

Toward an Experimental Foundation for Benefit-Cost Analysis

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Abstract

Benefit Cost Analysis is based on the theoretical model of Walrasian general equilibrium. In recent decades the assumptions of this model, and its ability to predict economic behavior, have been seriously undermined. Empirical results from experimental economics and neuroscience have uncovered regularities in human behavior that may provide a base for new approaches to welfare theory and economic policy. These empirical findings do not challenge basic economic concepts but they do imply that our assumptions about “rational behavior,” “opportunity cost,” and “social welfare” should be revised using sound scientific evidence and methods. This research has the potential to make benefit-cost analysis more reflective of how people value gains and losses, and more responsive to considerations of environmental and social responsibility.

1. Introduction – Welfare Economics and BCA

The related fields of behavioral economics and evolutionary game theory are revolutionizing the way economists think about human decision making (Kahneman, Wakker and Sarin, 1997; Gintis, 2000; Fehr and Fischbacher, 2002). The economic approach to utility and economic welfare is moving beyond “armchair theorizing” to carefully conducted empirical analyses of actual human behavior. Recent research calls into question the traditional model of “rational economic man” underlying benefit cost analysis (BCA) (Kahneman and Tversky 1979; Güth, Schmittberger, and Schwarz 1982) The rational actor model has been shown to be a poor predictor of individual choice (Field 2001; Henrich et al., 2001; Glimscher, Dorris and Bayer 2005). On the positive side, empirical results from game theory, behavioral, and experimental economics have uncovered regularities in human behavior that may provide a base for new approaches to welfare theory and economic policy (Kahneman and Sugden, 2005; Layard 2005). These new approaches have far-reaching implications for environmental valuation and benefit-cost analysis (Gowdy, 2004). Recent research results have the potential to make BCA more reflective of actual human decision-making and more responsive to considerations of environmental and social sustainability.

The traditional economic worldview underlying BCA, and associated definitions of sustainability, is rooted in mid-twentieth century welfare economics with its key assumptions about rationality, efficiency, and the ability of policy makers to identify potential Pareto improvements (Gowdy, 2004; Bromley 2006). The standard economic approach to environmental valuation and policy is forcefully spelled out in several high profile guidelines for economic analysis (Arrow et al., 1993; Arrow et al., 1996; U.S. EPA, 2000). These papers are

commendable in their advocacy of transparency and consistency in designing environmental protection policies, but they are flawed by a rigid adherence to an outdated economic methodology (Knetsch, 2005). In these guidelines, contrary to an expanding body of evidence from experimental economics, improving the human condition (increasing social welfare) is equated with increasing per capita income, and “rationality” is defined as conforming to the axioms of consumer choice embodied in rational economic man.¹ Advocates of the standard approach to BCA usually begin with the very reasonable observation that people try to do the best they can with the limited resources at their disposal and that individuals are generally the best judge of what is best for them. However, the facts that people act in their own best interest, that they respond to incentives, and so on, does not justify accepting standard BCA assumptions. Income is an important component of well-being but there are other, equally important, contributors.² People respond to a variety of non-monetary (as well as monetary) incentives. Self-interest includes acting fairly towards others, adhering to social norms, and enforcing these norms even at cost to oneself. Preferences include things like inequality aversion, loss aversion, maintaining or improving one’s social position relative to others, and non-linear and non-uniform discounting of the future.

Recent advances in economic theory and a growing body of empirical findings call into question many of the underlying assumptions of the standard approach (Gintis, 2000; Gowdy, 2004, 2005). These standard assumptions include (1) equating consumption with well-being, (2) setting aside questions of distribution and relative income by invoking the notion of a Potential Pareto Improvement, (3) implicitly assuming that money is a universal substitute for anything, and (4) assuming that preferences are stable and self-regarding so that the social benefits and costs of a project or policy are simply the sum of their costs and benefits to isolated individuals. Behavioral experiments, neuroscience studies, and game theoretic experiments have demonstrated that market consumption cannot be equated to well-being, lexicographic preferences are prevalent, especially with regard to environmental features, and that preferences are other-regarding. How individuals value monetary payoffs depends on social context, relative position, and the reference point of the valuation. The assumptions underlying the standard BCA approach are at odds with observed human behavior and they yield poor predictions of the economic decisions people actually make. What do the new economic models of human behavior mean for BCA?

