Universitat Autònoma de Barcelona

Dipòsit digital de documents de la UAB

This is the **accepted version** of the article:

Padilla, Emilio. «Intergenerational equity and sustainability». Ecological economics, Vol. 41 (2002), p. 69-83. DOI 10.1016/S0921-8009(02)00026-5

This version is available at https://ddd.uab.cat/record/247661

under the terms of the BY-NC-ND license

This is a postprint version of the article:
Padilla, E. (2002) "Intergenerational Equity and Sustainability", *Ecological Economics*, Vol. 41 n.1, pp. 69–83.
https://doi.org/10.1016/S0921-8009(02)00026-5

Intergenerational equity and sustainability

Emilio Padilla

Departament d'Economia Aplicada

Universitat Autònoma de Barcelona

Edifici B, Campus de Bellaterra

08193, Bellaterra (Spain)

Tel: 34 93 581 34 15

Fax: 34 93 581 22 92

Email: emilio.padilla@uab.es

Abstract

This paper explores the limitations of conventional economic analysis of intergenerational problems and examines some of the alternatives suggested in the literature. It is argued that proper consideration of future generations has at least three requirements. First, when future costs and benefits are considered, it should be taken into account that they are to be enjoyed by different generations. Second, the sustainability requirement should be adopted. This represents an equity commitment to the future and implies the recognition that future generations have the right to nondeteriorated ecological and economic capacity. The paper studies the ways in which the recognition of these rights might be incorporated into economic evaluation and management. Third, an appropriate institutional network to enforce the recognition of these rights in decision-making processes should be constituted. Its design and necessary functions are also analyzed.

Keywords: Intergenerational Equity; Sustainability; Sustainable Development; Discounting; Project Evaluation; Rights; Institutions.

1. Introduction: discounting and future generations

Conventional evaluation and management methods have been widely criticized because of their implied discrimination against the interests of future generations. This has been particularly stressed in the recent literature of climate change (e.g. Azar, 1998; Chapman and Khanna, 2000). For a proper consideration of future generations in economic analysis, it would seem to be necessary to overcome several limitations of conventional analysis.

One of the points that has generated most controversy is discounting. Conventional economic analysis gives less importance to the flows that take place in the future. There are justifications for such discounting as well as numerous criticisms (for reviews see Markandya and Pearce, 1988; and Price, 1993). The application of discounting devalues and practically removes from the analysis the impacts that occur in the distant future. As a consequence, projects with distant costs and prompt benefits are strongly favored, while distant benefits are strongly devalued. Therefore, the choice of a discount rate has strong implications on the distribution of well-being between generations. Broome (1992), Cline (1992), Nordhaus (1994), and Fankhauser (1994) agree about the importance of this choice for the prescribed level of mitigation of greenhouse gases. A higher discount rate implies a greater discrimination against future generations (and so lower abatement of greenhouse gases), although any positive discount rate leads the analysis to strongly devalue and almost ignore distant impacts.

However, there is not a unique relationship between discounting and environmental degradation. If the discount rate applied influences the global investment level, a low rate would lead to a high investment. On the one hand, this would lead to higher capital endowment bequeathed to future generations, but on the other hand, it would imply greater use of natural resources and greater environmental degradation (Pearce and Turner, 1990). This last argument creates doubts about the final effect of conventional discounting on the environment. Nevertheless, if the negative effects that different investments causes on the environment were

avoided or properly accounted and compensated, higher investment should not entail greater environmental degradation.

