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# ***Staff Paper***

## **Economic Analysis and Efficiency in Public Expenditure**

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## **Economic Analysis and Efficiency in Public Expenditure**

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### **Abstract**

Benefit-Cost Analysis involves several steps: development of a program information structure (product categories), estimating the production function, pricing benefits and costs, adjusting for opportunity costs, choice of investment criteria, and incorporating uncertainty. Each step involves conflicts of interest that can only be resolved by political (collective) choice of property rights assigning opportunities to the various interest groups. The rules of benefit-cost analysis for public expenditure are equivalent of private property rights established by legislative and court decisions for the market economy. The traditional separation of technical analysis and political choice is not longer tenable. Theory and practice point to a more interactive, iterative relationship between analysts and politicians.

27 pages

# Economic Analysis and Efficiency in Public Expenditure

by A. Allan Schmid<sup>i</sup>

Cost-benefit analysis (CBA) is a set of economic tools used to evaluate the budget size and content of public spending and regulation. Economists are divided over the extent to which CBA can be an independent and authoritative guide to political choice. It is widely used in practice by many governments to evaluate large-scale public infrastructure projects such as roads, bridges, airports, harbors, and water control. It is also used for education and health projects. Increasingly it is used to evaluate regulatory actions. Politicians are also divided as to the use of CBA. They are pleased if the analysis supports what is politically attractive and they tend to ignore the analysis if it is not. It is used much more for identifying a list of projects with positive net returns than for ranking projects when budgets are constrained. This review will put cost-benefit analysis tools within a constitutional and institutional framework.<sup>ii</sup>

CBA distinguishes economic from financial analysis. Since a major rationale for government expenditure is to improve upon the performance of the private commercial sector, certain things are accounted for in an economic CBA that would not be in a private financial analysis. There are several contenders for how this is to be done. It will be seen that neither a financial nor an economic analysis escapes judgments of a political character as to what constitutes an improvement in social welfare.

One school of thought promised to make an independent assessment of efficiency without any instruction from the political authority, who was assumed to be interested in maximizing economic product. There have been several attacks against this position. One was an objection on distributive grounds (Ball, 1979), (Campen, 1986), (Adler & Posner, 1999). The hard line defense was to say that distribution was a separate political matter, and for optimal results, government should redistribute income on a lump-sum basis if it so desires, and not interfere with provision of goods and services. If this line could not be held, some economists were willing to have the benefits to some designated parties politically weighted.

I. M. D. Little and J. A. Mirrlees (1974) argued that the analyst could not independently substitute shadow prices for nominal prices affected by taxes, tariffs and exchange controls without asking for the intent of politicians. If the intent of these policies were corrective of income distribution, then it would be value presumptive for the analyst to replace nominal prices. Earlier Little (1957) critiqued the use of consumer surplus in making welfare comparisons. The theoretical tool which Mishan (1988) and others called the distinguishing feature of policy oriented CBA, Little called a context for political decision. This will be elaborated below in a section on non-marginal projects.

The second attack on analysis made independently of political input is relatively new and comes from those who prize environmental goods and services that do not usually have market prices and accrue to future generations. These products (both project inputs and outputs) did not get fully accounted for (Daly, 1991) (Pearce & Nash, 1981). This seemed to provide an opening for political pricing, but the gap was putatively closed by travel cost and hedonic methods and contingent valuation surveys. The faith in authoritative welfare economics seemed to be renewed by the promise that economists could find new ways in which people inadvertently revealed their

preferences, or these could be measured and aggregated directly and without the bias that politicians introduced when listening to voters.

Another attack upon independent authoritative analysis came with the work of Robert Sugden and Alan Williams (1978). They argued for a "decision-maker's approach" which required some explicit input from the politicians. Also see (Stilwell, 1999). The argument was strongest with respect to the discount rate, which Sugden and Williams said could only be a matter of political choice and not a matter of data to be discovered by the analyst. This decision-making approach was sharply critiqued by E. J. Mishan (1982) who in a review said that much would be lost if the economist could no longer be regarded as independent and authoritative. This critique was made in spite of the fact that earlier Mishan had argued that for a project to go forward it must meet both tests of willingness to pay and willingness to sell (Mishan, 1981, 163). This advice makes ranking ambiguous without political input. In the 1988 edition of his book, Mishan says, "I virtually forswear earlier endeavours to base the Pareto criterion of economic efficiency on a consensus, or 'virtual constitution', which, if tenable, would render economic calculation, and economic ranking of alternatives, independent of the outcome of the (democratic) political process (Mishan, 1988)."

There has been a revolution in the theoretical welfare literature in the last 20 years that has not yet been fully felt in applied CBA. One its major ideas is the theory of second best. It says that if the prior income distribution is not politically acceptable, no welfare implications can be drawn from present prices. If costless lump-sum redistributions are not available, then redistribution via projects cannot be ruled out as inefficient. The same holds for the prices produced by imperfect capital and labor markets in disequilibrium. The gap between theory and application is nowhere better illustrated than in the work of Boadway and Bruce (1984). They demonstrate the limited applicability of first-best theory in a second-best world with many households with diverse preferences. Yet, in their last chapter devoted to CBA they limit their analysis to "projects which have no perceptible effects on the market prices for goods and factors of production in the economy" and assume that "the economy can be treated as if all persons are identical so that no distributive weights are needed (292)." In other words, they apply CBA to a make-believe, first-best world.

The basis for persistent disequilibria in capital and labor markets is another closely related theoretical development. Stiglitz (1987a) argues that information costs imply that markets will be in disequilibrium even if pure competition and no institutional constraints are present. This reasoning suggests that full utilization of resources is not simply a matter of enforcing competitive markets. Government projects and regulations are part of the everyday management of the economy and not created just to fill the breach of an occasional externality or business cycle slump. For example, disequilibrium means that everyone will not have the same marginal rate of time preference, thus necessitating some political resolution of the conflicting preferences.

Giandomenico Majone (1989, 15) has labeled authoritarian policy analysis as "decisionism". He says it assumes a unitary decision maker and is not applicable when there are two or more actors with different objectives. Decisionism assumes all conflicts have been settled and choice of projects or regulations is a technical puzzle to be solved rather than a political judgment to be made. Modern political science is often critical of the Wilsonian faith in technocratic government.

A nascent theory of behavioral economics also has implications for the role of technician and politician. The behavioral sciences remind us that people and their perceptions differ. The

analyst is just another observer with her own cognitions and it can't be assumed that conflicts in perception can be solved outside of the political process.

The literature now contains an applied CBA consistent with second-best welfare theory and the reality of a second-best world. The decision making approach has been extended to a fuller political economy approach where political input has a place appropriate for a democratic society and where no self appointed analyst elite usurps representative multi-level government unwittingly or otherwise.

The outline for such an approach can be sketched by considering in turn the major steps in CBA including establishment of a nominal accounting framework, estimation of the production function, direct benefit estimation, evaluations of non-marginal projects, opportunity cost adjustments for imperfect labor markets, time preference in the context of imperfect capital markets, and preferences for uncertainty adjustments. At each step the iterative interaction between political authorities and analyst will be indicated.

### **Input and Output Categories**

The first place where judgment is needed for analysis is in choice of the nominal input and output categories. Nothing can be priced unless the physical quantity of a set of characteristics is understood. This taxonomic choice involves the level of detail and aggregation of product characteristics. When is one product different enough to be given a separate name? Cost-effectiveness analysis presumes that the outputs are desirable and just asks how they can be most cheaply produced. But, even elementary cost-effectiveness analysis can not be done without agreement on whether the cost data is comparing products of equivalent quality. Since people differ on how similar is close enough, some political input is needed. Usually the content of product qualities is chosen by reference to statements of objectives in authorizing legislation. Some dialogue is needed between analyst and politician to establish construct validity (the relationship between qualitatively stated objectives and quantitative results). These are matters of judgment and not simply matters for a logician (Majone 1989, 47).

The issue here is analogous to that in industrial organization where one sign of non-competitive behavior is undue product differentiation. But, what is "undue" for one person is not for another and thus legislative and judicial guidance is needed antecedent to cost comparisons. This issue is the same as that involved in choice of program budget categories that facilitate or hinder comparisons between government agencies.

The issues in selecting output categories may be illustrated with the case of education. Most budget information presented to legislators is in terms of the costs of inputs—books, teachers, buildings and equipment. However, CBA requires information on outputs. What does education produce? The first measures that come to mind might be number of students taught in various subjects, contact and credit hours, and number of graduates. These are some of the measurable outputs but they tell us little about what the students can do. This might be measured by some aptitude tests that measure skill levels. Different tests emphasize different skills. In any case, it can be asked, what are these skills for. The answer might be conceptualized in terms of employment and income of graduates. But, keep in mind that not all of the sought after impacts of public projects result in a change in income. If an impact such as informed citizenship is omitted from an educational project's performance, it is as if the effect were priced at zero. The further we move along the continuum from inputs to intermediate outputs to final impacts on people's lives, there are more substitutes for any one agency's projects. There may be only one agency producing

credit hours in music instruction, but there are more that produce music appreciation and performance.