2. Experimental Economics and the Demise of Traditional BCA

Criticisms of conventional economics are not new. Many of the “new” findings of behavioral economics and game theory can be found in the work of Hobson (1902), Veblen (1907) and others writing one hundred years ago. The reasons why current criticisms are finally having an impact are first, they are based on replicable experiments, and second, these experimental results offer constructive alternatives to modeling the behavior of economic agents (Gintis, 2006). What are the major points of departure between the assumptions of conventional BCA and the findings of contemporary experimental economics?

Income cannot be equated with well-being

Conventional BCA assumes that (properly adjusted or “Hicksian”) income can be equated to well-being. The fact that income is not a good proxy for happiness has long been a

topic of interest to economists, inspired in part by the pioneering work of Easterlin (1974), Hirsch (1976), and Scitovsky (1976). This early work influenced the “limits to growth” literature within ecological economics but had only a limited impact within the economics profession as a whole. For the most part, those economists who took the limitations of income measures seriously merely modified traditional GDP accounts to include social and environmental considerations. A spate of recent work on the components of well-being uses direct measure of subjective utility as an alternative to per capita GDP (Kahneman, Wakker, and Sarin, 1997; Frey and Stutzer, 2002; Layard, 2005). Subjective measures of well-being show consistently that, past a certain fairly low level, increasing income does not lead to permanent increases in well-being. Real per capita income in the U.S. has increased sharply in recent decades but reported happiness has slightly declined (Blanchflower and Oswald, 2000). Studies of individuals also show a lack of correlation between increases in income and increases in happiness (Frey and Stutzer, 2002).³

There is a growing literature of non-welfaristic approaches to development policy. Sen (1999) has called for an approach to development emphasizing the ability to live an informed and full life rather than concentrating solely on income creation. Nussbaum (2000, Chapter 4 and Web site of Human Development and Capabilities Association) has gone even further in calling for “distributive justice” creating the conditions for the realization of a set of central human capabilities.⁴

Current work in quality of life indicators has resulted in theoretically sound measures of subjective well-being and suggests a much more robust approach to economic accounting for public policy than merely modifying existing flawed income measures of social welfare (Frey and Stutzer 2002; Layard 2005). A growing number of economists advocate the use of measures of subjective well-being in the objective welfare function rather than revealed preferences, that is, using an empirically-based subjective utility function (based on experienced utility) rather than a consumption function (Kahneman and Sugden, 2005).

The relatively weak link between income and happiness raises some serious questions about conventional BCA and the conventional economic interpretation of sustainability. If increasing income has not made the current generation better off, how can we say that higher income will make future generations better off? If monetary income is assumed to be a good proxy for well-being, and if money measurements can accurately reflect the productive value of natural and manufactured capital, then the question of sustainability is reduced to “How much money should we leave future generations?”⁵ Using income as a measure of utility almost automatically makes everything substitutable. But if we use a direct measure of well-being the question becomes something like “What should we leave future generations to insure that their well-being is not reduced by current human activity?” If we institute policies that will increase the well-being of the current generation, will this make future generations better off or worse off? What are the trade-offs between current and future well-being? (Gowdy, 2005)

Losses are valued more than gains

One of the most well-established facts in the valuation literature is the large discrepancy between willingness-to-accept (WTA) a loss and the willingness- to- pay (WTP) for an equivalent gain. Numerous experimental tests reveal WTA to WTP ratios clustering from 2:1 to 5:1 with many results considerably higher (Brown and Gregory, 1999). The fact that humans are

loss-averse—people place a higher value on losing something they have rather than gaining something they do not have—is by now well-established (Knetsch, 2005). Yet conventional BCA assumes that values are determined independently of a reference state. WTA and WTP are assumed to be equal (given a small income effect and small budget share) so that WTP measures may be used even in cases where losses are involved. Since most environmental valuation situations involve losses this approach leads to a systematic bias toward undervaluing environmental features. Behavioral evidence indicates that the appropriate choice of measure depends on a reference state and the reference state may not be the existing state (e.g., oil spilled on a scenic shoreline). Evaluating the value of environmental quality to future generations almost always involves losses (loss of climate stability, non-renewable resources, clean air and water).

