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ECONOMIC VALUATION: ITS ROLE AND USE IN ASSESSMENT AND PLANNING

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1. THE ROLE OF ECONOMIC ANALYSIS

Development is an organic process. Many individual variables and decisions contribute to the whole. The natural systems and environment that surround us react to, and are affected by, the development decisions that are made. Economic analysis is one approach to ordering the many variables involved in development, an approach that imposes a degree of rigor by its explicit discussion of alternatives and trade-offs, and its use of monetary values to the extent possible. Other approaches have been developed to assist in environmental impact assessment and land-use planning and some of these have been discussed at this meeting. This paper will focus on the role for, and uses of, economic analysis in assessment and planning and how economics can be a valuable aid to the decisionmaker.

Properly applied economic analysis can be used as a neutral tool that presents information in an organized way. Assumptions should be clearly stated and relevant data presented. The results of the analysis should be seen as an aid to the decision making process. These results are then incorporated with social, cultural, political and other considerations. For these reasons, economic analysis is seen as a "necessary but not sufficient" element for decision making.

1.1. The Overall Natural System Framework

The focus of the methodology outlined here is the individual project. This is because projects present discrete problems to be analyzed, have definite goals or desired outcomes, and are usually the unit for funding and implementation decisions. A steel mill, a subway, a new hotel, an agricultural development program are all examples of projects. A broad land use study, such as the Han River Basin Study in Korea, is somewhat different. The individual components of such a study are larger and the goals of the study may be represented by broad indicators. At another level, the project may be a program of activities for a river basin - or other region -- and be composed of many discrete sub-projects. Nevertheless, many of the same techniques used to analyze a specific project may also be used in such studies.

Regardless of the level of aggregation, the relationship of the project being examined with its environment must not be overlooked. Because the environment and various natural systems support, directly and indirectly, all project activities, the good and bad effects of a project on the natural system must be taken into account. A sensitivity to these effects and their incorporation in project analysis can result in more sustainable development and more profitable projects measured from the perspective of society's welfare.

1.2. Incorporating Environmental Quality Effects

The main emphasis of the economic valuation work described here is on how external or environmental quality effects, both good and bad, can be incorporated in project analysis. Figure 1 illustrates this approach. The project under consideration could be an urban development project, an industrial development, a highway or any other activity. The effects of the project can be divided into a 2-by-2 matrix dependent on the location of the effect, and the valuation of the same effect.

Figure 1. The Location and Nature of Various Project Inputs, Outputs and Environmental Quality Effects

VALUATION OF GOODS, SERVICES AND EFFECTS	Location of Goods, Services and Environmental Quality Effects: ON-SITE	OFF-SITE
MARKETED	1 Usually included in an project analysis	2 May be included
NON-MARKETED	3 Seldom included	4 Usually ignored

As seen in Figure 1, the project can have project flows (inputs, outputs, residuals) and effects that occur both on-site (within the project boundary) and off-site (outside of the boundaries). These flows and effects can also be either marketed and therefore valued in economic terms, or non-marketed. For example, the project may be a coal-fired power plant located in an urban area. One possible division of flows and effects follows:

(i) on-site, marketed — coal, water, electricity
(ii) off-site, marketed — soot damage to nearby buildings
(iii) on-site, non-marketed — noise
(iv) off-site, non-marketed — SO_2 emissions, distant fly ash, aquatic plants and animals damaged by hot waste water, visible plume, haze

What distinguishes the various categories is the extent to which a physical flow or effect occurs within the boundary of the project

and the extent to which monetary values can be placed on these variables. The division is not alway clear. Coal soot and dust can dirty nearby buildings, the cost of washing and cleaning these buildings is easily determined and the power company may be asked to pay, hence this becomes an off-site, marketed effect. When the same dust or fly ash drifts a long way it may still dirty buildings, people or laundry. Now the close physical connection between the power plant and the soot produced has been broken and this negative environmental effect has become both off-site and non-marketed. A cost for clean up can still be determined but it becomes harder to assign this cost among the various possible sources of soot or dust pollution. Another example of an off-site, non-marketed effect is the reduced visibility caused by power-plant generated haze.