Just as CBA must account for non-marketed outputs, it must account for non-marketed inputs. And this too requires choice of categories. For example, a flood control project requires as an input certain wetlands. To price this input requires agreement on qualitative categories which might stop only at area of wetlands or of wetlands of different qualities, perhaps differentiated by the plant species involved and depth and frequency of water. Some environmentalists will want one taxonomy and some another. Before one can ask willingness to pay, one must specify the product.

If the input or output of a proposed project is similar to a previously evaluated project, the issue is what features make them similar so that the previous value can be applied to the goods of the new project (external validity). When you compare goods and say they are similar in all relevant dimensions, you are making a judgment about what is relevant, i.e., what makes them valuable. The names and categories of goods call attention to their valued features. In some cases the name itself differentiates goods. For example, in the private sector, different brands of aspirin sell for different prices. Chemically they are the same, but all consumers do not see it that way. An example in public regulation is the wide range in cost-effectiveness in rules that save lives. We save a life in one area and fail to save a life in another that would cost less. Either governments are woefully inconsistent, different lives saved have different values, or different lives are incommensurate. It is clear, for example, that a life saved in a dramatic fearful context (say cancer or a catastrophe) is regarded as more valuable than a life saved in what is regarded as background risk (such as auto accidents). Since goods cannot label themselves, their taxonomy has policy implications.

### **Estimating the Production Function**

There is much technical expertise in experimental design to establish whether the project input caused a change in output (internal validity). But, better designs cost more and some judgment is needed on whether the reduction in threats to internal validity are worth the cost. Definitive randomly assigned treatments (projects) are rare, which necessitates some qualitative judgment on the weight of the evidence behind alternative projects. These judgments are such that reasonable people may differ and settling differences is what politics is about. This judgment will be discussed further below in the context of uncertainty.

The following are threats to internal validity: history, selection, maturation, instrumentation, testing, statistical regression and experimental mortality (Campbell & Stanley, 1963). Before and after project comparisons are cheap but cannot rule out various explanations for changes in impact other than the presence of the project. A with and without analysis is needed. Various quasi-experimental designs can control for various threats to internal validity and constitute an academic specialization in itself. These include time series analysis, dynamic control groups, regression models, and pre-project and post-project control groups.

All quasi-experimental designs require specification of variables. This specification can be relatively straightforward in an agricultural irrigation project where we know the factors that must be isolated (controlled) to separate the water input from other inputs affecting crop yield. But these production functions are less well understood for many projects such as education and health. The relationship between inputs and some final impact on human wellbeing may be so poorly understood that there is no choice but to estimate intermediate outputs and value them even when their more ultimate consequence is not well known. For example, education analysts might be

forced to try to value the worth of a one point increase in a standard test score because the production function relating test scores to success in a graduate program and ultimately in skill levels and income of graduates are not understood.

*Ex-post* estimates of the production function are useful for two purposes. One is for accountability to determine if a project accomplished its objectives. It is also useful as input into evaluating a proposed project. A measure of the relationship between an established project and some change in output or impact is still only one point on a production function needed to evaluate a new proposal. To establish optimal size of a new project, at least several points would be necessary to indicate increasing and decreasing returns. In practice, analysts seldom have a production function and must make guesses on scalar questions.

External validity refers to whether the proposed project is enough like previous ones that the *ex-post* results can be applied. Often the input-output relationship was established in a pilot or experimental setting. When it is scaled up to field conditions, the results may differ. Project designers are always expressing their individuality and creativity, and often add features that they believe may enhance the project, but may actually reduce the results obtained previously.

### **Opportunity Cost Adjustments**

In many cases, available prices do not reflect opportunity costs and must be adjusted. The adjusted prices are referred to as *shadow prices* and arise in the context of taxation and tariffs, monopoly, subsidies, foreign exchange, and labor policies. The use of shadow prices is one of the differences between an “economic analysis” appropriate for public decision making and a “financial analysis” appropriate for a private firm.

Taxation and Tariffs. The first-best tax is a lump sum that does not drive a wedge between demand and supply prices. But such a tax is not feasible and adjustments must be made. The opportunity cost of an input or output depends on whether the project affects the total amount supplied or displaces a previously available unit. If the project output adds marginally to total supply of a consumer good, the appropriate shadow price includes the tax because it is what consumers are willing to pay. But, if the project output displaces a previously produced unit, the appropriate accounting value is the marginal cost of production net of taxes.

This reasoning, however, is disputed by Little and Mirlees (1974). They regard indirect taxes as correcting income distribution. They state, “taxation and subsidization of consumer purchases is a useful and socially desirable weapon of policy. Project planners and economic advisors have no general warrant to attempt to nullify the effects of that tax system (224).” For example, government may wish to reduce consumption of some market goods and increase investment or production of government goods. This tax may be a market corrective, and not a mistake. Treatment of taxes is not simply a technical issue where the analyst can assume that the government has made a temporary mistake and really wants to disregard its policies elsewhere.

If inputs are purchased for the project, the value is net of tax if the input constitutes added production. The opportunity cost is the marginal cost of production. But, if the input is in fixed supply and diverted from other uses, the value is what others would have paid for it including taxes. The question again arises whether the government was just raising revenue or was it trying to restrict private sector use of the input to obtain some policy objective. Knowledge of supply and demand elasticities is necessary to calculate whether the inputs and outputs represent additions or diversions. In practice, this knowledge is costly to acquire and many agencies ignore taxes altogether.



A tariff is just another form of tax. For goods traded internationally, the shadow price is the border price (f.o.b.) for exports and c.i.f. for imports (Little and Mirlees, ch. 12).<sup>iii</sup> This shadow price reflects opportunity cost of production when imports are substitutes. Again, the intent of government policy must be considered. If project output would lower prices to domestic producers outside of the project who are favored intentionally (perhaps infant industry protection), then the government does not want new output even if it were cheaper at the moment.

Monopoly and Economies of Scale. A monopoly price above a competitive equilibrium price is a kind of private tax and the same principles apply as noted above. Where marginal costs of production are relevant, an additional problem arises with decreasing cost industries. Such firms cannot price at marginal cost because total costs could not be covered except by taxes. Consider the evaluation of a public waterway project that replaces traffic on a private railroad. The price charged by the railroad necessarily reflects average cost. The cost saving by serving the diverted traffic with the project instead of the existing railroad is the marginal, not the average cost. (This situation raises a distributive issue in that the remaining users will now face a higher average price since total cost is divided by fewer users). If there is a projected shift in demand for transport services and the railroad is at capacity, then the added project output is valued at the old price. The expected demand curve is the key information needed.

Foreign Exchange. The values of project exports and cost of project imports are influenced by foreign exchange rate policy. In theory, the market for currency should adjust in value so that the value of exports tends to balance imports in the long run. In practice, this equilibrium may not occur. The United States has perennial trade deficits even with floating market-determined exchange rates. Many poor countries aggravate their foreign trade deficits with exchange controls, quotas and tariffs over the objection of the International Monetary Fund. If a country accepts its current income distribution and wants to maximize the value of consumption, the imports used in the project that might have gone to private consumers should be valued at what the good would sell for in the domestic market in domestic currency, although it is higher than expected without controls. Shadow pricing assumes that the government wanted to achieve the results it would have obtained with a general devaluation. But this raises the question of why government used quotas and fixed rates in the first place. The issue again is whether the government's policy is a mistake or a corrective. Governments want to do more than reduce trade deficits; they want to shape the allocation of access to available foreign currency. Dasgupta et. al.(1972) state, "The shadow price of foreign exchange thus depends on how increments of foreign exchange will be divided among alternative uses, not on the wishful thinking of the project analyst who perceived (or misperceives) the irrationality of the overall policy framework in which he operates (Dasgupta & Pearce, 1972)."

Foreign exchange policy and monetary policy interact. A country might try to reduce imports by devaluation or quotas, which will raise import prices in the domestic currency.. The government may accommodate consumers who want to maintain their consumption with an increase in the money supply. The resulting inflation will not reduce imports as expected. Foreign exchange policy can be defeated by monetary policy. CBA is not independent of macro policy, even if World Trade Organization rules and treaties tend to only look at exchange rates and tariffs.

Unemployment, Labor and Wages. Disequilibrium in labor markets is another context in which analysts compute shadow prices to replace nominal prices paid to the unemployed. Involuntary unemployment means that the opportunity cost of labor used on a government project is less than the going wage. If labor produced nothing without the project, then there is nothing lost if put to work on the project. The shadow price is zero. In perfect markets, a decline in aggregate demand would result in lower marginal product of labor and thus lower wages. But in practice,

wages are often sticky and the unemployed do not or cannot offer to work for less than the prevailing wage. Stiglitz (1987a) argues that information costs prevent employers from hiring labor even when its marginal value product exceeds the wage. Lowering wages may decrease the average quality of labor and thus is not in the employer's best interest.

