capital accumulation was virtually nonexistent due to a lack of political security for productive capital. The natural resource base during that time was limited and consisted principally of renewable resources; technical progress was nonexistent or very slow. Thus, economic growth was limited and one person's obtaining more wealth would generally be at the expense of an "unjust" reduction in another person's wealth. With the vast majority of persons living at bare subsistence, a loss of wealth could result in severe deprivation or starvation. Under these conditions, which prevailed until the 1400s, institutions intended to attain the social justice goals of Plato or Aquinas would be reasonable. If our future is to be one of relatively little economic growth, it is possible that social justice goals could become more important than they are at present.

Beginning in the mercantilist period, capital accumulation (made feasible by the greater security for capital in the emerging nation-states and protection of private property rights), vast expansions of the renewable resource base (resulting from exploration and colonization of the New World, Africa and Asia), an increasing rate of technical progress, and greater urbanization combined to permit national income to grow. By the middle of the 19th century, the development of increasingly energy-intensive technologies and expanding use of non-renewable resources led to rising per capita incomes and widespread adoption of the maximize wealth goal as the basis for measuring economic efficiency and developing social policies.

In the 20th century, one person acquiring more wealth need not be at the expense of another's subsistence or wealth. Economic growth has made it possible for everyone to acquire rising amounts of material goods. Much of this economic growth, especially after

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and hypothesized relationships among variables increase the probability that a correct decision or prediction will be made.

1950 when technologies based on high energy use and organic chemistry came into widespread use, was at the expense of the quality of the environment.[14] Moreover, as the value of working time rose with higher real incomes, consumer spending shifted dramatically towards energy intensive durable goods and transportation services, and towards increased use of processed and packaged foods and goods that could be thrown away to avoid spending time on maintenance.[15] The end result of these trends, which were direct implications of pursuing the maximize wealth goal, was deteriorating environmental quality, loss of open space lands around cities, and the creation of widespread hazards to human health and the population of many organisms.

The second topic deals with how the maximize wealth goal has been modified over time to permit adaptation to problems created by economic growth and urbanization/suburbanization and, later, rising levels of pollution and loss of environmental quality. The first major modifications were those of FDR's "New Deal," which were intended to increase economic security in a world where people were becoming increasingly specialized and urbanized, thus becoming increasingly dependent upon the market for their subsistence as well as for the luxuries they were seeking. The second major modification came in the Kennedy/Johnson administrations where there was increasing concern for the plight of low income persons, minorities, working women and consumers. In both of these cases, pursuit of the maximize wealth goal by policy makers was constrained by the perceived need to increase peoples' economic security and enhance the relative income positions of minorities and other special interest groups.[16] Thus, government policies which were aimed at putting our nation's resources to higher valued uses were analyzed with respect to their impact on jobs, low income persons, minorities, etc., and some of the potential net economic benefits to be obtained from directing resources towards higher valued uses were diverted to expanding employment opportunities and providing greater security for retired persons and persons investing in common stock, real estate and other assets.

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14. A required reading for my class on this subject is B. COMMONER, THE CLOSING CIRCLE (1971).

15. A required reading for my class on this subject is S. LINDER, THE HARRIED LEISURE CLASS (1970).

16. Both the "New Deal" and the "New Frontier" of Kennedy and Johnson had their antecedents in the Populist movement, when economic conditions were not yet suitable for these policies.

With the adoption of the National Environmental Policy Act (NEPA)[17] in 1969, pursuit of the maximize wealth goal has been further constrained.[18] Prior to the enactment of NEPA, economists making benefit/cost studies had been estimating the economic value of some of the environmental impacts of water resource development projects.[19] These benefit/cost estimates were necessarily arbitrary and subject to considerable controversy and litigation. NEPA handled this problem by requiring that an environmental impact statement (EIS) be prepared, that the decision maker study the EIS, and that trade-offs between net economic benefits and environmental impacts be considered. The environmental impacts need not be quantified in terms of dollar values, and no specific weighting system for trading off estimated net economic benefits against potential reductions in environmental quality was imposed by NEPA. Courts have recognized the essentially political nature of the decision process created by NEPA and limit their review to procedural matters.[20] Under NEPA, capital, labor, land, and other natural resources that could be used to increase the value of the nation's output of goods and services may be used to increase the quality of the environment or, in the case of some natural resources, not used at all.