Perhaps *the* core assumption of economic theory is the sanctity of individual choice. As Randall (1988, 217) put it economists are “doggedly non-judgmental about people’s preferences.” If this is so, then behavioral evidence about how people actually make economic decisions should not be ignored in BCA calculations and environmental policy.⁶ Loss aversion implies that if environmental protection policies are to respect human preferences, these policies should err on the side of caution. The precautionary principle was originally based on considerations of uncertainty and irreversibility. It is also justified by evidence from experimental economics.

People use different discount rates for different circumstances

The way discounting is applied in traditional BCA is also at odds with experimental results showing how people actually discount the future. Arrow et al. (1996, 222) state clearly that the discount rate should “be based on how individuals trade off current consumption for future consumption.” Yet traditional BCA uses a single straight-line discount rate for everything from local development projects to evaluating far-in-the-distant-future effects of global climate change. Experimental economics has revealed that people use different discount rates for different circumstances. Loss aversion also applies to the future and people tend to discount future losses at lower rates than future gains (Loewenstein, 1988). Behavioral studies also show that people discount the near future at a higher rate than the distant future (Laibson, 1997). Since humans apparently hold a preference for discounting the future “hyperbolically” should not a hyperbolic discount rate be used rather than straight line discounting? People also use different discount rates for different kinds of things (Gintis, 2000). Money in a bank account is discounted differently than a scenic view, a happy life, or the future well-being of the human species (Price, 1993).

The value of gains and losses depends on relative position

In standard BCA individual preferences are independent and additive. Social benefits and costs are calculated as the unweighted sum of the benefits and costs to individuals. WTP estimates assume that people care only about absolute income not their income relative to others. By contrast, experimental results show that economic behavior is based on preferences that are endogenous, that is, dependent upon social context and the relationship of the evaluator to others. This has been demonstrated in hundreds of behavioral, game theoretic and neuroscience experiments (Gintis, 2000). Other-regarding behavioral includes reciprocity, inequality aversion, pure altruism, spiteful or envious preferences and altruistic punishment. (Fehr and Fischbacher, 2002). Such preferences affect basic economic behavior. For example, it has been found that a

woman is significantly more likely to work outside the home if her sister's husband earns more than her own husband (Neumark and Postlewaite, 1998; Frank and Sunstein, 2001). There is considerable evidence that the wage structure of firms reflects the effects of wage comparisons on worker morale (Bewley, 1999).

3. What's an Agency to Do? The Policy Implications of Behavioral Research for BCA

The above considerations do not imply that benefits and costs are unimportant. Nor do they imply that income is unimportant, or that only relative position matters, or that basic economic concepts like opportunity costs, individual choice, and the importance of incentives are of no value. Economists should follow their own admonishment that the starting point of analysis should be individual preferences. But assumptions about preferences and preference formation should be based on scientific evidence about how humans actually behave, not on armchair theorizing about how people *should* act in the stylized world of Walrasian general equilibrium. Economics is maturing rapidly as a science and new theoretical developments and current empirical research should be incorporated in BCA. On this point there seems to be a convergence between mainstream economic theory and the more critical approach of ecological economics. Many ecological economists are using contemporary models of human behavior and many mainstream economists are calling for realistic models of human behavior in BCA. Hanley and Shogren (2005, 28) express the need to incorporate contemporary experimental economics into benefit cost analysis.

Great value will exist, however, in developing a realistic yet formal behavioral underpinning for a revised CBA procedure/paradigm which relaxes the neo-classical straightjacket that has become uncomfortable for those who study environmental problems. This might be based on a more flexible, and therefore perhaps context specific model of rational-choice, where "rational" here means rational for both the individual operating within active and passive institutional context.

What are some policy implications of adopting a more realistic, evidence based approach to BCA? The most important implication, the one that all the others follow from, is to ground BCA in scientifically sound theories of human and firm behavior.

