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Toward a New Welfare Foundation for Sustainability

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ABSTRACT

The debate over various definitions of sustainability has for the most part been conducted within the framework of traditional welfare economics. Discussion has centered on technical issues imbedded within the functional forms of various optimization models, especially the coefficient of the elasticity of substitution and the social discount rate. A more basic problem is that intractable theoretical difficulties within welfare economics call into question the results of traditional models of sustainability regarding intergenerational welfare. Another difficulty is that equating per capita consumption with welfare contradicts empirical evidence that suggests that the link between happiness and wealth/income is relatively weak. Alternative approaches to measuring well-being are being developed and these have great potential to move the sustainability debate forward.

Keywords: Boadway paradox, happiness, potential Pareto improvement, utility, weak sustainability, welfare theory

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I. INTRODUCTION

The debate between advocates of weak and strong sustainability has, for the most part, focused on the substitutability between natural capital and human-made capital of various sorts (see the summary by Pezzey and Toman, 2002). A great deal of work has explored the conditions for optimizing intergenerational social welfare but little attention has been given in the sustainability literature to the intractable difficulties inherent in making Pareto consistent welfare comparisons. Weak sustainability is firmly rooted in the New Welfare Economics (NWE) that dominated economic theory from the late 1930s until the 1990s (Bowles and Gintis, 2000; Suzumura, 1999). The emphasis of NWE is on achieving efficiency in allocating economic outputs and inputs through substitution and seeking potential Pareto improvements (PPIs). Weak sustainability is based on the work of Solow (1974, 1993) and Hartwick (1977, 1996) concerning the allocation through time of an exhaustible resource. The basic idea is that social welfare (defined as the sum of individual utilities) should be non-declining through time.[1] Welfare is (explicitly or implicitly) equated with consumption, broadly defined, so sustainability across generations is assured by maintaining the total stock of capital used to generate economic goods, broadly defined. In the weak sustainability framework, substitution is not only permitted, it can be a moral imperative: if the net present value generated by transforming natural capital into human-made capital is greater than the net present value generated by leaving natural capital intact, then this transformation should be done (Beckerman, 1994; Solow, 1993). Otherwise the inefficient use of capital will mean that future generations will be needlessly worse off.[2]

Advocates of strong sustainability argue that traditional neoclassical models overestimate the possibilities of substitution between natural and manufactured capital including the related problems of complementarity, irreversibility, pure uncertainty, and discontinuous change (Daly, 1995; Gowdy, 2004; McDaniel and Gowdy, 2000; Ng and Wills, 2002). The debate over strong sustainability has, for the most part, also taken place within the framework of NWE. The question of the substitutability of manufactured for natural capital can be reduced to a purely empirical question within neoclassical economics as to the elasticity of substitution between different kinds of capital. Weak sustainability, and strong sustainability as it relates to capital substitutability, boils down to applying the Second Fundamental Theorem of Welfare Economics and "getting the prices right." But the problems with NWE models of sustainability run much deeper than disagreements over which prices to use and the degree of substitutability between human-made and natural capital. NWE has foundered on the attempt to make social welfare judgments without making interpersonal comparisons of utility. This calls into question a central concern of economics during the last fifty years, that is, the identification of the most "efficient" economic policies to increase the output of goods and services. The theoretical difficulties with neoclassical measures of potential Pareto improvements, and the abandonment of NWE by leading neoclassical theorists, are critically important for the sustainability debate.

If the NWE framework cannot be used as a guide to evaluate welfare changes over time, what framework should take its place? Fortunately, theoretical and empirical research is quickly filling the void left by NWE. Economists are going back to Bentham to ask the question: “What makes people happy?” (Dixon, 1997; Easterlin, 2001; Frey and Stutzer, 2002; Kahneman, Wakker and Sarin, 1997; Layard, 2003; Ng, 1997, 2003; Schwarz and

Strack, 1999). Accepting the validity of interpersonal comparisons of well-being, what economic policies should be put in place to increase the greatest good for the greatest number? Instead of using consumption as an indicator of well-being, economists are directly estimating human "welfare" in all its complexity. This body of work has the potential to move the sustainability debate out of the quagmire of theoretical difficulties associated with the NWE. Replacing the perfectly rational *Homo economicus* with realistic models consistent with known facts from anthropology, neuroscience, and psychology is a logical step toward improving economic science (Camerer and Loewenstein 2003). Among the most important findings of the happiness literature are these: (1) traditional economic indicators such as per capita NNP are poor measures of welfare, (2) utility depends on interpersonal comparisons and relative position, (3) all humans have common, identifiable biological and psychological characteristics related to their well-being. These observations have direct bearing on the sustainability debate and have the potential to guide intergenerational welfare and environmental preservation policies.

II. THE WELFARE FOUNDATIONS OF WEAK SUSTAINABILITY

The conventional definition of sustainability originates from three papers from a symposium published in the *Review of Economic Studies* (Dasgupta and Heal, 1974; Solow, 1974; Stiglitz, 1974). The framework for those papers and subsequent analysis is summarized by Pezzy and Toman (2002, 5) as:

$$\max_{C(t),R(t)} \int_0^\infty U[C(t)]\Phi(t)dt \qquad (1)$$

where U is instantaneous utility, C is consumption flow, R is the rate of resource depletion, and ϕ is the utility discount factor. Stavins, Wagner, and Wagner (2002, 3) offer a similar

formulation, explicitly including the notion of the choice of consumption paths and dynamic efficiency:

$$W(t) \equiv \int_0^{\infty} U[C(\tau)]e^{-r(\tau-t)}d\tau \tag{2}$$

where "total welfare" W(t) is maximized over all feasible consumption paths c(τ), U(c(τ)) is a broadly defined utility function which includes both direct and indirect consumption, t is a specific time period, and r is the social rate of time preference. The same basic definition of sustainable welfare is given by Asheim (1994); Hartwick (1994), Kraukraemer (1985); Pearce and Atkinson (1993), and Russell (2001, 303) among others. The condition for intergenerational sustainability is:

$$dW(t)/dt \geq 0 \tag{3}$$

This is the "weak" or "economic" definition of sustainability. A sustainable economy exhibits dynamic efficiency and a non-declining stream of maximized social welfare over time (Stavins, Wagner and Wager, 2002). Two problems with this approach to sustainability are discussed here. First, insurmountable theoretical difficulties exist with determining whether a change in welfare dW(t)/dt is positive or negative using NWE methods. Second, the link between per capita consumption and welfare is weak.

