GREAT LAKES FISHERY COMMISSION

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Unrevealed Economic Values of Ecosystem Management

by:

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UNREVEALED ECONOMIC VALUES OF ECOSYSTEM MANAGEMENT

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EXECUTIVE SUMMARY

In the 1960's people noticed that the quality of the Great Lakes environment was rapidly deteriorating. Lake Erie was even "dying." By the 1970's, in response to public demand, the U.S. and Canadian governments began multi-billion dollar programs to reverse this trend.

As part of a Great Lakes Fishery Commission study of the feasibility of rehabilitating Great Lakes ecosystems, economists noticed that part of the benefit/cost equation for rehabilitation seemed to be missing (Francis, et al, 1979). Although the public seemed clearly willing to pay the cost of rehabilitation, the benefits of all the uses barely matched the cost. Non-use values were missing, whereas many felt that they should be substantial in these cases.

Since economists had just begun to develop theories of non-use, or "unrevealed," values, the GLFC's Board of Technical Experts asked a small group of economists to investigate the theory and practicality of estimating unrevealed values for use in evaluating such choices. This document reports the group's findings.

The group concluded that economic theory could rigorously support the notion that several kinds of demands or values may leave little or no observable evidence in our economic system, and that at least three of them could be relevant in ecosystem rehabilitation: existence value, option value and quasi-option value. We also concluded that techniques were now being developed that would likely provide reasonably acceptable estimates of existence and option values.

Non-market values are values of resources or resource uses that are not explicitly bought or sold, so the values are not explicitly established in any markets. However, non-market values can often be deduced by observing money or time expenditures associated with the resource uses. For example, preferences for living in clean vs polluted air can sometimes be deduced from housing prices.

Unrevealed values are a peculiar subset of non-market values. Consumers normally have no choice about unrevealed values. They receive these positive or negative values whether they want them or not, without allocating any money, time, travel or other

resources. With or without the good the consumer's external behavior is exactly the same. Therefore, we cannot expect normal consumer choices to reveal consumer preferences in these cases.

Existence value may be defined as the value of knowledge of the existence of a good, apart from any use of the good. The demand for existence of unique, irreplaceable goods--like the existence of a "healthy" Lake Erie--may be measured in terms of aggregate willingness to pay (or willingness to sell) purely for their existence.

Option value is the value of an option that keeps available the possible future use of a resource, apart from the expected future value of using the resource. Option "price"--the expected value of future use plus option value--is much like the price of insurance. For insurance, we pay the expected value of future losses plus an additional sum representing our willingness to pay for risk reduction. The value of ecosystem rehabilitation may be greater than the value of expected future use if the rehabilitation gives people more confidence in the future availability of that use. The value of the increased confidence is option value.

Quasi-option value is the value of information gained by delaying an irreversible decision. This value is observable ex post facto, so it is not truely unrevealed. Our evaluation of quasi-option value was limited to separating it conceptually from option value. However, it could be an important factor in ecosystem rehabilitation decisions.

Existence and option values may be estimated through carefully thought out bidding games--"contingent valuation" techniques. Research comparing contingent valuation with actual willingness to pay or to sell shows that these techniques can give consistent, although usually biased, results. These biased appear to be correctable.

Another technique, experimental economics, should help varify economic theories about consumer behavior, including the relatively new theories of unrevealed values. Experimental economics observes economic behavior in laboratory situations.

The group agreed that existence values could be a large component of the benefits or costs of choices like ecosystem rehabilitation. Option value, judging by the insurance market, is probably limited in size to a small fraction of other values.

PREFACE AND ACKNOWLEDGEMENTS

This study was part of a larger study of the feasibility of Great Lakes ecosystem rehabilitation conducted by the Great Lakes Fishery Commission. The first phase of that study was lead by George R. Francis, John J. Magnuson, Henry A. Regier and Daniel R. Talhelm, and involved over fifty close cooperators from 1977 through 1979 (Francis, et al, 1979). The second phase was lead by those four and Hallett J. (Bud) Harris, and involved many additional dozens of cooperators (Harris, et al, 1982). This study was included as part of the second phase because these values were one of the major information "gaps" encountered during the general systems analysis of phase one. Henry Regier deserves to be recognized as the intellectual architect of the ecosystem rehabilitation effort. His leadership provided the primary inspiration for this study as well. His vision of broadly interdisciplinary cooperation in solving major problems has been one of the major forces that have made it possible for social scientists to effectively contribute to the GLFC's mission.

This economic study was simple and inexpensive. No data were collected. Yet we made considerable progress in developing the theoretical and methodological frameworks for unrevealed values. At least five scientific papers have already been published, and considerable further work may have been stimulated. Option value had already been established in the literature, but it was still not clearly defined and was confused with several other ideas about values. Existence value and option value now seem established as standard fare for resource economists, in part because of this study.

This study was lead by Talhelm, Richard C. Bishop, Lawrence W. Libby, Kenneth E. McConnell, and Alan Randall. A. Allan Schmid also helped in the initial stages. Workshop participants included all of these except Schmid, plus Peter Bohm, John Hof, Rebecca Johnson, Karl-Goran Maler, Charles Plott, Douglas Rae, John Rosenthal, V. Kerry Smith, Anne Thomas (Fisher), and Peter Victor. Thomas helped organize the workshop. A short follow-up session was held in October, 1981, attended by Bishop, Johnson, Libby, McConnell, Randall and Talhelm.

I. ORIGINS AND PURPOSE OF THIS STUDY

GREAT LAKES ECOSYSTEM REHABILITATION FEASIBILITY STUDY

The Great Lakes have suffered a succession of degrading assaults, continuing for over 100 years. Pollution, habitat destruction, toxic contamination, species extinctions and introductions of undesirable exotic species have drastically altered large components of the ecosystem. By the 1970's people seriously feared that Lake Erie was "dying" and that many people would suffer toxic poisoning.

This trend has now been largely reversed, at a cost of billions of dollars.

What seems amazing is that most of these assaults were side effects of activities carried out for other purposes. The Great Lakes were an open resource, providing a cheap input for abusive economic activities. Now we have found that we must pay to "clean up the mess." It even seems desirable to rehabilitate entire ecosystems. We have also found that we must change the institutions that have permitted these abuses in the first place. This means that we must pay more to use the resources, just to keep from harming the environment (ie, we must incur greater expenses in conducting our economic activities).

This situation prompted this study. In 1977, the Great Lakes Fishery Commission (GLFC) began a feasibility study of rehabilitating ecosystems as a whole, rather than by just considering a component at a time (see Francis, et al, 1979 and Harris, et al, 1982). As a part of that study, Talhelm, Bishop and others very roughly estimated the current, observable costs and benefits of water pollution control for the Great Lakes (Francis, op cit.). Because of the clearly observable public support for "cleaning up" the Great Lakes, they expected to be able to show that the benefits were greater than the costs. To their surprise they found that observable benefits (including recreation, water supply and other benefits) were, at most, in the same "ballpark" as known costs. They concluded that either (1) their estimates of benefits were too low, (2) that the political process was misreading the public benefits of pollution control, or, more likely, (3) that a significant portion of the benefits were not derived from a observable uses of the lakes.

If the later is true, economists may be overlooking some of the benefits and costs of pollution control and other decisions affecting the environment. For example, the overwhelming, world-wide support for "saving" Lake Erie suggests that many people are willing to pay for the assurance that the lake will continue to exist in a "healthy" state, even though they may never intend to visit or otherwise "use" the lake. Since benefits are measured in terms of willingness to pay, total benefits of pollution control will be understated if we follow the usual practice of only measuring the willingness of users to pay.

Since the goal of economic assessment of choices is to objectively weigh the advantages and disadvantages of choices in terms of benefits and costs, including non-market benefits and costs, our economic assessment of ecosystem rehabilitation strategies would be incomplete. Therefore, a part of the second,

more detailed rehabilitation feasibility studies included a provision to investigate the theory and practicality of estimating "unrevealed" values: social values that cannot be estimated by observing only users or transactions of some kind.

UNREVEALED VALUES CONFERENCE

Economists have long recognized the problem of estimating values of goods not traded in markets. However, only in the last 25 years have methods been developed for doing so, beginning with the problem of estimating the values of outdoor recreation. It turns out that recreation consumer choices are not much different than consumer choices for market goods. A variety of recreation "products" are available to the consumer at various "prices," where the prices consist of travel and other use costs borne by the consumer. Once we define the products and consumer prices, demand and supply can be estimated with standard econometric techniques. Demand and supply equations permit us to estimate resource use benefits in terms of willingness to pay for use, and costs of lost resource use in terms of willingness to accept compensation for lost use privileges. Other techniques were developed to estimate willingness to pay and willingness to accept more directly through bidding games ("contingent valuation").

However, values that could not be deduced by observing consumer choices had received little attention. By 1981 economists had written a few articles about the possibility of option values. Existence values, bequest values and related possible values had been little more than suggested. Contingent valuation seemed the most likely measurement technique, although many economists were skeptical about ever prefecting the technique. Therefore, a workshop seemed an appropriate first step (Talhelm, et al, 1980).

A workshop was held in June, 1981, to consider the nature of unrevealed values, possibilities for measurement, and their possible roles in resource management choices. The workshop was organized by Talhelm, Bishop, Libby, McConnell, Schmid and ~~Fisher~~. Thome A small number of other economists were invited (see Acknowledgements). Papers were presented by Bishop, Bohm, Maler, McConnell, Plott, Smith, Randall and Talhelm. A summary is presented in section III. At least six papers have been published as a result of this effort (see Appendix).

PURPOSE OF THIS DOCUMENT

This document reports the results of this investigation to the Great Lakes Fishery Commission and the wider Great Lakes management and research community. Section II provides an overview of our conclusions on unrevealed values and the implications of these values for ecosystem management. The section begins with an explanation of the role of economic information in ecosystem management decision making, then goes on to provide a taxonomy of unrevealed values, explain what we can deduce about their sign and magnitude, and explain how to include them in weighing the advantages and disadvantages of management choices. Section III reviews in more detail the findings of the workshop. Section IV provides general recommendations. The Appendix contains a reprint of a paper by Talhelm that provides a

more technical review of unrevealed values, and abstracts of ~~six~~ other workshop-related technical papers on various aspects of unrevealed values. The ~~six~~ papers were not included here due to their length, but most are published and all are available from the GLFC.

II. OVERVIEW

IMPLICIT AND EXPLICIT ECONOMICS OF ECOSYSTEM MANAGEMENT DECISIONS

Occasionally economists are asked what, if anything, economics might have that could possibly contribute to "technical" subjects like fish and wildlife population management or ecosystem rehabilitation. "Oh," the question continues, "I can see why economists might be involved in commercial fisheries, I have seen surveys of angler and hunter expenditures, and I know management costs money...but those are only superficial to technical problems like ecosystem rehabilitation. What could a social scientist add that would really help much?"

The answer lies in realizing that **any** choice made by humans is a **social** choice. Therefore, any human choice is a social science subject.

If we claim to be rational, then our choices must be based on some assessment of the advantages and disadvantages of the choice. Further, since it is a human choice, the rationale must ultimately assess the advantages and disadvantages to **humans.** Broadly defined, this is the subject of economics. It is particularly interesting to economists if the choice involves any market or non-market goods or services, including environmental goods or services. The choice may also involve an assessment of the effects of the choice on animal populations or on ecosystem functions, and this is the interest of biologists and ecologists. Ultimately, however, any decision becomes a choice of whether or not people will realize a net advantage if they carry out some action.

The goods or services may be spent or received by one individual purely in his/her own behalf, by a collection of individuals, or obligated by individuals acting on behalf of others. The latter is of particular interest here, because agencies like the GLFC must implicitly or explicitly evaluate the advantages and disadvantages to their constituents of the agency's decisions. The role of economists in this case would be to assist the decision making process by providing an objective assessment of the advantages and disadvantages to the public of difficult choices. If all the advantages and disadvantages could be expressed in a common denominator we are all familiar with--costs and benefits--that would help even more.

Economists would like to be able to objectively assess all the human advantages and disadvantages of choices like rehabilitating ecosystems, expressed conveniently in terms of benefits and costs. However, economic theory and technology are not yet capable of this task. Even if it were possible, we would probably find it to our advantage to limit the role of economic evaluation to providing informational guideposts, rather than incurring the cost and delay of obtaining complete certainty for every question.