Free BCA from its Walrasian general equilibrium foundations

BCA was originally designed as a pragmatic way to examine real world tradeoffs, not a universal blueprint to maximize social welfare. Specific government policies are most often formed within a limited frame of reference, for example, a municipality deciding whether or not to build a new bridge or road. These kinds of tradeoffs are not made against "everything else." Policy makers choose from a limited range of options and the tradeoffs are made among those options. Many of the complicating issues discussed above can be safely ignored by a municipality deciding whether or not to build a bridge, a road or a community center. These are very different kinds of decisions than formulating policies to deal with the impacts of global climate change or worldwide biodiversity loss on future generations.

Many environmental policies have been designed to create the fictitious world of Walrasian competitive equilibrium rather than deal with the specific problems under consideration. Numerous theoretical papers have been written and conferences organized on global trading of carbon credits, putting “proper” prices on biodiversity, or assigning property rights to protect renewable environmental resources. These are important policy tools for economists, but they are not the only game in town. Market-based approaches have frequently failed because they bury the objective (protecting biodiversity, reducing the amount of carbon in the atmosphere, mitigating the effects of acid rain) within the fictitious and unreachable goal of maximizing Hicksian income with all its scientifically unsound assumptions about human nature, the structure of actual economies, and the production process.

Experimental results suggest that context is critical for applying BCA. This further suggests that the policy focus should be on the specific problem faced, not on meeting the conditions of abstract economic theory. Economic theory only provides tools of analysis, it does not provide the end goal. The behavioral findings discussed above point to the need for pragmatism and flexibility in applying BCA. Traditional BCA may be appropriate for local projects with limited time horizons but in the cases the Walrasian superstructure is unnecessary. In cases involving large geographical scales and very long time horizons, the Walrasian approach is inappropriate.

As Pesendorfer (2006, 712) points out, behavioral economics established itself by rigorously examining the failures of standard economics rather than being a stand-alone alternative. A valuable contribution has been that results from behavioral economics, game theory, and neuroscience have demonstrated clearly that simply modifying the basic Walrasian framework will not give yield a satisfactory model of human behavior. But now behavioral economics is at the second stage of developing a unified description of human decision-making that can lead to better policy formulation. We need now to focus our attention on observing how and why people make choices, on identifying consistent patterns in these observed choices, and determining how these choices might be predicted (Reiskamp, Busemeyer, and Mellers, 2006).

What sort of behavioral regularities can be placed in a general framework that will contain a consistent and realistic theory of human decision-making? How can these regularities provide policy guidance to the issue of sustainability?

Well-being, money, and relative position

Purely monetary measures of costs and benefits tend to overestimate the costs of implementing regulatory policies and underestimate the value of the benefits of those policies. Ackerman and Heinzerling (2004) looked at three examples of regulatory success—the removal of lead from gasoline, protecting the grand canyon from hydroelectric dams, and the regulation of workplace exposure to vinyl chloride—and found that none of them would have passed a conventional benefit-cost test (see the discussion in Tietenberg, 2006, 54-56).

The well-being literature has also found differences in rival (or positional) and non-rival goods. This suggests that non-rival ways to increase well-being are more cost-effective than increasing things that are rival. For example, reducing the risk of death or injury is non-rival (Frank and Sunstein, 2005) and leisure time is non-rival (Layard, 2005). But income, past a

certain level, is rival so that an increase in everyone's income has no lasting effect on well-being. Health and safety standards at the expense of income growth may not be the classic monetary "trade-off" that conventional economics suggests. Aspects of environmental quality—clean air, clean water, scenic views—are also apparently non-rival. Again, forgoing income growth in favor of increasing environmental quality may not be a trade-off at all in terms of the well-being of society. This research suggests tailoring policy to the specific problem at hand rather than imposing a one-size-fits-all model.

Use a variety of discount rates

Discounting the future is essential to BCA. And again it is a concept that makes perfect sense for relatively short term decisions involving money. For several reasons, including impatience, opportunity cost and risk, for an individual making a decision today, receiving \$100 today is better than receiving \$100 a year from now. Discounting is also appropriate, for example, in the case of a local government deciding whether or not to build a new community center or to spend the money on highway improvements. But as we extend our time frame of reference, and as we broaden our policy considerations, simple straight-line discounting makes less and less sense. In the case of global climate change, monumentally damaging consequences occurring a hundred or more years from today are inconsequential in terms of their present discounted value. In this case, as in the case of many other kinds of environmental damages, uncertainties multiply as we go further into the future.