Sustainability as an Intergenerational Potential Pareto Improvement

Weak sustainability is based on welfarism, the claim that individual preference data are both necessary and sufficient to form an index of social welfare (Chang, 2000; Mongin, 2000, 23). A public policy $\mathbf{p}^* \in \boldsymbol{P}$, where $\boldsymbol{P}$ is the set of feasible policies, is said to be Pareto efficient if there does not exist an alternative policy $\mathbf{p} \in \boldsymbol{P}$ which leads to a Pareto dominant utility allocation (Coate, 2000, 442). So a change in policy would be represented by $\Delta \boldsymbol{P} =$

$\{\Delta \mathbf{p} : \mathbf{p}_0 + \Delta \mathbf{p} \in P\}$. Any policy change $\Delta \mathbf{p}'$ is efficient if and only if $\mathbf{p}_0 + \Delta \mathbf{p}'$ is a Pareto efficient policy. A problem for the strict Pareto approach, that any change must benefit at least one person and harm no one, is that it is so restrictive to be of little practical use. Consider Figure 1 showing an Edgeworth-Bowley box diagram for two goods (**X** and **Y**) and two consumers (**A** and **B**). Consider point **a**. All that can be said about a movement away from this point is that any point in the cross-hatched area is preferred since both consumers are better off, and that any point in the lined area is not preferred since both consumers are worse off. A movement from **a** to **b**, even though it represents a movement from a Pareto inefficient to a Pareto efficient distribution, cannot be justified since it makes consumer **A** worse off.

FIGURE ONE ABOUT HERE

The New Welfare Economics was an attempt to expand the strict Pareto criterion and still retain the welfaristic position that utility is not comparable between individuals. The NWE vision was to establish appropriate criteria for evaluating distributional changes that do not involve value judgments. The same policies could be recommended by all economists regardless of their economic philosophies or political views (Hicks, 1939, 696). The rationale for this is the Kaldor-Hicks compensation test; if the gainers can compensate the losers and still be better off (a Potential Pareto Improvement or PPI), then the policy is justified. For example, a movement from point **a** to **b** in Figure 1 is justified as a PPI since the gainer (consumer **B**) can potentially compensate the loser (consumer **A**) and still be better off by moving to a point on the contract curve such as **c** within the cross-hatched area. But over fifty

years of theoretical work has led inexorably to the conclusion that determining the welfare consequences of an economic policy change cannot be done by simply summing individual welfare changes (Boadway, 1974; Bromley, 1990; Chipman and Moore, 1978; Scitovsky, 1941; Suzumura, 1999). The basic problem is that relative prices change when redistribution occurs so that, in effect, calculating PPIs involve comparing partial equilibrium situations and drawing general equilibrium conclusions (Blackorby and Donaldson, 1990; Boadway, 1974, 938; Johansson-Stenman, 1998; Jones, 2002).

FIGURE TWO ABOUT HERE

Figure 2 illustrates the notion of an intergenerational PPI. Consider some policy change initiated at time t that will affect the welfare of those in time t+1. Examples of such policy changes include global warming (Nordhaus, 2001), and biodiversity loss (Weitzman, 1992). Policies affecting the global economy invariably make some worse off and others better off (Gerlagh and van der Zwaan, 2002). The vertical and horizontal axes show the total utilities of two consumers $\mathbf{A}_t$ and $\mathbf{B}_t$ at time t and the total utilities of consumers $\mathbf{A}_{t+1}$ and $\mathbf{B}_{t+1}$ at some future time period t+1. Assume that consumers $\mathbf{A}_t$ and $\mathbf{A}_{t+1}$ have identical tastes, as do consumers $\mathbf{B}_t$ and $\mathbf{B}_{t+1}$. Alternatively, we can assume that $\mathbf{A}_t$ and $\mathbf{A}_{t+1,}$ and $\mathbf{B}_t$ and $\mathbf{B}_{t+1}$ are the same consumers with unchanging tastes but living in two different time periods. Suppose we wish to evaluate some sustainability policy, say investing in climate change mitigation, that would take effect in period t+1. Using the PPI principle, a movement from X on the utility possibilities frontier UPF_t to X' on UPF_{t+1} would satisfy $dW/dt > 0$ since potentially we could move to X'' on UPF_{t+1} so that $\mathbf{A}_{t+1} > \mathbf{A}_t$ and $\mathbf{B}_{t+1} > \mathbf{B}_t$. But, if we begin at X' on

UPF_{t+1} and ask whether or not we were better off at the original point X on UPF_t the answer is "yes" since from X' we can move to X''' where $\mathbf{A}_t > \mathbf{A}_{t+1}$ and $\mathbf{B}_t > \mathbf{B}_{t+1}$.[3] Intergenerational applications of the PPI principle also run afoul of the Boadway and Scitovsky paradoxes.

Boadway (1974) proved that the compensating variations (CV's) for a lump sum redistribution of income have a positive sum. This implies that conventional measures of potential Pareto improvements are unreliable even for the purpose for which they were designed, namely, comparing small changes within a short time span. According to Boadway (1974, 926): "when comparing alternative projects or policies, the one with the largest net gain is not necessarily the 'best' one in the compensation sense." When CV's are calculated at constant prices (using either ex ante or ex post prices) they are partial equilibrium measures and, as Jones (2002, 1) observes:

> … they coincide with CV's measured in general equilibrium if there is a single market clearing price ratio along the contract curve, which is the case when consumers have identical and homothetic preferences. Once the relative price changes along the contract curve the two measures do not coincide, and as the "Boadway paradox" demonstrates, partial equilibrium CV's are misleading measures of potential welfare gains in these circumstances.

This critique applies to any NWE-type welfare change. W(t) need not be economic output or per capita consumption; it can be any single-valued measure of welfare. The changing numeraire problem exists whether prices or some other measure of relative value is used. Prices are merely an indicator of preferences, and any other relative valuation indicator would change as tastes change with changing reference points (Brekke, 1997). The changing reference point problem is, of course, compounded when comparing individual preferences across generations.