The point is that decisions of public agencies like the GLFC are social choices made on behalf of their constituents. Decisions about the budget and scope of the GLFC are also public choices, but usually broader in scope and context. Objective economic assessments could benefit the public by improving the ability of decision makers to determine which actions are in the best interests of the public and which are not.

Environmental decisions are typically based only on implicit evaluations of public benefits and costs. Even decision makers may not think of their actions in benefit/cost terms. Instead they probably often decide on the basis of "gut feelings" for what is in "the best public interest" or for what is "best for the resource." Objective assessments would clarify the choice, give the decision maker more insight into public values and increase accountability.

For instance, the generic decision to rehabilitate lake trout populations in the Great Lakes has become part of the mission of the GLFC. That decision was based on some collective judgement about the desirability to the public of rehabilitation and the liklihood of success at a reasonable cost. In other words, an implicit benefit/cost analysis. Once that decision was made, smaller implementation decisions can be made without reevaluating the rehabilitation question. However, implimentation is implicitly constrained to stay within reasonable costs and within a justifiable, explicit budget. Further, it is constrained to produce a rehabilitated fishery that is worth the cost. Suppose lake trout could be rehabilitated only if there were never any harvest because all the fish were needed for natural reproduction, or suppose that for some reason all natural lake trout turn out to be contaminated; unfit for human consumption. Under such conditions, it is unlikely that the public benefits would be high enough for the public to support an expensive rehabilitation program. In fact, with the success of put-grow-and-take stocking of lake trout and salmon, the desirability of relying on natural reproduction (ie, rehabilitation) may have diminished. If so, the benefits may now be less than they were in the original evaluation.

SCIENTIFIC ECONOMICS

If human values are subjective, unique to each individual, and, in the case of environmental "goods," not even visualized by the individual in monetary terms, how can economists provide an objective, "scientific" estimate of social benefits and costs?

Economic science rests on the assumption that individual choices are rationally-considered expressions of preferences of the individual at that point in time, under given income and other constraints and expectations. In other words, economists assume that the individual knows his/her preferences and that those preferences are revealed through observable choices, such as purchases in a market, or working for wages. Recent work has extended "observable choices" to also include elicitable choices: We can ask people how they would respond to hypothetical choices.

This assumption about revealed preferences makes it unnecessary to probe into the psychological makeup of individual preferences. We simply accept that the individual is the best judge of his/her preferences. Further, we assume that social preferences are the simple aggregate of individual preferences.

Under these assumptions, if we observe that 50,000 pounds of perch fillets will be sold per day at $4.00 per pound, we can conclude that consumers find those perch fillets to be the most

valuable use for $200,000 per day, compared to all other possible purchases with that sum.

Generally, individuals will agree to any voluntary trade of one good for another if he/she expects to be better off in some respect after the trade. Because money is a surrogate for all market goods and services, a sale or purchase is a more general form of a trade of one good for another. In other words, whenever we buy or sell something, we are chosing between that thing and all other things we can purchase with the money. Both willingness to pay for (purchase) something and willingness to sell something (ie, willingness to accept compensation to give it up) are measures of preferences. By aggregating these observations across all individuals we have a clear, **objective** expression of social preferences or values, under existing conditions of income distribution, rig and ru

Benefit/cost analysis is modeled on this principle. We can think of benefits as willingness to pay for the project, and costs as willingness to accept compensation for producing and/or tolerating the project. If benefits exceed costs, and if we have accurately counted all the benefits and costs, we can objectively conclude that people, in aggregate, prefer the project. We can also say that it passes the compensation test: Everyone who must give up something could be adequately compensated, such that they--by their own evaluation--would be no worse off with or without the project, and yet benefits would be left over. No one would be worse off, and one or more people would be better off: a clear gain in aggregate.

In reality, people are not always adequately compensated for loses caused by other people. Benefit/cost analysis merely asks whether they could be.

EXTRAMARKET VALUES

Many in conservation circles do not trust benefit/cost analysis to accurately count all the benefits and costs. It is obvious to them that the values of some things affected by some projects are not easily measured. Many environmental "goods and services" are, by necessity and/or tradition, not traded in markets. Public values for these goods and services are not readily observable. Unless we can find ways of objectively estimating such values on the same terms as other values, our benefit/cost calculus will be incomplete.

Conservationists easily cite cases in which environmental values were left out of benefit/cost analyses, either knowingly--for lack of information--or unknowingly. This lack of information is particularly obvious for environmental projects like ecosystem rehabilitation. How do we count all the values of "saving" Lake Erie?

While economists have long recognized the problem of estimating willingness to pay and/or willingness to sell for non-market (or "extramarket") goods and services, they only recently have found objective ways of estimating many of them. In most cases we can find some way in which people must trade market goods and services for non-market goods and services. Recreation participation, for example, costs time and money even if if the participant does not have to purchase the use of the recreation resource. We can

deduce from consumer behavior in such cases how willing they would be to trade market goods for non-market goods if necessary.

Many procedures like this have been developed to estimate surrogate values for different kinds of non-market goods and services. Some are more successful than others. Even direct observations of market data are imperfect and must sometimes be modified because government and other institutions distort consumer and producer choices in various ways and degrees. Many books describe the overall principles and problems of benefit/cost analysis in more detail than we can here. Freeman, 1979, Sinden and Worrell, 1979 and a few others concentrate on the problem of measuring non-market values. Francis, et al, 1979 and Harris, et al, 1982 explain basic principles, practices and problems in an ecosystem rehabilitation context. In this document we will concentrate on the theory, importance and measurement of unrevealed values.

UNREVEALED EXTRAMARKET VALUES

Unrevealed values are a peculiar subset of non-market values: values about which consumers normally have no choice. Consumers recieve them whether they want them or not, without allocating any money, time, travel or other resources. With or without the good the consumer's behavior is exactly or practically the same. Only his/her utility level, or sense of well-being, changes. Therefore, we cannot expect normal consumer choices to reveal consumer preferences for the goods or services that produce the values.

Unrevealed values can be either positive or negative. We will generally treat them as positive, but they usually have negative analogs. Option value is an exception. Our discussion continues the debate found in the economics literature about whether option value must be positive for goods with positive values.

The fact that one's utility level would change indicates that one would allocate his/her resources to receive the benefits (or avoid costs) if it were necessary. In other words, if consumers had to purchase (sell) the benefits in the same manner as private goods and services, we could expect their choices to reflect the benefits recieved. Our task is to estimate consumer willingness to pay and/or willingness to sell without being able to deduce it from normal consumer behavior.

Existence value is an example. People around the world were shocked to hear in the 1960's that Lake Erie was "dying." The response indicated that people everywhere cared. Apparently, people who have never used Lake Erie, and who plan never to use it, would have been willing to contribute, if necessary, to save Lake Erie. Therefore, we could say the "health" of Lake Erie has existence value. The public choice implications are that we must look beyond the present and expected future use of Lake Erie to determine the full benefits of pollution control aimed at saving the lake.

Evidence of existence value and some other unrevealed values may appear when people are threatened with the loss of the values. Campaigns to collect money to "save" certain animals or ecosystems we know about but are unlikely to use in any way, are examples. Sometimes, in response to possible loss we pass legislation like

the Endangered Species Act in the U.S., or look to government to provide and/or protect these values. Such responses explicitly or implicitly recognize the values and allocate resources to protect them. However, contributions to organizations, legislation and tax levies may only partially assess the values. More accurate assessments may help us choose more wisely in a changing world.

This becomes even more important as we increase our efforts to protect environmental components and environmental systems. Too often in the past, non-market environmental values--values to humans--were ignored or assumed to be low, leading to overuse and abuse. To replace overuse and abuse with protection and enhancement, we must find ways to incorporate the correct values into our decisionmaking. What was once considered "free" becomes costly: We pay more for pollution control and forego some uses of our environment. While that could have a positive economic impact--perhaps increasing gross national product slightly--the mere act of converting a free good to a costly one can only decrease human welfare. However, we have little choice. We must convert such goods to protect or enhance the benefits they provide. The important point is that both underspending and overspending on environmental protection will reduce human well-being.

Unrevealed values are attributable to two general sources (Table 1). First, values may be unrevealed for indivisible goods

Table 1. Types of unrevealed values.

I. INDIVISIBLE GOODS ("pure public goods") received jointly by by the public.

   A. Normal pure public goods usually provided by government. Generally replacable goods or services.

   B. Existence of unique, irreplacable natural phenomena or goods.

   C. "Pure social equity": indivisible benefits (as in pure public goods) derived from measures that increase the aggregate public sense of fairness or equity by redistributing wealth, power or opportunity.

II. PRIVATE INEVITABLE GOODS which consumers cannot consciously provide for themselves.

   A. Option value: the value of a reduction in uncertainty to individuals about their future use of public goods and some private goods, for which private insurance is not able to provide this risk reduction.

   B. Pure windfall goods or events received unpredictably.

   C. Ambiguous information about future benefits or costs.

because individuals receive the services of the good whether or not they respond to the good's presence. National defense is a classic example. It cannot be divided among recipients. Indivisible goods are sometimes also known as "pure public goods"

because once they are produced, by their nature they are automatically received by the public. They are usually provided by government or groups acting in the public interest because individuals have no incentive to pay for using the goods. Existence value and "pure social equity" fall in this category. Second, values of private (divisible) goods may not be revealed if the consumer cannot respond to the availability of the good for technical or institutional reasons. We could call these "inevitable" goods. Option value, unpredictable or windfall goods, and ambiguous information about future benefits and costs fall in this category. Species and ecosystem protection and rehabilitation have been justified in part because the consequences of not protecting them were unpredictable. We have confidence in the future products of natural ecosystems, and we know that altering ecosystems can have effects ranging from extremely beneficial (eg, agriculture) to extremely detrimental (eg, global climate change, Lake Erie dying, chestnut blight).

Two key factors in this classification of unrevealed values are (1) the divisibility of the benefits received and (2) the nature of the production process: whether the goods (a) form part of our human heritage, (b) are produced in normal production processes or (c) are imposed as institutions by which we organize our society. Figure 1 illustrates how various goods might be compared in these

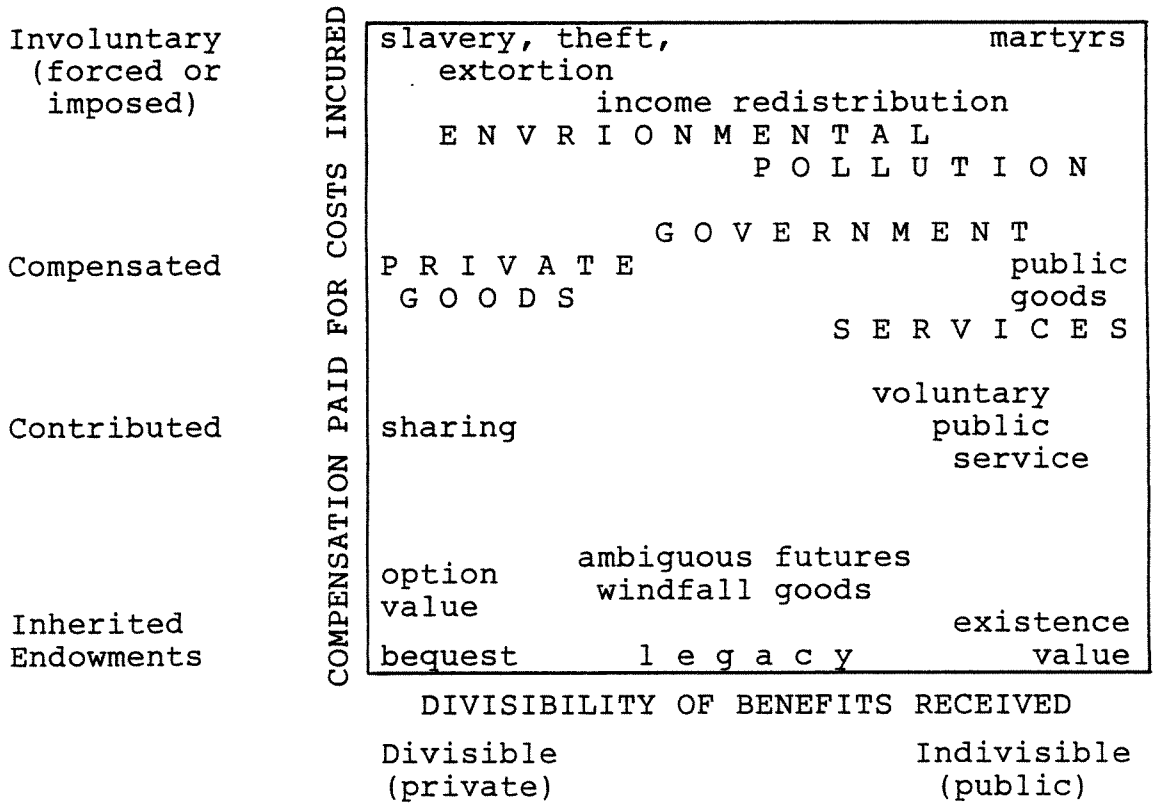

Figure 1. Types of goods organized by divisibility of benefits and nature of production.

two dimensions. Unrevealed values tend to be the categories most distant in each direction from normal private goods. They tend to be near the bottom, on the right and near the top.