The issue, therefore, is how to properly take all of these effects into account. Those product flows and effects that occur on-site and are marketable are usually all included in a conventional, engineering-economic analysis. It is the effects in the other three quadrants of Figure 1 that are frequently ignored. Quadrant 2 effects (off-site, marketed) may be included in an analysis while quadrant 3 effects (on-site, non-marketed) are seldom considered and quadrant 4 effects (off-site, non-marketed) are almost always ignored.

Whether the goods, services or effects occur on-site, off-site, are marketed or not, they all still have value and affect society's welfare. All of these effects then properly deserve to be included in the analysis and the problem becomes one of identification, measurement and valuation. It is to this end that the economic valuation work of the East-West Center's Environment and Policy Institute (EAPI) has been directed.

1.3. The Timing of Environmental Assessment and Valuation

The traditional approach to external or environmental quality effects has been to treat them as separate and distinct from the "true" goods and services produced by a project. This has resulted in ex-post analyses of projects and the preparation of EIAs after the design and engineering stages have been completed. Not surprisingly, this has frequently resulted in expensive remedial adjustments and difficult trade-offs as attempts are made to reconcile the EIA and the finished project design. In the worst case, the EIA is ignored and environmental quality effects are disregarded.

Because of the firm belief that environmental quality effects and other externalities represent costs and benefits that should be included in economic analysis, the EAPI approach explicitly recognizes these quadrant 2, 3 and 4 type effects and includes them early in the project planning and design process. There are two main reasons for this. First, since they represent benefits or costs to society they are real welfare effects that should properly be included in the analysis, just as direct project inputs and outputs are included. Secondly, incorporating these effects early is more efficient in terms of project design than retro-fitting later or using mitigation measures.

For example, specifying a more efficient boiler design may add 10% to a power project's costs but thereby avoid expensive retrofitted pollution abatement equipment that might add 15 or 20% to total

project cost. This hypothetical example seems straightforward and obvious because experience has taught us about these various options. It is in other projects where adverse off-site effects have traditionally been ignored that a more careful and complete analysis can lead to a solution that is both attractive economically as well as conserving environmental quality.

1.4. Various Economic Approaches

There are various approaches to the economic analysis of projects. Since confusion can exist over what framework or accounting stance is being used, it is helpful to clarify the various options.

One fundamental difference is between financial and economic analysis. While both approaches are based on economic theory, the economist uses the two terms to indicate quite different approaches. A financial analysis is what accountants do. It is done from the standpoint of the individual or a private company. It uses market prices and financial interest rates. It includes taxes, subsidies and other items that economists term "transfer payments". A financial analysis basically asks how much profit any activity will return to the individual or firm. It is narrowly concerned with the first quadrant in Figure 1 and largely ignores off-site or non-marketed effects.

An economic analysis is concerned with society's allocation of scarce resources and the net welfare effects of any project. This approach is used to analyze alternatives and to place welfare gains and losses in perspective. As might be expected, an economic analysis uses a broader accounting stance and ideally includes the goods, services and effects that occur in all four quadrants in Figure 1. When market prices represent true scarcity in the economy they are used. When there are distortions due to government intervention or other factors appropriate "shadow-prices" are used. All prices are real, constant, inflation-free prices. The discount rate is usually different than the market interest rate and may represent the opportunity cost of capital (e.g., other investment opportunities forgone) or pure rate of time preference (e.g., people's preference for present rather than future consumption). Transfer payments are ignored; only those actions that involve real economic welfare gains or losses are included.

In the work reported on here, all analyses are economic rather than financial in nature. Both approaches may justifiably be used in evaluating a project. The financial analysis will tell whether or not the individual or private firm will find the project attractive and profitable; the economic analysis will show whether or not the project is an efficient way for a nation to allocate resources and whether or not net social benefits are positive or negative.