Conventional cost-benefit analysis discounts all future impacts by applying the time preference as if they happened to present individuals. This procedure ignores the fact that society is composed of mortal individuals of different generations.[1] When a project extends over several generations, it does not seem justified to apply the time discounting of those who started it as if society were made up of immortal individuals. There is a big difference between considering the efficient allocation of consumption during one's own life span and considering the potential consumption by future generations. The lack of consideration that discounting implies for future generations is not based on any equity criterion but on a rather arbitrary extension of time preferences of present generations beyond their existence. The discounting justified on the decreasing marginal utility of consumption because of economic growth also meets with problems. Applying a discount rate based on the assumption of future prosperity might jeopardize this assumed prosperity by giving a low weight to future impacts (the 'optimist's paradox'). In addition, if discounting is applied to future individuals because they are thought to be richer, this reasoning would also justify the weighting of present individuals depending on their wealth, which is rarely done (Azar and Sterner, 1996).

Some authors argue that markets reflect individual preferences, and that the approaches incorporating market discount rates are adequate. However, several problems prevent markets from reflecting altruistic preferences appropriately. According to the 'isolation paradox' an individual will sacrifice consumption to benefit future generations only if the guarantee exists that others will also do so (Baumol, 1952). Sen (1961) compares the transfers to future generations with the prisoner's dilemma: it would be optimal for the individual if others invest, while one would be better off without investing. The concern about future generations takes on public good characteristics. The reason is that individuals benefit from other people's transfers, even though they themselves do not make any (Marglin, 1963). These reasons weaken the

incentives to make appropriate transfers to future generations. Therefore, the market does not lead to an efficient intergenerational allocation.

The market rate of interest does not reflect the preferences of individuals regarding the well-being of their descendants. Furthermore, conventional calculations of the social rate of discount based on individual time preferences also obviate future generations well-being. In fact, they even ignore the existence of different generations, adopting the 'immortality assumption'. The weights to apply to future generations should reflect the altruistic preferences of society and not just be an arbitrary extension of the time preferences of the present.

Nevertheless, the consideration of altruistic preferences does not guarantee that the interests of future generations are appropriately protected. The unborn have neither political power nor representatives. When considering actions that can seriously affect several generations, the legitimacy of taking only into account the preferences of present generations should be questioned in order to assure the commitment to equity between generations that sustainability represents. If future generations have certain rights that should be respected, these rights should be included in the analysis. This paper studies the ways this recognition of rights might be incorporated into economic evaluation and management.

The present article is organized as follows. Section 2 reviews some alternatives to discounting that have appeared in the literature. Section 3 analyses the limits of mainstream economics regarding sustainability. Section 4 proposes an alternative approach assuming sustainability as an equity commitment to the future. Section 5 presents the evaluation process incorporating this requirement. Section 6 studies the necessary reform and creation of institutions for a sustainable management of resources. Section 7 concludes.

2. Alternatives to avoid the damage discounting applies to future generations

[1] Ramsey (1928, p. 543) already claimed that discounting the consumption of future generations for pure time preference "is ethically indefensible and arises merely from the weakness of the imagination."

Several authors argue that the social discount rate should be lowered in projects with important intergenerational effects (e.g. Daly and Cobb, 1989; Cline, 1993). On the one hand, sound arguments justify an adjustment of the market rate in order to obtain the appropriate social rate. The market rate of interest does not consider in a proper way questions such as externalities or public goods, among others, and some authors argue that it is necessary to adjust it (e.g. Marglin, 1963). On the other hand, what is not correct at all is to use an arbitrarily chosen low discount rate for favoring future generations. This reduces the choice of the discount rate to choosing the one that leads to a result that has been previously decided, and therefore removes any objectivity or scientific rigor from the evaluation process. The important question should be determining the appropriate criteria and processes that should follow the decision process. As Howarth and Norgaard (1993, p. 339) note, cost-benefit analysis is properly concerned with allocative efficiency while concerns for distribution should be addressed by following principles of intergenerational justice. The mere use of an arbitrary low discount rate leads the analysis to obviate the preferences between present and future consumption and to invest in projects with inferior returns. In any case, this type of proposal is unable to incorporate the interests of future generations into the analysis.