There is both academic and political debate over the existence and implication of involuntary unemployment. Some prefer to maintain the pressure for deflation rather than increase public spending and projects. Employers who experience sustained demand for their product even in general recessions would prefer lower wages and do not want the government to provide an alternative source of employment. Some object to government spending and borrowing in principle and do not want more projects during recession. Some believe that there is no such thing as involuntary unemployment and if labor will not work at lower wages, then it values leisure highly and deserves what it gets. If governments want to trade off full use of available labor to obtain other objectives such as reducing redistributive inflation, increasing corporate profits, or increasing its foreign competitiveness, it does not want to have labor priced below nominal wages. Even if a shadow price were used, the implied increase in public projects and aggregate demand could be offset by reducing the money supply. [Pearce, 1981 #781] 109

In practice, many U.S. agencies use a zero opportunity cost if a project uses unemployed resources. But some analysts make adjustments for the value of home production and part-time work. The chance of a project to draw from the unemployed pool is a function of the required and available skills and the rate of unemployment (Haveman & Krutilla, 1968). The issue is most contentious in developing countries. Lewis (1972) argued that it would be possible to move agricultural labor to public projects with no reduction in agricultural output. However, Stiglitz (1987b) recommends a price above the agricultural wage for urban projects because urban labor is often already excessive from mistakes in migration to non-existent jobs. This rural to urban migration may cause congestion and volatile political protests. More public projects could exacerbate the problem. These raise fundamental policy issues.

Intersectoral Interdependence. The utilization of labor caused by the project is more than that involved in construction and maintenance. A project has indirect effects on suppliers of inputs and the processors of outputs. Each of these in turn has suppliers. An input-output model can trace these linked activities stimulated by the project. The model contains a series of linked data of who buys from whom to produce another unit of output. A row in an input-output table shows purchases per unit of gross output. For every dollar of sales from a given industry it buys inputs from other firms and households. These are the first round or direct requirements and they can use unemployed resources. Inputs are needed in turn to produce these direct requirements and so on. These subsequent rounds are called indirect requirements. The sum of direct and indirect requirements is called an interdependency coefficient and is displayed in the Leontief Inverse matrix. Income multipliers are needed for project evaluation. This so called Type I multiplier indicates the direct and indirect income changes emanating from a dollar of increased sales of each producing sector. This income is then spent and the induced production of consumer goods further expands the economy. A Type II income multiplier is a ratio combining the direct, indirect, and induced coefficients. This ratio is a large multiple of the original project output.

The input-output tables are a snapshot of a moment in time and do not necessarily indicate what would happen with expanded output in one sector. If economists could easily predict supply responses to new demand, much of the economic development problem would have been solved long ago. To allow for frictions and bottlenecks, most analysts only use the Type I multiplier. They do not assume that the economy is perfectly coordinated (Haveman & Krutilla, 1968). Once

we have the income multiplier, it must be converted to an employment multiplier. Then the chance of the new activity using unemployed resources nationally and in a region where the project is located must be estimated.

Part of the answer to the question of frictions and bottlenecks lies in the incentives for the potential direct and indirect inputs to be produced. An agency may brag upon all of the activity its project has made possible. But, this activity must be rewarded or it will not happen. For example, a flood prevention dam allows expansion of farming and processing. But these cannot happen without complementary investments in such infrastructures as roads, education, and health. From the perspective of other public agencies, it is their projects that made possible the farming and the returns to the dam. The multiplier can be calculated from any point and not every agency can count the same effects. There is no technical answer to the question of allocating credit for employment multipliers. Just as there is no marginal product for complements, credit for the contributions of complementary investments is necessarily partly political. Evaluation, planning and coordination are interdependent. Economic development is more complicated than just ranking individually considered projects and assembling them into a budget.

Regional unemployment. There may be sectors and regions of substantial unemployment even if the total economy is nearly fully employed. The shadow pricing of resources in these regions is problematic. Some argue that it is only a question of time when the resources will move on their own, thus obviating the need to bring jobs to them. Or, a retraining program may be preferred to finding projects that can use the available skills. The culture of nations and regions differ in their attachment to place. Governments that accommodate to place preferences will want to shadow price the unemployed labor. Others will not. Immobility of people may be related to immobility of some of their goods. If a region depopulates, there may be large losses in the market value of their houses and the output of community infrastructure.

Summary. All are agreed that decisions should be made in terms of opportunity costs, but whose? The price of labor on public projects cannot be separated from the objectives of macro policy, which are a matter of political conflict. A government that intends to put downward pressure on wages may purposely create unemployment (or take advantage of it when it occurs). The last thing they want is for the project agencies to have larger budgets as a result of higher net returns when wages are computed at some shadow price instead of the higher market price.

The distributive issues can't be settled in a separate transaction. In a second-best world, the government is likely to want to pay the nominal wage. For example, in the U. S., the Davis-Bacon Act requires it. If projects are built using shadow prices that would not otherwise be built, they are the occasion for some taxpayers to make transfers to project labor.

### **Pricing Benefits and Costs**

Analysts are called on to supply prices when project inputs and outputs are not marketed. This problem requires inferences from indirect evidence of willingness to pay that is the essence of the economist's technical expertise.

Analogous Good Method. One of simplest methods is to reason from the price of an analogous good to that of the non-marketed project good. This approach returns to the first topic above, namely to establish that the goods are perceived as comparable.

A common application of the analogous good method is to projects that increase human longevity. People are in effect purchasing longevity when they buy products that reduce risk or trade reduced income for increased longevity. The inferred value can then be used to value projects that increase longevity. The difference in income in jobs of different risk is a measure of the

willingness to pay to reduce risk. The method depends on the analyst's ability to control for other factors affecting income differences (Freeman, 1979).

Intermediate Good Method. Even though the output of a public project is not sold, the output may be an input into the production of a good that is sold. The method requires the estimate of an enterprise budget with and without the project. It requires data on the production function including all inputs and their prices, and the price of the final non-project product. Project gross benefit equals the change in net income. It is what the user of the project output could afford to pay for an input into the user's activity. A flood control project is a common example. Flood control is a high exclusion cost good and cannot be marketed directly because of free riders. But flood control changes net income from farming in the flood plain. The method is also widely used to evaluate education and training programs. The benefit is the change in net income of the participants with and without the program (Hardin & E.Borus, 1971).

A human capital conception is commonly used in valuing life in the context of safety projects and regulation. Life can be viewed as input into income production. Mortality and morbidity reduce lifetime earnings. The health project output may not be marketed, but it is input into labor that is marketed. A number of political issues arise. Should consumption or total income be the correct measure (Jones-Lee, 1976)? Should the measure be based on objective historical data or individual subjective estimates of participants (Akehurst & Culyer, 1974)? Should all impacts be monetized (Viscusi, 1996)?

To use the opportunity cost of lifetime earnings as a measure of project output value is to make a political choice of property rights and income distribution (Kelman, 1981). The practice includes a decision to put the potentially harmed person in the position of a buyer of safety rather than a seller entitled to be free of harm. This approach raises the first-best vs. second-best question. If income distribution had all been settled or one could obtain the desired distribution outside of projects and regulations via costless transfers, then the human capital approach would be unambiguously Pareto-better. The same point can be made with respect to environmental products.

The value of the intermediate project good can be derived from linear programming which estimates a shadow price for any input whose use is constrained below the optimum level. For example, if farmers are constrained in fertilizer use because of concern for ground water quality, a linear programming model will estimate the reduction in income (value lost because of an inferior input substitution). The income lost is the opportunity cost of regulation to be compared to its benefits.

Cost Saving Method. A current expenditure is evidence of willingness to pay. If the project can reduce expenditures that would otherwise be made, this is a benefit. If the project is a perfect substitute for a former expenditure, the saving is a measure of gross benefit. A common application is in transportation projects (Harrison & Quarmby, 1974). A project may substitute for an existing mode of transport and save fuel, time, wages of drivers, repair to equipment, and capital costs of goods in transit. Another application involves damages avoided and reparative expenditures. If there is effective demand for the repair, then its avoidance is a benefit. Medical care is an example. The prevention of an injury for which medical care would be required is a benefit.

Differences in human perception create the need for political resolution. For example, the cost saving method commonly used in transportation project evaluation requires a choice between the analyst's perception of time saved and that of the actual users of the transportation. The same problem arises in the context of exposure to hazardous events. Sugden and Williams (1978, 179) give the label of "merit goods" to products that people would want if they understood their best

interests. Whether this approach represents desirable caring or paternalism requires political judgment.

Access Cost-Quantity Demanded Method. Another opportunity to infer the value of project output is when consumers face different market-valued costs of access to a non-marketed good. Travel costs to gain access to recreational goods is an example and the method is often referred to as the travel cost method although other access costs are possible (Smith, 1971) (Bockstael, 1995). The method works best when applied to a specific site that is the main purpose of a trip. The travel and time costs are estimated for different distance zones and the rates of attendance from each zone gathered. It is then assumed that if a person with no travel cost were asked to pay an entrance fee equivalent to the costs faced by others, their quantity demanded would be similar. It must be assumed that people respond to the total cost regardless of its composition. Statistical models can be developed to control for income and other socio-economic variables thought to affect demand (Gum & Martin, 1975).

The conversion of hours spent to dollars is a problem if there is disequilibrium in labor markets. The wage rate may not indicate the marginal value of time or money for people with all or nothing fixed hours (Bockstael, Strand, & Hanemann, 1987).

Rent and Hedonic Price Models. In the above discussion of access cost-quantity demanded method (travel cost), value is inferred from different behavioral responses to variations in the cost of a market valued good controlling access to a publicly provided good. It is also possible to compare the prices paid for different goods with differential access to a publicly provided good. For example to benefit from an environmental amenity, one must pay more than for an otherwise similar good without the amenity provided by public investment or regulation. A house overlooking a public park will have a higher price than one of similar size some distance away. This economic rent (return above opportunity cost) is direct evidence of willingness to pay. For a producer's good, it is the capitalized present value of the flow of expected future income from the better situated land.