The next subsections describe existence and option value in more detail. Appendix A describes the four other kinds of unrevealed values in slightly more detail, and provides more of the technical details of existence and option values.

EXISTENCE VALUE

Existence value may be defined as the value of knowledge of the existence of a good, apart from any use of the good. If existence is a separable asset of a good, as this definition implies, we can treat it as a separate good with its own unique demand, supply and values. This section explores this possibility. We find that people seem to behave as if the existence of unique goods is separable. However, this, in turn, leads us to consider how best to define unique goods.

Existence is an indivisible, nonexclusive attribute of a good, even though the use of the good may be divisible and exclusive. For example, the existence of blue whales is not divisible among individuals, nor can the existence of blue whales be limited to certain individuals. However, the use of blue whales could be divided among people, and people could be excluded from using them. Even **knowledge** of blue whales could be both divisible and exclusive, and may also be costly.

Although existence and existence value appear to be separable from the use of a good, existence value is somehow still dependent upon use--at least passive uses such as observing or studying. Use is necessary to produce knowledge, and people must have knowledge to demand and value existence. Use value and existence value seem generally to be positively related: The more we use something, the more we develop an affinity for it. However, they are not always positively related, because the more we "use" smallpox and mosquitoes, the less we seem to like them. The fact that one person's knowledge may be gained by learning about another person's experience should make no essential difference. Reading about something, or viewing it on television or in the theater can change the value we place on its existence.

Does this mean that we might be able to estimate existence values by observing consumer behavior? Consumers have to spend time and/or money to acquire knowledge. If we could observe such expenditures, we could conceivably estimate implicit values of knowledge and other uses. However, the great difficulty is that we would have to separate expenditures for the purpose of developing existence information or existence values from expenditures for knowledge or for other reasons. It seems implausable that people allocate expenditures for the explicit purpose of developing existence values. In addition, the relationship between existence value and expenditures for knowledge or other uses seems too vague and independent to offer much hope for estimating existence values.

If the existence of blue whales, for example, is really a separate good, people should treat it as any other indivisible, nonexclusive good. Therefore, we could expect certain kinds of

consumer behavior. First, we would expect that whether blue whales exist or not, by itself, would affect our sense of well-being, or utility level. In this case, we receive existence value from something as long as it exists. We tend to think of it in terms of our natural heritage or our human heritage. When we learn that the good no longer exists, we lose part of our heritage and we feel a sense of loss. Second, suppose blue whales were extinguished. The change in our utility attributable to knowledge of the extinction of blue whales should be additive to the change in our utility attributable to our loss of direct or indirect use of blue whales (including ecosystem effects). In other words, our observable reactions--allocation of time and resources--should be separate and additive, the same as they are for other pairs of complementary goods. We would expect both users and non-users to be willing to pay, if necessary, to prevent the extinction of blue whales. Users should be willing to pay up to an additional amount called resource rent and consumer surplus: their total value of use, minus all costs of use. Third, indivisible, nonexclusive goods are non-market goods, provided by government or volunteers, if at all; much like defense, fire protection, and lighthouses. Existence should be the same. Such goods are also equally available to all, received by all, and the cost of providing it for one more person is either zero or very low.

What kinds of goods have existence value? Using the above criteria, people seem to behave as if unique natural phenomena like whales, the Grand Canyon and Niagara Falls have high existence values. They also behave as if human products like the Mona Lisa, the Statue of Liberty, Beethoven's symphonies, and perhaps even the 1957 Chevrolet have existence value.

What about Lake Erie? If Lake Erie "died" it would still exist. It would be nutrient enriched and oxygen deprived, such that many of the organisms that now live there would no longer be able to do so. In short, the lake would become "a stinking mess." Apparently the world-wide support for saving Lake Erie was not really existence value for Lake Erie, but existence value for Lake Erie's "health." One could easily argue that Lake Erie's health is unique. However, this raises the troublesome question: What is an unique good and what is not?

Uniqueness and similarity are merely products of the human tendency for generalization. In some respect each plant and each animal is unique, including single celled plants and animals. Similarly, each square inch of the earth's surface, each snowflake, each apple, each banana and each can of baked beans is unique. Humans have developed classification systems and names for plants, animals, chemicals, lakes, oceans, goods, services and economic values to help us organize our lives. We define things as unique if it is important to us to distinguish them from everything else.

Economists develop classification systems for goods and services. If a set of items is sufficiently similar, they usually refer to them as good X and treat them as exactly alike for analytical purposes. However, what is sufficiently similar for some purposes is insufficient for other purposes. For some purposes all food is one good. For other purposes all fish are alike, or all lake trout, or all lean lake trout, and so on.

Economic analyses usually assume that all objects that we call the same product--all lean lake trout, for example--are perfect substitutes for each other, but not perfect substitutes for other products. This is true both for substitution in demand and substitution in supply.

This suggests that we could arbitrarily define uniqueness--either uniqueness in demand or uniqueness in supply--as the degree of substitutability of one object for another. Therefore, virtually anything could have some existence value. The degree of uniqueness of an object, in the eyes of the consumer, would partially determine the magnitude of its existence value. If it were someone's pet, we could even agree that a individual lake trout is unique enough to have existence value.

The replaceability or irreplaceability of an object also determines uniqueness. The Statue of Liberty is unique among art objects, but our ability to replace it limits its uniqueness in supply, and therefore limits its existence value. No object is exactly replaceable (in the physical sense), but every object is partially replaceable (for human purposes) if we are willing to pay enough.

Economists have found that people apparently find widely varying goods to be substitutes in demand. For instance, one's willingness to pay to save whales could easily depend upon how recently he/she has been asked to contribute to help save flood victims, buy band uniforms, and other good causes. Our income is limited, so we must develop ways of substituting each thing for each other thing.

Finally, how can we measure existence value, and what magnitudes are we likely to find? Currently, our greatest hope for measuring existence values for many goods appears to be "contingent valuation:" bidding game techniques in which selected consumers are carefully asked to determine the maximum they would be willing to pay, and the minimum they would accept as compensation, for specific choices. We can judge the accuracy of these techniques through experiments in which actual markets are experimentally established for non-market goods like hunting permits, and compare the results to contingent valuation results. Other researchers observe consumer behavior under laboratory conditions and compare their results at some point to real life behavior. Results in both cases show that contingent valuation yields perhaps surprisingly good results. Many economists now feel that such studies can be used in many cases to reduce the uncertainty of the decision making process. In the end we will probably find that values implicitly assigned to existence value by various political, legal and administrative processes are often in the right ball park. They should be if government represents the people well.

OPTION VALUE

Option value is the value of an option that keeps available the possible future use of a resource, apart from the value of using the resource. It is something like the value of insurance. For example, suppose we could estimate the entire future value of angling in Lake Erie. In other words, the value of the choice

between having all of that angling and having none. That value is known as the present value of the future consumer surplus attributable to that angling; expected consumer surplus (CS) for short. Suppose also that the future of the fishery is uncertain, either (1) because the lake might not support edible fish in the future, or (2) because at least some anglers are unsure that they will want to fish in the lake in the future, perhaps because they plan to fish for salmon in Lake Michigan instead. For either reason consumer surplus could range between a high amount and zero. Option value (OV) is the maximum amount anglers and potential anglers would be willing to pay (or the minimum selling price they would accept) in addition to CS purely to increase their certainty that the angling will be available in case they want it. The total future value of the angling--total willingness to pay or willingness to sell--is the sum of the two, known as "option price" (OP) (equation 1).

$$OP = OV + CS \qquad (1)$$

Option price is much like the price of collision insurance for an automobile. The total insurance payment is greater in the long run than the expected cost of collision damages (equation 2). The

$$\begin{aligned} \text{Ins. Pmt.} &= \text{Value of risk reduction} + \text{Expected damage costs} \\ &= \text{Cost of Ins. Co.} + \text{Expected damage costs} \end{aligned} \qquad (2)$$

difference for the consumer is the value of the risk reduction. The difference for the insurance company is the capital and labor cost of the company, including profits.

We normally think of option value as a positive willingness to pay for risk reduction. However, economists have demonstrated plausible cases in which option value could be negative. Whether it is positive or negative depends on two factors: (1) risk preferences: whether the consumer is risk averse or risk loving, and (2) demand uncertainty: the value of increased certainty judged by present preferences could be less than the loss from being "stuck" with the cost of a good not wanted in the future.

There are two kinds of option value; one for supply uncertainty and the other for demand uncertainty. The risk preference factor could cause either kind of option value to be positive or negative. However, only demand uncertainty option value is affected by changing preferences, since we assume demand is constant when we consider supply uncertainty.

Supply uncertainty is the type of uncertainty we associate with insurance. In the Lake Erie example, we could be uncertain about the ability of the lake to support fish in the future, so we might go to greater lengths in controlling pollution to ensure that the fish will be available. This extra security becomes much more important when we realize that we could lose the fish permanently through a single pollution event, and that they might be replaced by organisms that have negative value. Option value is our willingness to pay extra for pollution treatment, beyond the expected value of future uses that would be lost.

Demand uncertainty is uncertainty about whether we will wish to use a good in the future. We might be willing to pay to keep a good available just to ensure that it will be available in case we

want to use it. Hospitals and emergency services have been cited as examples. This is like having auto insurance available only for ten-year, non-refundable periods, and trying to decide whether to purchase ten years of insurance for a second family auto that may or may not be wanted in the future. This is not necessarily unrealistic. We must often choose in present time whether or not to purchase an option that we may or may not use in the future. For example, we spend money and/or forgo valuable uses so parks or fragile ecosystems will be available in the future. We can assure supply availability at a maximum cost of OV + CS. However, putting it simply, if we are unsure of whether we will have any future use value (CS), then option value (OV)--the value of our assurance of future availability--could be very low or conceivably even negative.

As is the case with existence value, our greatest hope for measuring the option values of indivisible or nonexclusive goods is some form of contingent valuation bidding game. Also, as with existence value we can visualize cases in which option value could be negative. Currently we must trust political processes, governmental administrators and volunteer groups to assess option value. Economists expect to be able to reliably estimate option value in the near future. Because people have difficulty visualizing option value, researchers will probably estimate it by first estimating option price and consumer surplus, then finding the difference. Judging by the insurance market, it seems unlikely that option values would be very large in comparison with use values.

III. WORKSHOP SUMMARY

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TAXONOMY OF VALUES

Values vs motives for values

One object of the workshop on unrevealed extramarket values was to reconsider the large number of types of values that had been suggested by various authors as being important. These included existence value, option value, quasi-option value, bequest value, heritage value and several others. The group tried to evaluate which of these were merely separate "motives" for valuing a particular resource, and therefore essentially unimportant for measuring total value, and which were really separate resource values. After all, when we observe the values of market goods it is not necessary to know **why** the consumer bought the good, but only how much was paid for it. If motives are relatively unimportant when valuing market goods, why should they be important for extramarket goods? Bohm suggested that they are not important, and that things such as bequest value and heritage value are merely motives for existence value. In other words, an individual may value the existence of a resource for a variety of reasons, none of which are actual "use" by that individual. The resource may be valued because it is linked to the history of a culture, or an individual may want to be sure a natural resource will still exist for the next generation to enjoy. In either case, an accurate measure of existence value would take into account these motives. Bohm suggested that we might be inviting double counting problems by focusing on motives and calling them values.

The result of this discussion was a tenative reduction of the taxonomy to three types of values which were still deserving of more attention: option value, quasi-option value and existence value. We continued to evaluate this choice through the rest of our session, as will become apparent. Later, at the end of the workshop, we still felt that these were clearly separable from each other and from other kinds of values, and yet they incorporated all of the other unrevealed values under discussion. Talhelm (1983) later developed a more complete framework which may incorporate all unrevealed values. This is summarized in Section II, above.

