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FOUNDATIONS OF AN ECOLOGICAL ECONOMICS

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ABSTRACT

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In an attempt to set out some of the foundations for an ecological economics, this paper interprets the objective of a sustainable society as one in which a Rawls-style concept of distributive justice is applied in an intergenerational context. Rawls' theory derives a concept of justice as fairness from hypothetical situations in which each member of society does not know his or her position in that society. In the context of this paper, this 'veil of ignorance' relates to uncertainty about which generation one belongs to. Some suggestions are made as to how such a concept might be extended to non-human species, but the *general* argument is that the biophysical requirements of a sustainable society will in general serve the purposes of habitat and species preservation. The question is then raised as to whether existing forms of economic organization — free market, mixed, and planned — contain any built-in mechanisms to secure sustainability. Contrary to the arguments of neoclassical economics in which prices change so as to secure resources for the future, it is argued that none of the economic forms can offer guarantees of sustainability. The basic conditions for an 'ecologically bounded' economy are then set out.

INTRODUCTION

> "A correct conception of our relations to animals and to nature would seem to depend upon a theory of the natural order and our place in it. One of the tasks of metaphysics is to work out a view of the world which is suited for this purpose; it should identify and systematize the truths decisive for these questions. How far justice as fairness will have to be revised to fit into this larger theory it is impossible to say. But it seems reasonable to hope that if it is as sound as an account of justice among persons, it cannot be too far wrong when these broader relationships are taken into consideration."
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> JOHN RAWLS, 1971, *A Theory of Justice*

In this quotation John Rawls is telling us that our moral relationship to the natural environment and to other living creatures is a task for metaphysics, which, in turn, is something larger in concept and scope than a

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theory of justice among persons. While we cannot expect a theory of justice as fairness to answer questions about the 'ought' relationship between man and environment, the ingredients and structure of a justice theory should provide us with some sort of template for an environmental ethic. The theme of this paper is twofold.

First, we shall argue, but in outline only, that, while justice as fairness is not sufficient for an environmental ethic, a Rawlsian style justice concept does assist in formulating a minimum strategy for policy towards other sentient beings.

Second, and in more detail, the design of an economy such that it maximizes some measure of social (human) welfare but subject to biophysical constraints will assist in, but will not be sufficient for, attainment of the notion of extended justice. That is, pursuit of ecologically constrained economic activity will have as one of its effects the conservation of living resources which an extended justice concept establishes as most deserving of care. But observation of ecological constraints serves other functions too, most notably self-preservation and intergenerational justice as well as justice between other life forms and humans. The relationship between the constraints and serving these anthropocentric objectives is a necessary one; for the constraints are actually derived from the objectives.

JUSTICE AS FAIRNESS

Rawls' theory of justice (Rawls, 1971) is intratemporal, but it has been applied to intergenerational choice by Page (1977). The essential objective is to see if a set of moral principles can be derived from an analysis of what it is to be a rational individual, rather as Kant attempted to do in terms of finding goals which all rational individuals would accept. The artificial construct used by Rawls is an original position, a sort of constitution-making gathering of parties, who face a 'veil of ignorance' about the exact location within society of each individual. In the intratemporal context, then, an individual in the original position would not know whether he or she was going to be rich or poor, advantaged of disadvantaged. In the intertemporal context the important thing is not knowing into which generation the individual will be placed. Each individual does have a rational life plan and will aim to choose rules for allocating people to resources so as to achieve the life plan. Each individual also knows something about the nature of society, the general facts about the relationship between life plans and the endowment of primary goods. Primary goods are rights and liberties, opportunities and powers, income and wealth (and later in Rawls' theory, self-respect, akin to Kant's human dignity). What distinguishes primary goods from other goods, according to Rawls, is that a rational being will

always prefer more primary goods to less. A principle of justice is then derived from rational life plans, some knowledge of how society functions, and some knowledge of the relationship between life plans and primary goods, all in the context of the original position and the veil of ignorance.