Once the appropriate accounting stance (financial or economic) has been chosen, the actual evaluation can take two forms. A conventional project evaluation probably uses a benefit-cost framework that largely ignores off-site or non-marketed goods, services or effects. As this approach is extended and broadened, more and more of the quadrant 2, 3 and 4 type effects are included. This is sometimes called "extended" benefit-cost analysis but it actually is just conventional analysis that includes a wider range of goods, services

and effects. In an attempt to help this process, a team of economist associated with the EAPI has produced the Guide, a text on economic valuation techniques (Environment, Natural Systems, and Development: An Economic Valuation Guide by M.M. Hufschmidt, D.E. James, A.D. Meister, B.T. Bower and J.A. Dixon. Johns Hopkins University Press, 1983). The Guide illustrates both the overall approach to project evaluation as well as the various techniques that have been developed to place monetary values on many of the external and environmental effects of projects. A companion casestudy workbook has also been developed; this workbook uses case studies from the Asia-Pacific region to illustrate the use of various valuation techniques.

2. THE EAPI APPROACH TO ECONOMIC VALUATION

The EAPI approach to the problem of economic valuation of environmental quality effects of development projects is outlined in the Guide. Its basis is in neoclassical welfare economics and the orientation is towards practical approaches to valuing these environmental effects and incorporating them in the project planning process.

A series of discrete steps can be followed in applying this approach. The first step is identifying the boundaries of the analysis. That is, the project or activity being analyzed needs to be examined to determine how broad the analysis should be. The boundary drawn should be wide enough to include most major, identifiable results and effects but not so broad that analysis is impossible. For example, the urban power plant project referred to earlier may have a boundary that includes the air, water and noise pollution in the immediate vicinity. Acid rain and distant deposition of fly ash and soot may be excluded from the analysis. Obviously, choosing the boundary of analysis is subjective and there are always trade-offs between a broader, more complete analysis and the data requirements for more distinct or indirect effects.

Once the boundary of analysis has been chosen and made explicit, the other steps can proceed. The next step is to analyze the activity under consideration and identify all flow of goods and services as well as effects on the environment. This includes the usual marketed goods and services used or produced by a project (such as capital, labor, land, inputs, products) as well as less tangible, unpriced or off-site goods, services or effects. As in Figure 1, this step attempts to identify all of the variables involve in all four quadrants.

These effects are then quantified; the actual amount or extent of the goods, services and effects is counted. Some effects may not be quantifiable directly (such as the actual production of acid rain by a power plant or the esthetic loss in a ruined view) but these still should not be excluded. Throughout the analysis, any effects that cannot be quantified or valued can be retained as qualitative rather than quantitative information. Qualitative information can be very important in the final decision.

After effects are quantified, monetary values are placed on these effects. This process can be either simple or difficult. Goods, services or effects that are traded in the market are easy to

value (coal, labor, electric energy) and are traditionally included in an economic analysis. It is when effects are not priced or usually traded that innovative effort is needed. The EAPI Guide is designed to illustrate many of the techniques that have been developed to place monetary values on external or environmental quality effects. The last part of this paper discusses a number of these techniques and gives a case study illustration.

As a parallel step, preventive and remedial measures can be developed for incorporation into the project to reduce undesired external or environmental effects. The cost of these measures need to be included in the analysis as well as the benefits or reduced costs of the effects of these measures.

For example, in the power plant project, the negative external effects of air and noise pollution may lead to a new design for filtering flue gases and soundproofing the structure. These measures incur costs but also produce benefits. Both the costs and benefits need to be included in the analysis.

The last step is the economic evaluation of the entire project including the direct and indirect, on-site and off-site benefits and costs. In many ways, this is the easiest step — project evaluation and benefit/cost analysis have well developed methodologies. Assumptions have to be made on the appropriate time horizon for analysis and the discount rate to be used and then the appropriate decision criteria is chosen. This criteria may be net present value, the benefit/cost ratio or internal rate of return. These evaluation techniques are covered in many standard references (Gittinger 1983; Mishan 1982; Gramlich 1981; Sudgen and Williams, 1978; and Squire and van der Tak, 1975). The new casestudy workbook also presents some useful information on evaluation techniques (Dixon, Hufschmidt and Wattanavitukul, 1984).

