The Revolution in Welfare Economics and Its Implications for Environmental Valuation and Policy

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ABSTRACT. *Two research programs are brought together to contribute to the growing body of work on alternatives to standard welfare-based approaches to environmental valuation and policy. The first is the theoretical literature undermining the "new welfare economics." The second is the growing body of work on endogenous preferences. Both these research programs point to the necessity of interpersonal comparisons in welfare economics. This paper focuses on (1) the theoretical flaws in the use of Potential Pareto Improvements as a policy guide, (2) the "filtering" of expressed preferences through the axioms of consumer choice, and (3) the role of endogenous preferences in a reformulation of environmental valuation and policy.* (JEL D61, Q28)

I. INTRODUCTION

In spite of mounting empirical evidence and a growing body of theory demonstrating the logical inconsistencies and empirical shortcomings of neoclassical welfare economics.[1] This framework continues to dominate attempts by economists to place values on environmental features. Judging from the contents of the leading environmental economics journals, day-to-day work by applied economists is curiously disconnected from current work in mainstream economic theory. A time lag between theoretical frontiers and everyday practice is normal in any science, but its consequences are severe in the case of environmental valuation. Current U.S. policies on climate change and biodiversity preservation, for example, rely heavily on welfare economic models whose legitimacy depends crucially on weak theoretical formulations, and on

assumptions known to be at odds with actual human behavior. Particularly problematic is the use of the concept of a Potential Pareto Improvement (PPI) as one of the major economic tools for evaluating alternative environmental policies.

Two problems mar the welfare-based, cost-benefit approach to environmental policy. The first is the intractable theoretical difficulty of determining PPIs using the Kaldor-Hicks criterion. The second problem is that empirical estimates of PPIs using cost benefit analysis (CBA) filter data collected from actual respondents by forcing them to fit the restrictive assumptions of consumer choice theory. These problems are connected in that they both point to the need for a valuation and decision-making framework that moves beyond the rational actor model of the new welfare economics (NWE)[2] and explicitly consid-

[1] Mainstream economics is becoming so diverse that the term "neoclassical" is increasingly hard to define. I use the term "neoclassical welfare economics" to denote that branch of neoclassical theory based on the "New Welfare Economics" described in this paper.

[2] The new welfare economics was a reaction, in the late 1930s, to the "old" welfare economics of Pigou. Building on Pareto, it attempted to construct a welfare economics based on ordinal utility and without relying on interpersonal utility comparisons. Two broad approaches to this task were the *compensation criteria* approach discussed above and the *social welfare function approach* of Bergson, Samuelson, and others. This second approach did not concede that ethical judgments were necessary. According to Arrow (1951, 108) "[The] 'new welfare economics' says nothing about choices among Pareto-optimal alternatives. The purpose of the social welfare function was precisely to extend the unanimity quasi-ordering to a full social ordering."

ers interpersonal welfare comparisons. As Sen (1970, 50) puts it "nothing much of interest can be said on justice without bringing in some interpersonal comparability."

The new welfare economics is summarized in two Fundamental Theorems:

The First Fundamental Theorem of Welfare Economics: Assume that all individuals and firms are selfish price takers. Then a competitive equilibrium is Pareto optimal.

The Second Fundamental Theorem of Welfare Economics: Assume that all individuals and producers are selfish price takers. Then almost any Pareto optimal equilibrium can be supported via the competitive mechanism, provided appropriate lump-sum taxes and transfers are imposed on individuals and firms.

These two theorems have been the backbone of neoclassical theory and policy in the decades since World War II. Lockwood (1987, 811) writes of the Second Theorem: "It is no exaggeration to say that the entire modern microeconomic theory of government policy intervention in the economy (including cost-benefit analysis) is predicated on this idea." Likewise, Fisher (1983) writes, "The central theorems of welfare economics (i.e., the first and second fundamental theorems) may be the single most important set of ideas that economists have to convey to lay people."

The Second Fundamental Theorem implies that if a particular state of the economy is judged to be desirable, it may be achieved through lump-sum transfers. The rationale for distinguishing between alternative states of the economy is the Kaldor-Hicks criterion. If the magnitude of the gains from moving from one state of the economy to another is greater than the magnitude of the losses, then social welfare is increased by making the move even if no actual compensation is made. This is a Potential Pareto Improvement (PPI) and as Stavins, Wagner, and Wagner assert (2002, 5), "This is the fundamental foundation—the normative justification—for employing benefit-costs analysis, that is, for searching for policies that maximize the positive differences between benefits and costs." Establishing environmental policies through the identification of PPIs to evaluate costs

and benefits is central to the leading environmental economics texts.[3] A PPI is fundamentally different from the notion of Pareto efficiency that simply says that an efficient state is one in which any change will make at least one person worse off. A PPI is a change that helps one person and harms another.

Criticisms of NWE are frequently dismissed as attacks on a "straw man" (Pezzey and Toman 2002, 18) and this reaction is so prevalent it is worth discussing in some detail. The "straw man" criticism usually refers to attacks on the First Fundamental Theorem not on the Second Theorem. Economists rightly point out that few contemporary economists rely on the First Fundamental Theorem—externalities, market failures, and imperfect competition are almost universally recognized by economists. The Second Fundamental Theorem is then invoked to expose the naiveté of those who criticize the welfare economics approach—economists recognize that market failures must be corrected through enlightened government intervention. For example, Portney (2002, 1–2) writes, "Some criticize BCA [benefit-cost analysis] on the grounds that it supposedly enshrines the free market and discourages government intervention. However, BCA exists precisely because economists recognize that free markets sometimes allocate resources inefficiently, causing such problems as dirty air and water."[4]

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[3] See Hanley, Shogren, and White (2001, 69–72); Kahn (1998, 108–9); Kolstad (2000, 36–38) (who gives an informative discussion of social welfare functions and criticisms of the utilitarian perspective, 38–41); and Russell (2001, 51–52).