The use of an intergenerational PPI approach is implicit in neoclassical models of sustainability (Hartwick, 1994; Solow, 1993; Stavins, Wagner and Wagner, 2002). Even so, some argue that weak sustainability insists on a strict Pareto criterion since it calls for future generations to be at least as well off as the current generation. According to Neumayer (1999) weak sustainability "denies the validity of potential Pareto improvements in an intergenerational context and demands actual compensation if future generations would suffer from an action that benefits current generations." But this is only true if each generation is characterized by a "representative agent", an "average person" or any similar formulation where the welfare of a group of people is represented by a single entity. This is a widely used way to get around the paradoxes arising from PPI comparisons. Neumayer's analysis, for example, "...mainly looks at inter-generational as opposed to intra-generational distributional questions. That is, in effect, for most of the analysis I assume that either the intra-generational distribution is just or that it is otherwise taken care of" (Neumayer, 1999, 12). This is exactly the critical assumption behind the Hicks-Kaldor compensation principle.[4] Weak sustainability employs the potential, not strict, Pareto principle because it looks only at one index number for each generation, thereby ignoring intragenerational distribution and product mix. Even the simple case of two commodities and two consumers presents intractable problems for the welfaristic approach. Chipman and Moore (1976, p. 398) write:

> If there is only one commodity, desired by all individuals, then tastes are identical. And if there is only one individual, tastes are trivially identical. We shall see that if the proposition 'an increase in GNP implies an improvement in potential welfare' is to be true in the general case of m individuals and n commodities, and if equilibrium is determined by competition in the market in the absence of centrally planned direction, tastes must be identical....when observations are made on competitive equilibria in different hypothetical situations, in order for us to be able to conclude that an increase in GNP implies an improvement in potential welfare in all such conceivable situations, it is necessary for preferences to be identical and homothetic.

The essential picture of a modern economy, as pointed by Adam Smith well over two hundred years ago, is millions of individuals, groups, and firms each pursuing their own interests and somehow ending up with a more or less stable order. Paradoxically, NWE macroeconomic models, including models of sustainability, consider almost no activity which requires coordination or interdependence (van den Bergh and Gowdy, 2003). NWE models of sustainability cannot do what is claimed for them unless tastes are identical and preferences are homothetic. Interpersonal comparisons of utility seem to be both necessary and desirable in judging alternative policies (Hammond, 1996; Harsanyi, 1987; Sen 1999).

The Hartwick-Solow rule for weak sustainability is that an economy is sustainable if it maintains the capital stock necessary to sustain welfare. But moving the focus of sustainability from output to the capital required to produce it only compounds the theoretical difficulties. The Cambridge debate over capital highlighted several theoretical difficulties with the neoclassical production function and the role of capital in NWE (Harcourt, 1972). Robinson (1954) pointed out that the neoclassical (Clark-Knight) concept of capital cannot serve as an input in a production function since it must be measured in monetary units, and thus the value of the input “capital” cannot be separated from the value of the output it is producing. Like "utility", "capital" is heterogeneous and apparently intractable theoretical problems arise when its heterogeneity is recognized. The neoclassical solution, paralleling the use of the representative agent in utility theory, is to create a homogeneous kind of capital ("leets" or “putty-clay”). As Asheim (1994, 257) has demonstrated, “with multiple capital goods, it is not in general possible to construct an exact indicator of sustainability on the basis of current price information.” The importance of the Cambridge controversies for the Hartwick-Solow rule is that the value of capital as a factor of production depends crucially

on income distribution. This is a problem for measures of natural capital as well as manufactured capital.

The weak sustainability solution to the intergenerational welfare problem, separating capital stock from the output it produces, does not work unless an assumption is made that either substitution among different kinds of capital is universal or that money is a substitute for anything. But the value of capital, natural or otherwise, cannot be defined independently of output. And it is not true that with a given stock of capital, *anything* at all can be produced. The aesthetic value of a rainforest cannot be re-produced if the rainforest no longer exists. How can we know what sorts of capital to maintain without knowing the details of what is to be produced? The "value" of sustainable capital depends on the "value" of sustainable consumption. If capital cannot be consistently defined even for strictly economic capital like machines, it is perhaps näive to assume that it can be defined in the case of "natural capital" consisting of essential but largely unknown ecosystem functions and relationships.

III. CONSUMPTION, HAPPINESS AND SUSTAINABLE WELFARE

The new welfare economic analysis of sustainability begins by defining utility broadly but after that the maximand W(.) becomes, in one form or another, the output of a market economy (output, consumption, or per capita consumption). Ideally 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 (Nordhaus, 2001). The most widely-used indicator of sustainable welfare is a non-declining per capita consumption of goods and services (Beckerman, 1994; Dasgupta, 2002; Nordhaus, 2001; Pearce and Atkinson, 1993).[5]

Dasgupta (2002) offers an analysis of sustainability based on the Ramsey-Koopmans social welfare function:

$$W(t) = \int_0^{\infty} U[C(\tau)]e^{-\delta(\tau - t)}d\tau \qquad \delta > 0 \tag{4}$$

This approach assumes a strictly concave and monotonically increasing utility function, "time consistency", that social welfare through time is a function only of capital assets K(t), and the existence of a "correct" and positive social discount rate δ. Consumption is aggregated into a single consumption good, C. Following the rationale of the Kaldor-Hicks criterion, Dasgupta argues that changes in a "wealth like index" is a measure of a society's well-being, taking both the present and future of that society into account. Dasgupta (2002, 7) writes: "This means that changes in wealth over time in a country can be used to identify whether or not the pattern of development is sustainable." An increase in social welfare is equated to an increase in wealth and an economy is sustainable if the index of wealth is non-declining over time. This is also an application of the PPI principle across generations. The same argument is made in Nordhaus' (2001) models of global climate purporting showing the excessive costs of climate change mitigation. Nordhaus also uses a Ramsey model where total utility (social welfare) is equal to per capita consumption c(t) times population P(t). Nordhaus uses this model to evaluate climate change policies by comparing the before and after effects of the policies on discounted aggregate world economic output.

Economic texts are dominated by the view that utility is derived from consuming market goods and services. As Frey and Stutzer (2002, 73) point out, most economic textbooks do not even discuss the meaning of utility but merely assert that utility is equivalent to income U = U(Y) and dU/dY > 0. For example, in recent survey article Slesnick (1998) uses the terms "welfare", "well-being of individuals", and "household utility" interchangeably. Each empirical measure discussed by him "infers changes in welfare from the consumption behavior of households" (Slesnick, 1998, 2108). Survey-based

by him “infers changes in welfare from the consumption behavior of households” (Slesnick, 1998, 2108). Survey-based measures of well-being are excluded from Slesnick’s discussion because they are “subjective” and “fundamentally different from welfare estimates based on households’ revealed preferences” (Slesnick 1998, 2109). The still-prevailing view is that the revealed preference utility function depicts some sort of natural law unaffected by the vagaries of human psychology.[6] For one isolated individual the assumption that, *ceteris paribus*, dU/dY is positive seems reasonable. But a growing body of evidence shows that it is not generally positive in a real life social context, at least above some minimal income level (Frey and Stutzer, 2002). Ng (2001) has demonstrated that economic growth may reduce welfare even with individual and government optimization.