As discussed above, evidence suggests that people discount the near future at a higher rate than the distant future. If economists are to be true their basic assumption that preferences are sacrosanct, then the discount rates they use should reflect this observation. Related to this is the finding that anticipation may be a positive thing in itself so that something in the future may have a higher value and at present (Loewenstein, 1987). For example, preserving national parks and other wildlife areas is important because people anticipating using them in the future (after retirement, for example). Straight-line discounting underestimates future value in these cases. Of course, the larger issue in cases like global climate change which may have devastating consequences hundreds of years into the future is that the BCA policy framework, including discounting, is inappropriate.

BCA and sustainability

BCA analysis of sustainability is rooted in conventional Walrasian theory as expressed clearly in a review article by Arrow et al. (2004). In a narrow BCA framework sustainability means a non-declining per capita income, which in turn means maintaining the capital stock necessary to produce it (the Hartwick-Solow rule).⁷ "Sustainability" does not imply anything new for policy analysis beyond the traditional admonishments of economists to correct market failures and completely assign property rights (Beckerman, 1994). With all externalities taken into account (that is, all human preferences are correctly reflected in market prices) uncertainty reduced to risk, and so on, the proper policy is to maximize the discounted flow of future income. As Solow (1973, 169) puts it:

If the economy or its participants are forward-looking and far-seeing, the prices of investment goods will reflect the market's evaluation of their future productivity, including the productivity of the future investments they will make possible. The

right prices will make full allowance even for the distant future, and will even take account of how each future generation will look at its future.

Of course Solow is equating “the economy” with the mathematical construct that is the Walrasian CGE model.⁸

In the Walrasian framework, the only reason to implement an environmentally friendly policy—climate change mitigation for example—would be if such a policy increases the discounted flow of future consumption, and that should be done anyway, with or without the sustainability criterion.⁹ The only decision for policy-makers concerning sustainability is a one-shot decision about the “proper” social rate of discount to use in allocating resources between present and future consumption (that is, present consumption versus investment for future consumption) (See Dasgupta’s, 2006, comment on the Stern global warming report). Along an optimal consumption path the market rate of return on investment should equal the social rate of return on consumption (Arrow et al., 2004, 155). The social rate of return in this framework depends on the preferences of a “typical individual” or “representative agent” so that addressing the most thorny real-world policy difficulties is avoided. No flexibility or contingency plans can be built into

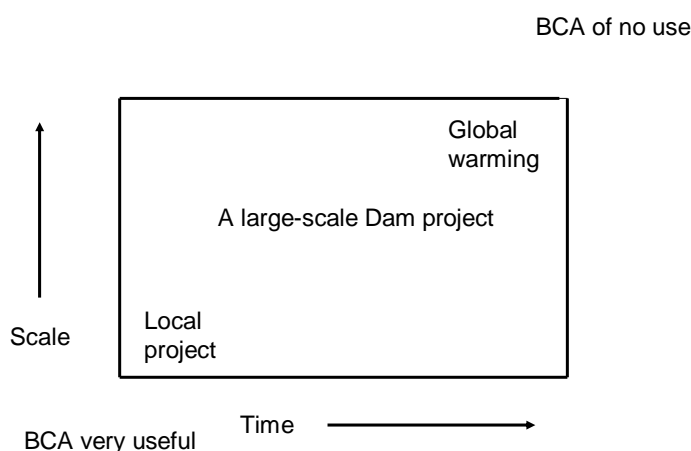


Fig 1. BCA in time and space

such a rigid system of analysis. Sustainability is not an issue than can be addressed by the conventional tools of economic analysis. As shown in figure 1. BCA is most useful for the kinds of cases for which it was first formulated, that is evaluating the benefits and costs of a specific local public project such as a new bridge. But within the envelope of Walrasian economics, BCA became the way to look at everything from biodiversity loss to the effects of climate change a hundred years in the future. The further we broaden the scope of the problem in time and space the more inappropriate BCA becomes.