Fisher and Krutilla (1975) develop a methodology that applies a 'growth factor' to the benefits of resource conservation and a 'decrease factor' to the benefits of exploiting it. The idea is that the natural resources that become scarcer have a growing relative price, while the benefits of its exploitation diminish as new technologies appear. Weitzman (1994) also argues that at higher economic development, environmental impacts will be more important, because of both their physical relevance and their valuation. This fact should affect the level and the temporal profile of the 'environmental discount rate', making it smaller than the market rate and declining. Tol (1994), Rabl (1996) and Hasselmann (1999) use similar arguments for valuing climate change impacts. However, these arguments imply a change not in the conventional use of time discounting but in the appropriate valuation of impacts, and they maintain many limitations (such as assuming perfect substitutability). The adjustment for the reasons they suggest does not necessarily have to obey an exponential function as the discount factor.

Furthermore, they do not solve the fundamental concern of this article, the explicit consideration of future generations interests.

The 'modified discount method' of Kula (1988) explicitly incorporates into the analysis the different generations affected by each project under consideration. First, it discounts the consumption flows enjoyed by each generation through their time preference. Then, it obtains the total profitability of the project, adding up the discounted flows of each generation. This method gives the same weight to all generations, which implies ignoring the preferences of most of the components of present society.

There is a group of proposals that basically consists in the weighting of the discounted flows of the different generations (Nijkamp and Rouwendal, 1988; Bellinger, 1991; Pasqual, 1999). These proposals reflect the fact that society prefers its own consumption to the consumption of future generations. Collard (1981) affirms that it is appropriate to let each generation apply its time discount and then consider the consumption of future generations through a weighting that shows society's altruistic preferences.

If the intergenerational weighting reflected altruistic intergenerational preferences, the analysis would gain in efficiency, since the benefits to be enjoyed by future generations would be considered by following social preferences. What happens in other solutions is that the consumption of the future is weighted in a rather arbitrary way. This is the case with conventional discounting, where the time preference of the individuals of the initial society is extended to future generations. However, even if altruistic preferences were correctly accounted, this would not imply that sustainability or any other equity criterion were completed.

To appropriately address the problem of intergenerational equity, more than modifying the discount or the weights applied to the different generations, it is essential to overcome the limitations of conventional economic analysis in relation to a sustainable development. Some of these limitations are discussed in the next section.

3. Conventional analysis and sustainability

3.1. Intergenerational externalities

Intergenerational problems arise due to the fact that present actions determine the economic and ecological capacity that the future will inherit. There are externalities between generations because future generations do not participate in decisions that will affect them. These externalities have some peculiarities. The unborn are unable to defend their interests in current decision making: they cannot bid in present markets, nor can they participate in the political process. Furthermore, present decisions can have an irreversible nature. Thus, future generations must resign themselves to suffering the consequences of present actions.

Conventional analysis considers that externalities are market failures. But in this case what occurs is market nonexistence. Thus, conventional solutions are not valid. In particular, the 'Coasian' analysis is out of place: there is no possible agreement between the parts because future generations are not present nor represented either. As for the 'Pigouvian' solution, it is based on a hypothetical market valuation in which the future cannot participate, so the values given to the future would be arbitrary. Furthermore, the internalization of these externalities depends on the will of institutions where future generations are not represented. Therefore, a much deeper institutional modification than the classic market adjustments is necessary. First of all, what should be questioned is the legitimacy of a conventional analysis where the same existence of the future is included as something contingent to present preferences.

3.2. Economic efficiency

The efficiency in the allocation of resources of conventional analysis refers to a market in which the only preferences expressed in some way are those of present generations. It implies discounting the future, and as was shown above, favors the imposition of strong costs to the future and puts in danger its economic and ecological capacity. Conventional analysis also adopts the Hicks-Kaldor compensation test, which involves that if the benefits of a project are higher than the costs it is efficient to undertake it independently of who gains and who loses. This criterion loses much of its legitimacy in the intergenerational setting (Azar, 2000), and it is

also hardly justifiable in many intragenerational cases. The question is who gives present generations the right to impose strong ecological damages on future generations? In the absence of effective compensation it seems at least a quite contestable premise. Many authors also argue that ecological damages to future generations cannot be compensated by doing them some other good (Sen, 1982; Barry, 1991; Spash, 1994; Azar, 2000).