Valid measures require that the market be competitive and buyers mobile. This requirement will insure that no user surpluses will exist when a new equilibrium is reached after implementation of the project. Then any increase in utility or factor returns gets translated into observable differences in rent. For example, if air quality were improved in a slum area and no new buyers were available to bid up the prices, then utility perhaps increased but it is not observed in market prices.

Regional boosters often claim large benefits from a project that attracts new migrants and business. They cite increases in land values around the site but ignore changes in rents off site. Only the *net locational advantage* of a site contributes to national income. For example a business may move and thereby decrease rents in its old location and increase rents in the project area. It is only the change in the business net income with and without the land enhancing project that is a benefit, and not the before and after rents at the project site. Freeman concludes "in general, property value changes can be interpreted as benefits only when there is some mechanism to assure that there are no economic surpluses accruing to households, and when there are no changes in wages or other factor prices (Freeman, 1979,151)." Also see (Hoehn, Berger, & Blomquist, 1987).

In many cases, land rent is embedded in the price of a multi-attribute product. These other attributes can be controlled in a *hedonic equation* and calculation of the implicit price of the project produced attribute. For example, to estimate the value of a project that enhanced air quality the value of housing ( $X$ ) is related to air quality ( $Q$ ) and a number of other variables such as number of rooms ( $C_k$ ) and lot size ( $C_j$ ). The implicit price function is:

$$P_{X_i} = f(C_{ik}, C_{ij}, Q_i)$$

The implicit price of the project enhanced characteristic can be found by differentiating the implicit price function with respect to that characteristic. This differentiation gives the increase in expenditure of (X) that is required to obtain a house with one more unit of air quality *ceteris paribus*. See (Harrison & Rubinfeld, 1978) and (Freeman, 1993, ch. 11).

Contingent Valuation. Instead of inferring values by past choices, people can be asked directly of their willingness to pay. This method is the only alternative for new products. People can be asked their maximum willingness to pay for various quantities of a good (Cummings, Brookshire, & Schulze, 1986) (Bateman & Willis, 1999). The sample data can be projected over a relevant population of users of the project and a demand curve estimated. This approach is often called the contingent valuation method because the values obtained are contingent on the interpretation of hypothetical markets and products. The responses are known to be affected by choice of the survey format, reminders of alternatives, starting place bidding values, product description and familiarity.

As these individually constructed studies accumulate and are put before decision makers, there is a question of additivity and whether the consumers budget constraint is fully operative (Brown & Shogren, 1998, 12). In theory, consumers always have in mind all the ways they might spend their income. But in actuality consumers are affected by the sequence in which items are called to attention. In grocery stores, sales of an item can be affected by placement in the store. It might be referred to as the “end of aisle phenomenon.” This phenomenon is no less true in politics.

The use of contingent valuation (bidding games) requires the resolution of political questions.<sup>iv</sup> The process can't begin unless it is decided whether the question is willingness to pay or sell. As noted in another context above, this is a basic property rights question that is antecedent to market exchange or any simulation thereof. The framing of the questions, the anchor point, and the degree to which opportunity cost tradeoff is made explicit all are known to affect the resulting prices. Legislators seek membership on the rules committee because control of the agenda affects outcomes. Economists at least since Kenneth Arrow (1963) also understand that grouping of issues (order of vote) affects the formulation of winning coalitions. Yet, this is ignored when analysts go off by themselves and make an independent contingent valuation study without political input.

The parallels between surveys (contingent valuation) and a politician sampling and acting upon constituents' preferences is striking. Both processes are subject to the same issues of sampling, framing, and aggregation. Both involve issues of property rights. Some economists are willing to rewrite the constitution and promise to independently measure the revealed “true values” of sovereign voters. Others say, “there may be no single ‘true’ behavior if preferences vary across time and between choice-making circumstances (Shabman & Stehenson, 1996, 441). The question of true value is not simply a problem of principal-agent. Rather, the issue is the aggregation of the preferences of multiple principals and the dynamic learning environment of the principals whose preferences are evolving. After reviewing the effect of alternative framings of willingness to pay questions, McFadden (1994, 706) concluded that “The experiments display patterns that are more easily explained by ‘constructed’ preferences rather than by rational individualistic stationary preferences.” An extended argument is not possible here, but there is nothing inherently superior about market prices or prices inferred from indirect evidence of willingness to pay or surveys vs. administrative prices, i.e. reservation prices set on publicly owned resources or bid prices to acquire resources for public use (Schmid, 1989) (Vatn & Bromley, 1994). If it is legitimate for the legislature to change property rights and generate alternative prices in the market, it is legitimate to choose those prices directly under one constitution or set of political rules (or surveys) or another.

Existence and Option Benefits. The methods described above are applied to the active use of goods. People also value the passive use of goods. They derive utility from just knowing that something exists. For example, people may derive satisfaction from knowing that giant redwoods exist even if they never plan to see them. This is referred to as *existence value* (Krutilla, 1967).

People may value an option to utilize a good. Just as investors buy a stock option that they may or not exercise, people value a project or regulation that preserves an option to enjoy a product such as the environment, a hospital, or a transportation alternative. Further, it may be desirable to delay taking an action that would be costly to reverse. The term *quasi-option value* can be used to describe differences between the expected value of delaying an irreversible decision and the value of adopting it immediately (Arrow & Fisher, 1974). Purchase of this option allows for learning and changing preferences. Contingent valuation is typically used to measure existence and option benefits (Vining & Wimer, 1998).

### **Non-marginal Projects**

Some projects and regulation are large enough to cause a change in prices of the output and inputs. A non-marginal project may depress prices such that it has no net benefits. Yet, consumers are better off. Many applied economists measure this welfare change with an estimate of the *compensating variation (CV)* defined as the maximum willingness of an individual to pay that would keep them on the same utility level as before the project. Alternatively, the welfare change could be measured with the *equivalent variation (EV)*, defined as the willingness to accept an amount that would maintain the same utility level as obtained after the project. It is the income necessary to forgo the benefits of the price decrease. These measures need not be the same (Hanemann, 1991). They differ because of income effects, substitution effects and loss aversion. CV is limited by a person's income while EV is not. Mishan (1976) advocated that a project must have net benefits using both measures.

EV and CV require holding utility constant and are difficult to measure empirically. Consumer surplus (CS) approximates EV and CV and is more tractable, but has its own conceptual problems. Consumer surplus is the amount that a consumer would pay over actual payment. It is represented by the area under the demand curve and above the price (the total area under the demand curve for a non-marketed good, which is then compared to cost of the project). Empirical measurement is complicated to account for changes in the prices of multiple other goods, path dependence as a function of the alternative sequences of change in the various prices of substitutes and complements, adjustments in the quantity demanded if maximum willingness to pay is extracted for intra-marginal units (compensated demand curves), income effects, and multiple period analysis to account for learning, and consumer adjustments. Slesnick argues that these and other considerations are theoretically, conceptually tractable for the individual consumer, but there remain severe data problems in practice. Use of household data requires a "large number of observations on household demand that include information on the prices paid for the goods....further application of these methods will require the parallel development of alternative data sources (Slesnick, 1998, 2124)."

The use of consumer surplus for project justification is equivalent to a firm being a perfectly discriminating monopolist. The amount of consumer surplus that such a firm can extract depends on whether other firms are also trying to do it (Hoehn & Randall, 1989). Not all firms, whether private or public, can simultaneously extract the consumer surplus that is estimated for each one acting alone assuming no one else is trying. As Samuelson (1963, 197) once noted, some otherwise bankrupt firms would have survived with price differentiation.

Even if the conceptual and empirical problems of measuring CV, EV or CS for an individual are solved, it is quite a different matter to aggregate them into a measure of social welfare. This question is addressed in the social welfare section below.

### **Valuation over Time**

Projects have different cash flows over time, differ in size and length of life. To compare projects there must be a common denominator. It is the capital market that allows any particular cash flow (with negative and positive values) to be converted to reference standard. One can borrow to bring consumption forward or lend to delay it to the future. A short project can be made comparable to a long one by reinvesting the proceeds. The critical element to this process is the rate of time preference.

A unit of value can be consumed now, or invested and consumed later. If it is consumed now, it may be inferred that the utility now is greater than the utility later even if the number of units is greater. There is always a reference rate of transformation of present to future values. It may be the rate of interest on a savings account or bond. If the future value is rejected, it implies that the rate of growth in value produces less utility than present consumption. The project competes with consumption and other investments. The project's ability to transform today's income into tomorrow's is compared to the utility of consumption and alternative investments. So if a person has a time preference of 10%, that person will prefer consumption or alternative investments unless the project can transform today's income (project cost) into future consumption at a rate greater than 10%. Tomorrow's cash flow is discounted by the rate of time preference. The rate or speed at which the future consumption is discounted backward can be expressed as  $1/(1+r)^t$  where  $r$  is the rate of discount and the exponent  $t$  is the year in which income is received. If the discounted value of the project is less than one, it is rejected. Alternatively, one can think in terms of terminal values of the longest available investment. The project (or alternative investments) is transforming or compounding present values into future values. Unless the project can do a better job of compounding, it is rejected. Compounding or discounting at the same rate of time preference is a symmetrical process. An amount compounded forward to a terminal value, and then discounted at the same rate produces the same value starting place. (More on investment criteria below.)