The third topic involves consideration of the role played by the rising costs of obtaining information about the nature, extent, and danger of environmental pollution from existing and future technologies. Economics, like the physical sciences, makes extensive use of partial equilibrium analysis, where all but a few of the relevant variables are held constant. The behavior of the system when the remaining variables are changed is then studied and policies to improve the functioning of the system are developed. This approach has led to great advances in scientific knowledge, but is it appropriate where highly complex ecological and human systems are involved and information about them is gained through

17. National Environmental Policy Act of 1969, Pub. L. No. 91-190 § 102, 83 Stat. 852 (1970).

18. For more on the use of constraints to make the maximize wealth goal more politically acceptable as economic conditions have changed *see* R. F. Rooney, *Economics for America's Third Century*, in THE ECONOMICS OF AMERICA'S THIRD CENTURY: A DISCUSSION (R. F. Rooney, M. B. Johnson & W. R. Allen eds. 1978).

19. For an extended discussion of benefit/cost analysis prior to NEPA, *see* Prest & Turvey, *Cost-Benefit Analysis: A Survey*, 75 ECON. J. 683 (1965). For a discussion of benefit/cost studies since NEPA, *see* A. SCHNAIBERG, THE ENVIRONMENT, ch. 7 (1980).

20. *See e.g.*, Calvert Cliffs v. AEC, 449 F. 2d 1109 (D.C. Cir. 1971).

observing behavior? The answer may have been a qualified "yes" when human populations were much smaller than they are today and technologies were based on naturally occurring, renewable resources. The natural ecological system could absorb and adapt to the demands placed upon it by humans under those conditions. There was little need for humans to incur the costs of obtaining a great deal of information about how their technologies and population levels might impact the natural systems. Moreover, three centuries ago, when humans first began to apply the scientific method to attempt to expand their ability to produce goods and services, the ability of the natural system to adapt to whatever humans might do was very great. Hence, there was little need for a social or legal system that regulated new technologies, or was concerned with rights to use the environment as a place to dispose of wastes or appropriate natural resources over which no one had asserted a claim.

As human population grew, energy and resource intensive technologies were developed and widely applied. Wastes that were toxic and non-biodegradeable were created and spread throughout much of the world's eco-system. The activities of humans began to be capable of making substantial and possibly irreversible changes in the world's eco-system. In effect, the eco-system became less able to adapt to human activities and maintain the rough stability inherent in diverse biological systems. At this point, which probably was reached around 1900 and certainly was reached by 1950, social institutions and the legal system were forced to begin to adapt to the potential for harm inherent in modern technologies, particularly those based on petroleum and nuclear reactions. In order for these institutions to adapt to the realities of modern technologies and increasingly interdependent and complex production activities in such a way as to avoid inflicting harm on humans or destabilizing the natural eco-system, greater amounts of information about the potential impact of these technologies is necessary. This led to two major problems for decision makers.[21]

First, obtaining information about the potential environmental impacts of an existing or new technology is not free, as anyone who has come into close contact with the preparation of an EIS is well aware. Reviews of the scientific literature, the new primary information that has to be gathered, the new experiments that

21. For an extended discussion of these two problems *see* C. W. CHURCHMAN, CHALLENGE TO REASON (1968).

have to be performed, and the analysis of this information is expensive and time consuming and requires considerable expertise. Moreover, because of the expense of gathering this information, some of the information about the impacts of the technology may be ignored, and some of the experiments that would add to our knowledge of potential impacts are not performed. Worse yet, our scientific knowledge relating to the potential impacts of the technology may not be great enough for us to know what information to gather or which experiments to perform. The result is that we permit the use of technologies that are profitable and consistent with the maximize wealth goal, yet have potential environmental impacts that we may not understand. Thus, we perform "grand social experiments" on ourselves which may have irreversible and disastrous results.[22]