What emerges from this hypothetical context, according to Rawls, are rules for the organization of society, social choice rules. The institutions which result from these rules would have two characteristics: (a) each individual would enjoy equal rights to the maximum amount of personal freedom compatible with the freedoms of other individuals; (b) any inequality in society would be derived from positions open to free competition, and inequality would be justified if and only if it operated to the advantage of everyone.

Characteristics (b) are the difference principle and its adoption by individuals in the original position under the veil of ignorance is formally equivalent to the MAXIMIN principle in which each individual secures the greatest protection possible against the risk of being the poorest member of society. Note that the concept of poorness in this context relates to primary goods. Rawls' theory is in terms of primary goods and not in terms of all the constituent parts of gross national product. The difference principle becomes an injunction to maximize the primary goods available to the most disadvantaged individual in society.

INTERGENERATIONAL JUSTICE

While Rawls mentions the intergenerational context in passing, this theory of justice is really about intratemporal fairness. Page's contribution is to extend the Rawlsian idea to justice between generations. This has a very important implication. For if we are not sure in the original position to which generation we shall be allocated, the MAXIMIN principle will oblige us at least to ensure that future generations are possible, i.e. that we do not remove the conditions for future life. In fact it will dictate more than this condition. Page argues that it will dictate the requirement of 'permanent livability', which he interprets to mean that the resource base is kept intact. Essentially, each generation must have the opportunity of equal access to natural resources. Natural resources are themselves not primary goods in this interpretation, nor is access to them. Rather, it seems more appropriate to see such equal access opportunity as a condition for the fulfilment of Rawlsian primary goods. Essentially, one factor determining the access to primary goods is natural resource endowment. But if those endowments vary between generations, primary goods will vary between generations, and this can only be justified if we can demonstrate that all generations are better off by this inequality. In this way, the apparent right to use a unit of an exhaustible resource now infringes a more fundamental right to primary goods.

Rawls' theory as it relates to intratemporal justice has been severely criticized (Wolff, 1977) and Page's extension of the theory to the intergenerational context is open to similar criticism and to quite separate objections. Among the latter it is possible to identify more readily with the intratemporal context since the parties to the hypothetical original position are identifiable now. In the intertemporal context we are asked to think in terms of identified individuals now and persons who do not yet exist. Perhaps more important, it is a repeatedly argued view that inequality in resource use is justified on the difference principle because by converting natural resources now to capital an existing generation can pass on to next generations a higher level of welfare. That is, all generations can be made better off by a present biased use of the resource base.

This criticism can be dealt with as follows. Observe, as Page does, that if 'permanent livability' really is some form of categorical imperative emerging from the intergenerational social contract, it is quite inconsistent with the adoption of standard intertemporal efficiency conditions given by economic theory. Those conditions would state that in order to obtain intertemporal efficiency, each generation should maximise the present value of net gains (Page, 1977). But present value criteria may also dictate the extinction of renewable resources; in general they will do so when the discount rate being used exceeds the natural rate of regeneration of the resource, as will often be the case for slow growing species such as hardwoods, whales and elephants (Clark, 1976). Particularly, it will apply for resources that have zero growth rates, i.e., non-renewable resources. Not too surprising, we discover that intertemporal efficiency and intertemporal justice are likely to conflict.

Let us summarise and consolidate the position thus far. Rawls' theory of justice applied in an intergenerational context suggests a permanent livability criterion whereby there must be equal opportunity to survive and equal opportunity to have access to the natural-resource base. The only justification for unequal resource endowments for each generation is if all generations can be made better off as a result of this inequality. The standard reason for such inequality is that the maximization of the present value of net gains will be intertemporally efficient. But the present value approach is also consistent with reducing the stocks of natural resources, renewable and non-renewable. Thus, equality of resource base endowments by generation is more likely than not to be the outcome of an intergenerational justice principle. Whether such a principle is accepted depends on its moral appeal, or on the extent to which it is accepted that Rawls has succeeded where others, including Kant, failed, namely in demonstrating that certain ethical principles are derivable from a concept of rationality. (For the record, I do not think Rawls succeeds, but that arises from a difficulty facing all secular discussion of ethical principles, namely that such a 'proof' is not possible at all.)