2.1. Categories of Valuation Techniques

As should be clear by now, a key component of this entire natural system assessment and economic valuation approach is the ability to place monetary values on various external or environmental effects. Because these effects have frequently been difficult to value, they have largely been ignored in the past. The Guide presents extensive information on the techniques available and gives examples of their use.

The Guide is roughly divided into techniques for valuation from the benefit side and from the cost side. This division is somewhat arbitrary. A benefit forgone or lost is a cost just as a cost avoided is a benefit. Table 2 presents one classification of the major valuation techniques presented in the Guide. Other classifications could also be made. [illegible] important, however, is the selection of the most appropria[illegible]que or techniques given the project under consideration and [illegible] and other resources available. This section presents a [illegible]e of techniques in capsule form.

Table 2. Classification of Cost and Benefit Valuation Techniques for Assessing Effects on Environmental Quality

Valuation technique	Examples of application: Producer goods and services	Examples of application: Consumer goods and services
Market oriented		
Benefit valuation using actual market prices of productive goods and services		
(a) Changes in value of output	Loss of value of agricultural crops caused by seepage of toxic chemicals	
(b) Loss of earnings	Value of productive services lost through increased illness and death caused by air pollution	
Cost valuation using actual market prices of environmental protection inputs		
(a) Preventive expenditures	Cost of environmental safeguards in project design	Cost of noise insulation; cost of intake water treatment
(b) Replacement cost	Cost of replacing structures damaged by acid rain	Cost of additional painting of houses damaged by air pollution
(c) Shadow project	Cost of restoring commercial fresh-water fisheries damaged by discharges	Cost of supplying alternative sport fishing and recreational facilities destroyed by development project
(d) Cost-effectiveness analysis	Costs of alternative means of disposing of wastewater from a geothermal energy project	
Benefit valuation using surrogate markets		
(a) Marketed goods as environmental surrogates	Cost of sewage treatment processes as proxy for water purfication by ecosystems	Price paid for visits to private parks and entertainment as proxy for value of visits to wilderness area
(b) Property value approaches	Changes in commercial property value as a result of water pollution	Changes in residential property value from air pollution
(c) Other land value approaches		Prices paid by government for land reserved for national parks
(d) Travel cost		Valuation of recreational benefits of a public park
(e) Wage differential approach		Estimation of willingness of workers to trade off wages for improved environmental quality
(f) Acceptance of compensation	Compensation for damage to crops	Compensation for adverse health effects, e.g., Minamata disease
Survey Oriented (hypothetical valuation)		
Direct questioning of willingness to pay		
(a) Bidding games		Estimate of willingness to pay for access to an urban park
Direct questioning of choices of quantities		
(a) Costless choice method		Hypothetical applications to air pollution

2.2. Techniques Based on Actual Market Prices of Good and Services

It is always preferable to use techniques that rely on actual market prices when such prices are available. By observing the values placed on goods and services in the marketplace, we can learn a great deal about the revealed preferences of consumers. A number of common techniques use this approach.

The change in the value of output approach uses market prices to value physical changes caused by a project. These changes can occur both on-site and off-site. For example, an upland watershed stabilization program may have an external, environmental benefit — increased production in lowland fields due to better and more plentiful irrigation water. The value of this increased production is one measure of the benefits of the project.

Another approach is to examine loss of earnings. In a Bangkok example, a leather tannery produced toxic wastewater. A water treatment plant would cost ฿ 12 million; was it worth building? Presently the toxic wastewater causes illness, lost work, and medical expenses for nearby residents. In an analysis of the proposed plant, the value of lost earnings saved and medical costs avoided if the treatment plant was built was used as one measure of the plant's benefits. In addition, increased edible fish production was valued (change in value of output). The analysis showed that the proposed treatment plant yielded direct benefits that were larger than the plant's cost. In addition, there were other unknown or unquantifiable environmental benefits. The treatment plant was built.

2.3. Techniques Based on Market Prices of Environmental Protection Inputs

Sometimes it is not possible to accurately measure or value an external or environmental quality effect. In other cases, a decision has been made that a certain level of environmental quality must be maintained (e.g. to protect human health). In these and other cases, the analysis can focus on the costs involved in meeting set emission or ambient environmental standards or in mitigating negative effects and thereby give guidance concerning policy alternatives.