Differences Among Individuals. A person's time preference varies with their present and expected wealth and its certainty, age, impatience, and concern for future generations. Generally we expect poor people to have a higher time preference than the rich. Still, if all had access to the same capital markets and could borrow or lend at the same rate, they would have the same *marginal* rate of time preference. A person with the higher rate will be a borrower and the person with the lower rate will be a lender until their rates converge in general equilibrium. In practice, capital markets are not perfect. People cannot lend and borrow at the same rate because of risk and transaction costs. Lenders may ration credit. Different amounts of savings earn different rates of interest. Individuals face different tax rates that are not proportional to benefits. Differences in marginal rates of time preference can persist and government will have to choose between rates preferred by different people.

Cost of Capital Approach. Differences in time preference among individuals would not matter if government made decisions according to its cost of capital. As long as the government project has returns greater than the cost of its capital, it can make people with different time preferences better off. However, they will differ as to the means of financing (Sugden & Williams, 1978). Assuming a project is to be undertaken, persons with a marginal time preference lower than



the government's cost will prefer to be taxed since they do not have as good an opportunity as the government. Persons with a higher marginal rate will prefer government borrowing since they have better things to do with their own money. Further, individuals with different rates will differ over project ranking because they would want to use different rates for reinvestment compounding to compare projects of different lengths.

Nevertheless, if the cost of capital is what policy makers want, what is it? Some suggest it is the after-tax rate of return on long-term government bonds (Lesser & Zerbe, 1998, 256). The length of term is usually left vague since projects are of differing lengths. Is this to be the nominal rate at the time a project is evaluated or the expected rate? If it is the expected rate, whose expectations count? In principle, if the benefits are in nominal terms then the discount terms should also be nominal. In practice, it is sometimes difficult to tell whether the projected future prices an agency uses are in real or nominal terms. There is a huge literature of differing estimates of the opportunity cost of capital. Lesser and Zerbe examined the rate of return on government bonds since World War II, on low-risk railroad bonds, and on commercial paper from about 1887 and conclude that the 3% was the cost of capital in inflation adjusted dollars. (Lesser & Zerbe, 1998, 262).

In practice, the U.S. water resources agencies use the nominal rate on 15-year government bonds in the year previous to a project's evaluation. Changes in this rate are slowed by limiting change in any one year to .25%. Other agencies use different rates or none at all.

Is the discount rate for public projects a matter of data to be observed, or a public choice to be decided and given to the analyst? With a perfect capital market, everyone would have the same time preference at the margin. People with initially different time preferences would borrow and lend, and market rates would adjust until all players are in equilibrium. But in disequilibrium, people have different opportunities and differ over the desirability of financing public projects by borrowing or taxation as noted above. Some further political resolution of conflicting interests is necessary even if the distribution of factor ownership (wealth) were acceptable and there were many borrowers and lenders (no market power). The literature, of which Sugden and Williams (1978) and DeAlessi, (1969) are representative, seems to have shifted to viewing the choice of discount rate as a political decision rather than a datum to be discovered. Pearce and Nash (1981, 164) observe that "no single school of thought on discount rates commands consensus among economists...the issue is one of choosing a discount rate in a second-best world, so that behaving as if first-best conditions prevailed...does not seem relevant."

Inter-generational Discounting. Inter-generational trade-offs in use of the environment are especially marked by differences in preferences. The property rights issue is not just differences in time preferences among members of the present generation, but which generation owns the environment. Choosing a low discount rate does not clearly favor future generations because of its opposing effect on intensity of resource use and the scale of total development (Pearce, Markandya, & Barbier, 1989) (Daly, 1991). If future generations are to be given rights, it is best achieved by some sustainable development constraint rather than by discount rate policy. This argument is the rights equivalent of making future generations joint owners and then government as its agent (trustee) deciding not to sell to the present generation of users. None of this political question is instructed by technical measures of any existing discount rates. Robert Solo suggests that "Maybe the idea of a unitary decision maker—like an optimizing individual or a wise and impartial advisor—is not very helpful when it comes to the choice of policies that will have distant-future effects about which one can now know hardly anything. Serious policy choice may then be a different animal, quite unlike individual saving and investment decisions (Solo, 1999)." Solo uses

the term “responsibility” to describe the choice context. This issue raises questions of deontological rights rather than willingness to pay (Adler & Posner, 1999). It is about ideology and working out the meaning of doing the right thing.

### **Investment Criteria**

There are several investment criteria or tests for project acceptability and ranking. They differ in their implicit assumptions on reinvestment of net cash flow and the manner in which the different scales of projects is accounted for. When these dimensions are standardized, all criteria produce the same results.

Net Present Value. NPV is the summed discounted value of the cash flow produced by the project.  $NPV = \sum B_t / (1 + r)^t$  where  $B$  equals the net cash flow in each year  $t$ . It could be zero, negative or positive. The rule is to invest in any project with a positive NPV. It would be efficient to expand the budget so that all such projects could be undertaken. If for some reason there is capital rationing, it will be necessary to rank projects. This ranking should not be done by going down a list of projects and stopping when the budget is exhausted. Since NPV is an absolute amount this would give an advantage to large projects. For ranking, some sort of rate is needed to relate return to a unit of capital, or the NPV must be maximized for some set of projects that exhaust the budget.

The opposite but symmetrical concept to NPV is net terminal value (NTV). It uses compounding instead of discounting.  $NTV = \sum B_t (1 + r)^t$ . A project with a positive NTV will also have a positive NPV.

Internal Rate of Return. The IRR is defined as the rate of discount that reduces the cash flow of a project to zero net present value. It is the discount rate  $r$  for which the sum of  $B_t (1 + r)^t =$  zero. It is an average rate of return. A project that produces a given IRR is equivalent to the time flow of the given initial investment compounded forward for the given number of years at an interest rate equal to the IRR. The choice criterion is to invest in any project in which IRR is greater than the opportunity cost of capital. The World Bank uses IRR to qualify projects for loans (Gittinger, 1982, 331).

Benefit-Cost Ratio. A rate of return can also be constructed out of present values. A common measure is to compute the ratio between the present value of benefits and the present value of costs. Any ratio involves a choice of denominator, usually what is considered to be the most limiting source of funds. This choice is a matter of political judgment. Capital ( $K$ ) is defined as negative cash flow in any year. Operating cost that can be covered by receipts is not limiting and can be netted from the numerator. Still, Eckstein (1961, 63-4) observed that U.S. agencies receive an annual appropriation that must cover both capital and operating outlays. Nevertheless, the clients of these agencies may not want consider operating costs as limiting. A more serious problem is that if operating costs are not considered limiting it will encourage agencies to classify as many costs as possible as operating when they design the project (Kuhn, 1962, 174). There is also a question of the source of capital in federal systems where part of the cost is from a local government and part national. A ratio could be constructed to reflect a political judgment on whose capital is the most limiting. There can also be an issue of whether to count as limiting private investments that complement the public investment.

Criteria Comparisons. Use of any investment criterion makes an assumption about reinvestment of net cash flow. Reinvestment is necessary to compare projects of unequal life. A net present value calculation carries forward net cash flow indefinitely at the rate of discount chosen to calculate NPV. The internal rate of return carries forward net cash flow at the internal

rate of return implicit in the project. These rates are unlikely to be the same and so the two criteria can produce different rankings though they will both identify the same set of projects with some net return. This inconsistency can be eliminated by the *terminal value method* that makes explicit the rate of reinvestment (Schmid, 1989, 20). If there is not another project that earns as much as a short lived project, then the latter's IRR is not relevant. Likewise, if there is another project that earns more than the rate used to discount cash flow, that rate of discount is not relevant.

If the cash flows are explicitly compounded at the politically chosen opportunity cost, then all criteria will produce the same ranking. Any political judgment on the opportunity cost of capital reflecting disequilibrium can be incorporated. For example, the benefits received by those with better opportunities than the government will want to receive the net cash flow and make their own reinvestments while those with poorer opportunities will want the government to reinvest if it has better alternatives. Different opportunity costs for portions of capital could be implemented if politically desired. This standardized and reconstituted cash flow reflecting reinvestment can produce a Normalized Terminal Value Ratio with whatever definition of capital is desired. If preferred, a normalized IRR could also be computed. Once the different assumptions implicit in each criterion have been superseded by transformation (actual cash flow over a common period) all criteria will produce the same ranking (Mishan, 1976, chs. 37 & 38) and (Robison & Barry, 1996, chs. 4 & 6).

The ranking issue may be of little importance in practice. Ranking is not used for decision making in the U. S. or by the World Bank. No politically favored project is ever forgone just because a higher return one is on some list. No agency publishes a ranked list of projects. Neither does the U. S. executive office publish a list of ranked projects across agencies. Since all criteria described above identify the same list of projects with some net returns, the ranking issue is moot. This equivalence would not be the case if the rate of return were used to size projects. If different sizes of projects were explicitly considered for a site or purpose, then their ranking would be affected by different criteria. In practice, project designers often have some rule of thumb for what a project should look like. Where project size and capital intensity are explicitly examined, there is a tendency to extend scale so that the net benefit of each project is maximized where marginal cost equals marginal benefit. This approach is incorrect with capital rationing. The scale should be extended until the ratio of marginal cost to marginal revenue is the same as that ratio for the marginal project (which will be earning more than the opportunity cost of capital with capital rationing).