[4] In the same vein, Fullerton and Stavins (1998) present a lucid defense of the standard approach by invoking four "myths" about economists. The first myth is that "economists believe that the market solves all problems" and their correction to the myth is that government intervention is frequently necessary to correct market failures (the Second Fundamental Theorem). The second is "the myth that economists always recommend a market solution." But, most of the discussion of this "myth" is an argument for tradable permits, a market-based policy tool based on the Second Theorem. The third is the myth "that when non-market solutions are considered, economists still use only market prices to evaluate them." Again the debunking of this myth falls back on the Second Theorem—market prices need to be corrected for market failures. Fullerton and Stavins

Another "straw man" response is that economists recognize the limitations of cost-benefit analysis and few advocate CBA as an exclusive policy tool.[5] It is true that many leading environmental economists are careful to point out its limitations (Hanley 1999; Portney 2002), but it is hard to deny that CBA drives the environmental policy recommendations of most economists. Most revealingly, environmental valuation studies that do not rely on neoclassical welfare economics are usually met with derision by mainstream economists. For example, regarding the attempt by Costanza et al. (1997) to value wetlands by estimating the cost of replacing nature's service with human technological substitutes, Portney responded, "Ludicrous. . . . Equating nature with its replacement worth is seductive, but from an economist's perspective, a non sequitur. Something's economic benefit is determined by how much people are will-

ing to pay for it" (Wall Street Journal online 2002). It may be valid to claim that attacks on the First Welfare Theorem are attacks on a "straw man," but criticisms of the Second Theorem and its use by economists are much more serious and they are seldom addressed by the mainstream.

The next section discusses the welfare foundations of CBA and the theoretical and empirical difficulties in calculating potential Pareto improvements. Section 3 examines the role of PPIs in the sustainability debate, Section 4 discusses current research in endogenous preferences and its relevance to environmental valuation, Section 5 presents some alternatives to the utilitarian welfare model, and Section 6 concludes.

II. THE NEW WELFARE ECONOMICS AND COST BENEFIT ANALYSIS

The new welfare economics grew out of the classical utilitarianism of Bentham and Mill. The idea of a welfare function is utilitarian in the sense that its goal is to measure individual wants and to construct an index of utility (Welch 1987). Classical utilitarianism focused on trade-offs between different members of society and thus had a definite moral content. Interpersonal comparisons of utility were part of welfare theory as late as the 1920s as in Pigou's argument that, because of the law of diminishing utility, "Any cause which increases the absolute share of real income in the hands of the poor, provided that it does not lead to a contraction in the size of the national dividend . . . will in general, increase economic welfare" (Pigou 1920, 89). But with the ordinalist revolution and the positivist twist on utilitarianism by Hicks, Kaldor, and Robbins, the moral content of welfare theory was abandoned. Income distribution was left to philosophers and politicians, not economists. Economics was to be "scientific" not "subjective." Interpersonal comparisons of utility were to be avoided as being "normative" value judgments not "positive" statements of fact. In recent years, however, problems with the NWE have led theorists to abandon, or at

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are correct in referring to these three myths as attacks on a "straw man." But the fourth myth is that "economic analyses are concerned only with efficiency rather than distribution," which is exactly the cornerstone of the Hicks-Kaldor PPI (see footnote 5) and the basis of contemporary cost benefit analysis. This is not a myth. The point that economists are concerned with efficiency, and that questions of distribution should be left to politicians, is made four times in a nine-page paper by Stavins, Wagner, and Wagner (2002).

[5] The claim is sometimes made that although CBA should not be the only policy criterion, it is still a valuable tool. But even if traditional CBA is considered as only one input into a larger political process, it is still of no use if estimates based on welfare economics are unreliable. CBA is based on summing individual choices made independently in a market context, but the real policy challenge is the messy task of reconciling individual differences in a social context until a consensus emerges. In formulating environmental policy, costs and benefits involve an array of economic, social and environmental values. Attempts have been made to incorporate endogenous preferences into a CBA framework (Harris, Driver, and McLauglin 1989; Johansson-Stenman 1998), but in the end collective action is resistant to the optimization framework of NWE. An emerging alternative to welfare based CBA is multi-criteria assessment (MCA). MCA, in various forms, evaluates projects on diverse criteria such as efficiency, equity, or sustainability, and allows for a more realistic assessment of substitutability and complementarity between criteria (O'Neill and Spash 2000).

least move beyond, this narrow interpretation of the scope of economic inquiry.

PPI Measures of Welfare Changes

The difficulties with neoclassical welfare theory have been known for decades (Albert and Hahnel 1990). Until recently, however, problems such as the Scitovsky, Allais, and Boadway paradoxes were considered to be theoretical anomalies having little relevance to practical applications of the PPI principle. Current work, however, in behavioral economics and game theory shows that actual human behavior is better explained by the "paradoxes" than by the axiomatic model of consumer choice. There are sound behavioral explanations for the widely observed deviations from "rational" economic behavior.

The Kaldor-Hicks criterion seems straightforward. If one person values his gains from an economic change more than a second person values her losses, potential total welfare increases so this represents a potential Pareto improvement. Such a change is justified even if no actual compensation is paid. Most economists have followed Kaldor's view that *economic* policy recommendations should be determined by efficiency; distribution is a problem for politicians.[6] Undermining this separation

argument are more than fifty years of theoretical work demonstrating that PPIs cannot be identified by comparing individual welfare changes.

Theoretical Difficulties with the Kaldor-Hicks Criterion

The PPI criterion was supposed to allow economists to make policy recommendations regarding any two points on different utility possibilities curves such as those shown in Figure 1. But Scitovsky (1941) demonstrated that if a movement from one point to another in utility space can be shown to be Pareto improving according to the Kaldor-Hicks criterion, then it may also be shown that a movement back to the original point is also Pareto improving. Using the PPI criterion a movement from point X to point X′ should be made since from X′ it is possible to move to X″ where both consumers are better off compared to the original point X. It is also true, however, that a movement from X′ to X is justified because from X it is possible to move to point X‴ where both consumers are better off compared to the starting point X′ (see Varian 1992, chap. 22).[7] To eliminate this cycling problem, Scitovky proposed a double criterion for a potential

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[6] The separation argument and the related compensation principle have an interesting history. The early formulators of the principle exhibited a deeper understanding of its implications than later advocates. Chipman (1974, 579–81) makes the point that the separation principle makes more sense for a collectivist economy than under a *laissez-faire* system. If the question of fair and equitable income distribution is addressed by the political system, then it *may* be legitimate for economists to concentrate on the efficient allocation of resources in production. This was the position of Pareto and Barone, but this qualification in applying the PPI was abandoned by Hicks, Kaldor, and those who followed them. Pareto wrote (1971 [1906], 366), "one could say that the social organization might be changed in such a way that all members of the society could enjoy greater well-being, or at least some of those members could enjoy greater well-being without harming any others. Or one could say that the people who suffer from the social organization not being at maximum ophelimity could, if they were allowed to reach that maximum position, pay an amount such that everyone would find the new organization advantageous." But according to Kaldor (1939, 550), "There is no need for the economist to prove—as indeed he could never prove—that as a result

of the adoption of a certain measure nobody in the community is going to suffer. In order to establish his case, it is quite sufficient for him to show that even if all those who suffer as a result are fully compensated for their loss, the rest of the community will still be better off than before. Whether the landlords, in the free-trade case, should in fact be given compensation or not, is a political question on which the economists, *qua* economist, could hardly pronounce an opinion." Modern dissenters include Mishan (1980), who argued that the PPI criterion might be justified if adequate safeguards are in place to insure that its effects will not be regressive and Little (1950) who believed that the question of income distribution is logically prior to the question of ideal output.