Second, we may be pursuing the wrong goals and thus evaluating our technologies, social institutions, and legal systems using goals that are dangerously narrow or out of date with respect to present day technologies and highly interdependent economic systems. That is, the goals which we use to judge the efficiency of various alternatives may be such that when we think we are improving the performance of the system, we are in fact destabilizing the system or reducing its efficiency. For example, to solve the so-called energy crisis, the Federal government may promote expansion of nuclear power plants that could possibly kill or maim many humans and other organisms and render large areas of the earth uninhabitable. Given the inherent dangers of the nuclear power system, maintaining or increasing energy production may be the wrong goal. The maximize wealth goal may be the wrong goal because it encourages the use of non-renewable energy resources such as petroleum. However, determining which goals are appropriate for evaluating technological alternatives with potentially serious environmental impacts requires a great deal of information, possibly so much information that a very substantial proportion of the nation's gross national product would have to be allocated to information gathering and processing. Would our economic and political system be willing to allocate substantially more of its capital and labor resources to such an activity in light of the necessary reduction in living standards that would result and the likelihood that information crucial to determining appropriate

22. *See* Arrow & Fisher, *Environmental Preservation, Uncertainty, and Irreversibility*, 88 Q.J. ECON. 312 (1974).

goals may be overlooked or not gathered? This is a very fundamental issue, and one that economists and legal scholars and practitioners will have to grapple with in the foreseeable future.

The fourth topic is closely related to the last point. It addresses how human beings develop and institutionalize social goals that ultimately come to define rational behavior. Contemporary economic theory is based on empirical observations of the behavior of persons. However, empirical studies of how people behave leave the analyst totally uninformed about the reasons *why* people behave in the observed manner. For example, since the maximize wealth goal—together with various politically imposed constraints —has been guiding economic policy decisions and the decisions of private persons for more than a century, many people have come to view behavior that is consistent with that goal as being rational. This goal is the only context within which they have made decisions, and for the most part those decisions have worked out well because they resulted in sustained and historically unprecedented economic growth. Yet as Marcuse points out,[23] focusing on the behavior of persons responding to a long-held or strongly-held social goal obscures the issue of whether the maxiize wealth goal is itself rational. Making such a determination requires a theory of society and its historical development in response to changes in a wide range of economic, technological, sociological, political, ecological and geological factors. This leads to the kind of philosophical inquiry that dates back to at least Plato's *Republic*.

The fifth topic concerns the basis of the charge that environmentalists are elitists who wish to impose their values on society. Environmentalists believe that the vast majority of people do not understand the potential impacts of their actions on the quality of life and on future generations. They feel that society does not place a high enough value on maintaining a clean environment and protecting essentially natural areas from exploitation. People have strong preferences for private goods in hand relative to public goods and actions that may not yield benefits for many years or are relatively intangible with respect to their lives. Hence, benefit/cost analysis of policies to protect the environment will understate the benefits and overstate the costs, since virtually all of the costs generally involve giving up tangible private goods or the resources necessary to produce them. The environmentalists, thus, appeal

23. *See* H. MARCUSE, ONE-DIMENSIONAL MAN, chs. 4, 7 (1964).

to people to accept the judgments of scientists as to whether a particular natural resource or polluting product should be used. Prior to NEPA, the principal determinant of whether a resource or product would be used was its value resulting from the interaction of market demand and supply.

The principal conclusion of this part of the course is that there may be good reason to challenge the maximize wealth goal as the principal basis for determining whether a particular legal decision involving impacts on human health, the stability of the eco-system or the use of non-renewable resources is efficient (or rational). Pursuing economic efficiency, even as it is constrained by NEPA and other environmental legislation, may lead to permitting "grand social experiments" and detrimental irreversible outcomes that could have been avoided had some other societal goal been used to evaluate the desirability of particular decisions. However, lest the reader get the wrong impression, immediate abandoning of economic efficiency as a criterion for social decision making is not being advocated. What is pointed out repeatedly to the students is that unthinking acceptance of economic efficiency as the basis for decision making may be irrational. They should be receptive to considering alternative theories of cooperative human behavior that appear to be more rational given the likely future environment within which our society must operate. They should also keep in mind that many politically powerful persons have vested interests in the present system and may view any change in societal goals as sufficiently threatening that they will do their utmost to use the legal system to maintain the maximize wealth goal as the basic criterion for social decision making.