Use vs non-use values

What appears to be an obvious distinction between types of values--based on whether or not we can observe use--turns out to be much more complex. What is resource "use" and how do we explicitly define it? Maler attempted to answer at least the second half of that question in his presentation and first paper, "Some thoughts on the distinction between user and non-user values of an environmental resource." Using the framework of consumer theory, Maler shows how an expenditure function can be derived for an individual who has zero non-use value for a particular resource. The **use** value for the resource can then be found from this function. He also defines the expenditure function which can be used to find total value for that resource. If total value (TV) and use value (UV) can be found, then non-use value (NUV) is the

difference: TV - UV = NUV. While some measures of UV are available for certain resources, the problem of estimating TV is just as difficult as that of estimating NUV. Maler points out that his analysis says nothing about **estimating** NUV, but rather it attempts to define UV and NUV in a way that can avoid double counting.

Maler's analysis assumes that we can define a good X, that is strictly a "use of the resource." Then, if the marginal willingness to pay for X is zero when no use takes place (X = 0), we can say that there are no non-user values for that good. The problem is that defining X can be difficult. If the resource is a recreation area, X might be visitation, measured as visitor days. However, this may not include every form of recreation that may be considered "use." National Geographic may publish a story on the recreation area which thousands of people pay to read. Is this also a use of the recreation area? Maler states that in a very broad sense, resource "use" is identified any time a change in the supply of that resource affects consumer demands for any goods. In an operational sense, selecting the appropriate measure of X becomes subjective. Dividing TV into UV and NUV is therefore not unique, but rather depends on the indicator of use (X) that is selected. Smith pointed out that this may be an index number problem: We could aggregate all of the private commodities that make up "use" into an X if we could find the proper common denominator.

While it may be nice to be able to explicitly differentiate between use and non-use values of a resource, Bohm pointed out that if we know total value, it makes no difference how it is partitioned between UV and NUV. For decision-making purposes, the change in total value attributable to the given choice is the relevant measure that applied economists should seek. We have focused on NUV here because these values have often been left out of benefit/ cost accounting.

OPTION VALUE

Option value was first introduced into the literature by Weisbrod (1964) and has been the subject of a number of articles since then (see for example, Long (1967), Cicchetti and Freeman (1971), Schmalensee (1972), Bohm (1975), Conrad (1980), Anderson (1981), Graham (1981), Smith (1983), Cook and Graham (1977)). Option value was first defined as originating from consumer uncertainty of future demand. Even consumers who turn out not to demand a good in the future might be willing to pay some amount in the present to ensure that the good will still be available in case they should demand it. Therefore some people who never use a good are still willing to pay to preserve their option for future use. However, the important question to ask is whether the willingness to pay for this option (option price) is any greater than the expected value of having access to the good (expected consumer surplus, CS). If option value (OV) differs from expected user benefits, then option price must be the sum of expected consumer surplus and option value, equation (3). Stated another way, people would have

$$OP = OV + CS \qquad (3)$$

to be willing to pay a risk premium in addition to the value of their expected future use to ensure the certainty of future access to the good.

Bishop's paper, "Option Value: An Exposition and Extention," uses consumer theory to define the relationships between option price, option value, and expected consumer surplus. Bishop first reviews the option value literature, stating the result of each article in common terms for comparitive purposes. Most of the discussion, both in Bishop's paper and at the workshop, centered around Schmalensee's (1972) disturbing conclusion that option value could be either positive or negative. Schmalensee had therefore proposed leaving option value out of benefit/cost analysis, since we do not know a priori whether it adds to, or subtracts from, user benefits. Bishop describes in detail how Schmalensee arrived at his conclusion and agrees that, given certain assumptions, the sign of option value can be either positive or negative. Bishop gives the following intuitive explanation for negative option value: "...(before,) only the risk associated with not buying the option was considered. ...However, there is also a risk associated with buying the option: having paid the option price, the option may turn out to be useless. It is how the consumer views these risks at alternative option prices that determines the sign of option value." (p. 17)

While both Bishop and Bohm agreed with Schmalensee that the sign of option value is indeterminate in cases of demand uncertainty, they did not agree that the concept should be abandoned for benefit/cost analysis. Bohm (1975) argued that to measure expected consumer surplus in the way Schmalensee defined it would require the economist to measure people's preferences and income expectations across a number of states. In other words, we would have to estimate consumer values both for cases in which they do demand the good in the future, and for cases in which they do not, together with the attendant assumptions consumers must make in the various cases. He felt this would be an impossible task and suggested instead that option price replace both consumer surplus and option value in estimating future benefits.

Bishop agreed with a reply from Schmalensee (1975) that future user benefits can be estimated by projecting current demand into the future, rather than by trying to measure it across states as Bohm had suggested. However, Bishop also agrees with Bohm that option price is the relevant measure of future benefits, if it can be accurately measured. While there are problems with contingent valuation techniques, Bishop feels attempts to estimate option price would be valuable.

While option value has traditionally been defined in terms of demand uncertainty, a substantial amount of time at the workshop was also spent discussing "supply side" option value. This refers to the case in which the consumer is certain of demanding the good in the future, but is uncertain about its future availability (Bishop, p. 19). This is equivalent to purchasing insurance against possible loses. Bishop again uses consumer theory to show that under the assumptions of certain utility functions and income, option value is clearly positive in the case of supply uncertainty. While "supply side" option value is still a sum we

could add to future use value for benefits estimates (if we could the project increases supply certainty), only future users would pay it. Future non-users have zero "supply side" option value.

Smith also discussed supply side option value in his paper and presentation, "Option Value: A Review and Assessment" (since revised and published: see Smith, 1983). His conclusion that supply side option value is positive was based on a much different analysis than Bishop's. Smith explained how option value analyses depend on the following three questions:

1. What is the source of the uncertainty?
2. How is the uncertainty in decision-making ultimately resolved?
3. Does decision-making permit progressive learning to incorporate new information that may resolve some of the uncertainty? (p. 3)

Notice that the last two questions imply an analysis which takes the passage of time explicitly into account. Smith calls this using a "time-sequenced" analysis, which differs significantly from the "timeless" analyses which were considered by Bishop. Smith shows that in a time-sequenced model option value is clearly positive. He also states that "the practical measurement of option value will most certainly require a time-sequenced model of individual decision-making" (Smith, 1981, p. 18). However, Smith also analyzes timeless option value, based on the insurance literature of Cook and Graham (1977). Here he shows that "irreplaceability of the asset, as an attribute of individual preferences, together with risk aversion implies a positive option value" (p. 17). Bishop and Smith appear to agree that option value for supply uncertainty is always positive in a timeless analysis.

The distinction between what Smith calls time-sequenced analyses of option value and what has traditionally been called quasi-option value is not clear. While workshop participants generally agreed that quasi-option value is the value of information gained by delaying an irreversible decision (and therefore has a positive value), how this concept relates to what has traditionally been called option value was not settled. Bishop suggested this question as an area for future research.

EXISTENCE VALUE

The workshop discussed option value longer than planned. As a result, McConnell only briefly introduced the concept of existence ualue. However, his paper, "Existence and Bequest Value" (1983) treats the topic much more thoroughly.

McConnell describes existence value as "the willingness to pay (or to accept compensation) for the existence of a resource without the prospect of using the resource" (p. 255). He distinguishes, much as Maler did, between deriving value from <u>in situ</u> use of a resource and deriving value from the resource without any <u>in situ</u> use. His analysis of how the resource enters the utility function is similar to that which Maler used to distinguish between use and non-use value. Under this framework,

any change in the utility derived from marketed goods (i.e. any change in the demand for marketed goods) caused by a change in the supply of a resource,

~~any utility change attributable to the amount of use of any good, or the level of production of any good~~, signals a value other than pure existence value. For example, media coverage of contamination in the Great Lakes is a "use" of the Great Lakes. The value of that information is a kind of use value. As a practical matter, however, McConnell suggests that the analyst focus on the distinction between in situ use and non-in situ use of the resource: "Existence demand means an individual values a resource even when there is no in situ use" (p. 256).

McConnell rigorously defines existence value so that it satisfies three basic criteria:

1. Existence value plus use value should equal resource value.

Therefore,

2. resource value should equal existence value when there is no use value, and
3. resource value should equal use value when there is no existence value (p. 260).

McConnell points out that use value can be zero if the price of using the resource is too high. For recreation, that price is usually a function of the distance a consumer has to travel to use the resource, and therefore consumers living different distances from the resource will face different prices for using the resource. McConnell concludes that existence value differs for users and non-users because they do not face the same price and source vector (p. 261). For example, Hawaii residents view Hump-backed Whales more often than Great Lakes residents, because costs are lower to Hawaii residents; therefore their existence values could differ as well. Randall and Stoll (1983) and Talhelm (1983) explain that existence value may be acquired in much the same way as information or knowledge. One develops an affiliation over time, which changes one's existence value. Knowledge is also a necessary component of existence demand.

The~~s~~ implic~~ations of existence values are~~ that both users and non-users must be sampled when estimating resource value by contingent valuation methods. Further, "in the case of resources that have national prominence, it is necessary to sample people from all over the country" (McConnell, 1983, p. 261). One of the estimation problems involved here is clear: How do analysts determine which non-users to survey in estimating existence value?

Maler and McConnell have both defined non-use values in similar ways. Based on this definition, pure existence value is the only type of value that clearly fits into the non-use category. Option value clearly depends on the possible amounts of future use and therefore must be theoretically considered a use value. The only case that may qualify is option value for demand uncertainty in instances in which the consumer never actually demands the good.

While most of the discussion at the workshop centered on the demand for "existence goods," some have disagreed since then over how the existence good should actually be defined. Randall and Stoll (1983) portrayed existence demand and supply as varying with the amount of the good. For example, in the case of the endangered California Condor, they portray existence supply and

demand as in Figure 2. Their concept of marginal existence value seems to imply that existence demand and supply are not tied to whether the Condor exists or not, but rather to how **many** of the Condors exist.

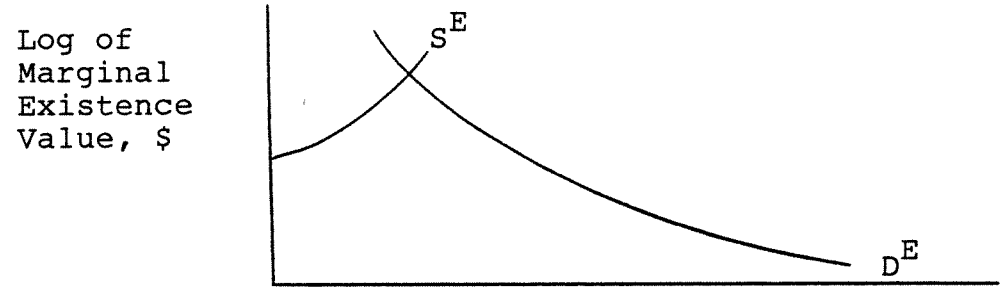

Figure 2. Existence demand and supply of California Condors as related to the population of Condors (after Randall and Stoll, 1983, p. 269).