[7] As Varian (1992, 407) puts it, "[The compensation principle] gives no guidance in making comparisons between Pareto efficient allocations, and it can result in inconsistent comparisons. Nevertheless, the compensation test is commonly used in applied welfare economics."
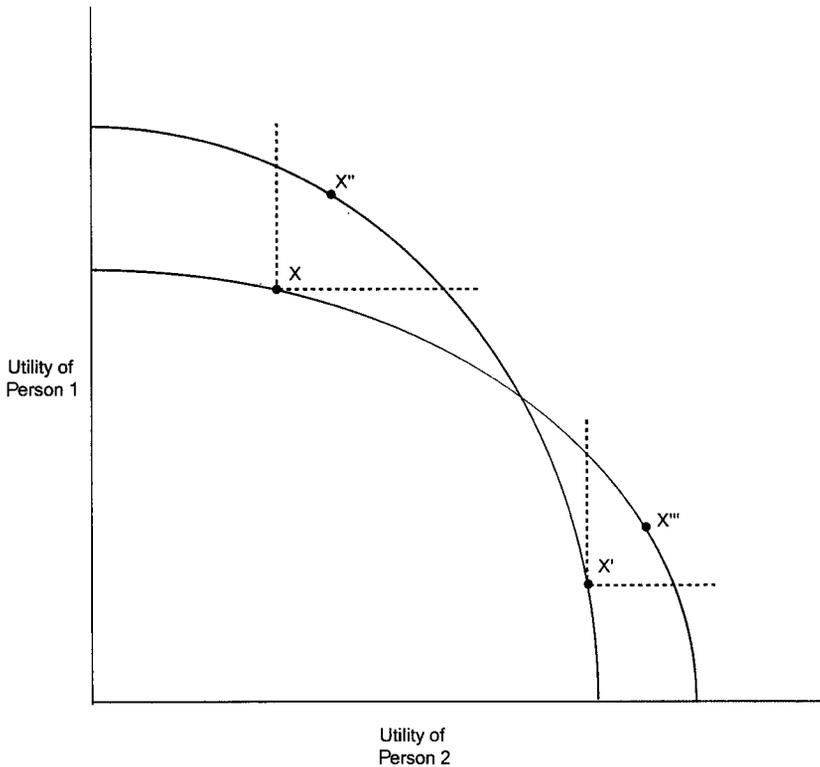
FIGURE 1
CYLING UNDER THE PPI TEST (ADAPTED FROM VARIAN 1992, 406)

Pareto improvement. It must be shown that the gainers from a change can compensate the losers so they will agree to the change (Kaldor criterion), and it must also be shown that it is not possible for the losers to bribe the gainers not to make the move (Hicks criterion). But Gorman (1955) showed that the Scitovsky criterion violates the transitivity assumption (see Suzumura 1999, fig. 3)

The PPI was an attempt to broaden the Pareto criterion without making interpersonal comparisons of utility. Another attempt was constructing a social welfare function (SWF) to choose a point on a grand utilities possibilities frontier or on a production possibilities frontier (PPF).

Figure 2 shows that using a SWF might "stick" the choice at either A or B, on a particular PPF, depending on which was the starting point. If the initial Pareto equi-

librium is at B with associated social welfare functions W_{B1} and W_{B2}, point B would be preferred to point A because it is on a higher social welfare curve. On the other hand if the starting point is A with its associated social welfare curves W_{A1} and W_{A2} then point A would be preferred to point B.

A change in initial distribution of goods (income) means a change in the reference points that determine Pareto optimality. The points A and B on the production possibilities frontier are associated with points A′ and B′ within an Edgeworth box for each amount of goods X and Y. Each utility possibilities frontier in Figure 1 can be derived from one of the two contract curves for consumption shown in Figure 2. The necessary condition for general Pareto optimality is that the slope of the PPF, the rate of product transformation of Y into X ($RPT_{Y \text{ for } X}$), is
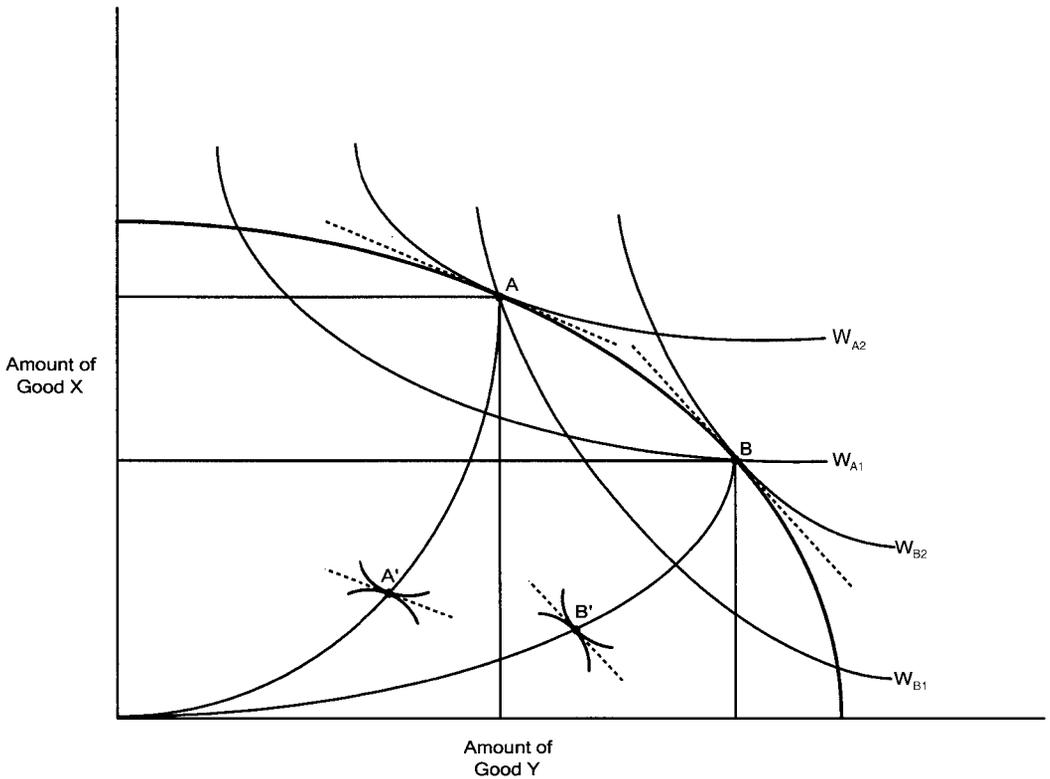
FIGURE 2
A PRODUCTION POSSIBILITIES FRONTIER WITH TWO SOCIAL WELFARE OPTIMA

equal to the common marginal rates of substitution Y for X ($MRS_{Y \text{ for } X}$) in consumption for each person. These slopes will be different at different points along the PPF, meaning that in competitive equilibrium, the price ratios for X and Y will be different at A and B. This general independence of welfare distributions and relative prices means that we cannot make general equilibrium statements comparing points on the PPF.