## **Uncertainty**

Project outcomes are often uncertain. History is full of examples of project failures and cost overruns (Pohl & Mihaljek, 1992). Future prices of outputs and operating inputs are problematic. There are some projects in which it is possible to attach mathematical probabilities to outcomes with some confidence. In other cases, expectations can only be qualitative.

Expected Value and Expected Utility. The different possible environmental conditions that affect outcomes are referred to as states of nature. These might be physical conditions such as the weather or other things affecting the production function or prices. Take the case of weather that would affect the outcome of an agricultural project. Fifty years of rainfall records would allow analysts to state the probability of a range of rainfall amount. There is an unavoidable element of subjectivity even when some data are available. One hundred years would be better. There is uncertainty about the probability estimate. The range of possible outcomes and their probabilities can be described in terms of expected value (EV) which is the weighted average of the outcomes.

$EV = \sum_i p_i x_i$  where  $x_i$  is the value of the  $i$ th possible outcome and  $p_i$  is the probability of its occurrence. The expected value is an appropriate description of cash flow if the decision-maker only cares about the mean and not its variance. Variance is equal to  $\sum_i p_i (x_i - EV)^2$ . However, the project with the highest expected value may not be preferred to another if its variance is high. For a detailed exposition of risk preference measures see (Zerbe & Dively, 1994, chs. 15 & 16).

A person who is prepared to act upon expected values regardless of variance is said to be *risk neutral*. The risks must be independent, and future states of nature should not have wealth effects or threaten survival. The risk neutral are in a position to wait as needed for the average result to occur. But if there are costs to risk bearing such as going bankrupt before the results average out, such a person is *risk averse* and is going to trade off mean and variance.

The tradeoff of mean and variance can be made formal with the concept of *expected utility* (EU). This tradeoff is implicit in a utility function relating income to utility and would incorporate any diminishing marginal utility of income. Such a utility function might be revealed with a bidding game asking people to choose between different payoffs with different probabilities. It is necessary to assume that utility is proportional to probability. While this is not absurd, there is no compelling reason to think it is true for most people for most kinds of projects.

Can the government be regarded as a risk-neutral investor applying the expected value criterion? The government can in principle spread the risk across many people, thus making each person's risk small (Arrow & Lind, 1970). But in practice there is no institution for adjusting taxes to variation in the states of nature and to distribute benefits as dispersed national dividends in proportion to taxes. Groups lobby for projects because of unique and large expected benefits, and if disappointed, they have used up their political capital and may not get another project. Thus they are not risk neutral. It cannot be assumed that people want government to make risky decisions as if variance and beneficiaries did not matter.

People have different preferences for the tradeoff of mean values and their variation. There are few markets for recording these preferences. Each person can't independently adjust a portfolio of public projects to obtain their preferred risk exposure. This difficulty means a political judgment is needed.

Uncertainty is an area where behavioral economics has a lot to offer. Greater risk is tolerated if that risk is voluntary, immediate, known precisely, controllable, and familiar. Much of the decision analytics separates the perception of mean values from perception of their variation, but much empirical evidence exists that the perceptions are inter-related. The frame for viewing attitudes toward uncertain events has a lot to do with what is seen. A political compromise among differing perceptions is needed.

In practice, government employs a variety of directional rules of thumb rather than any formal all-encompassing formula. Some agencies do use expected values, some add a contingency allowance to costs, and some make the case that their estimates were a conservative choice from among alternative estimates. Benefits and costs often turn on population and utilization projections. The methods used to estimate future prices are sufficiently vague that it is difficult to tell what assumptions are being made. The only thing that can be said is that there is some method that the agency and its clients have become comfortable with. No matter how careful and systematic other dimensions of analysis may be, adjustments for uncertainty are sometimes necessarily so loose that they may overwhelm the implications of other judgments. It is common for an analyst to offer a sensitivity analysis. This analysis indicates how project outcomes might differ with various states of nature, but is in itself not a systematic choice tool.

With some kinds of projects there is *fundamental uncertainty* and it is not possible to even name the categories of possible effect let alone their probability. Perhaps the implication of all of this is for management and monitoring of whatever projects get implemented, rather than worrying about which project to build. In an uncertain world, flexibility is a virtue. Designing into the project an ability to adjust as the future unfolds may be more valuable than a formal process for comparing projects of fixed dimensions.

## **Social Welfare**

What can cost-benefit analysis say about social welfare? It has become popular among applied economists, particularly in recreational and environmental projects, to sum individual CV's or EV's or consumer surplus as a measure of the social value of a project including those with a price decrease. Most theorists on the other hand have been hesitant to endorse it. The beneficiaries of a project may not be the taxpayer who pays for it. A project may increase the income of the rich and decrease the income of the poor. The problem is that of the first-best assumption of optimal income distribution in the many-consumer economy (Tresch, 1981, 198).<sup>v</sup> If costless lump-sum transfers are not available, Boadway and Bruce (1984, 271) conclude that, "The use of the unweighted sum of household compensating or equivalent variations as a necessary and sufficient indicator of potential Pareto improvement is rife with difficulties." The theory has been worked out mostly in the context of taxes but the implications are the same. Tresch (1981, 351) says "it may not be very useful to think of the effects of distorting taxes in terms of deadweight loss. Unambiguous notions of efficiency loss involve the use of the expenditure function, which is best suited to one-consumer economies."

A review of the literature led Slesnick to conclude that "it is now widely accepted that consumer surplus should not be used as a welfare measure (1998, 2108)." The restrictions necessary to use a summation of individual CV's or EV's include homothetic preferences (all income elasticities of demand equal one) or preference functions must be parallel with respect to the numeraire good to avoid path dependence (Chipman & Moore, 1980). This requirement is contrary to empirical evidence. Another restriction is that all individuals have the same marginal utility of money. Again, this seems contrary to evidence. Assuming a representative agent will not do.

The Pareto Principle is often used to finesse the problem of interpersonal welfare comparisons. A good project has net gains such that the gainers could compensate the losers and still have something left over. (Some are better off without anyone being worse off.) This unanimity requirement seems unreachable in practice. Perhaps then the test could be only that of a potential Pareto improvement. The project would be acceptable if the gainers could compensate the losers even if not actually done.<sup>vi</sup> Choice of test would seem to require a major ethical judgement. Sen (1979) argues that the New Welfare Economics is irrelevant. If compensation is not actually provided or could not be provided with lump sum taxes and transfers, it has no implications for public policy.

The point is not that the Pareto Principle or potential Pareto criterion is right or wrong, but rather that *any* criterion is a political value judgment. As Slesnick (1999) puts it, "Any effort to develop an index of group welfare must inevitably make normative judgments in which gains to some are weighed against the losses to others (2137)." The problem with aggregation "is that the expenditure function provides an exact representation of individual preferences for a fixed set of reference prices  $p$ . The choice of the prices used to 'cardinalize' preferences needs to be invariant to this choice (2141)." While use of CV or EV "has the appearance of being a positive measure of

the change in aggregate welfare, it is no less normative than methods based on explicit social welfare functions. The sum of Hicksian variation depends on the distribution of well-being and the underlying ethical assumptions are often ambiguous (2151).” Any use of the Pareto Principle privileges the *status quo* which requires an ethical judgment. And even what constitutes the *status quo* is a matter of interpretation and judgment.

The applied economist can scarcely do better than conclude as did Little (1957, 184) when he said "The best criterion for investment decisions must, within wide limits, be determined at dynamic and administrative levels--and not at the level of static welfare theory." Which private or public firms are to be allowed to act in terms of being a discriminating monopolist is fundamentally a distributive question. Consumers don't know what they are sovereign over until they know whether they will be subject to price differentiation, and firms producing complements and substitutes are not sure of their prices until they know whether other firms can differentiate. Note that if you approve of the distributive implications you call it price differentiation, but if not, you call it discrimination.

The constitutional and institutional context for CBA is implicit when Ball says, “There are an infinite number of possible Pareto-efficient points for the economy of the neoclassical model. Attainment of any of them depends on the initial distribution of resources between individuals in the economy. For each of these infinite number of Pareto-optimal points, there consequently corresponds a different set of ‘efficiency’ prices (Ball, 1979, 76).”

Benefits and costs are what they are because of the underlying income distribution and the distribution of property rights (Samuels & Schmid, 1997). “Benefit-cost analysis is inseparable from the law in important respects. That is why a benefit-cost analysis does not make the decision itself. Rather, benefit-cost analysis requires the law to make clear the pattern of major rights that frame the analysis, and to determine whose values are to be counted (Lesser & Zerbe, 1998, 241).” The contrast of EV and CV is a function of property rights. The starting place for EV is that of a rights holder listening to bids while CV is that of non-owner who is a buyer rather than a seller of an opportunity. Like all property rights this must be legitimated by governmental collective choice. The analyst must be instructed and cannot arbitrarily choose the starting place.