Talhelm (1983) takes an opposing view. He feels that existence value is an all-or-none type of value: What matters is the **existence** of the Condor, not how many of them exist. This is illustrated in Figure 3. Therefore, above a safe minimum number,

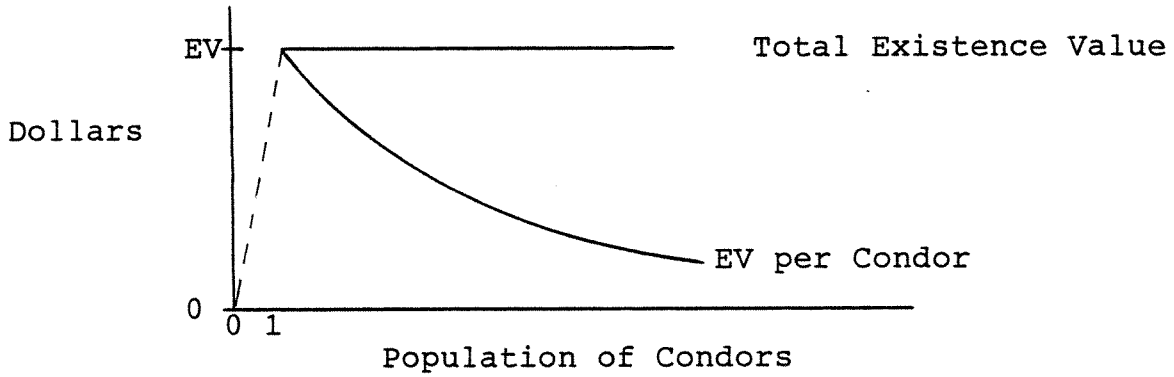

Figure 3. Existence value (EV) of California Condors as related to the population of Condors (as defined by Talhelm).

with which the species could survive and reproduce, the consumer would derive an existence value for the species. If the species is extinguished, the existence value is lost. Under this framework, existence value would be constant above the safe minimum number, assuming that increased numbers do not lead to encreased knowledge of or human affiliation with Condors. Existence demand would simply be twc points: one portraying "existence value per existence" in the case in which the Condor exists, and the other at the origin portraying zero existence value in the case in which the Condor is extinct. In a sense, Talhelm defines the existence good as the species rather than the population of that species. This has the result of focusing our attention of defining what we mean by existence, uniqueness and irreplaceability.

It is clear that this conceptual problem must be settled before the theory of existence demand can advance. A future conference focusing on existence value could help solve these problems.

OPERATIONALIZING THE CONCEPTS

In addition to exploring the theory of unrevealed extramarket values, the workshop tried to evaluate how these values might actually be estimated. Some workshop participants were invited to discuss their experience in measuring unrevealed extramarket values, as described below. In addition, Randall provided a valuable perspective on the role of this information once we are able to estimate it. See his papers, "The Economist and the Public Policy Process" and "Economic Surplus Concepts and Their Application in Benefit Cost Analysis." A variety of potential problems in these areas were discussed. Eventually a separate workshop was suggested to address the problems more thouroughly.

Estimating option value

While the theoretical discussions focused on defining option **value**, we generally agreed that option **price** would be the theoretically correct measure of future benefits from a resource. Estimating option price poses some difficulties, but finding option value would require that expected consumer surplus be measured as well as option price. According to Smith and Bohm, expected consumer surplus, in the sense that Schmalensee defined it, can never be satisfactorily estimated. Economists would need to know the alternative future "states" that people subjectively perceive (ie, their perceived alternative income levels, future goods and prices available, and future preferences), as well as the subjective probabilities attached to those states. The whole idea of uncertainty of future preferences may be difficult for people to respond to. If an individual strongly prefers something today, can we expect that individual to imagine being disinterested in it next year? Finding a way to get people to reveal state-specific future preferences, and devising a method for aggregating these demands across individuals would be a formidable, if not impossible, task.

Estimating option price is also complicated. Bohm pointed out that we must assume that people can accurately state their willingness to pay, and, in fact, "should" pay for the resource in question. All incentives to misrepresent preferences must also be neutralized. These problems must be overcome whenever we attempt to measure willingness to pay in a hypothetical situation. Bohm described how he overcame some of these problems when he estimated willingness to pay for a proposed pay TV program in Sweden (Bohm, 1972) and a proposed bus line in Stockholm. In the later, potential riders were divided into two groups and presented with different mechanisms for paying. Individuals in one group would pay as a lump sum, determined by individual willingness to pay, and would be alowed to ride as long as the total of these payments was sufficient to pay for the line. This mechanism would encourage individuals to understate their willingness to pay. The other group would have to pay a low fee per month equal to operating costs per rider. This mechanism would encourage

individuals to overstate their willingness to pay. All respondents were made aware of their incentives. Bohm's object was to obtain an **interval** of estimation which could then be compared to the cost of providing the service. In general, if the interval were small, the cost of providing the service would be likely to lie either above or below the interval, and the analyst could say with relative assurance that cost either exceeded benefits or did not. However, if the cost fell somewhere within the interval, one could not conclude whether or not benefits exceed costs. In his tests for strategic response biases, Bohm found only slight differences, demonstrating that strategic biases may be small. He also demonstrated that strategic responses can be countered by counter-strategic questioning.

Experimental economics

Plott introduced a promising area of research for improving extramarket valuation techniques. Plott is one of the pioneers in experimental economics, a field which tests the theories of economics by putting people into laboratory situations and observing their actual behavior. For example, subjects may be given money and asked to play the roles of demanders and suppliers, with actual monetary rewards for successful strategic behavior in some cases. We could then observe how they respond to rule changes, such as auctions vs sealed bids vs posted prices, or to market vs non-market commodities. From the above discussions, it seems clear how this type of research could help evaluate the relatively new theories of extramarket goods.

According to Plott, the key to experimental economics is to reduce a more complicated problem into simple components which can be evaluated one at a time. He usually attempts to demonstrate precisely stated propositions in very simple settings. As a result of some of his earlier work, Plott offered the following observations as being relevant to estimating extramarket values:

1. "Framing" the question or problem influences the result. For example, how people respond to questions about their preferences depends largely on how the question is framed.
2. People tend to put a little too much weight on evidence, using Bayes Law, forgetting the prior probabilities of the two states. For example, if we ask people which of two populations a given sample came from, and state the probabilities, they will tend to choose the population that looks most like the sample, forgetting the prior probabilities.
3. People tend to be "overconfident" about probabilities.
4. In judging risky situations, people will judge one way in one sphere and another in another sphere; even when the degree of risk is identical and only the nature of the risk is different.

When we think back to Schmalensee's definition of expected consumer surplus, we can see how the above observations lend credence to Bohm's skepticism of ever being able to measure this value empirically.

Plott has also extensively investigated group decision making in the form of committee behavior. This work can help us understand processes by which public goods are allocated. Democratic societies rely largely on political processes to allocate public goods. This means that small numbers of people come together to arrive at decisions through committee processes. Plott's work involved placing people in committee situations and analyzing how decisions were actually made under different committee rules (eg, Robert's Rules of Order). He offered the following conclusions:

1. People come to committees with their minds made up.
2. There is no indifference. People have well-articulated preferences and are advocates.
3. Committees operate under well-defined processes, such as Robert's Rules, and these processes influence the outcomes.
4. **None** of the well-articulated theories (gravitational model, Euclidean mean, dominant male, maximum benefit, etc.) correctly predict committee actions.

This means that we are left with no known, consistent theory that explains how the preferences of individuals are aggregated in the political process. This is not to say that the market place does a better job of aggregating preferences. The market prescribes a certain set of rules which are better known and different, but not necessarily "better," than the rules of the political process. Plott's observations point out that market and non-market goods may be allocated on the bases of two separate sets of rules. This further complicates the valuation process.

The role of information in the public policy process

The overall purpose of this project was to evaluate the possibility of including unrevealed extramarket values in benefit/cost evaluations of ecosystem rehabilitation. It seems to be widely understood that such evaluations fall short of their mark if they do not include such values. Since the information that the economist provides can carry a great deal of influence in the public policy process, it is especially important that economists have theoretically sound methods of generating and presenting the information necessary. Randall pointed out that "Information has a central role in the policy process, and accordingly, the role of the economist as generator and disseminator of information must be emphasized." While Randall does not see this as the only role for the economist, it is one that has traditionally been emphasized. Randall went on to describe how economic analyses can add information and reduce uncertainty in the decision making process.

The institutional setting

One of the problems in estimating unrevealed extramarket values is defining the institutional and technical setting that is appropriate for estimating willingness to pay for a particular good. Government provides many goods and services, and consumers never express their willingness to pay for each one, nor for the entire bundle. Consumers think in terms of taxes paid rather than

in terms of willingness to pay for each item. Is it appropriate then, to choose one or a few of these goods, and attempt to measure a direct willingness to pay by consumers? The problem is even greater for environmental values we receive that are not even related to taxes or consumer expenditures.

Stated another way, when we estimate the existence value of "saving" Lake Erie, for example, should we first ask respondents to assume that they will be paying for other existence values as well, or only for Lake Erie? The assumption will affect the answer. How many and which public goods should we consider together as candidates for moving from the category of unpriced goods to the category of priced goods? Consumers have a limited budget which is, at any given time, allocated between present consumption of marketed goods, taxes, and future consumption (savings). When we add a non-market good (even hypothetically) to the number of goods which a consumer must divide the budget amongst, we are implicitly changing the amount of income available to spend on all other goods and services. This actually happens when we pay higher taxes and higher consumer prices to save endangered species and to control pollution.

Any value, either actual or hypothetical, carries with it certain conditions or constraints. The constraints appropriate for the particular choice at hand will probably differ from the constraints appropriate for another choice. If such constraints affect the consumer's budget in significantly different amounts, the resulting values will differ in amount and in context.

We can imagine that the first non-market good to compete for a part of the consumer's budget might gain a large dollar share. The non-market good may be valued more highly than many market goods which were previously purchased. However, when the tenth, or hundredth non-market good is added, the limited budget will already be allocated to highly valued goods and services and very little might be left to allocate to this next good. Obviously the order of introduction will make quite a difference in the amount of the budget allocated to a particular good or service. It is quite possible that the consumer values the last good added more than the first, but if he/she is not able to reallocate the entire budget with each additional good considered, then the value of each good will have a different context (constraints). We must interpret each value only under those particular constraints.

Even a technique which only considers one non-market good at a time will encounter this problem. If the entire bundle of non-market goods appropriate to a particular choice competes for the consumer's budget at the same time, then the consumer should be asked to judge the relative value of the entire bundle. If the relative values of the components of the bundle are needed, the consumer could judge the values of each of the components under the same constraint (the bundle). Also, how can the analyst put the consumer in a realistic choice situation if the consumer is not going to actually have to pay for the non-market goods?

These and other questions relating to contingent valuation techniques were brought up at the conference and are discussed briefly in some of the papers. Again, this problem needs further work. As mentioned earlier, a future conference was suggested to focus on measurement techniques.

IV. RECOMMENDATIONS

Further work on resource values

1. The theory and methodology of estimating unrevealed values are still not complete enough to justify attempts to **definitively** estimate these values for benefit/cost analyses of projects. Both theory and methods need further development. Several specific points needing further work were suggested in Section III. Participants felt that workshops or symposia could advance both theory and methods in these areas.

2. On the other hand, participants in this study seemed to agree that we have reached a stage of development sufficient to support rough estimates. We know that some decisions, such as ecosystem rehabilitation decisions, significantly affect unrevealed values. It seems far better to explicitly estimate these values, even with "ball park" estimates, than to continue deciding blindly. It is important, however that everyone who uses the estimates realizes their uncertain nature.

3. The GLFC should attemt to better understand all of the various economic and social values and impacts related to Great Lakes fisheries management. This understanding would help clarify choices, and help facilitate planning for strategies designed to protect and enhance the benefits received by the public from these fisheries.

Human dimensions in policy and management

4. It is important to recognize that values differ greatly among individuals. For example, whereas some anglers prefer wilderness angling, others find that unappealing, and prefer more-urban settings with plenty of other people around. The point is that recognizing and managing resources for diverse interests can often benefit the public much more than managing for the average user. Considerable research is needed to identify this variety of preferences and to identify practical means of targeting management efforts toward a wide variety of these preferences. Public involvement is one possible tool for discovering and serving diverse interests. It could (1) help managers keep in touch with public preferences, (2) keep the public informed of management realities, and (3) let the public share some of the responsibility for the dreams and uncertainties in management.

Even reducing the risk of fish population collapses by rehabilitating the lake trout may not be preferred by all: Option value could be negative for some people. Let us state this example in different terms: Most people probably prefer that risks be reduced in most aspects of their lives. However, some people may generally prefer risks. Judging by participation in lotteries, office football pools and home poker games, most North Americans prefer at least some risk. Therefore, some may be willing to accept more risk in fisheries management than others, and some may even prefer more risk.

5. Recommendation 4 implies that economists and other social scientists should become more intimately involved in GLFC affairs.

For example, economics can not only clarify benefits and costs of decisions, but can predict how consumers and producers will respond to regulations, rules, changes in international, national or local economies, strategies adopted for economic rehabilitation or for ecosystem rehabilitation, and many other factors.

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VI. APPENDIX

ABSTRACTS OF PAPERS PRESENTED AT OR DERIVED FROM WORKSHOP

BISHOP, R. C. 1982. Option value: an exposition and extension.