The focus of environmental criticisms of weak sustainability has been that human welfare is enhanced by non-market environmental amenities (Daily, 1997) and that natural capital is essential to the production process (Costanza et al.,1997). The neoclassical answer has been to insist that welfare should be defined as broadly as possible, and that capital should include everything that generates welfare. Weak sustainability advocates rely on the Second Fundamental Theorem of Welfare Economics, that is, almost any Pareto efficient outcome can be achieved via competitive markets through enlightened government intervention. Once all externalities are identified and corrected a sustainable economy may be achieved. As Beckerman argues, weak sustainability "appears to be redundant and unable to qualify as a logical constraint on welfare maximization" (Beckerman, 1994, 203).

If it is not true, or only very weakly true, that $dU/dY > 0$ where does this leave the sustainability debate? If increased consumption does not lead to increased welfare, how do we re-define the welfare function W(t)? It seems clear that definitions of social welfare

necessarily involve interpersonal comparisons of utility, but most economists are reluctant to accept "subjective" measures of well-being. Psychologists have long argued that well-being derives from a wide variety of individual, social and genetic factors. Economists came to the issue later but significant contributions have been made by Easterlin (1974, 2001); Frank (1999); Frey (1997), Hirsh (1976), Ng (1997); Oswald (1997) and Scitovsky (1976). The increasingly high level of rigor of experimental psychology has helped to make the idea of measurable utility acceptable to economists (Ferrer-i-Carbonell and Frijters 2004; Frey and Stutzer, 2002, 21). Methods have been devised and tested and calibrated to accurately measure levels of happiness across individuals and even across cultures. According to Ng (1999) and others we are now closer than anyone could have imagined to developing something like Bentham's "hedonometer" providing a cardinal measure of utility. The existence of sound, scientific measures of well-being, together with an increasing array of social, environmental and economic indicators (Flynn, Berry, and Heintz, 2002) makes it possible to determine economic policies that will directly enhance social welfare.

What makes people happy? Surveys, behavioral experiments, and neurological analysis have identified key factors positively influencing well-being. These include health (especially self-reported health) (Ferrer-i-Carbonell and van Praag, 2002), close relationships and marriage, intelligence, education, and religion (Frey and Stutzer, 2002). Age, gender and income also influence happiness, but not to the degree once thought. Some "stylized facts" about income and happiness have been established. First, people in wealthier countries are generally happier than people in poorer countries (Diener, Diener, and Diener, 1995). But even this correlation is weak and the happiness data shows many anomalies. For example, some surveys show that people in Nigeria are happier than people in Austria, France and

Japan (Frey and Stutzer, 2002, table 2.2, p. 35). Second, past a certain stage of development, increasing incomes do not lead to greater happiness. For example, real per capita income in the U.S. has increased sharply in recent decades but reported happiness has declined (Blanchflower and Oswald, 2000; Lane, 2000, Meyers, 2000). Similar results have been reported for Japan and Western Europe (Easterlin, 1995). Studies of individuals also show a lack of correlation between increases in income and increases in happiness (Brickman, Coates and Janoff-Bulman 1978; Frey and Stutzer 2002). Third, security seems to be a key element in happiness. Large welfare gains would come from a focus on improving welfare based on those things that increase individual security like health insurance, old age security, employment and job security. Fourth, mental health is a crucial factor in happiness. Frey and Stutzer (2002) and Layard (2003) argue, based on happiness survey results, for more public spending on mental health, especially for the very young since apparently the first few years of a person's life play a large role in their future happiness. If we want future generations to experience a high and sustainable level of welfare, we are likely to get high rates of return by investing in policies to insure adequate child nutrition, health care, education, and family counseling. Fifth, richer social relationships generally make people happier. This implies that welfare gains may be obtained from increased leisure time, and more public spending on social and recreational infrastructure. All of this research implies that the focus on GNP growth as a means to increase welfare may be misplaced. Ng (2003, 307) has demonstrated that analyzing preferences while ignoring the larger objective of welfare or happiness introduces a systematic materialistic bias:

> Such a bias, in combination with relative-income effects, environmental disruption effects, and over-estimation of the excess burden of taxation, results in over-spending on private consumption and under-provision of public goods, and may make economic growth welfare-reducing.

What are the implications of all this for environmental sustainability? There is some evidence that when individuals are more secure financially (not necessary wealthier) they are more likely to care about the well-being of future generations and the well-being of the environment. Rangel (2003) argues that social security is good for the environment. Several of the economic security increasing policies discussed above—providing health care, job security, and a minimum income—may be classified as "backward generational goods" (BIGs). These goods play a crucial role in sustaining investment in "forward intergenerational goods" (FIGs) like environmental preservation. So it seems that focusing policies on subjective indicators of happiness, rather than on per capita income, would pay a double dividend. People would be happier and also more willing to support polices promoting environmental sustainability. Welsch (2002) uses reported well-being for 54 countries to estimate a hedonic indicator of the trade-off between environmental quality and per capita income. Welsch's study is path-breaking in that it takes self-reported happiness as an indicator of welfare, and treats per capita income as an explanatory variable. Welsch finds support for the hypothesis that specific forms of pollution are negatively related to well-being. Johansson-Stenman, Carlsson, and Daruvala (2002) found that, not only are people averse to inequality, risk, and a decline in relative standing, the social marginal utility of income may turn negative even at non-extreme income levels. Regarding the environment there is considerable evidence that at least some people hold non-anthropocentric ethical views (Johansson-Stenman, 2002).

Focusing policy on well-being rather than per capita consumption might have important positive implications for sustainability. But even if sustainable welfare policies are

based on scientifically measured "preferences" this leaves us with the problem that it may not insure the preservation of the life support systems of the planet. Examples abound of societies that apparently worked well in satisfying the preferences of their citizens but ended in ecological collapse (Brander and Taylor, 1998). Humans get subjective well-being from nature but this does not insure that individuals living today will choose to preserve those features of nature that may be essential to future generations. Viewing the essential life support systems of the planet as mere inputs into a utility function, no matter how broadly defined, denies the basic biophysical nature of the human species. To fully develop a viable alternative to weak sustainability, scientific measures of the factors contributing to human well-being are needed but also needed are indicators of the physical and biological requirements for long-term human survival.