Boadway (1974, 926) demonstrated that "when comparing alternative projects or policies, the one with the largest net gain is not necessarily the 'best' one in the compensation sense." The Boadway paradox, like the Scitovsky paradox, arises from the fact that estimates of income compensated welfare gains, at constant prices, are partial equilibrium measures. These measures coincide with general equilibrium measures

only if there is a single market-clearing price ratio at every point on the contract curve, a condition that holds only if preferences are identical and homothetic (Jones 2002). If relative prices change with a redistribution of income, as they almost certainly would in a general equilibrium system, then PPI estimates are incorrect measures of potential welfare gains.

Numerous other theoretical dilemmas with the PPI approach have been identified. Brekke (1997) shows that the choice of a numeraire matters when the marginal rates of substitution differ among consumers. Samuelson (1950) showed that it is not certain that group A is better off than group B even if group A has more of everything. A basic problem for welfare economics is that the axioms of consumer choice refer to a single individual or a rep-
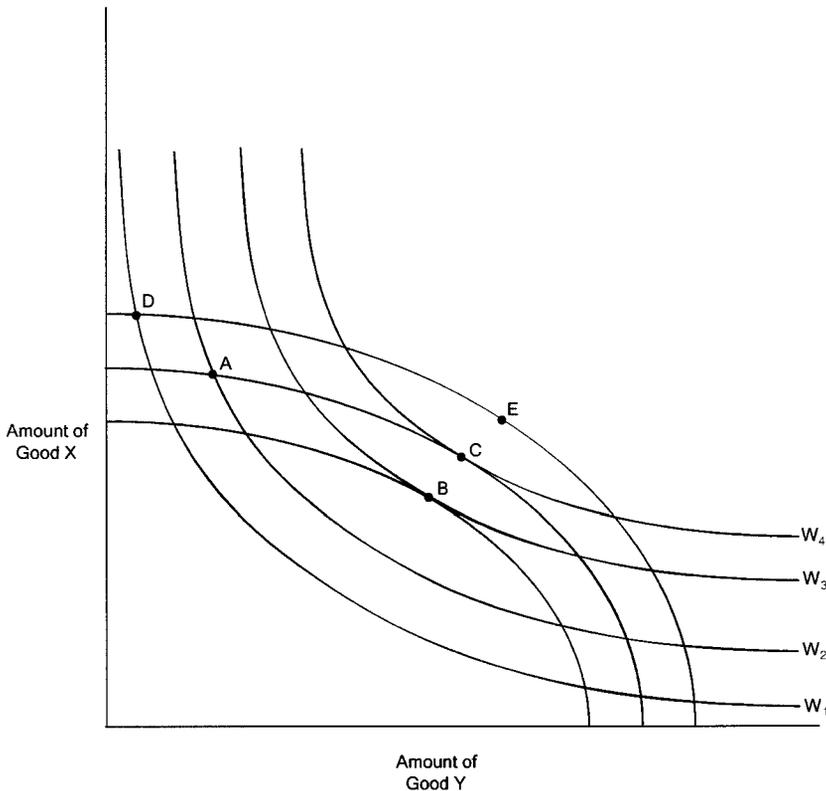
FIGURE 3
EFFICIENCY AND SOCIAL WELFARE

resentative agent, and they break down in the case of two or more persons (Chipman and Moore 1976). In the case of two or more persons, even *within* the narrow framework of neoclassical welfare theory, it cannot even be proved that more is preferred to less—perhaps *the* basic assumption of modern economics (Bromley 1990).

The upshot of these results for welfare economics is that the Kaldor-Hicks PPI rationale for comparing two states of the economy has some fundamental problems that preclude its practical application. There is no theoretically justifiable way to make welfare judgments without interpersonal comparisons of utility and this is not permissible under the stringent requirements of neoclassical welfare economics (Bromley 1990; Suzumura 1999). In 1978, Chipman and Moore (1978, 581) summarized the outcome of discussions about the Kaldor-Hicks-Samuelson-Scitovsky new welfare economics, "After 35 years of technical discussions, we are forced to come back to Robbins' 1932 position. We cannot make policy recommendations except on the basis of value judgments, and these value judgments should be made explicit." This position is even more secure after another 25 years of theoretical discussions.

Output Mix and Social Welfare

The PPI criterion has also been used to argue that increases in output (shifts in the PPF) are an improvement because they are potentially welfare enhancing. But as Figure 3 shows, if output mix changes, it is possible that an increase in output can reduce social welfare. Suppose a technologi-

EXPRESSED PREFERENCES	ELIMINATED BY	CONSUMER CHOICE AXIOMS	POLICY IMPLICATIONS
Lexicographic Preferences	→ Eliminated by →	Continuity Assumption	→ Everything is tradable
Hyperbolic Discounting	→ Eliminated by →	Time Consistency Assumption	→ Straight line discounting
Endowment Effect	→ Eliminated by →	Symmetric Rationality Assumption →	WTA=WTP
Other-regarding Preferences	→ Eliminated by →	Independent Choice Assumption	→ No collective decisions, no pure altruism
Process-regarding Preferences	→ Eliminated by →	Outcome-regarding Preferences	→ Process does not matter, only outcome

FIGURE 4
PREFERENCE FILTERING THROUGH THE AXIOMS OF CONSUMER CHOICE

cal change, indicated by an outward shift in the production possibilities frontier, moves the economy from B to A. Assuming welfare increases with consumption, this move should be made under the Kaldor-Hicks test since total output (consumption) goes up. The output of both goods can potentially be increased by moving from A to C. But in moving from B to A, welfare declines as indicated by the move from the social welfare function, W_3, to a lower social welfare function, W_2. In economic arguments for growth, the separability principle is extended to say that output mix is a political, not an economic problem. It is claimed that efficiency is a "positive" goal, while the question of the proper mix of goods and productive inputs involves "normative" judgments. An increase in efficiency is a good thing since it is theoretically possible for political authorities to redistribute the efficiency gains so that the physical output of both goods is greater (on W_4). A basic simplifying assumption, (as in the Nordhaus climate model discussed below), is that higher levels of total consumption (output), mean a higher level of total social welfare (for an explanation of the steps involved in going from maximizing utility to maximizing GNP, see Dorfman 1993). Applying the efficiency rule would dictate a move from point A not to point C, but rather to point D (since from D is theoretically possible to move to point E) on a higher PPF, but an even lower social welfare curve W_1. This shows that output mix as well as income distribution, both ignored by the PPI criterion, should be essential elements in measures of social welfare changes.