IV.

PUBLIC GOODS AND RELATED CONCEPTS

Once the students have a reasonably good understanding of the concept of economic efficiency and the nature of the maximize wealth goal that it implies, the class discussion shifts towards consideration of (1) the nature and implications of the existence of public goods and transactions costs, and (2) the kinds of public policy options that are available to solve the problems resulting from the existence of public goods and transactions costs. These issues appear, from the other papers in this issue, to make up the bulk of the law and economics courses taught by the authors.

Since my environmental economics course does not treat the specifics of the institutional and legal relationships that have evolved during recent years, I will only discuss the broad concepts and issues involved.

Public goods have two essential characteristics. The first is that they are jointly supplied to two or more persons, which means that one person can use the public good without reducing the amount of the public good that is available to other persons. The air and bodies of water are examples of public goods so long as they are not polluted. A freeway or a mountain trail are public goods so long as they are not congested. Where emissions of pollutants or congestion are involved, what one person does affects the ability of other persons to use the public good. The legal system generally creates some kinds of rights with respect to the use of a public good, with existing users often being "grandfathered" and having different rights than persons wishing to use the public good for the first time.

The second characteristic involves the costs of excluding others from use of the public good. Some public goods, such as a sports attraction, are privately owned because the costs of excluding people who do not buy tickets are low relative to the ticket price. The public goods that are of major significance for environmental quality, however, generally have the characteristic that excluding other persons from using them is expensive relative to the value of the public good to its owner or any potential owner. Moreover, the value of the public good may change over time relative to the cost of excluding persons from its use, giving rise to various problems associated with unambiguously defining property rights. For example, the owner of a parcel of land between a public road and the beach may leave the land undeveloped for many years because there is insufficient demand for its use to warrant spending the money to fence it or place buildings on it. However, if demand increases to the point that the owner finds it profitable to exclude others from crossing it or to build a building that blocks views of the ocean from the road, other persons are excluded from using what was previously a public good. When landowners, in particular, attempt to assert their ownership of public goods such as open space or airspace affecting scenic vistas, there may be considerable political opposition and legal challenges to the right of the property owner to modify or eliminate public access to or enjoyment of what was previously a public good.

In principle, economic analysis can be used to determine whether

the assertion of some level of governmental control over use of the public good is efficient relative to the maximize wealth goal. Government control takes three principal forms: Restricting the property rights of owners through such devices as zoning, building and health codes, or development permits; regulating the use of property through pollutant emissions standards, noise standards, and other rules; and taxing the users of public goods or requiring the purchase of what amounts to admission tickets. For example, economic analysis can be used to determine whether, in a particular case, it would be more efficient to reduce air pollution by applying a tax to each pound of sulfur dioxide emitted per hour or by regulating the use of fuels that contain sulfur compounds. The approach used by economists is to estimate the total benefits and costs from various types and levels of governmental control, with the type and level of control yielding the greatest benefits net of costs being the most efficient.

Although several examples of the principles used in making these calculations are provided in the environmental economics course, my emphasis is more on the problems and inherent limitations of these calculations than on the mechanics of the calculations, which are best left to a course in benefit/cost analysis. The principal limitation comes from the inherent nature of public goods. Since there is no market where public goods are bought and sold, there is no objective way to determine the value of the public good. How do we determine the value of a day of fly fishing on a wild river or waterskiing on a reservoir? What is cleaner air worth to someone living or working in a polluted area? Since people do not buy or sell public goods, the value they place on another unit of such goods is not revealed to the analyst. Opinion surveys are unlikely to reveal such values for a number of reasons, with the most important probably being overstatement of the value if the respondent does not bear part of the costs of the government control, and understatement of the value if he does. Also, the respondent is unlikely to give as much thought and consideration to his decision if he is valuing a public good rather than a private good which he must buy if he is to enjoy it. This inability to determine objectively values and costs where public goods are involved can lead to expensive and time-consuming litigation that can so reduce the value of the public good that the owner may abandon his attempt to appropriate the right to use it.