Land Econ. 58(1): 1-15. Presented at unrevealed values workshop, Gull Lake, MI. (Photocopies available at cost from Great Lakes Fish. Comm., Ann Arbor).

Since Weisbrod (1964) first suggested option value, the concept has been embroiled in an increasingly complex, technical debate. Schmalensee's (1972) argument--that option value may be positive, negative or zero even for risk averse individuals--limits our ability to infer that the benefits of significant natural assets like Sequoia National Park include positive option values held by non-users.

The first section of this paper reviews and clarifies the arguments about option value. Some of the first arguments may be clarified by defining option value (OV) to be the difference between total willingness to pay, or option price (OP) and expected future use value, or consumer surplus (CS): OV = OP - E(CS). Cicchetti and Freeman (1971) argued that option value was clearly positive. However, Schmalensee showed that their argument turns on the untenable assumption that consumer preferences change when prices change. Schmalensee shows that option value may be positive or negative. The consumer either buys an option he/she may or may not use, or does not buy one and risks not being able to use the resource in the future. It is how the consumer views these risks at alternative possible option prices that determines the sign of option value.

The other section of the paper defines supply-side option value: demand (preferences) is certain, but the future availability of the resource is still uncertain. This case is essentially the same as accident or fire insurance. To reduce risks, consumers are willing to pay more than the expected value of future losses. Therefore, supply-side option value is the positive value of risk reduction.

MALER, K.-G. 1981a. Some thoughts on the distinction between user and non-user values of an environmental resource.

Unpubl. Presented at unrevealed values workshop, Gull Lake, MI. (Photocopies available at cost from Great Lakes Fish. Comm., Ann Arbor). 10pp.

The main difficulty in distinguishing between user and non-user values is in defining use. We can assume that if non-use value is zero, then when a good is not used, the marginal utility derived from the good will be zero. The paper shows mathematically, using standard economic assumptions, that environmental changes may affect consumer expenditures for one or more market goods through "weak complementarity." If so, that defines a "use" of the environment. We can theoretically derive all use values from

various related changes in consumer demand, even use values of non-prices environmental resources.

However, total value may not coincide with use value. The difference will be defined as preservation or existence value.

In short, user values of environmental resources are defined on the basis of actual behavior of the individual, and can be calculated from information on the demand functions for private goods if one also knows the effect on the demand from changes in the environmental resource. Preservation value is then simply defined as the residual between the total value (which is basically a theoretical concept) and the user value. By definition, preservation values do not leave any traces in behavior. The only way to estimate these values seems to be to force the individual into a situation where he/she has to choose between either having the change in the resource and paying for that change, or not having it.

MALER, K.-G. 1981b. Optimal land use, some theoretical aspects.

Unpubl. Presented at unrevealed values workshop, Gull Lake, MI. (Photocopies available at cost from Great Lakes Fish. Comm., Ann Arbor). 36pp.

This paper argues that, contrary to previous arguments, uncertainty about future costs and benefits of irreversible decisions may work in favor of preservation (ie, not taking irreversible actions) and against development. It begins first by defining degrees of irreversibility in economic terms, in a generalized mathematical model of land management. Irreversibility is expressed as a cost of restoration or rehabilitation. Higher possible restoration costs for more-irreversible choices tend to reduce the advantages of those choices relative to more-reversible alternatives.

The other section introduces uncertainty, showing how risk alters the choice. If a develoment is strictly irreversible, and if the decision maker is risk neutral, simply replacing uncertain variables with expected values will bias the decision in favor of irreversible decisions and against preservation. However, replacing strict irreversibility with degrees of irreversibility forces us to recognize that practically everything has some degree of irreversibility. For example, once capital goods are embodied in a particular enterprise, they often lose most or all of their opportunity value. Thus the bias introduced when uncertain variables are replaced by their expectations may very well work in favor of preservation and against development.

McCONNELL, K. E. 1983. Existence and bequest value.

in Rowe, R. D., and L. G. Chestnut, eds. Managing air quality and scenic resources at national parks and wilderness areas. Westview Press, Boulder, CO. pp. 254-264. (Photocopies available at cost from Great Lakes Fish. Comm., Ann Arbor).

It seems clear that we as a society value many natural resources for their own sake. Benefit cost analysis must be expanded to include existence value.

Existence demand for a good is basically the same as the demand for any pure public good. The marginal rate of substitution between any two goods purchased on the market is independent of the existence attribute of unique resources, but the marginal utility of the existence is positive. In other words, the utility function is weakly separable in market goods and existence. However, information about existence is costly and may influence the consumer's budget, violating this definition. If information is an essentially costless public good, then existence demand means an individual values a resource even when there is no in situ use.

Bequest demand is basically the same. Only consumer motives differ.

Most goods that have existence value are also valued for their use, although perhaps by different people. Existence value plus use value is equal to resource value. The difference can be observed in cases in which resource values are still positive when use value is zero. To make sense, use value must be zero when use is zero. That could happen if the cost of use increases sufficiently to drive consumption to zero. Further, existence value may be related to use, because the more we use something the more its existence affects us. Because the cost of using or visiting unique natural resources depends on our travel costs, our existence values for these resources may also differ with proximity.

When we put together the facts that (1) existence value is difficult to measure, (2) both users and non-users may have existence value, and (3) we have existence value for all goods services and characteristics that make up the quality of life, we find that the implications for benefit cost evaluation are dramatic.

RANDALL, A. 1981. The economist and the public policy process.

Unpubl. Presented at unrevealed values workshop, Gull Lake, MI. (Photocopies available at cost from Great Lakes Fish. Comm., Ann Arbor). 25pp.

This paper addresses the question of an appropriate role model for the economic scientist in contributing to the public policy process. This contribution must be as a generator and disseminator of fundamentally limited information in the public policy process, rather than as an arbiter of good and evil. The information must be scientifically objective to be credible.

One concept of the public policy process posits the existence of a policy decision maker, who is literally decisive in the policy process. (In reality, decision makers, even dictators, must be supported by some degree of public consent, so in effect they are more or less constrained by the wishes of the public.) In a strongly heirachical decision making process, economists may play the "humble technician" role, providing unbiased information about how to optimize a decision maker's objective function, and

about the expected results of policies being considered by the decision maker.

In an alternative concept of the public policy process, decision making is more diffuse. Conflicts are resolved in many different arenas. Here, no one is entirely above self interest. In this model, economists roles include helping formulate policies, evaluating decision processes and helping determine objective functions. Non-objective information and overtly normative positions by economists are likely to be identified as such by others. Economists participate in a "market in ideas," although they lose control of information once they release it.

In the real world, the economist is more than a "humble technician," potentially powerfully influencing public policy development by controling information, but limited in power by the public decision process. The economist's effectiveness is determined in the market for ideas.

Much of this role of economists is embodied in benefit cost analysis. However, economists do not intend for benefit cost analyses to routinely make public decisions. Such strict rules would undermine the fundamental tenets of the diffuse decision process. Instead benefit cost analysis documants benefits and costs, changing the terms of public debate.

Some participants in the decision process, including presidents, attempt to use benefit cost analysis not for its own sake, but to help them pursue their own goals. The diffuse decision process itself has built-in mechanisms to help counter such pressures. Here the role of the economist is to provide quality control in the analysis, and to provide objective benefit cost evaluations for information for the diffuse decision process.

RANDALL, A. AND J. R. STOLL. 1983. Existence value in a total valuation framework.

in Rowe, R. D., and L. G. Chestnut, eds. Managing air quality and scenic resources at national parks and wilderness areas. Westview Press, Boulder, CO. pp. 265-274. (Photocopies available at cost from Great Lakes Fish. Comm., Ann Arbor).

This paper examines the role of existence value and its relationship to total household value. The household production function model can accomodate such non-market factors as learning and information in specifying household valuation processes. The total value of a good is the consumer's surplus from all household activities using the good, where consumer's surplus is defined as the net benefits ramaining after all household production costs have been incurred. Total value may be divided into the broad categories of use value and existence value. Any activity that alters one's consumption of goods and services generates use values. This definition includes natural resource values derived from reading about the resources in a book or magazine, and viewing photographs, as well as other kinds of vicarious consumption. Option value is also a use value.

Existence values may be generated by simply knowing a resource exists, without affecting one's consumption of other goods and services. Uniqueness and irreversiblility are not essential to

existence value, but marginal existence values depend in part on the availability of substitutes and the supply of existence. For example, the marginal existence value of the endangered California condor surely exceeds that of cattle, even though the total existence demand for cattle probably is greater. The existence supply of cattle is enormous.

Information is essential to existence value. Small shifts in information may drastically shift existence value, as, for example, when the snail darter was discovered. It seems clear that the concepts of information and discovery, substitution possibilities, and relative scarcity (rather than strict irreversibility) will eventually make important contributions to a more complete theroy of the values attributable to future use and existence.

Four recent studies present emperical evidence that option price and existence value are measurable and generate emperically significant values. However, validation problems have not been resolved. The measurement problem is complicated by the fact that existence values are widespread and unpriced. Complex programs that alter many unpriced values simultaneously or in concert with other programs provide a confusing array of valuation questions.

SMITH, V. K. 1981. Option value: review and assessment.

Unpubl. Presented at unrevealed values workshop, Gull Lake, MI. (Photocopies available at cost from Great Lakes Fish. Comm., Ann Arbor). 27pp.

This paper argues that the discrepancies in past evaluations of option value arise largely from two differences in the analytical structures used to describe it. The first, and most important of these for the potential practical measurement of option value, arises from the use of a "timeless" versus a "time sequenced" approach to modeling the role of uncertainty in individual decision making. The second arised from a failure to appreciate, within the "timeless" models, the complications introduced by state specific utility functions. One of the important aspects of this confusion led to the Bohm/Schmalensee exchange over the appropriate definition of risk aversion. The second explains the association between seemingly unambiguous findings of Cicchetti and Freeman and their specifications for total utilities to make the state specific utility functions commensurate.

It does seem fair to conclude on the basis of the analysis to date in both frameworks that option value will be positive for risk averse individuals' decisions for unique or irreplaceable assets. This conclusion would appear to hold regardless of the framework adopted once supply uncertainty and irreplaceability are explicitly incorporated into the analysis. Nonetheless, the practical measurement of option value will most certainly require a time sequenced model of individual decision making. This model must explicitly consider both the source and the means of resolution of uncertainty, as well as the methods through which the information associated with such progressive resolutions (over time) are incorporated into the subsequent decisions.

Managing Air Quality and Scenic Resources at National Parks and Wilderness Areas

edited by Robert D. Rowe and Lauraine G. Chestnut
foreword by Russell E. Dickenson

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24. Unrevealed Extramarket Values: Values Outside the Normal Range of Consumer Choices

Daniel R. Talhelm

INTRODUCTION

It seems intuitively apparent that the benefits and costs of "drastic" choices of natural resources allocation--such as "irreversible" alteration of "unique" resources through species extinction, natural feature destruction, or "severe" ecosystem alteration--would not be limited to the present and future direct and indirect users of the resource. Nonusers also seem to experience direct gains or losses. For example, both "saving" Lake Erie from "dying" and protecting visibility at the Grand Canyon appear to be widely supported by people who have no intention of using either. There is some evidence that, at least in the Lake Erie example, nonuser values comprise a significant portion of the benefits. Despite widespread public support for rehabilitation, the benefits to users appear to be only about as great as rehabilitation costs (Francis et al. 1979). Unless such "unrevealed" values can be described and estimated, the various forms of benefit cost analysis will sometimes be inadequate.

Unrevealed extramarket values are those values that are not revealed by observing resource use occasions, because the values (1) are not explicitly established through market transactions, and (2) normally require no significant allocation of time, travel, or other resources economists might observe to estimate implicit values (Talhelm et al. 1980). However, the fact that there are these values implies that individuals would allocate corresponding resources if necessary.

Such activities are normally only revealed through actions such as voting, political activities, and verbal statements, although occasionally they are partially revealed through voluntary contributions or through compliance with "involuntary" assessments like taxes or ransom payments. The values of all indivisible goods (i.e., "public goods") and many goods other

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than those we normally think of as public goods also have values that are unrevealed in this respect.

One purpose of this paper is to examine the theoretical economics of various forms of unrevealed values. I propose six forms of these values, defined on the basis of the mechanisms causing the values to be unrevealed. The most important mechanisms are indivisibility and ambiguity.