Preference Filtering in Empirical Cost-Benefit Studies

So the first problem with CBA is the theoretical difficulty in calculating welfare changes. The second problem lies with the way neoclassical welfare economists empirically estimate the value of losses and gains. At the core of neoclassical welfare theory is the rational-actor model of human behavior. Individuals act to maximize utility according to consistent, constant, well-ordered, and well-behaved preferences. In the rational-actor model, preferences are exogenous, that is, other individuals or social institutions do not influence them. The argument for using individual preferences as the starting point is a powerful one. It is a good thing for individuals to have what they want, and each individual is the best judge of what he or she wants. According to Randall (1988, 217) economists are "doggedly nonjudgmental about people's preferences." But are they? In fact, by forcing individual preferences through the narrow funnel of rational choice theory, economists are denying individuals a whole range of choices falling under the rubric of *endogenous preferences*, that is, preferences that depend on the individual's personal history, interaction with others, and social context.

Figure 4 shows some of the ways collected information about consumer attitudes is filtered by economists through the axioms of consumer choice (transitivity, non-satiation, continuity, completeness) to fit the stylized "facts" of neoclassical welfare economics. Through these filters, subjectivism and val-

ues enter economics in a non-explicit way that is much harder to recognize than when making explicit value judgments. These filters take a variety of forms.

For example, in surveys using the contingent valuation method (CVM), "protest bids" are very common. These may be in the form of "extreme" bids of zero or infinity. One reason for these bids is the existence of lexicographic preferences—people may place absolute values on environmental preservation and refuse to make trade-offs between environmental features and money (Spash and Hanley 1995; Stevens et al. 1991). Lexicographic preferences violate the continuity assumption implying smooth and continuous tradeoffs between goods. Lexicographic preferences are ubiquitous in CVM results although their share of total responses varies considerably (see Rekola 2003, Table 1). In many CVM surveys, these bids are excluded from the analysis thereby disenfranchising those respondents. A recent trend in CVM studies is to filter out lexicographic preferences by designing surveys to elicit market-compatible responses.[8] Bid cards, for example, restrict choices in CVM surveys to a given set of offers, thus forcing them to conform to the normative assumptions of the investigator. Environmental features are forced to be equivalent to market goods. Sagoff (1988, 94) calls this a *category mistake* because analysts ask questions as if they were about objective facts, when these questions are really about subjective interests and desires (see the discussion in Keat 1997). According to Sagoff (1994), equating "values" to "preferences" commits a fundamental category error.

Considerable evidence exists that people value the medium and distant futures about the same (hyperbolic discounting). Yet, cost-benefit analysis uses straight-line discounting to evaluate environmental features. Another ubiquitous filtering of pref-

erences is the use of Willingness to Pay (WTP) rather than Willingness to Accept (WTA) measures of environmental value. One justification for this is the assumption of "symmetric rationality" which ignores known behavioral patterns like the endowment effect. According to the authors of the influential NOAA panel report (Arrow et al. 1993, "the conceptually correct measure of lost passive-use value for environmental damage that has already occurred is the minimum amount of compensation that each affected individual would be willing to accept." In spite of this, the NOAA panel recommends the WTP measure "the willingness to pay format should be used instead of the compensation required because the former is the conservative choice" (Arrow et al. 1993, 32), and also due to "the cause of concern that respondents would give unrealistically high answers to such questions" (Arrow et al. 1993, 4). What constitutes an "unrealistically high" answer is not discussed, nor is why a "conservative choice" is best even though it is theoretically inferior. Again, if economists really mean to take consumer sovereignty seriously, they should not filter consumer preferences by imposing their own criteria as to what constitutes a reasonable response. In spite of strong criticism (Bromley 1998; Knetch 1994; Spash 2002a) WTP measures are almost always used in CVM studies.

The insistence on self-regarding rationality (independent choices) ignores the widespread evidence that people act to affect the well-being of others both positively and negatively (Gintis 1998, 2). Collective choice based on "other-regarding behavior" is restricted in the rational actor model. The actions of others also affect our choices. As Sagoff (1988) points out, people make different decisions as citizens than they make as consumers. Willingness to sacrifice for future generations or protecting wild species, for example, is likely to be greater if one knows that others will also sacrifice. Although evidence for altruism exists even in individual actions, it is more likely to occur in a social context (Fehr and Gächter 2000). Finally, in the rational-actor model, preferences are outcome regarding, that is,

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[8] Johnston and Swallow (1999, 308), referring to evidence for "non-neoclassical" preferences, suggest: "Research may also identify means to minimize such behavior, and encourage respondents to apply neoclassical optimization to the full range of hypothetical survey scenarios."

people care only about the quantities and qualities of goods exchanged. In reality, people are also concerned about the processes, particularly the issue of fairness (Gintis 1998). People care about process as well as outcome.

III. POTENTIAL PARETO IMPROVEMENTS AND THE SUSTAINABILITY DEBATE

Much of the environmental valuation literature is concerned with the issue of sustainability, and here, too, the PPI concept is invoked by environmental economists to argue that sustainability policies should be judged according to their relative efficiency in maintaining total economic output. In these models of sustainability, income distribution and output mix are ignored. Only total output counts.[9] For example, Nordhaus' (1992, 2001) models of global climate change use an objective utility function of the form:

$$\max_{c(t)} \sum_{t=1}^{T} U[c(t), P(t)](1 + \rho)^{-t} \qquad [1]$$

In his estimates of [1], Nordhaus uses a Bernoullian utility function where total utility (social welfare) is equal to the logarithm of the flow of per capita consumption $c(t)$ at time t times population $P(t)$ at time t. In his DICE model, future utility (consumption) is discounted at the real interest rate, ρ. A CES utility function forces

the elasticity of substitution to be the same between any pair of consumption choices. The world's consumers are lumped together into a single representative agent (eliminating any concern with the welfare paradoxes discussed above). A single constant-returns-to-scale firm produces the world's economic output. Using this model, climate change policies are evaluated by comparing the before and after effects on discounted aggregate world economic output. Nordhaus' conclusion, that certain climate mitigation policies are too costly from society's point of view, is based on an application of the PPI concept at the global economy level. Nordhaus' DICE and RICE models are much more than harmless academic exercises to frame the policy issues. They have been widely cited by policymakers as proof that aggressive policies to combat global warming are not cost effective.