IV. SUMMARY AND CONCLUSIONS: TOWARD CONSILIENCE

The first major difficulty with measures of weak sustainability is the theoretical impossibility of making welfare comparisons without resorting to interpersonal comparisons of utility (Chipman and Moore, 1978; Suzumura, 1999). In spite of this, the Kaldor-Hicks approach is followed by most current applications of economic theory to the sustainability problem. By this approach, it is assumed that as long as some index of total welfare is increased it is possible to make some people happier without making anyone else less happy. But contemporary microeconomic theory tells us that, even if all externalities, including intergenerational ones, are corrected the NWE still offers no theoretically consistent basis to evaluate changes in the well-being of different contemporary individuals, much less changes in the well-being of different generation.

The second major difficulty with weak sustainability is the use of per capita consumption as a proxy for welfare. Findings from happiness surveys, and other evidence about well-being and environmental attitudes, suggest some very different sorts of policies than those based on sustaining per capita consumption. The argument that economists could concern themselves with efficiency and ignore distribution has proved to be theoretically unsupportable. This calls into question the preoccupation of economists with increasing net economic output in the view that this will, at least potentially, lead to greater social welfare.

Most important for the sustainability debate is the implication of contemporary welfare theory that more economic growth is not the key to sustain well-being or environmental integrity. But how much economic growth do we need to provide money for the material things that contribute to making people happy? Can we "develop" without growing? Can one country stop growing or would this amount to unilateral disarmament, leaving that country behind in the technology, capital investment and entrepreneurial dynamism necessary to successfully compete in a capitalist economy. What policy changes would the transition to a happiness economy require? Finally, and perhaps the most serious issue, how is human welfare related to sustaining the life support systems of the planet? How directly can welfare, however broadly defined, be related to preserving ecosystems and non-human life forms necessary for long-run human survival?

The failure of NWE has spurred the search for a more scientifically valid foundation for economic theory and policy. In fields as varied as development economics, game theory, and finance new models are being developed based on actual human behavior in its institutional and environmental contexts. A common theme in these new models is "consilience", that is, "the linking of facts and fact-based theories across disciplines to create

a common groundwork for explanation" (Wilson, 1998, 8). Integrating economics with anthropology, biology, and psychology can lead not only to better economic policies for immediate human welfare, it can also lead to a better understanding of how humans fit in with the rest of the natural world. Such an understanding is essential if *Homo sapiens*' presence on the planet is to be something more than a fiery but short-lived phenomenon.

References

Asheim, G. (1994). 'Net National Product as an Indicator of Sustainability', *Scandinavian Journal of Economics*, vol. 96, pp. 257-265.

Beckerman, W. (1994). 'Sustainable Development: Is it a Useful Concept?', *Environmental Values*, vol. 3 (3), pp. 191-209.

Bergh, C.J.M. van den, and Gowdy, J. (2003). 'The Microfoundations of Macroeconomics: An Evolutionary Perspective', *Cambridge Journal of Economics*, vol. 27, pp. 65-85.

Blackorby, C. and Donaldson, D. (1990). 'A Review Article: The Case Against the Use of the Sum of Compensating Variations in Cost-Benefit Analysis", *Canadian Journal of Economics,* vol. 3, pp. 471-94.

Blanchflower, D. and Oswald, D. (2000). *Well-Being over Time in Britain and the U.S.A*., NBER Working Paper 7481, Cambridge, MA: National Bureau of Economic Analysis.

Boadway, R. (1974). 'The Welfare Foundations of Cost-Benefit Analysis', ECONOMIC JOURNAL, vol. 84, pp. 926-39.

Bowles, S. and Gintis, H. (2000). 'Walrasian Economics in Retrospect', *Quarterly Journal of Economics*, vol. 115, pp. 1411-1439.

Brander, J. and Taylor, S. (1998). 'The Simple Economics of Easter Island: A Ricardo-Malthus Model of Renewable Resource Use', *American Economic Review*, vol. 88, pp. 119-138.

Brekke, K. (1994). 'Net National Product as a Welfare Indicator', *Scandinavian Journal of Economics*, vol 95, pp. 241-252.

Brekke, K. (1997). 'Hicksian Income from Resource Extraction in an Open Economy', *Land Economics*, vol. 73(4), pp. 516-527.

Brickman, P., Coates, D., and Janoff-Bulman, R. (1978). 'Lottery Winners and Accident Victims: Is Happiness Relative?', *Journal of Personality and Social Psychology*, vol. 36, pp. 917-927.

Bromley, D. (1990). 'The Ideology of Efficiency: Searching for a Theory of Policy Analysis', *Journal of Environmental Economics and Management*, vol. 19, pp. 86-107.

Camerer, C. and Loewenstein, G. (2003). 'Behavioral Economics: Past, Present, Future', in (C. Camerer and G. Loewenstein eds.) *Advances in Behavioral Economics*, Princeton, Princeton University Press.

Chang, H. (2000). 'A Liberal Theory of Social Welfare: Fairness, Utility, and the Pareto Principle', *Yale Law Review*, vol. 110, pp. 173-235.

Chipman, J. and Moore, J. (1976). 'Why an Increase in GNP need not imply an Improvement in Potential Welfare', *Kyklos*, vol. 29, pp. 391-418.

Chipman, J. and Moore, J. (1978). 'The New Welfare Economics 1939-1974', *International Economic Review*, vol 19(3), pp.547-584.

Coate, S. (2000). 'An Efficiency Approach to the Evaluation of Policy Changes,' ECONOMIC JOURNAL, vol. 110, pp. 437-455.

Costanza, R. d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R., Paruelo, J., Raskin, R., Sutton, P., van der Belt, M. (1997). 'The Value of the World's Ecosystem Services and Natural Capital', *Nature*, vol. 387, pp.253-260.

Daily, G. (1997). *Nature's Services*. Washington, D.C., Island Press.

Daly, H. (1995). 'On Wilfred Beckerman's Critique of Sustainable Development', *Environmental Values*, vol. 4(1), pp. 49-55.

Dasgupta, P. (2002). 'Sustainable Economic Development in the World of Today's Poor', paper prepared for the conference Scarcity and Growth in the New Millennium, Washington, D.C., Resources for the Future.

Dasgupta, P. and Heal, G. (1974). 'The Optimal Depletion of Exhaustible Resources', *The Review of Economic Studies*, Symposium Issue, pp. 3-28.