Cost-effectiveness analysis is a commonly used economic and engineering approach. It merely seeks the least-cost way of meeting some standard or goal. What is at issue here is that this approach can also be used to assess or value the costs (or benefits) of actions that reduce external or environmental negative effects. In one case study in Bandung, Indonesia, the city's textile mills produced large amounts of wastewater that damaged crops, killed fish and created other environmental ills. The analyst focussed on a variety of water treatment options ranging from mill by mill treatment to a central sewerage system. The most cost-effective solution, a modified central treatment plant, was recommended to the municipal authorities.

Another cost related approach is the preventive expenditure approach. In this case, the money spent by individuals or firms to counteract a negative environmental effect is used to place a value on the benefits of preventing the negative effect. These preventive expenditures are a minimum valuation of the costs imposed by the negative effect. In an airport example, a study was done on the cost

incurred by nearby residents to soundproof their homes. This preventive expenditure was then compared to alternate ways that the actual aircraft generated sound could be decreased (sound barriers, engine modification, runway realignment). Both pieces of information were then used to reach a decision on the control measures to be adopted.

The replacement cost approach is a related technique. In this case, the costs of physically replacing damaged or lost goods or services are a measure of the minimum value of preventing these losses. A large factory is near a public golf range, for example, and golf balls occasionally fly over and break windows. These windows are replaced at considerable cost in time and materials but it is not possible to identify the golfer causing the damage. These replacement costs can then be compared with the cost of installing a high wire mesh screen to prevent breakage of windows.

2.4. Techniques Based on Surrogate Markets

A whole range of techniques is based on surrogate markets, that is, the good or service in question is not readily monetized so an alternate or surrogate good or service is used as a proxy for it. These surrogate goods and services are sold in the market and therefore prices can be observed. This concept is best illustrated by use of examples.

The property value approach uses the prices of land, houses or other real property to place a value on a changed environmental variable. The old real estate law that the three important determinants of value are "location, location, and location" is a reflection of this. In one study in Boston, for example, the value of thousands of houses was analyzed and strict efforts were taken to match houses with similar physical characteristics — number of rooms, type of construction, access and other variables. The one variable that did change was the level of air pollution and, not surprisingly, the value of similar houses in polluted areas was less than in cleaner areas. This information can then be used to value the benefits from decreased pollution (the costs of pollution control are much more easily calculated).

Wage differentials are another way to place values indirectly on environmental quality effects. If some jobs are seen as unpleasant, hazardous or otherwise undesirable a wage premium may be required to entice workers. This differential gives some indication of the value or compensation demanded because of these effects. There are many complications with this technique and many of these are discussed in the Guide.

A more direct method to estimate the benefits of environmental improvement or maintenance is the travel cost approach. Usually used to value outdoor recreation locations (parks, rivers, cultural sites), this technique uses information on visitation rates and the cost of travelling to a site to construct a demand curve. From this curve, the area of "consumers surplus" received by users can be estimated. This may be very large even though the users may pay nothing to use a site and therefore the site has no observed market value. This approach is particularly useful in evaluating recreational areas where no, or only nominal, admission fees are charged.

A related technique relies on the value of marketed goods as environmental surrogates. A city may provide a free public playground with pools and play area; the area is heavily used but generates no revenue. How much is this service worth? One way to help value this is to examine the use rate at a private amusement area that charges a substantial entrance fee. This helps value the "consumers surplus" or welfare enjoyed by the present users of the public park.

In all cases involving surrogate markets, the information is useful for both valuing the environmental good or service under consideration as well as in helping decision makers to decide how much it is worth spending to maintain or improve the resource. This information can be a valuable aid in helping maintain and extend environmental goods and services to the public.

2.5. Hypothetical Valuation Techniques

The last set of techniques are based on surveys or hypothetical valuation. In this case, actual behavior is not observed. Rather, people are questioned about their willingness to pay to retain an environmental good or service or their willingness to accept compensation to give up that right. Other techniques use trade-off games to examine choices among different bundles of goods. The Guide has a listing of the various techniques and discusses the various biases that may occur.