Stavins, Wagner, and Wagner (2002) also define sustainability as dynamic efficiency[10] expressed as:

$$W(t) = \int_{t}^{\infty} U(c(\tau))e^{-\tau(\tau - t)} \, d\tau, \qquad [2]$$

overall feasible alternative consumption paths $c(\tau)$, where $U(c(\tau))$ is "the most general, idealized utility function comprising both direct consumption as well as the enjoyment of non-market goods and services and r is social rate of time preference." The condition for intergenerational equity is

$$\frac{dW(t)}{dt} \geq 0, \qquad [3]$$

where $W(t)$ is the maximized total welfare function from equation [2] (the original

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[9] Exposing the fallacy of equating an increase in GNP with a welfare improvement has a long history in the neoclassical literature. As Chipman and Moore (1976) demonstrate, even if it is assumed that all the problems with measuring non-market goods (the value of leisure, "housepartners" services, externalities and public goods) could be resolved, fundamental difficulties remain with using GNP as a measure of actual welfare, not to mention potential welfare. If the proportion of goods changes, even in the simple case of two people with different tastes, an increase in GNP could easily decrease total welfare. The arguments by Chipman and Moore (1976), Samuelson (1950), and others are in some ways even more powerful than those of heterodox critics of GNP welfare measures because they clearly show that even granting all the neoclassical welfare assumptions, and ignoring all the "second best" problems, increasing GNP is still an inadequate indicator of increasing welfare.

[10] In an analysis of sustainability, Stavins, Wagner, and Wagner (2002, 6–7) write, "In theory, it may be argued that sustainability is ultimately the most desirable policy goal, but in practice it is more reasonable to aim for potential sustainability in the form of dynamic efficiency (of an all-encompassing societal welfare function). We recognize that this opens an avenue for criticism of economics as being exclusively focused on efficiency rather than equity, but the efficiency criterion and related analytical methods are—ultimately—where the greatest strengths of economics lie."

formulation of equation [3] is given by Pez-zey 1989). Stavins, Wagner, and Wagner (2002) are explicit in their use of the PPI, including the separation principle, to judge whether equations [2] and [3] indicate non-declining welfare over time. They write (2002, 5)

> Economists resort instead [of the strict Pareto criterion] to seeking 'potential' Pareto improvements in the Kaldor-Hicks sense—world is viewed as being made better off if the magnitude of the gains and the magnitude of losses are such that the gainers can fully compensate the losers for their loses and still be better off themselves. Note again that under the Kaldor-Hicks crite-rion, the change is considered to be an improvement whether or not the compensation actually takes place. Actual compensation of los-ers by winners is essentially left to the political process.

In their policy prescriptions, leading en-vironmental economists seem unaware of the current literature in welfare econom-ics. Since this is unlikely, a more plausible explanation of the continued advocacy of the PPI criterion by these economists is that they hold such strong ideological bi-ases about the notions of efficiency, eco-nomic growth, and the superiority of mar-ket outcomes, they choose to ignore the theoretical difficulties involved (Bromley 1990; Koning and Jongeneel 1997, section 5). Economic arguments at first blush seem convincing. But we are frequently led by a leap of faith from "common sense" to neoclassical welfare theory. For example, in a recent paper Hanley and Shogren (2001) assert that "decisions researched over na-ture conservation using economic analysis are in some sense better than decisions reached without such an analysis." What economist would argue with this? But later in their paper "economic analysis" turns on the Potential Pareto Improvement cri-terion, "Can the gainers compensate the losers and still be better off?" an unan-swerable question in the new welfare eco-nomics framework.

IV. ENDOGENOUS PREFERENCES AND REAL HUMAN BEHAVIOR

If human preferences are to be the start-ing point for economic policy, models of human choice should describe behavior as it really exists and not as it "ought to be" to make them tractable in a neoclassical welfare economics framework. Recent re-search shows that preferences are endoge-nous, that is, they depend on the social context of individual choice. Several kinds of endogenous preferences are particularly relevant to environmental valuation:

The endowment effect. One of the major reasons for WTA > WTP is the endow-ment effect. It seems to be a psychological law that people prefer something they al-ready have to something they do not have (Kahneman and Tversky 1979). The hy-pothesis that losses are systematically val-ued more than equivalent gains has been verified in numerous experiments. Tests of the endowment effect have shown that it is not due to wealth effects, income dispari-ties, strategic behavior, or transactions costs (Knetch 1989). Dozens of experiments show that preferences depend on the direc-tion of the change, that is, whether people are paid to give up something they have, or have to pay to get something they do not have. The psychological model makes good predictions of economic behavior; the rational actor model does not.[11]

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[11] The argument is sometimes made by economists that opinion surveys and laboratory experiments do not carry the same weight as revealed market preferences. First, to say that market choices reveal what people really want ignores the well-known problems of price distortions due to externalities and market failure. One might claim that prices can be corrected for externalities (using CBA as Portney claims), but the public goods pricing problem is much more difficult. In any case, if choices are based on faulty price information they are unreliable as a policy guide. Second, as discussed in this paper, numerous studies indicate that people are not "rational" in their market choices (Kahneman 2003). Third, market choice restricts individual behavior and collective action. Finally, reading the psychological liter-ature, one cannot help but be impressed with the scien-tific rigor of modern behavioral research (see the papers in Kahneman, Diener, and Schwartz 1999). It seems to me that basing decisions affecting welfare or "well-being" on scientific evidence from hedonistic psychol-ogy could be more reliable than basing them on restric-tive and haphazard market choices. For example, the

Process regarding preferences. In environmental policy the process of arriving at a decision may be as important for public acceptance as the actual outcome itself. For example, in the ultimatum game, a "proposer" is given a sum of money and instructed to share it with a "respondent" who can either accept or reject the offer. Results of the game (mean offers and rejection rates) vary significantly according to the process through which money is obtained and offers are made. Offers are substantially lower if proposers win their position by doing well on a quiz (Hoffman et al. 1994). Rejection rates are much lower if respondents are told that the offers were generated by a computer (Blount 1995). In the prisoner's dilemma game, defection rates are significantly higher if the game is referred to as the "Wall Street Game" rather than the "Community Game" (Ross and Ward 1996). Results from these and numerous other studies in game theory, experimental economics, and behavioral economics show that models that do not take into account social processes such as community norms about fairness are poor predictors of economic behavior. Preferences are socially conditioned (Brekke and Howarth 2000, 2002). These findings are at odds with the neoclassical welfare model in which ends are given.