Dasgupta, P. and Heal, G. (1979). *Economic Theory and Exhaustible Resources*. Cambridge, UK, Cambridge, University Press.

Diener,E., Diener, M. and Diener, C. (1995). 'Factors Predicting the Well-Being of Nations', *Journal of Personality and Social Psychology*, vol 69, pp. 851-64.

Dixon, H. (1997). 'Controversy: Economics and Happiness', ECONOMIC JOURNAL, vol. 107, pp. 1812-14.

Easterlin, R. (1974). 'Does Economic Growth Improve the Human Lot? Some Empirical Evidence', in (P. David and M. Reder, eds.), *Nations and Happiness in Economic Growth: Essays in Honor of Moses Abramowitz*, pp. 89-125, Academic Press, New York.

Easterlin, R. (1995). 'Will Raising the Incomes of All Increase the Happiness of All?', *Journal of Economic Behavior and Organization*, vol. 27, pp. 35-37.

Easterlin, R. (2001). 'Income and Happiness: Towards a Unified Theory', ECONOMIC JOURNAL, vol. 111, pp. 465-484.

Ferrer-i-Carbonell, A. and van Praag, B.M.S. (2002). 'The Subjective Costs of Health Losses due to Chronic Diseases: An Alternative to Monetary Appraisal', *Health Economics*, vol 11, pp. 709-722.

Ferrer-i-Carbonell, A. and Frijters, P. (2004). 'How Important is Methodology for the Estimates of the Determinants of Happiness?' ECONOMIC JOURNAL, forthcoming.

Flynn, P., Berry, D., and Heintz, T. 2002. 'Sustainability and Quality of Life Indicators: Toward the Integration of Economic, Social and Environmental Measures', *Indicators: The Journal of Social Health*, 1(4), 19-39.

Frank, R. (1999). *Luxury Fever: Why Money Fails to Satisfy in an Age of Excess*, New York, Free Press.

Frey, B. (1997). 'A Constitution of Knaves Crowds out Civic Virtues', ECONOMIC JOURNAL, vol. 107, pp. 1043-1053.

Frey, B. and Stutzer, A. (2002). *Happiness and Economics: How the Economy and Institutions Affect Well-Being*, Princeton, Princeton University Press.

Gerlagh, R. and van der Zwaan, B.C.C. (2002). 'Long-Term Substitutability between Environmental and Man-Made Goods', *Journal of Environmental Economics and Management*, vol. 44, pp. 329-345.

Gowdy, J. 2004. 'The Revolution in Welfare Economics and Its Implications for Environmental Valuation and Policy', *Land Economics*, vol. 80 (May, forthcoming).

Hammond, P. (1996). "Interpersonal Comparisons of Utility: Why and How They Should be Made', in (A. Hamlin, ed.) *Ethics and Economics*, vol. 1, Chapter 22, Elgar, Aldershot, UK.

Harcourt, G. (1972). *Some Cambridge Controversies in the Theory of Capital*, London, Cambridge University Press.

Harsanyi, J. (1987). 'Interpersonal Utility Comparisons', in (J. Eatwell, M. Milgate, P. Newman, eds.), *The New Palgrave Dictionary of Economics,* vol. 2, pp. 955-958, Macmillan, London.

Hartwick, J. (1977). 'Intergenerational Equity and the Investing of Rents from Exhaustible Resources', *American Economic Review*, vol. 67, (5), pp. 972-974.

Hartwick, J. (1994). 'National Wealth and Net National Product', *Scandinavian Journal of Economics*, vol. 96, pp. 253-256.

Hartwick, J. (1996). 'Constant Consumption as Interest on Capital', *Scandinavian Journal of Economics*, vol. 98 (3), pp. 439-443.

Hicks, J. (1939). 'The Foundations of Welfare Economics', ECONOMIC JOURNAL, vol. 49, pp. 696-712.

Hirsh, F. (1976). *The Social Limits to Growth.* Cambridge, MA, Harvard University Press.

Howarth, R. and Norgaard, R. (1990). 'Intergenerational Resource Rights, Efficiency, and Social Optimality', *Land Economics*, vol. 66 (1), pp.1-11.

Johansson-Stenman, O. (1998). 'The Importance of Ethics in Environmental Economics with a Focus on Existence Values', *Environmental and Resource Economics*, 11, 429-442.

Johansson-Stenman, O. (2002). 'What Should we do with Inconsistent, Nonwelfaristic, and Undeveloped Preferences', in (D. Bromley and J. Paavola, eds.) *Economics, Ethics, and Environmental Policy*, Oxford, UK, Blackwell, pp. 103-119.

Johansson-Stenman, O., Carlsson, F., and Daruvala, D. (2002). 'Measuring Future Grandparents' Preferences for Equality and Relative Standing', ECONOMIC JOURNAL, vol. 112, pp. 362-383.

Jones, C. (2002). 'The 'Boadway Paradox' Revisited', Working Paper. Faculty of Economics and Commerce, The Australian National University, Canberra, Australia, August 13.

Kahneman, D., Wakker, P. and Sarin, R. (1997). 'Back to Bentham? Explorations of Experienced Utility', *Quarterly Journal of Economics*, vol 112, pp. 375-405.

Lane, R. (2000). *The Loss of Happiness in Market Economies*. New Haven and London, Yale University Press.

Layard, R. (2003). 'Happiness: Has Social Science got a Clue?', Lionel Robbins Memorial Lecture Series, London School of Economics, March 3, 4 and 5.

McDaniel, C. and Gowdy, J. (2000). *Paradise for Sale: A Parable of Nature*, Berkeley, University of California Press.

Meyers, D. (2000). 'The Funds, Friends, and Faith of Happy People', *American Psychologist*, vol. 55, pp. 56-67.

Mongin, P. (2000). 'Is There Progress in Normative Economics?' Invited lecture at the Fourth Annual Conference of the European Society for the History of Economic Thought, Graz, February 24-27.

Neumayer, Eric. (1999). *Weak Versus Strong Sustainability*, Edward Elgar, Cheltenham, U.K.

Ng, Y. K. (1997). 'A Case for Happiness, Cardinalism, and Interpersonal Comparability.' ECONOMIC JOURNAL, vol.107, pp. 1848-1858.

Ng, Y.K. (1999). 'Utility, Informed Preference, or Happiness: Following Harsanyi's Argument to its Logical Conclusion', *Social Choice and Welfare*, Vol.16, pp. 197-216.