Note that Page's 'permanent livability' characteristic is formally identical to the 'sustainability' criterion now widely used in the conservation literature (International Union for the Conservation of Nature, 1980). A sustainability ethic is in fact an ethic which is contingent upon the higher-order moral principle of intergenerational justice.

JUSTICE AND NON-HUMAN SPECIES

A principle of justice would seem inapplicable to the wider context of human and non-human species combined. By and large this must be because we cannot imagine non-human species assembling in the initial position to debate and formalize the rules by which society is to function in the broad. However, such a view is not satisfactory. If rights accrue partly because of sentience, it seems odd to exclude sentient beings other than humans simply because they cannot express preferences. It is hardly tenable to argue that the property of having a preference is something that is denied to non-humans. There is no evidence that animals behave much differently to us with respect to pleasure or pain. An extended theory of justice might therefore quite legitimately see humans as stewards for other species, not out of any metaphysical notion of stewardship but out of a rational consideration of the similarities and differences between humans and non-humans.

Such a concept is of course widely mooted in the literature on environmental ethics. We may gauge that its chances of wider acceptance are also growing, but for our purposes it is not necessary to espouse such an extended theory of justice, although the possibilities of such a theory contradict the view quoted from Rawls at the beginning in which our ethical relationship with the environment is regarded as being somehow 'beyond' a theory of justice. The reason that we do not need such a theory is as follows. We have seen that justice implies sustainability. We shall argue shortly that sustainability implies observation of biophysical constraints; and observing biophysical constraints implies the general (not universal) non-elimination of species. Thus, the justice principle will tend to conserve resources.

SUSTAINABILITY AND BIOPHYSICAL CONSTRAINTS

The sustainability criterion requires that the conditions necessary for equal access to the resource base be met for each generation. By implication, the resource base itself must be equal across generations. Construed in physical terms, such a rule is self-evidently impossible, because any positive use rate of non-renewable resources will reduce the stock available to the next generation. Page's solution to this problem is to rephrase the issue in terms of access.to constant real prices of non-renewable resources. That is, the objective of each generation is to keep the real price of extractive materials constant through time, and the mechanism he proposes for this is a depletion or severance tax. Essentially, a tax is imposed which is proportional to the rate at which resources are depleted. Depletion taxes should, in principle, be welcomed because of the way in which they will contribute to substitution of exhaustible resources by renewable resources, and to increases in the efficiency of resource use. Page's constant real price indicator, however, is defective since it assumes that real resource prices are reasonable indicators of resource scarcity. In general, we know this is not true because the conditions for prices to reflect scarcity in such a formalistic way are not present in resource markets (Hall and Hall, 1984). Nonetheless, the approach could be accepted as a very broad target if it is thought that renewables and exhaustibles should be treated separately.

Perhaps more sensible, however, is to express the resource base as a composite of renewables and exhaustibles and to be indifferent between which is used, subject to the strict constraint that the renewable resource use rate should never exceed the regeneration rate. Since the regeneration rate is itself manipulable through managed yield approaches, the option to expand the renewable resource base should always be present. In this way, the exhaustible resource base may well be diminished by present generations but observation of the biophysical constraint on renewable resources should permit steady substitution of renewables for non-renewables. Recall that the intergenerational justice principle will require that this composite stock of resources be approximately equal for each generation.

The composite resource concept should apply equally to the environment as a source of extractive resources, renewable and non-renewable, and to the environment as receiver of waste. In the latter context there will be wastes emitted which are non-degradable, i.e., the environment will have zero capacity to assimilate those wastes. This is equivalent to a non-renewable resource. In respect to other wastes, the environment will have a degrader capacity, an assimilative capacity. What is required of waste diposal, then, is that wastes should not be emitted or disposed of at levels in excess of this assimilative capacity. Note that the two sets of rules relating to the environment as extractive resource supplier and environment as waste receiver are not independent of each other. Boulding (1966) drew our attention to the relevance of the laws of thermodynamics. The First Law tells us that we cannot create or destroy matter. Thus, whatever is extracted from the environment by way of resources must return to the environment as waste. The only interruption to this process is the storage of extracted resources as