Time inconsistency and hyperbolic discounting. Time consistency is critical to the standard economic assumption that benefits delivered in the future should be discounted at a fixed rate. But behavioral studies indicate that people discount the near future at a higher rate than the distant future and they have different discount rates for different kinds of outcomes (Gintis 2000; Laibson

1997). Anticipation has been found to be a positive thing in itself and may result in something in the future having a *higher* value (Loewenstein 1987). This finding is relevant to environmental preservation policies such as preserving national parks and other wildlife areas because individuals may enjoy them more in the future (after retirement, for example) and the anticipation of this is important. Straight-line discounting is another filter that reduces the economic value of environment.

Biased cultural transmission. According to standard theory, people choose among various options by carefully and consistently weighing them according to efficient welfare-maximizing criteria. Results from a number of societies contradict this model of human behavior. Individual actors do not act as cost-benefit calculators who continuously adapt their behavior to changing environmental conditions. They may or may not respond "rationally" to incentives. The rational-actor model has proved to be a poor predictor of economic behavior (Henrich et al. 2001). Good predictions can be made, however, using models of biased cultural transmission (Henrich 2004). By *selectively* imitating respected individuals, people may insure that innovations become established in a community. Whether or not a particular innovation is adopted depends not so much on its "superiority" as determined by cost-benefit calculations, but rather on its conformance with established cultural patterns. This has far-reaching implications for the design of environmental policies, and calls into question the widespread belief among economists that incentive-based policies are always preferred.

Other regarding (social) preferences. Results from game theory and behavioral economics show that people act to affect the well-being of others, positively or negatively, even at significant cost to themselves (Fehr and Gächter 2002). A sense of fairness, including pure altruism, is a critical factor in economic decisions. This is illustrated in various game theory experiments such as the public goods game in which participants are willing to impose, at great cost to themselves, punishments on non-contributors,

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sustainability debate could be enhanced by using a welfare function W(.) defined as well-being or happiness (Frey and Stutzer 2002), rather than using a wealth or income index. It is well documented that the link between consumption (or income or per capita GDP) is weak (Frey and Stutzer 2002). Using scientific measures of happiness as an indicator of welfare would put the focus on sustaining or enhancing those things that really increase well-being.

even in the last round of the game (Bowles and Gintis 2000). These kinds of behavior patterns have important consequences for judgments about environmental values and policy design.

Have the theoretical breakthroughs described above had any significant influence on the theory and methods of environmental economics? Judging from articles published in the leading environmental economics journals and looking at the environmental policy prescriptions of leading economists, one would have to say "No." Neoclassical economists rightly point out that the neoclassical paradigm has been extended far beyond the limits of traditional welfare analysis. But in empirical work environmental economists continue to fall back on the discredited framework of the new welfare economics.

Traditional welfare economics has many strengths, especially if we reject its extreme manifestations in post–World War II, neoclassical-welfare theory. It remains a powerful statement of the worth of the individual and the rejection of "perfectionist" theories of human nature that have caused such havoc in the modern world. But individual preferences are distorted by forcing them into the straightjacket of the axioms of welfare economics, denying interpersonal comparisons of utility, and ignoring what has been learned about how humans actually make economic decisions. The expression of individual free will is shackled, not liberated, by the policy approach of the new welfare economics.

V. ENDOGENOUS PREFERENCES, REASONABLE VALUATION AND ENVIRONMENTAL POLICY

How can we broaden public input to policy questions beyond welfare-based CBA criteria and market-based measures of public opinion? As a starting point for policy guidance, it is useful to return to the discussion of endogenous preferences. As discussed above, numerous studies have shown that people are reluctant to give up something that they feel is theirs by right. This endowment effect (Gintis 2000) lends sup-

port to the notion of a safe minimum standard (SMS) and the precautionary principle. The SMS approach (Ready and Bishop 1991), the notion of "stewardship" (Brown 2001), and many other similar suggestions explicitly recognize that irreversible environmental damage should be avoided unless the social costs of doing so are "unacceptably high." The concept is necessarily vague because it does not rely on a single money metric as does CBA. It recognizes that environmental losses should be valued higher than economic gains, that a great amount of uncertainty is involved in judging the effects of environmental losses, and that there are limits to substituting manufactured goods for environmental resources. Interesting work is being done sorting out the different kinds of uncertainty facing environmental policymakers (Spash 2002b, chaps. 4 and 5). With the increasing threat of global and potentially catastrophic environmental changes, environmental policy must come to grips with strong uncertainty together with very serious consequences of making wrong decisions.

Work in welfare theory is also being done to move environmental valuation and policy beyond mere preference evaluation. People's individual preferences may be incompatible with long-term human survival (McDaniel and Gowdy 2000). Rights based or deontological values are widely held by the public, as indicated by numerous valuation surveys (Lockwood 1998; Spash 1997; Stevens et al. 1991). A rights-based approach is appropriate for policies affecting future generations. Do future generations have a right to clean air, clean water, and an interesting and varied environment? There is no reason to think that future generations would be any more willing than we are to have something taken away from them forever (especially things like a stable climate and biological species) as long as they are compensated by something "of equal value." A rights-based approach to sustainability moves us away from the welfare notions of tradeoffs and fungibility toward the two interrelated concerns of uniqueness and irreversibility. As Bromley (1998, 238) writes, "Regard for the future

through social bequests shifts the analytical problem to a discussion about deciding what, rather than how much, to leave for those who will follow." The question of what to leave also moves us away from marginal analysis and concern only about relative amounts of resources, toward looking at discontinuous changes and total amounts of resources. Corning (2000) has outlined a "basic needs" approach to sustainability whose starting point is the biological and psychological nature of the human species. Regardless of the characteristics of specific human cultures, we know that future generations will need, for example, nutritional food and clean water, appropriate health care, and a non-hazardous physical environment.