Since the persons benefiting from appropriating a public good generally are different from the persons who bear the cost of its

appropriation, the problem of whether the "winners" should compensate the "losers" arises.[24] Although it may seem ethically or morally proper for the winners to compensate the losers, several problems arise. How do we determine how much is gained or lost by someone appropriating a previously public good? How do we determine who are the winners and the losers? How are the costs of a legal action to be shared so that the "free-rider"[25] problem can be avoided?[26] Economists have generally ignored these problems or pleaded that economic efficiency only requires that total benefits exceed total costs and that economic analysis provides no principles for determining who should get what share of the pie. Students in the class generally believe that some sort of compensation should be paid.

Environmental pollution and the appropriation of what were previously public goods are special cases of what economists call "market failure." Market failure exists whenever normal functioning of the market does not result in maximizing the value of the nation's capital, labor and natural resources. The usual response to alleged market failures is for government to take action to alleviate the loss of economic efficiency. However, recent studies have come to the conclusion that attempting to relieve market failure can result in government failure.[27] Government failure results when the costs of government action (or legal actions brought in the courts by private persons) are greater than the benefits to be obtained through relieving the results of market failure. Its principal source, according to the "public choice" economists, is to be found in the nature of the voting rules used to make governmental decisions and the (generally rational) ignorance of voters with respect to issues that they perceive to have little or no impact on their personal lives. Thus, public choices are made that yield significant positive benefits to a relatively small number of people at the expense of substantially greater total costs borne at virtually subliminal levels by a large number of people.

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24. *See* Peskin, *Environmental Policy and the Distribution of Benefits and Costs,* in CURRENT ISSUES IN U.S. ENVIRONMENTAL POLICY (P. Portney ed. 1978).

25. A free-rider benefits from a change in resource use giving rise to an external benefit, but bears none, or a less than proportionate share, of the resulting costs.

26. Class action suits and special taxing districts for fire protection or the maintenance of rural roads are examples of institutions that reduce the undesirable effects of the free-rider problem.

27. *See* W. C. MITCHELL, THE ANATOMY OF PUBLIC FAILURE: A PUBLIC CHOICE PERSPECTIVE (1978).

Because of the virtually insurmountable difficulties of determining the value of public goods to the several parties involved, possibilities for government failure may be relatively great where environmental problems are involved. This does not mean that we should cease trying to solve environmental problems through government or private legal actions, but rather that considerable care should be taken to determine if government failure is likely.

V.

FUTURE GOALS FOR MEASURING ECONOMIC EFFICIENCY

In recent years there has been considerable discussion of whether there exist limits to economic growth as we measure it today.[28] Although this issue is one of the principal topics of a course in natural resource economics, the limits to growth issue is briefly discussed in the environmental economics course for two reasons. The first is that reducing rising environmental pollution imposes increasing costs on the industrial, agricultural, and transportation sectors of the economy as they grow larger. At some point, the portion of these environmental costs borne by the producers of goods and services may become great enough to exceed the value of further expansion, or government may find it politically expedient to adopt policies that reduce economic growth when it results in politically unacceptable losses in environmental quality. Law suits brought under environmental protection legislation are, of course, one way to make the costs of further economic growth apparent to the involved decision makers.