capital. Thus, any social objective chosen for a given generation, and which is itself formulated within the overall criterion of intergenerational justice as sustainability, must acknowledge that the resource required to achieve that objective will have implications for honoring the rule relating to the environment as waste receiver. Subject to capital embodiment, the rate at which resources are extracted must be equal to or less than the assimilative capacity of the environment to receive the thermodynamic equivalent of the wastes generated. This in turn means that either but not both of the constraints will be binding. The rate of resource extraction will be limited either by the assimilative capacity of the environment or by the rate of regeneration of renewable resources. In turn, the rate at which exhaustible resources are extracted is determined by the rate at which renewable resources can be perfectly substituted for exhaustibles. This combined rate of extraction must be less than or equal to the assimilative capacity of the environment.

The Second Law of thermodynamics has been stressed by Georgescu-Roegen (1971). We might caricature this law as the impossibility of total recycling. If resources were fixed in quantity but the Second Law did not apply, then we could ensure that sustainability is observed simply by recycling everything. The entropy law prohibits this path. Similarly, entropy would not matter if resources were infinite, and thus infinitely extractable resources would be disposed of to an infinitely large waste sink. The particular relevance of the Second Law for sustainability is that it is likely to make the rules relating to the receiving environment more dominant. This is because low-entropy resources are transformed into high-entropy waste. The higher the entropy the less the possibilities for recycling and the less are the chances of preventing the waste from entering the environment. Georgescu-Roegen's point is that, while entropy is a 'natural' process, the economic system as it has evolved in both capitalist and non-capitalist nations adds dramatically to the entropy of extracted resources. There are, of course, many examples of the economy being capable of minimizing entropy damage, e.g. by forbidding some entropic uses such as lead in gasoline, or by concentrating the high-entropy wastes as with sulphur removal in fossil fuel burning processes.

We come full circle, from a concept of justice to a concept of sustainability and to a set of rules expressed solely in physical terms for achieving sustainability. Note that these are the basic physical rules only. It is unquestionably the case that sustainability would require many other rules relating to social processes (O'Riordan, 1985). We shall investigate briefly in the final section the chances that existing national economic structures could achieve sustainability.

We need to know if there is anything in the existing structures of economies which would bring about and maintain sustainability. We classify these structures as: (a) 'unmodified free market', by which we mean a free market economy without intervention through the price system to control for environmental externalities; (b) 'unmodified planned', which refers to economies which are centrally planned but do not include in the planning process recognition of environmental externalities; (c) modified market economies in which externalities are controlled through some application of polluter charges and depletion taxes; (d) modified planned economies in which environmental externalities are controlled as part of the planning system; and (e) ecologically bounded economies which may be planned or unplanned, and in which the 'sustainability rules of the game' are honored.

Clearly, type (a) and (b) economies are figments of the imagination as there are no wholly free-market economies in the world, nor any wholly planned ones which ignore environmental problems in their entirety. Both are benchmarks. Type (c) economies correspond to the conventional economics stereotype in which pollution and resource depletion are regulated through Pigovian taxes and depletion taxes. In practice, as we know, no economy is regulated in this way, and economies in which pollution is regulated are invariably the same economies in which resource extraction is actually encouraged by resource depletion allowances rather than taxes, itself an interesting reflection on the understanding of the relationship between resource use and waste disposal. And of course, no ecologically bounded economy exists.

What we wish to know is whether economies which are not ecologically bounded, i.e., which do not set out to honor biophysical constraints, can ever be consistent with sustainability as an objective. To put it another way, is it necessary to introduce the biophysical constraints as rules, in which case new social processes are surely required, or is there some way in which existing paradigms of social and economic organisation will somewhat automatically guarantee sustainability? The answer, we suggest, is that there is no such guarantee and that the differences between the types of economy in terms of the sustainability objective are differences in the rate at which they deviate from that objective.