Ng. Y.K. (2001). 'Welfare-Reducing Growth Despite Individual and Government Optimization', *Social Choice and Welfare*, vol. 18, pp. 497-506.

Ng, Y.K. (2003). 'From Preferences to Happiness: Towards a more Complete Welfare Economics', *Social Choice and Welfare*, vol. 20, pp. 307-350.

Ng, Y.K. and Wills, I. (2002). 'Welfare Economics and Sustainable Development', in *Knowledge ofr Sustainable Development: An Insight into the Encyclopedia of Life Support Systems*, Paris, UNESCO Publishing.

Nordhaus, W. (2001). 'Global Warming Economics', *Science*, vol. 294, pp. 1283-1284

Oswald, A. (1997). 'Happiness and Economic Performance', ECONOMIC JOURNAL, vol. 107, pp. 1815-1831.

Pearce, D. and Atkinson, G. (1993). 'Capital Theory and the Measurement of Sustainable Development: A Measure of 'Weak' Sustainability', *Ecological Economics*, vol. 8, pp. 103-108.

Pezzey, J. (1989). 'Economic Analysis of Sustainable Growth and Sustainable Development', Environment Department Working Paper No. 15, Washington, D.C.: World Bank.

Pezzey, J. and Toman, M. (2002). 'The Economics of Sustainability: A Review of Journal Articles', Washington, D.C.: Resources for the Future, Discussion Paper 02-03.

Rangel, A. (2003). 'Forward and Backward Generational Goods: Why is Social Security Good of the Environment?' *American Economic Review*, vol. 93 (3), pp.813-834.

Robinson, J. (1954). 'The Production Function and the Theory of Capital', *Review of Economic Studies*, vol. 21, pp. 81-106.

Russell, C. (2001). *Applying Economics to the Environment*, New York, Oxford University Press.

Schwarz, N. and Strack, F. (1999). 'Reports of Subjective Well-Being: Judgmental Processes and Their Methodological Implications', in (D. Kahneman, E. Diener, and N. Schwartz, eds.) *Well-Being: The Foundations of Hedonistic Psychology*, New York, Russell Sage, pp. 61-84.

Scitovsky, T. (1976). *The Joyless Economy*. New York, Oxford University Press.

Scitovsky, T. (1941). 'A Note on Welfare Propositions in Economics', *Review of Economic Studies*, vol. 9: pp. 77-88.

Sen, A. (1999). 'The Possibility of Social Choice', *American Economic Review*, vol. 89, pp. 349-378.

Slesnick, D. (1998). 'Empirical Approaches to the Measurement of Welfare', *Journal of Economic Literature*, vol. 36 (4), pp. 2108-2165.

Solow, R. (1974). 'Intergenerational Equity and Exhaustible Resources', *Review of Economic Studies*, Symposium Issue, pp. 29-46.

Solow, R. (1993). 'Sustainability: An Economist's Perspective', in (R. Dorfman and N. Dorfman, eds.) *Selected Readings in Environmental Economics*, New York: Norton, pp. 179-87.

Stavins, R., Wagner, A. and Wagner, F. (2002). 'Interpreting Sustainability in Economic Terms: Dynamic Efficiency Plus Intergenerational Equity', Washington, D.C., Resources for the Future Discussion Paper 02-29.

Stiglitz, J. (1974). 'Growth with Exhaustible Natural Resources: Efficient and Optimal Growth Paths', *Review of Economic Studies*, vol. 41, pp. 123-157.S

Suzumura, K. (1999). 'Paretian Welfare Judgements and Bergsonian Social Choice', ECONOMIC JOURNAL, vol. 109, pp. 204-221.

Tietenberg, T. (2003). *Environmental and Natural Resource Economics*, 6th edition, Boston, Addison-Wesley.

Varian, H. (1992). *Microeconomic Analysis*, 3rd edition, New York:Norton

Weitzman, M. (1992). 'On Diversity', *Quarterly Journal of Economics*, vol. 107, pp. 363-405.

Weitzman, M. (1996). 'On the Welfare Significance of National Product in a Dynamic Economy', *Journal of Environmental Management and Policy*, vol. 36, pp. 201-208.

Welsch. H. (2002). 'Preferences over Prosperity and Pollution: Environmental Valuation based on Happiness Surveys', *Kyklos*, vol. 55, pp. 473-494.

Wilson, E.O. 1998. *Consilience*, New York, Alfred Knopf.

ENDNOTES

1. Sustainable consumption and intertemporal resource allocation has been extensively discussed. Dasgupta and Heal (1979) proved that a sustainable consumption path exists if a rising marginal product for the resource compensates for resource depletion. They also show that any positive discount rate implies declining consumption levels. Hartwick (1977) demonstrated that a constant per capita consumption path is possible if all scarcity rent is invested in capital. Howarth and Norgaard (1990) showed that efficient allocation of resources across generations does not necessarily result in sustainable consumption. Pezzey (1989) points out that the definition of sustainability as non-declining welfare over time is different than maximizing net present value. For further discussion see Pezzey and Toman (2002) and Tietenberg (2003, chapter 23).

2. Also central to this analysis is Weitzman's (1976) result that Net National Product (NNP) is equal to the present value of consumption. Following the usual economic convention of equating consumption and welfare, it is an easy step to the result that a set of prices exist so that maximizing wealth is equivalent to maximizing welfare (see the discussion in Brekke 1994). The Second Fundamental Theorem can then be invoked to take care of everything from externalities to existence values.

3. Each point on a production possibilities frontier will have a different contract curve in consumption space associated with it. The envelope of these, transferred to utility space, is a grand utilities possibilities frontier (GUPF). The Kaldor-Hicks criterion can only be applied if there are efficiency gains to be captured by moving from a non-optimal (meaning not maximally efficient) situation to (or toward) a Pareto efficient situation. So the Kaldor-Hicks criterion must compare situations where at least one of them is off the GUPF. Comparing two points on the GUPF would necessarily involve interpersonal comparisons of utility.

4. That weak sustainability uses the PPI principle is recognized by Stavins, Wagner and Wagner (2002). In order to judge whether a policy change will move the economy toward sustainability: [Instead of the strict Pareto criterion] "Economists resort instead to seeking `potential' Pareto improvements in the Kaldor-Hicks sense--the 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 criterion, the change is considered to be an improvement whether or not the compensation actually takes place. Actual compensation of losers by winners is essentially left to the political process."

5. Although Dasgupta and Solow define utility broadly it is clear that they mean only to insure that the Second Fundamental Theorem is invoked to correct all market failures. Utility still derives from consumption.