4. Concluding Comments

Standard BCA proceeds by making a number of highly unrealistic assumptions about human preferences. It is assumed that people have clearly defined preferences over all relevant outcomes related to their well-being. It is assumed that well-being can be equated with (properly

adjusted) measures of income. It is assumed that these preferences are stable, context independent, and internally consistent (Sugden, 2005). Literally hundreds of scientific papers published now routinely in every major economic journal have shown these assumptions to be at odds with actual human behavior.

Benefit –cost analysis was considerably improved when non-market sources of well-being began to be in BCA estimates. However, estimating non-pecuniary values uncovered many “anomalies” in preference formation including the WTA-WTP disparity, context dependent valuation, lexicographic preferences and so on. It is now time to take BCA to the next level and incorporate more realistic assumptions about human behavior, human well-being and preference formation. This does not mean throwing out powerful, basic economic concepts developed over the last century. It does mean defining and applying concepts like “rational behavior,” “social welfare,” and “opportunity cost” using empirical evidence and sound scientific methods.

Endnotes

1. The standard sustainability literature in economics recognizes that measured GDP fails to value many things that give people utility. The corrected GDP measure is called “Hicksian income.” But Hicksian income assumes that all externalities and public goods may be identified and correctly priced, no market power exists, and *everything* that gives utility to individuals can be properly priced so these goods can be traded in competitive markets. It also accounts for the maintenance of capital stock including so-called natural capital.
2. Welfaristic approaches to sustainability usually begin by defining utility broadly but after that the measure of welfare becomes, in one form or another, the output of a market economy (output, consumption, or per capita consumption). The caveat is sometimes made that this output is produced by an economy in which all prices are corrected for market failure (Solow, 1993) but in practice reported economic output is used (Pearce and Atkinson, 1993; Beckerman, 1994; Nordhaus, 2001; Dasgupta, 2002). Although the Second Fundamental Theorem of welfare economics may be invoked to claim that all market failures can and should be corrected, utility is still equated with consumption. See the discussion of this in Frey and Stutzer (2002, 73).
3. Part of the lack of correlation between income and well-being is due to the “positional” nature of consumption (Frank, 1999). It has also been argued that the growth in material prosperity has been accompanied by a decline in really important non-market goods like social capital, family support, etc. (Kasser, 2002).
4. It is widely accepted that increasing per capita income in poor countries is the key to increasing their well-being. China may be a counter example. Real income per capita in China increased by a factor of 2.5 between 1994 and 2005. Material well-being increased substantially, for example ownership of color TVs rose from 40 percent to 82 percent of households. But remarkably, according to a Gallop survey of 15,000 people, the percentage of people who reported being “dissatisfied with the way things are going in your life” rose from 20 percent to 35 percent, and the number who reported being satisfied fell from 80 percent to 65 percent (see the discussion in Kahneman and Kruger, 2006).
5. If people make interpersonal comparisons (which they do) this throws off the whole Walrasian welfare framework. Measures of Potential Pareto Improvements are rendered meaningless (Gowdy, 2004). Establishing a “formal” basis for the behavioral underpinning of BCA may be an impossible task.
6. Although the “sanctity of choice” makes individual freedom a core moral value (justifying market liberalism) the Kaldor-Hicks criterion is strongly inconsistent with this view.
7. The Hartwick-Solow rule for weak sustainability is that an economy is sustainable if the capital stock necessary to maintain economic output is non-declining. But this only compounds the theoretical difficulties. The Cambridge debate over capital revealed the theoretical intractability of the neoclassical production function and the role of capital in standard welfare economics (Harcourt, 1972). Capital measurement problems are compounded in the cases of natural and social capital.
8. BCA does not answer the questions of intergenerational equity directly since it focuses on efficiency alone. The implicit assumption is that perfectly efficient markets will correctly anticipate the needs of future generations, given a particular social rate of time preference. For further treatment of the intergenerational question see Howarth and Norgaard (1992) and Howarth (2005).
9. For an example of the standard economic to evaluate climate change mitigation see Nordhaus, 1992, for a critique and an alternative see Laitner, DeCanio and Peters, 2001.

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