Technical progress in reducing environmental pollution, resulting from decision makers being forced to recognize the costs of the environmental pollution they cause, can put this limit to economic growth further off in the future; however, scientists are doubtful that it can be put off indefinitely. The reason is to be found in the "increasing entropy law" of physics which implies that the ability of the environment to provide additional amounts of goods and services must decline over time unless increasingly

28. Although only resource depletion and environmental pollution are discussed in this section, there are many other reasons for declining economic growth in recent years. Besides those discussed in D. MEADOWS *et. al.*, THE LIMITS TO GROWTH (1972), there are inflation, taxation of incomes and capital, and increasingly widespread and burdensome government regulation. *See also* Haveman & Smith, *Investment, Inflation, Unemployment and the Environment*, in CURRENT ISSUES IN U.S. ENVIRONMENTAL POLICY, *supra* note 24.

greater amounts of energy are used. When fossil-fuel energy resources were generally available at constant or declining costs and there was the promise of low cost nuclear energy, the increasing entropy law was of little economic significance. Excellent examples are provided by the mineral extraction industries where lower grade deposits became economic to exploit as energy (and capital) intensive technologies were developed to exploit them. However, with energy costs rising significantly in recent years and relatively low cost nuclear energy unlikely to materialize, our ability to reduce the effects of rising environmental pollution, natural resource depletion, and top-soil erosion on economic growth becomes increasingly doubtful.[29] Although virtually all economists are still convinced that increased economic growth is both possible and desirable, greater numbers of people are coming to doubt it.

This leads to the last topic considered in my environmental economics course. If the rising cost of capital, energy and other natural resources, relative to the cost of labor, continues into the future, as it has since about 1970, will economic growth resulting from rising labor productivity be feasible? My conclusion and that of a growing number of economists is that the prospects for significant economic growth during the remainder of this century are relatively dim. Given that this is a reasonable hypothesis that comes to be accepted by a majority of Americans, does this imply that the maximize wealth goal—even as it has been constrained in recent decades—will no longer be an acceptable basis for economic policy and legal decisions? The answer appears to be "yes."

Several recent books by economists address this issue. The two that I use in my course are *The Steady State Economy* by Herman Daly[30] and *Small is Beautiful* by E. F. Schumacher.[31] Daly primarily focuses on the increasing entropy law and its implications for economic policy. He proposes that our society adopt minimizing entropy as its goal, which implies that we shift away from our present reliance on nonrenewable resources and develop institutions that limit population. Schumacher proposes that we consider adopting the goal of what he calls "Buddhist economics." With Buddhist economics, society's goal would be "to obtain the

29. For an alternative position, based on the availability of relatively low cost nuclear energy, *see* Goeller & Weinberg, *The Age of Substitutability,* 191 SCIENCE 683 (1976).

30. H. DALY, STEADY STATE ECONOMICS (1978).

31. E.F. SCHUMACHER, SMALL IS BEAUTIFUL: ECONOMICS AS IF PEOPLE MATTERED (1973).

maximum of well-being with the minimum of consumption."[32] This goal contrasts sharply with the maximize wealth goal since Buddhist economics "tries to maximize human satisfaction by the optimal pattern of consumption, while the latter (the maximize wealth goal) tries to maximize consumption by the optimal pattern of productive effort."[33] In both cases, the authors view the shift towards a new social goal to guide economic policy and legal decisions as an evolutionary process in response to the realities of contemporary technologies and rising capital, energy and natural resource costs.

The students generally find this discussion of alternative social goals to be among the most interesting in the course. If, in fact, there will be an evolutionary shift towards new social goals, legal scholars and practitioners will be in the forefront—just as they were in increasing our society's awareness of environmental problems and their potential solutions. The kinds of cases that are litigated, the scientific and other information that is used in resolving the cases, and the publicity of new ways to solve the economic, environmental and equity problems that will arise will be important determinants of the speed and direction of society's adaptive processes. Trends in legal decisions will influence the direction of legislation and bring the issues that appear to be most important to the attention of legislators. Economists will be stimulated to rethink their policy recommendations and to develop the best policy alternatives for attaining the emerging new goals. All of this must be done with due regard for the institutional stability inherent in decisions based on precedent and private property rights. Thus, the overall objective of the environmental economics course is to make the student aware of the complexities of the problems facing our society and the importance of maintaining a free, open society where all points of view are given their day in court and change can result from democratic adaptation.

32. *Id.* at 54.
33. *Id.* at 55.