The literature on endogenous preferences indicates that people care about means as well as ends. Human preferences include strong feelings about how goods are produced, and about fairness in terms of economic rewards and distribution. The process of decision-making is important and the process itself shapes preferences. These ideas are extensively discussed in the valuation literature on discursive ethics (O'Hara 1996), deliberative democracy (Jacobs 1997), and stakeholder negotiation (O'Connor 2002). A growing trend is to combine environmental valuation with these various forms of deliberative processes. Reasonable valuation (Hiedanpää and Bromley 2002) recognizes that individuals are embedded in social institutions and that preferences are created and re-created as the decision-making process unfolds.

Although it is not basic to the NWE framework, time consistency is almost always imposed on CBA calculations. This requires that the future be discounted at the same rate during all future time periods. The discount rate must be independent of the time period within which the costs and benefits occur. The existence of hyperbolic discounting implies that CBA may seriously underestimate the benefits of long-term environmental policies (Gintis 2000, 313). People also appear to have different discount rates for different kinds of outcomes (Loewenstein 1987). If we re-

spect stated preferences, straight-line discounting should not be used to place values on distant-future environmental damages such as those caused by climate instability or biodiversity loss. Using a constant discount rate in the case of long-term damages has two other major disadvantages. First, policies are very sensitive to the choice of the discount rate. At a discount rate of 1%, it is justified to spend 37 cents to avoid $1 damage in 100 years. At a discount rate of 4% it is only justified to invest 1.8 cents to avoid $1 damage in 100 years. Second, large damages in the future have almost no discounted present value and thus no effect on policy recommendations. For example, at a 5% discount rate the life of one individual at the present is worth more than a billion people 500 years in the future (Heinzerling and Ackerman 2002).

Hyperbolic discounting has been widely discussed in the theoretical literature but the idea has had little impact on the policy recommendations of most economists. Exceptions include Cropper and Laibson (1999) who recommend using hyperbolic discounting in the case of global warming and Chichilnsky (1996) who uses hyperbolic discounting in her model of sustainable development. Of course, this is not to say that straight-line discounting should be discarded in all capital investment decisions.

The standard attack on critics of NWE—that it is wrong to criticize the dominant theory unless a full-blown alternative is presented—is no longer valid (if it ever was). A number of alternative approaches to welfare theory are now being refined. The most prominent of the new welfare theorists is Sen (1970, 1977, 1997) who has constructed a theory of welfare economics based explicitly on moral premises. Sen, Fine (1975), Harsanyi (1977), and Blackorby and Donaldson (1977), to mention only a few, have proposed various ways to construct "quasi-orderings" based on interpersonal welfare comparisons. These necessarily involve ethical judgments. Also relevant is the contemporary literature on the determinants of subjective well-being. Psychologists and economists have estab-

lished that meaningful information about welfare (well-being) can be gathered from surveys asking peoples about their internal mental states (see the essays in Kahneman, Diener, and Schwartz 1999). Pezzey (1992) proposes an empirical approach to constructing a sustainability function based on psychological experiments on time preferences. The findings of Easterlin (1995), Frank (1985), Johansson-Stenman, Carlson, and Daruvala (2002) and many others imply that it is possible to construct welfare measures that reflect more meaningful changes in well-being than do NWE compensation measures.

VI. CONCLUDING COMMENTS

In spite of valiant attempts to build a positive, value-free science, neoclassical welfare economics remains an ethical and ideological system. Decades of theoretical work shows that, even if we grant all the restrictive assumptions of welfare economics, from *Homo economicus* to perfectly operating competitive markets, there is no way to "close" the neoclassical welfare system from within. There is no way to pick a particular Pareto optimal distribution without appealing to an ethical judgment. The potential Pareto improvement principle was promoted as an alternative to the social welfare function that brought economic theory uncomfortably close to making interpersonal comparisons of utility. But if we give up the PPI as a policy guide, economic policy recommendations must be replaced by explicit social welfare judgments, a distasteful prospect for many economists.[12]

The arguments presented in this paper are not meant to be a critique of all attempts to put numbers on the benefits and costs of moving from one state of the economy to another. I only criticize the framework of neoclassical welfare economics currently underlying most calculations of costs and benefits. Judging from the literature, and from conversations with cost-benefit advocates, most economists do not appreciate the theoretical difficulties involved in estimating welfare changes. And most non-economists are unaware of the leap-of-faith required in going from "estimating costs and benefits" to calculating a "Potential Pareto Improvement." Finally, there seems to be a lack of appreciation of the difference between individual choices ("BCA counts no values other than those held by the individual members of society." [Portney 2002]) and the restrictive assumptions of rational economic man imposed on cost benefit calculations. On one level, we can agree with Pearce's (1992) statement, "what economic valuation does is to measure *human preferences* for or against changes in the state of environments." Since all policy choices are made by humans, obviously some calculations of "preferences" lie behind any environmental policy. How these preferences are determined is the bone of contention. Are they forced into the straightjacket of welfare economics, or are they allowed to be expressed in the full range of human experience? *Homo economicus*, whose ghost lurks behind the policy recommendations of mainstream environmental economists, has lost out in the struggle for survival both within and outside the economics profession. Fifty years of theoretical analysis have demonstrated the impossibility of making welfare judg-

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[12] See the discussion of this point in Koning and Jongeneel (1997, section 5), which includes statements by prominent economists to the effect that the status and far-reaching authority of economists to comment on public policy would be undermined by abandoning the Potential Pareto Improvement principle. Blaug (1985) writes, "If we refuse, even in principle, to distinguish allocative efficiency from distributive equity, we must perforce reject the whole welfare economics and with it any conventional presumption in favour of competitive markets, and indeed, in favour of the price mechanism as a method of allocating scarce resources. Arguments for co-ordinating economic activity by markets would then have to be expressed in terms of political philosophy—for example, that markets diffuse economic power—and economics would in consequence

have to become a totally different subject." Likewise, in a justification of using the market rate of interest as the CBA discount rate, Arrow et al. (1996) write: "The alternative—over-riding market prices on ethical grounds—opens the door to irreconcilable inconsistencies. If ethical arguments, rather than the revealed preferences of citizens, form the rationale for a low discount rate cannot ethical arguments be applied to other questions?"

ments without interpersonal comparisons of utility. Evolutionary biology has shown that it is "rational" to care about others including the welfare of future generations and non-human species (van den Bergh and Gowdy 2003).

If we are to embark on the road to sustainability, meaning social harmony and environmental resilience, we must be guided by economic theories based on a solid scientific and theoretical framework. This framework is being constructed by economists working both inside and outside the professional mainstream. The task of constructing such a framework would be easier and faster if environmental economists would turn their attention toward contemporary models of human decision-making, and away from sterile applications of flawed theories.

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