Whether one uses the sum of CV's, uses a social welfare function or just sums real income changes, one is making an ethical choice. For example, in a health project, the life of a poor person measured by willingness to pay will be a function of future income preserved. This measure will make saving the life of a rich person more valuable than that of the poor. In practice, EPA uses the same value for all persons to justify a regulation (Adler & Posner, 1999, 86). Likewise, in a flood control project, saving a rich person's house is more valuable than that of a poor person. In practice, the Corps of Engineers does just that. They get signals from Congress as what is acceptable. Congress would prefer that the project meet the net benefits test without any explicit weighting or income distribution objective. The fact that the project does not rank high because a large portion of the beneficiaries are poor, is no problem since ranking seldom plays a role anyway. If the political support is there to help the poor in a particular location, the project will be funded over another with higher total benefits from whatever source. Analysts point out apparent inconsistencies in the amount spent to save a life in various regulatory programs (Tengs & Graham, 1996). Is this unsystematic or does the political decision regard these lives as different? Interpersonal comparisons do get made.

If analysts cannot provide an independent aggregative measure of social welfare, what can they do? Sen is at the frontier of thinking about social choice. He advocates a “capabilities” or “functionings” approach to get around all the problems with income measure (Sen, 1985). If

income and consumption are treated as an input to such capabilities as the degree of personal liberty, level of justice, life expectancy, health, etc., then we have something closer to a measure of utility. All of the money-metric problems such as reference prices are avoided. Slesnick believes that Sen's approach is theoretically sound, but alas, "It is difficult to imagine how this approach might be implemented empirically to provide a comprehensive welfare measure. Individuals' capabilities are not always the result of revealed preferences so we have little prospect for measuring individuals' valuation of their capabilities." 2148

Perhaps measurement issues miss the point. The issue is not how to sum up value choices already made (i.e. revealed), but how to inform their creation. Is not the relevant question how to structure public debate and political choice? Shall analysts ask the politicians for weights to be applied to the income of different people?<sup>vii</sup> Or shall we ask them to set substantive goals, for example, levels of living or greenhouse gas abatement? For example, Kopp and Portney suggest mock referenda for intergenerational decision making to get around the long term discounting problem (Kopp & Portney, 1999).

Sen's capabilities at the very least tie back to the choice of input and output categories and the taxonomy of products. The choice of product names and features is informed by consideration of what makes it good, i.e. how it serves utility. Marketers of private goods in their advertising try to tie their product to such things as sociability, re-creation, health, and security. When the analyst describes a good for contingent valuation, implements the analogous good method, or constructs a hedonic regression equation with variables to describe a multi-featured marketed good, something like Sen's capabilities and functionings are implicit or explicit.

## **Conclusion**

Analysis of each of the steps in cost-benefit analysis identified above reveals conflicts of interest (preferences) that can only be resolved by political (collective) choice of property rights assigning opportunities to the various parties. The rules of CBA function as property rights equivalent to private property rights established by legislative and court decisions for the market economy. A simple political weighting of the traditionally computed benefits received by different groups does little to clarify and inform the debate necessary to resolve the disputes over the several specific varieties of rights conflicts.

The separation of technical analysis and political choice is not tenable. Theory and experience point to a more interactive, iterative relationship between analysts and politicians. "The role of benefit-cost analysis is not to make decisions, but rather to inform them by providing information relevant for decision makers (Lesser & Zerbe, 1998)." The distribution of rights affects prices and thus any existing set of prices can't guide the choice of rights including those embedded in rules for appraising public spending and regulations. It can't be assumed that political choice has once and for all chosen the distribution of rights and that the only problem is the technical one of implementation of the preferences of rights holders. The process of public investment and regulation is never wholly exchange facilitating (solving market failure) nor wholly grant making, and the distinction needs continuous political input. The analyst need not apologize for asking more questions of the politicians. And the technical input is no less useful for the fact that as new politicians are elected, public investment priorities change. The value of analysis is in clarifying the substance of evolving preferences and in being explicit about whose preferences count. Mishan (1988, xiii) argues that the essence of an economic approach is the "basic maxim that individuals' expressed valuations alone are to count." But it is the responsibility of collective action to decide which individual counts when individuals conflict. The question of who counts

cannot be escaped whether the analyst uses a financial analysis containing only available and nominal market prices or an economic analysis containing shadow prices and non-market evaluations.

Which politicians do the analysts ask to obtain the necessary property right choices? Wouldn't an independent technical analysis be better than incorporating the policy objectives of a corrupt and unrepresentative government? Each analyst must make his or her own moral judgment. But, however tempting it is to right a perceived wrong, ultimately all must ask "who does the analyst represent and who elected the analyst to this job." Just as there is no market without property rights, there is no public choice without a constitution (civil rights). Alternative constitutional rights give more weight to some interests and less to others. The full implications of Arrow's Impossibility Theorem must now be acknowledged. There is no aggregate public interest which a political system can be designed to reveal with fidelity any more than there is an aggregate consumer interest which an economic system can be designed to reveal. Distribution of opportunities is a matter to be argued, chosen, and worked out, not just something pre-existing to be revealed. The debate can be informed but not instructed without presuming the answers to the distributive questions. Efficiency in public expenditures is not a prior fact out there waiting to be discovered, but is an artifact to be worked out. CBA is an information input into that political process and can make it as systematic as bounded rationality allows.

Nothing here should be read as a critique of CBA. The point is that CBA and economic efficiency have a constitutional base. CBA or any alternative requires political, ethical judgment and the key issue is whether these are hidden as technical issues or are explicitly invited political inputs. While there is much to be said for explicitness and openness in a democratic society, the pros and cons of systematic analysis in politics are too complex to be explored here. In closing, it should be noted that citizens and politicians do not have a universal, consistent, and strong preference for explicitness and clarification of the sources of winners and losers. The failure of applied CBA to reflect the evolution of second-best economic theory is only partly due to reluctance of economists to relinquish the role of supplying authoritative advice.<sup>viii</sup> The other part is a substantial public demand for self-deception and vainglory where we advertise a concern for the poor, human life, environment, or whatever, while acting selectively to the contrary. When politicians stand aside from resolving the conflicts of interest behind the CBA rules, they are able to embrace its results piecemeal--accepting its added legitimacy when it suits them, but labeling it academic irrelevance when they reject the results. If politicians were part of the systems analysis process, they would have to change its rules rather than selectively reject its conclusions.

## Bibliography

- Adler, M. D., & Posner, E. A. (1999). *Rethinking Cost-Benefit Analysis* (Working Paper No. 72). Chicago: Law School, University of Chicago.
- Akehurst, R. L., & Culyer, A. J. (1974). On the economic surplus and the value of life. *Bulletin of Economic Research*, 26, 63-78.
- Arrow, K. J. (1963). *Social Choice and Individual Values*. New Haven: Yale University Press.
- Arrow, K. J., & Fisher, A. (1974). Environmental preservation, uncertainty, and irreversibility. *Quarterly Journal of Economics*, 88(2), 312-19.
- Arrow, K. J., & Lind, R. C. (1970). Uncertainty and the Evaluation of Public Investment Decisions. *American Economic Review*, 60, 364-78.



- Ball, M. (1979). Cost-Benefit Analysis: A Critique. In F. Green & P. Nore (Eds.), *Issues in Political Economy: A Critical Approach*. London: Macmillan.
- Bateman, I. J., & Willis, K. G. (Eds.). (1999). *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EU, and Developing Countries*. Oxford: Oxford University Press.
- Boadway, R. W., & Bruce, N. (1984). *Welfare Economics*. Oxford: Blackwell.
- Bockstael, N. E. (1995). Travel Cost Methods. In D. W. Bromley (Ed.), *The Handbook of Environmental Economics*. Cambridge MA: Blackwell.
- Bockstael, N. E., Strand, I. E., & Hanemann, M. (1987). Time and the Recreation Demand Model. *American Journal of Agricultural Economics*, 69, 293-302.
- Bonnieux, F., & Rainelli, P. (1999). Contingent Valuation Methodology and the EU Institutional Framework. In I. J. Bateman & K. G. Willis (Eds.), *Valuing Environmental Preferences*. Oxford: Oxford University Press.
- Brown, G. M., & Shogren, J. F. (1998). Economics of the Endangered Species Act. *Journal of Economic Perspectives*, 12(3), 3-20.
- Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research*. Chicago: Rand-McNally.
- Campen, J. T. (1986). *Benefit, Cost, and Beyond: The Political Economy of Benefit-Cost Analysis*. Cambridge: Ballinger.
- Chipman, J. S., & Moore, J. C. (1980). Compensating variation, consumers' surplus and welfare. *American Economic Review*, 70, 933-49.
- Cummings, R. G., Brookshire, D. S., & Schulze, W. D. (Eds.). (1986). *Valuing Environmental Goods: An Assessment of the Contingent Valuation Method*. Totowa NJ: Rowman & Allanheld.
- Daly, H. E. (1991). Towards an environmental macroeconomics. *Land Economics*, 67(2), 255-59.
- Dasgupta, A. K., & Pearce, D. W. (1972). *Cost Benefit Analysis: Theory and Practice*. London: Macmillan.
- DeAlessi, L. (1969). Some Implications of Property Rights structures for Investment Choices within Government. *American Economic Review*, 79, 13-24.
- Dreze, J., & Stern, N. (1987). The Theory of Cost-Benefit Analysis. In A. J. Auerbach & M. Feldstein (Eds.), *Handbook of Public Economics* (Vol. 2, pp. 909-990). Amsterdam: North-Holland.
- Eckstein, O. (1961). A Survey of the Theory of Public Expenditure Criteria, *Public Finances: Needs, Sources, Utilization*. Princeton: National Bureau of Economic Research.
- Freeman, A. M. (1979). *The Benefits of Environmental Improvement*. Baltimore: Johns Hopkins University Press.
- Freeman, A. M. (1993). *The Measurement of Environmental and Resource Values*. Washington: Resources for the Future.
- Gittinger, J. P. (1982). *Economic Analysis of Agricultural Projects*. Baltimore: Johns Hopkins University Press.
- Gum, R. L., & Martin, W. E. (1975). Problems and Solution in Estimating the Demand for and Value of Rural Outdoor Recreation. *American Journal of Agricultural Economics*, 57, 558-66.