The other purpose is to examine one of these, existence value, in detail. Here, I propose that the existence value of a good is attributable to the consumer's state of knowledge about the good; not necessarily to the state of the good itself. Awareness of a good's existence is information capital that may technically change the consumer's utility function. The existence of unicorns, for example, could not be valued unless we discover (or hypothesize) their existence. Upon gaining awareness, the consumer may care about the good's future existence. The magnitude of the existence value of a good depends in part on how unique consumers feel the good is. Consumer views of uniqueness may differ greatly from physical, or supply, perspectives of uniqueness. Therefore, uniqueness and substitutability are also examined in detail.

The next section examines existence value. The succeeding sections briefly examine other forms of unrevealed values: options for future consumption, public goods, unpredictable events, values obscured by ambiguous information and altruistic values.

EXISTENCE VALUE

Existence value may be simply defined as the value of knowledge of the existence of a good, apart from any use of the good. Existence is an indivisible, nonexclusive attribute of a good, conceptually separable from but jointly produced by some "uses" of the good. Consider wild polar bears, for example. Few people ever expect to see a wild polar bear or to otherwise use one, yet many apparently value the fact that they exist. They would be willing to pay to maintain the bears' existence apart from any potential use. Apparently, many also value maintaining the options of seeing or hunting the bears, or perhaps having a polar bear rug, but these values fall into the option value category.

Although existence is an indivisible, nonexclusive attribute of a good, knowledge about and awareness of the good may be both divisible and exlusive, and may have a positive marginal cost. One acquires knowledge of the good either by observing or otherwise using the good, or through someone else's experience with the good. Therefore, using a good jointly produces knowledge and any other products of that use.

An experience that produces an awareness of good P, say the experience of either reading about or viewing a particular set of scenic vistas, may be represented as the household production and consumption of commodity Zp (viewing or reading):

$$Z_p = f_p (X_i, X_p, T_p) \qquad (1)$$

where the production inputs are X_i, a vector of time and goods resources; X_p, the scenic vista(s); and T_p, time spent consuming Z_p produces new knowledge or awareness of P. If the new knowledge changes one or more of the ways a consumer produces utility from his environment, it in effect technically transforms the consumer's utility function from $U = U(Z_i)$ to $U' = U'(Z_i)$, where Z_i represents the set of commodities consumed. The set Z_i may or may not change as U changes. The consumer may either maintain U' without further inputs of P, or acquire further information that transforms U' to U". At each stage, the consumer may value the existence of the good differently. Each input of P may produce (1) direct utility, (2) an intermediate product for later use, and/or (3) information capital that transforms U. If the input is simply the knowledge that P no longer exists, the only consumption activity might be the acquisition of that knowledge. The consumer's change in utility and/or utility function would indicate any change in value. The existence value of the good (if positive) would be measured as the equivalent surplus the consumer would pay to prevent the change, or as the compensating surplus the consumer would accept to compensate for the change.

Consider, as another example, the "honeymoon effect." Suppose an event would occur that would significantly reduce or eliminate good visibility in the Poconos. An economist estimating the loss in value attributable to the change in the character of air quality in the Poconos would not only have to estimate values for present and future use, but the value of the loss felt by the couple from Iowa who honeymooned there in 1923, but have never been back and have no intention of ever going back. They may feel a loss in utility just from knowing the scenic vistas are not like they were in 1923. The magnitude of their loss may depend on whether they enjoyed their honeymoon and whether they associate their happy or unhappy marriage with the visit. Perhaps they could even gain utility from the change!

If existence value is unrevealed by consumer resource allocations, $U(Z_i)$ and $U'(\ _i)$ could be the same except for the new information and the different willingness to pay to prevent extinction and willingness to accept compensation for extinction. However, $U(Z_i)$ could differ in other ways from $U'(Z_i)$ and still not reveal existence value. For example, knowledge of the scenic beauty at the Mt. McKinley National Park in Alaska might lead one to believe that other national parks in Alaska are also interesting and to acquire information about them. That second allocation of resources is attributable to the expected value of the information about other national parks in Alaska. Knowledge of these national parks may lead the consumer to read more about them or to view them again. The activities would reveal the total of the expected value of those activities and the expected value of additional knowledge.

Knowledge, like existence, may be a one-time event. Once knowledge is acquired, repetition is redundant. Values revealed by consumers in such one-time acquisitions could easily be misjudgments.

From the perspective of the household production function, consumption of a good (such as Z_p) enters one's cost constraints and one's utility function. This consumption choice might reveal the existence value of the good because part of the demand for the good is the demand for more knowledge about and awareness of the good. In other words, perhaps the demand for news, books, and other information sources could be separated into components, one of which could be attributed to existence value. Intuitively, it seems unlikely that the portion of knowledge and awareness attributable to a given resource is separable, particularly since (1) knowledge in an individual may be viewed as a technical change or a non-disposable capital acquisition (i.e., moving from U to U'), the value of which might be difficult for the consumer to estimate until after the fact, and (2) the knowledge/awareness content of news, books, etc., is hopelessly intertwined with other content related to other values. It would probably be as

easy for consumers to estimate the value of the existence of the resource in question as for them to estimate the value of their knowledge and awareness of the resource.

In short, existence may be considered a pure public goods component of resources. Standard definitions of public goods are appropriate, provided that they admit the role of information in the household production function for these goods, which they typically do not. For example, Randall (1981) defines a public good as "a good that, once produced, is available without rivalry" (p. 179). He also points out that most definitions imply non-exclusiveness as well as indivisibility (p. 190).

Market goods may have existence value as well, and as with natural phenomena, I would expect that the more unique and admired a good is, the greater would be its existence value. Classic examples are the 1957 Chevrolet, various coins, the Mona Lisa, national defense, the Empire State Building, and Beethoven's Fifth Symphony. Commonplace examples include tomatoes and Boeing 747 airliners. All of these have well-known uses; viewing the Mona Lisa, for example. Yet, we can at least conceive of existence values for each. The good produces the usual products, Z_i, as well as knowledge. Once the consumer has seen the Mona Lisa, or an illustration or description of it, his utility function has been transformed from U to U'. Even if the consumer never intends to view the Mona Lisa again, he may feel a loss if he is informed that it has been slashed, destroyed, or lost. The same holds for scenic conditions at national parks.

Uniqueness and substitutability

Significant natural phenomena like polar bears, Niagara Falls, and the Grand Canyon are obviously unique. Yet uniqueness and similarity are merely products of the human tendency for generalization. Every object is unique in some respect from each other one. We notice some differences more than others because those differences seem important to us. We abstract to the level that suits our purpose. The point is that uniqueness is not so much a natural phenomenon as a human invention for generalizing. The well-known biological and physical classification systems were developed to generalize about reproduction, genetics, physical structure, and other attributes more related to supply than to demand. Consumers' classification systems, determining substitutability and uniqueness in demand, may be based on a different set of attributes. Classification systems for man-made products sometimes relate more to production than consumption, although most seem to compromise between consumer awareness of differences and producers' desires for product differentiation.

Public values are determined more by uniqueness from the consumer's perspective than by biophysical uniqueness, even though the former is sometimes overlooked. If, for the purposes of an economic analysis, all units of a proposed group substitute "perfectly" for each other, they are the same good. Partial substitutes and complements are related goods, and poor substitutes are unrelated goods. Classes in any classification system are presumably assigned on the basis of the system developer's purpose and perspective. For example, from some perspectives, all scenic vistas are the same. From other perspectives, all national park scenic vistas are the same, all western national park scenic vistas are the same, all Grand Canyon scenic vistas are the same, or no scenic vistas are the same (each is unique). Mathematically, economists measure substitution in demand as cross-price coefficients, cross-price derivatives, or cross-price elasticities

between goods, implicitly assuming perfect substitution within each given good. For example, let

$$Q_i = f(P_1, P_2, P_3, I) \qquad (2)$$

represent the demand for good X_i, where Q_i is the quantity of X_i, P_i are the prices of good X_i and two other relevant goods, and I is consumer income per capita. If $S_{12} = dQ_1/dP_2 > 0$, goods X_1 and X_2 are substitutes. If S_{12} is infinite or "sufficiently great," goods X_1 and X_2 are the same good, according to standard definitions. However, S_{12} can be infinite only at the point where P_1 and P_2 are equal. If the prices differ significantly, S_{12} will be zero because the consumer will never substitute. He/she would have no reason to pay a higher price for one unit of a good when another identical unit is available at a lower price (assuming, of course, perfect information and zero or identical transactions costs). Therefore, perfect substitutes have $S_{12} = 0$, except at the switching point at $P_1/P_2 = R^*_{12}$, where S_{12} is infinite. Indifference curves between perfect substitutes X_1 and X_2 would be a straight line, and if $R_{12} \neq R^*_{12}$ a corner solution results in specialization in either X_1 or X_2. If X_1 and X_2 have the same units of measure, $R^*_{12} = 1$.

It follows that for close substitutes, S_{ij} may also vary depending on R_{ij}. The indifference curves are relatively flat but eventually intersect or parallel the axes. Here, $\alpha > S_{12} > 0$ for a range of R_{12}, say $R_1 < R_{12} < R_h$. A most effective rate of substitution is possible at S_{12}, where S_{12} is maximum at a corresponding R^*_{12}.

Uniqueness may be defined in terms of S^*_{ij} : good X_1 is unique if there is no good X_j for which S^*_{ij} is greater than some arbitrary level. However, since S_{ij} depends upon the definitions of the units of the goods, elasticity would be more useful for this purpose. Let ε^*_{ij} be the maximum point cross-price elasticity, where $\varepsilon_{ij} = (P_j/Q_i)\, S_{ij} = P_j\, dQ_i/Q_i dP_j$ for any corresponding R_{ij}. Then, a better definition of uniqueness is: good X_i is unique if there is no good X_j for which ε^*_{ij} is greater than some arbitrary level.

Given sufficient data, this definition could help us determine which resources are unique enough to consider special attention to preservation. Product definitions could be hypothesized and accepted or rejected using this criterion. For example, although fishing in Michigan's Great Lakes for salmon and trout is unique is some respect in each of the thirty-three counties in which such fishing is regularly available, salmon/trout angling in one county may be a close substitute for the same fishing in another county (see Jordan and Talhelm 1982). Perhaps some counties offer unique opportunities according to this definition; alternatively, perhaps salmon/ trout angling is only unique relative to other kinds of angling, perhaps any Great Lakes angling is only unique relative to non-Great Lakes angling, or perhaps angling is only unique relative to other forms of recreation. Such hypotheses could be tested by observing choices made by anglers from different locations, since the "prices" of these kinds of angling vary with travel distance.

With market goods, however, an arbitrary definition of uniqueness is unnecessary. Uniqueness appears as a economic rent that becomes capitalized into the market value of a product. Accurate estimates of willingness

to pay also reflect uniqueness in nonmarket goods such as Great Lakes angling.

Furthermore, in analyzing existence value, the change in quantity (dQ_i) is essentially meaningless, since the question at hand is the existence or nonexistence of something. Existence value may be considered the same as the all-or-none value of existence of the good (apart from any use or option values). Therefore, perhaps the best definition of uniqueness considers the all-or-none value of existence of the good, measured as either equivalent surplus or compensating surplus, and abbreviated here as WTP. This may be visualized as the sum for all consumers of the entire area under each consumer's demand curve for existence, since the price is zero (existence is a public good, provided at zero marginal cost to the consumer). However, the quantity axis must be a dummy number indicating existence at zero price and nonexistence at some price. We shall return to the quantity issue later.

There is some indication that although consumers may understand species extinction and differentiate between canyons, their willingness to pay to preserve the existence of "unique" phenomena (or goods) is highly contingent on the number of phenomena they have recently been asked to contribute to, and perhaps even on the number of charitable causes they have contributed to. For example, if the total "Save the Unicorn" group asked me to help save unicorns, I might contribute $A if I had not made any other significant contributions recently. I would probably contribute much less, say ($A-B), where A>B>O, if I had recently contributed to other similar groups. My short run discretionary income is more limited than long run, but I would make similar trade-offs in the long run. If unicorn preservation effort is good X_1, and other groups are X_2 and X_3, I suspect that my ε^*_{12} and ε^*_{13} would be relatively high. All three goods may appeal to my sense of altruism. In Lancaster's terms, all three goods may be independent inputs in my overall production of the same characteristics, altruism, or my sense of obligation to the "outer world."