6. Varian (1992, 93) writes: "A utility function is often a very convenient way to describe preferences, but it should not be given any psychological interpretation." He then goes on to characterize the utility function as exhibiting monotonicity, local non-satiation, convexity and so on. These are psychological assumptions about human behavior.

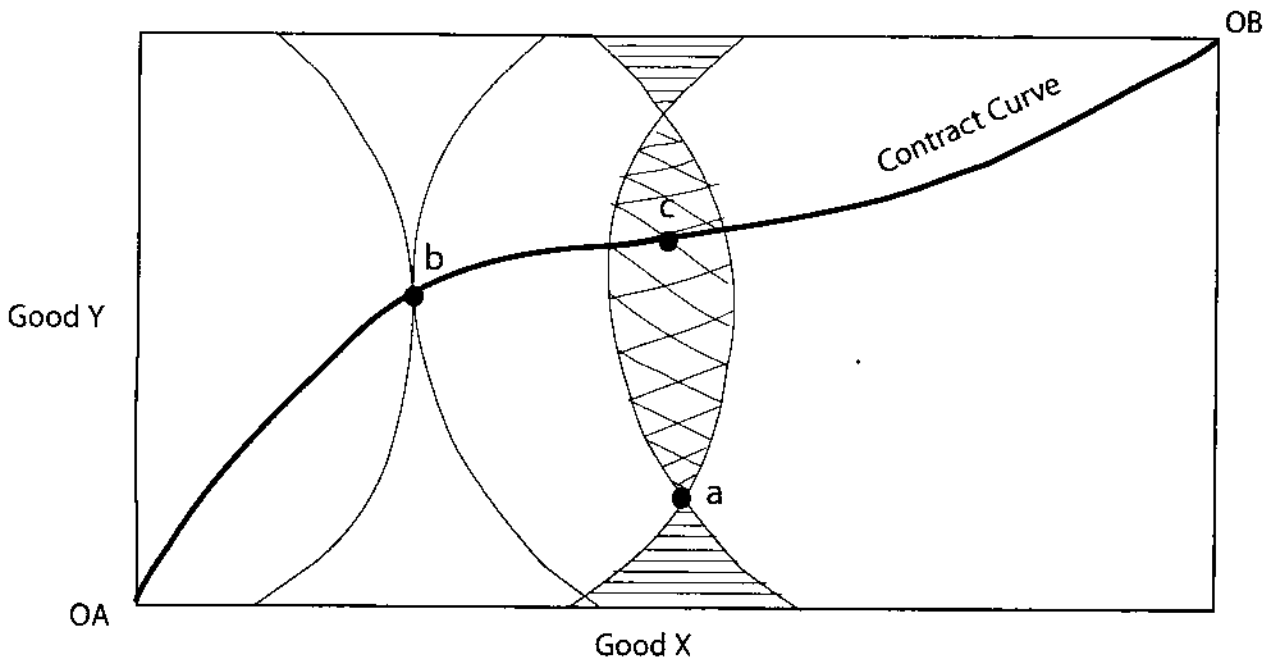

Figure 1. The Strict Pareto Criterion

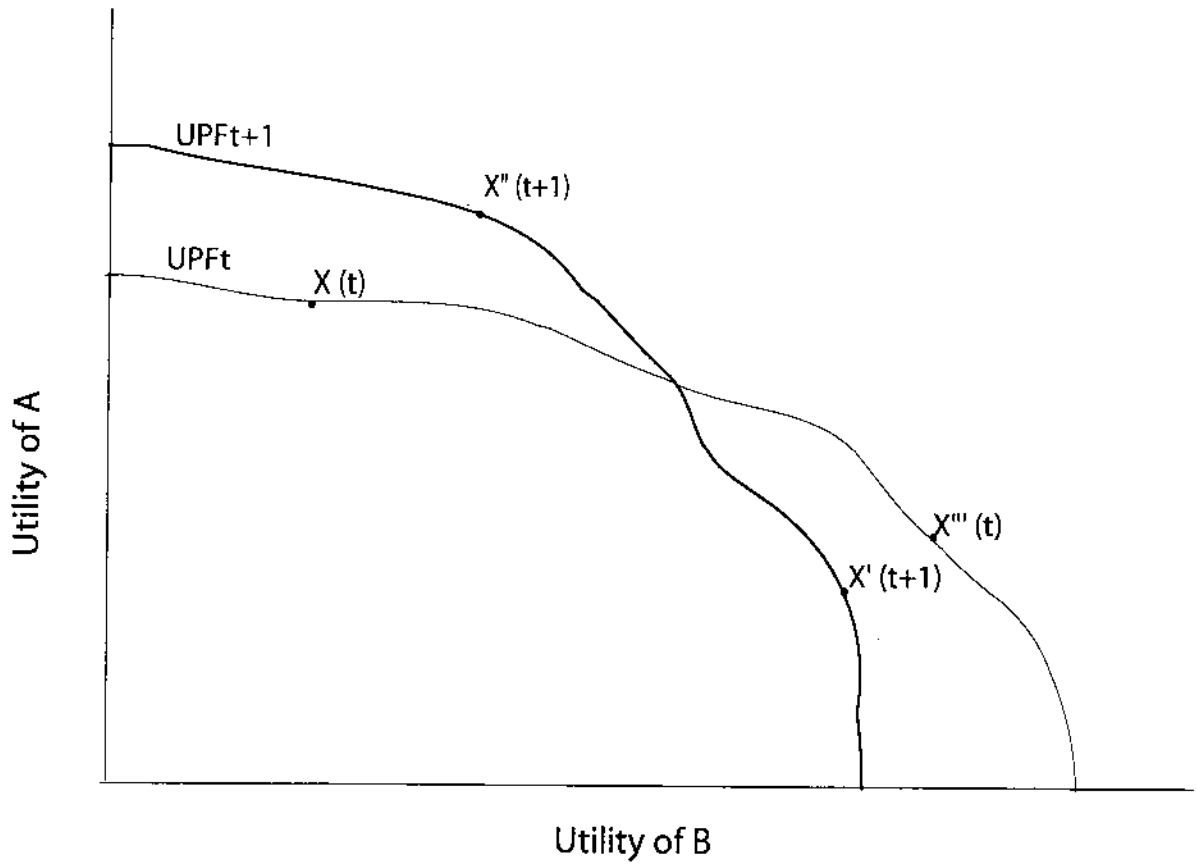

Figure 2. An Intergenerational Potential Pareto Improvement