The most commonly used survey technique is the bidding game. In this, the person interviewed participates in a bidding process to determine willingness to pay or compensation demanded. In one version users of a public park are asked if they are willing to pay $10 per year to keep the park open. If they are, the amount to be paid is raised in increments (of maybe $1 per year) until they respond negatively. If the initial response to the $10 bid is negative, the reverse procedure is followed until a positive response results.

Trade-off games use a different approach. In these cases, the person interviewed is offered a choice between several goods, one of which is an unpriced environmental good and the others of which are marketed goods. By observing which choices are made and varying the choices, an implicit value can be placed on the unpriced good. In a simple case a person is asked whether he or she prefers $10 or a 20% reduction in background noise level for one year. The choice is recorded and other people are given the same choice or other choices in which the amount of cash is varied but the 20% noise reduction is fixed. This information is then used to determine an average per person value of 20% noise reduction.

In all valuation attempts, the use of directly observed market prices is preferred. Hypothetical valuation techniques can frequently be very useful if carefully done and research is underway to extend the reliability and usefulness of this approach. These techniques are especially useful in valuing certain intangible environmental quality effects such as natural beauty and wilderness experience.

3. A CASE STUDY OF ECONOMIC VALUATION

There is no doubt that considerable skepticism exists over the use of these approaches to economic valuation of environmental quality

effects. For this reason, the burden is on the economist to show how these approaches can be used to place values and help make decisions about the allocation of scarce resources. The casestudy workbook was developed to help meet this need.

As an example, the results of a study of Lumpinee Park in Bangkok are presented here. Lumpinee Park is a large public park in a crowded city. It is heavily used by Bangkok residents for recreation and relaxation. Since no admission fee is charged it generates no revenue. Its location, however, makes it a highly desirable site for commercial and residential development — developments that could mean municipal income from land sales, taxes and other lease rent.

To place an economic value on the park, a study was carried out that used both the travel cost approach and a survey technique, the willingness to pay approach. The details are presented in the casestudy workbook and the results are summarized below.

The travel cost approach was used to determine the value placed on the park by users. Over a period of days, park users were randomly interviewed to determine their frequency of park use and their expenses in travelling to the park. Since no admissions fee was charged, the only "cost" to using the park was that involved in getting there. Not surprisingly, the farther away from the park people lived the fewer visits they made to the park. This information was then used to construct a demand curve for park visits and, by statistical analysis and by making the assumption that people would respond to an admissions fee in the same way as they would to increased travel costs, it was possible to estimate the "consumers surplus" or welfare benefits enjoyed by Lumpinee Park visitors. This surrogate market approach yielded a yearly value of the park of 11.9 million Baht (about $500,000).

The second technique relied on interviews with people from all over Bangkok. The people were interviewed at their homes and were asked how much they were willing to pay per year to keep Lumpinee Park open to the public. Adjusted for population distribution, this approach yielded a yearly value of 30 to 38 million Baht ($1.3 to $1.7 million). This estimate is higher than the travel cost estimate in part because it includes an element of "option value". That is, people are frequently willing to maintain a natural resource or amenity such as a park even if they don't use it because they like knowing that they have the option to use it if they so choose.

In this case study, two techniques were used to place a value on a free, natural resource — Lumpinee Park. The two estimates represent yearly use values and would have to be capitalized to determine the loss in economic welfare if the park was destroyed. These estimates place a minimum valuation on this resource. There are obviously other benefits that have not been included such as the value of a green, open space in a crowded city, the esthetic benefits of the Park, and its function as a natural system for use by birds and other wildlife. For these reasons, the information provided by these two approaches can be seen as aiding the decision maker in evaluating various potential policies for the use of the park.

In this way, economic valuation has an important role to play in the process of assessment and planning of our natural resource base. As new valuation techniques are developed, they can be combined with

our expanded understanding of the interrelationships of projects and natural systems to lead to development that is both sustainable and helps conserve and protect valuable environmental resources.

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