An indication that this is a real phenomenon was given by Randall and Stoll (Chapter 23 in this volume). Whereas Schulze et al. (1981) found that the average U.S. household would pay up to $86 per year to assure clean air in the Grand Canyon, they reported a University of Chicago study showed that Chicago people would pay an average maximum of $325 per year to assure clean air in Chicago, $355 per year to assure clean air in Chicago and the rest of the Eastern U.S., and $371 per year to assure clean air in Chicago, the Eastern U.S., and the Grand Canyon. Apparently, the substitution effect is great, although there could be some income effect. While both clean air and the Grand Canyon are unarguably unique, valuable resources, consumers apparently find satisfactory substitutes.

Note that in the unicorn example, I was not contributing precisely for the continued existence of unicorns, but for an organization which I believed would represent me in various ways in its efforts to save unicorns. It might purchase unicorn habitat, lobby Congress, advertise and/or do other things. While my contribution may indicate my unicorn existence value, it does not measure precisely that value.

One of the key issues in understanding existence value is specifying the quantity measure of existence. I suggested a "dummy variable" approach above, but perhaps there could be other approaches. Do only rare and/or physically unique organisms or physical features have existence value? Can we attribute existence value to each individual scenic vista or only to all. Consider the existence of one particular scenic vista. People

who have knowledge of a particular scenic vista may value its existence, and the magnitude of that value may depend on the extent of that knowledge. As with any good, the value any particular individual vista depends upon (1) the desirability of the attributes of that vista, (2) its uniqueness, which depends upon the extent which that vista is perceived as being different from other vistas, (3) the prices of the perfect and/or imperfect substitutes and of compliments, and (4) other factors such as the consumer's income. The existence value of a scenic vista depends upon the substitutability in demand of any other individual scenic vista for that scenic vista. In this case, many other sites may be practically perfect substitutes. Therefore the scenic vista's existence value would probably be low relative to that for all scenic vistas of a particular type. The existence values of (1) a particular set of scenic vistas, perhaps at one particular national park, (2) all similar scenic vistas, or (3) all scenic vistas depend on the same kinds of factors. The broader the definition of the good, the greater its existence value is likely to be. No matter how we define a good, its units of existence are the same; either that a specific good exists or it doesn't exist. Existence value is always an all-or-none question.

The existence value for a population may be divided by the number of units in the population to calculate average existence value. Marginal existence value, $d(WTP_i)/dQ_i$, would be zero because total existence value does not depend upon the number of units in the population (holding knowledge of the good constant).

Finally, existence values may conceivably be positive, zero, or negative. However, because it may be difficult to separate use-values from existence values, it may be difficult to detect negative or zero existence values. Goods that might have negative existence values are goods that apparently have negative "use" values, such as rampaging, life-threatening polar bears; smallpox; nuclear bombs; and mosquitoes. Even these might have positive existence values after we subtract their negative use values, attributable to bear attacks and damage, disease, destruction, and pesky bites. However, the empirical problem of restricting consumer's evaluations strictly to existence and not associated broader contexts may prove extremely difficult.

OPTION VALUE

Option value is the value of an option that keeps available the possible future use of a resource, apart from the value of using the resource. For example, I would be willing to pay up to $A if necessary to maintain the possibility (or option) of visiting a particular national park that might otherwise be closed, although my probability (π) of visiting the park may be almost nil even assuming the option is available. My net all-or-none value (i.e., Hicksian-compensated consumer surplus (CS) of the visit) would be $B. Therefore, my total willingness to pay for park visitation rights, my option price (OP), or $A, is my option value (OV) plus my expected net value of visiting, π(CS), or $B, equation (3). If either my

$$OP = OV + \pi (CS) \tag{3}$$

πor my CS is zero with certainty, then my OV would also be zero because I have no reason to maintain the option. However, OV could be positive even if I never exercise the option by visiting the park. The original concept of option value was that people who will never use a given resource may

nevertheless be willing to pay to maintain the option to use the resource. This implies that the value of resource use may not be equivalent to observable consumer surplus, as we had previously assumed; that people would be willing to pay more than their expected future value. That may seem unreasonable, so let us examine it further.

Current economics literature suggests that option value (1) may be merely the value of reducing the uncertainty about future use, much like the value of insuring our home or car (i.e., an option makes the possibility of future use more certain, reducing the risk of lost value); and (2) may be positive, zero, or negative under given conditions, depending in part upon whether demand or supply is uncertain. The analysis is essentially the same for users as for nonusers: Both may have positive values that are not revealed by normal user activities. For a more thorough discussion of most of the points here, see Bishop (1982).

First, consider that people would be willing to pay up to their expected future consumer surplus, π(CS), for an option for future use. (Assume the discount rate is zero so we can ignore discounting. It would add nothing and only complicate the argument. Similarly, let one possible future use occasion represent all possible future use occasions.) This includes eventual nonusers as well as users, by the simple nature of probability. Whether my π is .99 or .01, I could still eventually either be a polar bear hunter or a polar bear nonhunter. In either case, I would be willing to pay up to π(CS) to maintain this option. If people are good judges of π, accurately projected consumer surplus based on presently observed use would be the same as aggregate π (CS) estimated through a survey of the entire population of participants and nonparticipants. Participants receive CS>π(CS) values, whereas nonparticipants receive 0<π (CS) value. It is not clear whether this is the nonuser value Weisbrod (1964) had in mind when he proposed option value, or whether he was proposing OV as a risk premium.

Next, let us consider supply uncertainty and OV. In the example of my polar bear hunting option value, one of the reasons I was willing to pay to maintain my options was that I was uncertain whether sufficient numbers of bears would be available to permit hunting in the future. If my payment of OP now would help insure sufficient numbers in the future I may pay it. The reasoning here is precisely the same as the well known Friedman-Savage (1948) analysis of insuring. They showed that if the marginal utility of income is decreasing, the expected utility of a combination of uncertain outcomes is less than the utility of the equivalent certain outcome. For example, suppose my π = .01 because there is a π' = .99 that not enough bears will be available, but otherwise my π = 1.00. Then my expected consumer surplus is .01(CS) + .99(0) = .01(CS). Friedman and Savage showed that my utility under those initial conditions would be the same as my utility would be if I paid OV + .99(CS) to receive B with 100% probability. In each case, my net utility is worth .01(CS).

Next, consider demand uncertainty. Most of the literature has dealt with this source of option value rather than supply uncertainty. Here we assume the consumer is uncertain about his/her future utility function. Under one set of future preferences, the consumer will use the resource, under another set the consumer will not, all other conditions being equal. Again, the consumer would be willing to pay OP = OV + π(CS) to maintain the option in case he wishes to exercise it in the future. The conclusion so far appears to be that this kind of OV could be positive, negative, or zero. Basically, the analysis is that purchasing an option for $A could provide a future dollar gain of CS - A (good demanded) or a loss of A (good not demanded), and not purchasing an option could produce a "loss" of CS (good demanded but not available) or no effect (good not demanded). Without the option, expected utility, π(CS), is the weighted average of two points on the same utility curve, one point for income I and the other for (I - CS). With the option and certainty, expected utility is the average of utilities for two utility functions, but at the same income level (I - OP). Expected CS without the option could be greater than, equal to, or less than OP, so option value could be positive, negative, or zero.

The literature has not considered another likely source of "demand" uncertainty: the possibility that the consumer's constraints or household production technology will someday make a visit more attractive. If, for example, consumers have unforeseen reasons to be near the Grand Canyon, they may be able to take advantage of a low cost opportunity to visit the park. Another possibility is that future technical changes could reduce transportation costs. These possible cost reductions are actually supply changes from the household production function point of view (see Talhelm 1972, 1973, 1980), rather than demand changes, but they represent consumers' dreams about possible future use. Although the consumer remains on the same utility curve, a cost reduction increases his/her expected consumer surplus. The analysis here is the same as our supply uncertainty analysis above.

Finally, although we have recognized that a risk premium may be appropriately added to consumer surplus in certain cases to estimate project benefits or costs, we must also recognize that the risk premium may be negative or zero in some cases. Risk premiums should be routinely considered in benefit-cost analyses. There is also ample evidence of such premiums in the insurance market. Furthermore, options are commonly purchased for many assets.

PUBLIC GOODS

Public goods may be defined as indivisible goods. One person's consumption does not affect consumption by others. A classic example is national defense. The fact that I consume national defense does not add or detract from anyone else's consumption. Likewise, my viewing the flock of geese overhead does not detract from someone else's view.

Some authors assume or imply that public goods are also nonexclusive; that consumers cannot be excluded from consuming and cannot exclude themselves. We consume the level of national defense that is provided whether we want to or not. We cannot exclude ourselves without moving to another country, and even then we are affected by it. Existence is another indivisible nonexclusive good. Values of indivisible, nonexclusive goods are not revealed by normal consumer activities, although they may be at least partially revealed through voluntary contributions or political processes such as tax allocations, elections and assessment by elected representatives. These points were discussed earlier, and are further elaborated in most current microeconomics textbooks; so we will only go into further detail here on two more points. Existence was elaborated upon separately because it has not been widely recognized as a public good and because, like most other public goods, some analytical issues are peculiar to existence.

Many natural resources or attributes of natural resources are at least partly public goods. Services of the environment such as clean air and waste assimilation are examples. Environmental

also a public good, much like national defense or police protection. Scenic beauty is only partly public. It is indivisible up to the point where crowding becomes a problem, and often people can be excluded. Direct use of scenic beauty may sometimes be measured and consumer values estimated--consider Grand Canyon viewing, for example.

Finally, individuals generally "consume" public goods only indirectly. Individuals "consume" national defense in concept only, even though our concepts are based on actual weapons and human capabilities. Existence is similar; we consume the concept, not the resource. In other words, public goods are characterized by "nonconsumptive" use of some form, in that the consumer does not actually take possession of the good.

UNPREDICTED EVENTS

Have you ever been working in your yard or driving to work and are suddenly surprised by a flock of geese flying overhead? Suppose you allocated no time or money resources to enjoy the geese, but that you would have if necessary. The value of this unpredictable event was unrevealed by your overt actions.

This form of unrevealed value--consuming unpredictable goods without allocating any resources--is probably not an important source of consumer value. Practically all events may be predicted with some probability, and we allocate our resources based on expected results. However, there are events with positive and negative values that are unforeseen or for which the probabilities are so small that we ignore them. The values of such events are unrevealed by our overt actions.

AMBIGUOUS INFORMATION

Many things are improperly valued because we lack sufficient information. Ecological relationships and endangered species are among resources often cited as having unknown values. Bad experiences with introductions of exotic species, such as European carp throughout the U.S., sea lamprey in the Great Lakes, and starlings in North America may be readily cited as having had negative previously unrevealed values.

The value and role of information is well known. It's economic analysis is discussed in many textbooks. Our education system, our research investments and many other aspects of our lives involve information gathering for decision-making purposes.

Decisions may be deferred until further information becomes available (the value of this increased information is "quasi-option" value). Values of "irreversible" decisions are particularly sensitive to the lack of information.

ALTRUISM AND EQUITY

What is it worth to you to help the poor, starving people in Africa? To fight birth defects? To preserve your (or someone else's) religious ideals? Do we provide wilderness, scenic vistas and hospital care only for those who can pay their full cost? Such values are obviously important and are unrevealed or only partly revealed by normal market mechanisms. Economists tend to ignore them, particularly the values of fairness in resource allocation and equity in income distribution. They present special

values might be accurately estimated are now becoming available, the values themselves depend on both the existing income distribution and the social conventions we have chosen to live by. This web of cause and effect for such values presents substantial analytical difficulties that may be with us for a long time--some say forever. However, we seem to be fast approaching the day when many such values may be estimated, and no longer ignored.

CONCLUSION

Unrevealed or partially revealed values may be the rule rather than the exception in our lives. At first it may seem bewildering and preposterous to imagine being faced with all of these values with our limited incomes. If we had to pay in all instances where we could, our incomes would seem Lilliputian until we consider that our incomes would also be correspondingly greater. Both sides of the ledger would expand. Existence value, for example, could be thought of as part of our "real" wealth. We are enriched by the existence of things and diminished when they cease to exist.

Explicitly including "unrevealed" values in decision making and in "real income" accounts is revolutionary. It is an important component of the information explosion. The critical component of this revolution is the development of satisfactory valuation techniques. I am awed to contemplate the impact of widespread successful use of contingent value techniques or other techniques that disclose many of the multitude of "unrevealed" values we hold and unthinkingly exercise daily.

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