- Hanemann, M. (1991). Willingness to Pay and Willingness to Accept: How Much Can They Differ? *American Economic Review*, 81(3), 653-47.
- Hardin, E., & E. Borus, M. (1971). *The Economic Benefits and Costs of Retraining*. Lexington MA: Heath Lexington.
- Harrison, A. J., & Quarmby, D. A. (1974). The Value of Time. In R. Layard (Ed.), *Cost-Benefit Analysis*. Baltimore: Penguin.
- Harrison, D., & Rubinfeld, D. L. (1978). The Air Pollution and Property Value Debate: Some Empirical Evidence. *Review of Economics and Statistics*, 60, 635-38.
- Haveman, R., & Krutilla, J. V. (1968). *Unemployment, Idle Capacity, and the Evaluation of Public Expenditures*. Baltimore: Johns Hopkins Press.
- Hoehn, J. P., Berger, M. C., & Blomquist, G. C. (1987). A Hedonic Model of Interregional Wages, Rents, and Amenity Values. *Journal of Regional Science*, 27, 605-20.
- Hoehn, J. P., & Randall, A. (1989). Too Many Proposals Pass the Benefit Cost Test. *American Economic Review*, 79(3), 544-51.
- Jones-Lee, M. W. (1976). *The Value of Life: An Economic Analysis*. Chicago: University of Chicago Press.
- Kelman, S. (1981). Cost-Benefit Analysis: An Ethical Critique. *Regulation*, 5(January-February), 33-40.
- Kopp, R. J., & Portney, P. R. (1999). Mock Referenda for Intergenerational Decisionmaking. In P. R. Portney & P. P. Weyant (Eds.), *Discounting and Intergenerational Equity* (pp. 87-98). Washington: Resources for the Future.
- Krutilla, J. V. (1967). Conservation Reconsidered. *American Economic Review*, 57(4), 777-86.
- Kuhn, T. E. (1962). *Public Enterprise Economics and Transport Problems*. Berkeley: University of California Press.
- Leibenstein, H. (1987). *Inside the Firm: The Inefficiencies of Hierarchy*. Cambridge: Harvard University Press.
- Lesser, F., & Zerbe, Richard O., Jr. (1998). A Practitioner's Guide to Benefit-Cost Analysis. In F. Thompson & M. T. Green (Eds.), *Handbook of Public Finance*. New York: Marcel Dekker.
- Lewis, A. (1972). Reflections on Unlimited Labor. In L. D. Marco (Ed.), *International Economic Development: Essays in Honor of Raul Prebisch*. New York: Academic Press.
- Little, I. M. D. (1957). *A Critique of Welfare Economics*. London: Oxford University Press.
- Little, I. M. D., & Mirlees, J. A. (1974). *Project Appraisal and Planning for Developing Countries*. New York: Basic Books.
- Majone, G. (1989). *Evidence, Argument and Persuasion in the Policy Process*. New Haven: Yale University Press.
- McFadden, D. (1994). Contingent Valuation and Social Choice. *American Journal of Agricultural Economics*, 76(Nov.), 686-708.
- Mishan, E. J. (1976). *Cost-Benefit Analysis*. (2nd ed.). New York: Praeger.
- Mishan, E. J. (1981). *Economic Efficiency and Social Welfare*. London: Allen and Unwin.
- Mishan, E. J. (1982). The new controversy about the rationale of economic evaluation. *Journal of Economic Issues*, 16, 29-47.
- Mishan, E. J. (1988). *Cost-Benefit Analysis*. (4th ed.). London: Unwin Hyman.

- Pearce, D. W., Markandya, A., & Barbier, E. (1989). *Blueprint for a Green Economy*. London: Earth Scan.
- Pearce, D. W., & Nash, C. A. (1981). *Social Appraisal of Projects: A Text in Cost-Benefit Analysis*. London: Macmillan.
- Pohl, G., & Mihaljek, D. (1992). Project evaluation and uncertainty in practice: a statistical analysis of rate-of-return divergences of 1,015 World Bank Projects. *World Bank Economic Review*, 6(2), 255-77.
- Robison, L. J., & Barry, P. J. (1996). *Present Value Models and Investment Analysis*. Northport AL: Academic Page.
- Samuels, W. J., & Schmid, A. A. (1997). The Concept of Cost in Economics. In W. J. Samuels, S. G. Medema, & A. A. Schmid (Eds.), *The Economy As A Process of Valuation*. Cheltenham: Edward Elgar.
- Samuelson, P. (1963). *Foundations of Economic Analysis*. Cambridge: Harvard University Press.
- Schmid, A. A. (1989). *Benefit-Cost Analysis: A Political Economy Approach*. Boulder: Westview Press.
- Sen, A. (1979). The Welfare Basis of Real Income Comparisons. *Journal of Economic Literature*, 17(1), 1-45.
- Sen, A. (1985). *Commodities and Capabilities*. Amsterdam: North Holland.
- Shabman, L., & Stehenson, K. (1996). Searching for the correct benefit estimate: empirical evidence for an alternative perspective. *Land Economics*, 72(4), 433-49.
- Slesnick, D. T. (1998). Empirical Approaches to the Measurement of Welfare. *Journal of Economic Literature*, 36(Dec.), 2108-65.
- Smith, R. J. (1971). The evaluation of recreation benefits: the Clawson method in practice. *Urban Studies*, 8(2), 82-102.
- Solo, R. M. (1999). Foreword. In P. R. Portney & J. P. Weyant (Eds.), *Discounting and Intergenerational Equity*. Washington: Resources for the Future.
- Stiglitz, J. E. (1987a). The Causes and Consequences of the Dependence of Quality on Price. *Journal of Economic Literature*, 25, 1-48.
- Stiglitz, J. E. (1987b). The Wage-Productivity hypothesis: Its Economic and policy Implications. In M. Boskin (Ed.), *Modern Developments in Public Finance*. Oxford: Basil Blackwell.
- Stilwell, F. (1999). Cost-Benefit Analysis. In P. A. O'Hara (Ed.), *Encyclopedia of Political Economy*. London: Rutledge.
- Sugden, R., & Williams, A. (1978). *The Principles of Practical Cost-Benefit Analysis*. Oxford: Oxford University Press.
- Tengs, T., & Graham, J. D. (1996). The Opportunity Cost of Haphazard Social Investments in Life Savings. In Hahn (Ed.), *Risks, Costs and Lives Saved*. Oxford: Oxford University Press.
- Tresch, R. W. (1981). *Public Finance*. Plano TX: Business Publications.
- Vatn, A., & Bromley, D. (1994). Choices without prices without apologies. *Journal of Environmental Economics and Management*, 26, 129-48.
- Vining, A. R., & Wimer, D. L. (1998). Passive Use Benefits: Existence, Option, and Quasi-Option Value. In F. Thompson & M. T. Green (Eds.), *Handbook of Public Finance*. New York: Marcel Dekker.

- Viscusi, W. K. (1996). Economic Foundations of the Current Regulatory Reform Efforts. *Journal of Economic Perspectives*, 10, 119-31.
- Wildavsky, A. (1969). Rescuing Policy Analysis from PPBS. *Public Administration Review*, 29, 198-220.
- Zerbe, R. O., & Dively, D. D. (1994). *Benefit-Cost Analysis In Theory and Practice*. New York: HarperCollins.

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<sup>ii</sup> For a formal mathematical review, see (Dreze & Stern, 1987).

<sup>iii</sup> C.i.f. = import cost, insurance, and freight to the entry port.

<sup>iv</sup> For a review of contingent valuation use in the European Union, see (Bonnieux & Rainelli, 1999).

<sup>v</sup> Sugden and Williams (1978, 127-31) try to finesse the issues by assuming zero income effects. Reasonable applied analysts seem to differ on the reality of this assumption.

<sup>vi</sup> The Kaldor compensation test takes the *status quo* as the reference point and the winners compensates the losers. Losers are sellers. The Hicks compensation test requires the losers to pay potential winners not to undertake the project. Losers are buyers. Thus both actual and potential Pareto improvements have a starting place in property rights.

<sup>vii</sup> One problem with weighting incomes is that the resulting transfers and income changes are derivative. A citizen or politician can't know when deciding on a weight of .2 or .3 just how much income transfer is implied. The weight by itself is meaningless. A specific transfer budget with identified targets would be more explicit.

<sup>viii</sup> Other reasons for not pursuing systematic, explicit choice include (Wildavsky, 1969) argument that ambiguity is necessary to prevent political breakdown and ultimately civil war. (Leibenstein, 1987) makes a related point arguing that slack keeps firms with internal conflicts from coming apart.