The demonstration that this result holds is not given in detail here. It is readily available elsewhere (Pearce, 1976, 1987). Provided prices could be manipulated, for example by pollution and resource depletion taxes, it is possible to devise an economic system which would reflect the requirements for sustainability in the structure of the economy. However, the informational requirements for such a price structure to be devised are immensely complex. Moreover, if societies now discount the future very heavily, the potential for destroying life-support ecosystems is substantial. Put another way, it is not just necessary to have particular sets of prices for polluting goods and for natural resources, it is also necessary to have particular sustainable discount rates. The formidable obstacles to devising an economy with prices devised for sustainability suggest an alternative 'safety first' approach in which physical and ecological boundaries are observed. Prices can then be used to assist in honoring the constraints, but almost certainly not in guaranteeing their observation. The essential idea is that none of the economic systems other than the ecologically bounded ones has any built-in mechanism which would acknowledge the relationship between the macro-economic scale of activity and the requirements for sustainability. In the case of planned economies, it would be necessary for the planner explicitly to acknowledge the biophysical constraints and to secure planning objectives only within those constraints. But is is only in recent years that the planned economies have acknowledged that, contrary to the general interpretation of Marx and Lenin, the environment is not something that can be manipulated and controlled by human forces regardless of consequence. As far as the mixed and modified free-market economies are concerned, the requirement would be that their public sectors behave according to the ecological planning paradigms, and that prices ruling in the market sectors somehow reflect the overall objective of sustainability.

In fact it is possible to show that even an economy which regulates environmental problems in terms of optimal externality as defined by neoclassical welfare economics will not achieve sustainability. The basic reason for this is that optimal externality implies a non-zero level of externality, and there is invariably some positive level of pollution which is justified by the balancing of the costs and benefits of control. In turn this reflects an analysis of benefits of pollution control based on the impacts on individuals' welfare levels because of pollution. Only if those preferences are formulated in such a way as to reveal infinite marginal prices when pollution reaches some critical level in terms of ecosystem functioning would there be even a chance that prices could reflect the sustainability objective. But such functions would require unparalleled information requirements on the part of individuals, and not just some individuals, for it has to be the case that price itself is adjusted to infinite levels just before catastrophe occurs. We know from catastrophe theory just how gradual change can become catastrophic change without warning.

Sustainability as intergenerational fairness is thus not an objective which is likely to be served by planned, market or mixed economies. Only ecologically bounded economies can make that achievement. The prospects for securing such an economy are what should concern us, instead of further engaging in the delusion that planners and markets are all-embracing sources of wisdom.

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NEOCLASSICAL ECONOMICS AND PRINCIPLES OF SUSTAINABLE DEVELOPMENT

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ABSTRACT

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This paper reviews the principal policy-related issues for which the professions of ecology and economics provide conflicting prescriptions. Emphasis is placed on the work of the World Bank, although the issues raised are relevant to a broad range of organizations. Rather than providing definitive solutions, the paper suggests an agenda for research in the ecology–economics interface.

Present-day neoclassical economic theory and its applications to development policy seriously overlook or undervalue major ecological concerns. The economic values of environmental services, while very real, are systematically underestimated in cost–benefit analysis because of measurement and valuation difficulties. 'Intangible' environmental benefits, such as those derived from the preservation of biological diversity, are recognized even less in economic analysis. The irreversible environmental effects of projects or policies are usually treated no differently from more reversible effects. The practice of discounting economic costs and benefits strongly favors projects with short-term benefits and long-term costs, often (though not always) with highly negative environmental effects. Using Gross National Product as a measure of development progress encourages rapid overexploitation of a country's natural resource base. Extravagant natural resource consumption by industrialized countries may undermine long-term development prospects of developing countries. The emphasis of many developing countries on export crops rather than domestic food production often entails major environmental costs.

The paper outlines some of the principles of ecologically sustainable development. At the project level, safe minimum standards are an important environmental supplement to cost–benefit analysis. At the national policy level, steady-state economics can be used to reconcile economic planning with the limits to growth in natural resource consumption.

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