Economic theory posits that there are as many efficient solutions as initial distributions of resources considered.[2] However, the usual procedures take as appropriate the initial endowment of resources and put all the emphasis on the search for efficiency. But the efficient intergenerational allocation depends on which initial endowment of resources is assumed. Economic analysis can consider different distributions, but moral considerations about the rights of the future have to be included in order to decide which is the most appropriate.

Conventional economic analysis implicitly assumes that the Earth and all its resources belong exclusively to present individuals. What is more, the present has the power of deciding how to use these resources. As a consequence, the endowment that will reach the hands of future generations is just a residual of the decisions of present individuals and not the result of a negotiation or market including the interested parties. Although there are altruistic preferences, these do not solve the problem. For a satisfactory solution, both parts (present and future) should arrive at an agreement (which is certainly not possible) or make explicit the recognition of certain rights to future generations based on moral grounds (such as human rights), and act accordingly.

The efficiency in the allocation of resources is an essential requirement to facilitate that a waste of resources or an excessive discharge of residuals is avoided. Also, an efficient economy allows increasing the standard of life of present and future individuals. Nevertheless, being a necessary criterion for proper evaluation and management, its application should be limited whenever it conflicts with sustainability.

[2] Howarth and Norgaard (1990) illustrate this for the intergenerational setting.

3.3. Intragenerational equity and sustainable development

Both market valuations and environmental valuation methods in use depend critically on the income distribution of individuals (Martínez-Alier and Roca, 2000). Poor people, as happens with future generations, do not have any way of expressing their preferences in a market that measures them in monetary units. The social acceptability of these valuations depends on the social acceptability of the existent distribution. Also, it might be more adequate to ask people as citizens and not as consumers when valuing public goods (Sagoff, 1988). In some decisions, premises like 'one person one vote', or the recognition of certain rights, can be considered more legitimate than market valuations.

It is not correct to talk about development in situations where a good portion of society is prevented from enjoying a decent quality of life. What is more, if social injustice were serious enough it could become incompatible with the sustainability of the system. In many countries poverty leads to an unsustainable use of the environment. Other countries, instead, reach their development by imposing unsustainability in less developed regions (Pearce et al., 1989). In fact, rich countries have created their prosperity through an appropriation and unsustainable use of global resources. There is a sound reason for justifying the contention that the costs of abating global environmental problems (such as climate change) must be borne by rich countries: they are historically responsible for this ecological debt that all countries now suffer (Turner, 1993; Martínez-Alier, 1998).

To sum up, the search for sustainable development is close linked to the solution of problems of inequity that could endanger sustainability and are against the same concept of development.

3.4. Interdependence between economic and ecological systems

Generally, when economists talk about efficiency in the allocation of resources they usually consider only one of the functions of the environment: the provision of resources. But when talking about sustainability all the economic functions of the environment should be considered. The economy uses and modifies the environment not only by exploiting resources,

but also by using it as a dump for residual assimilation. Economic activity can also modify the leisure and enjoyment function of the environment, and even more gravely, it can alter the global function of life-support. The entropic nature of the economic system has to be considered (Martínez-Alier, 1991).

We are not fully aware of the effects of our behavior on the environment, or of the effects that a change in the environmental system could have on the economy. If we want to maintain the sustainability of the socioeconomic system, human activity should not work by endangering the ecological sustainability. Therefore, beyond the usual efficiency criterion, present behavior should follow more cautious criteria. Some authors argue that the economy (especially in some regions) has exceeded the size ecological systems can tolerate and that there is an urgent necessity of reducing the scale of economic activity (Daly and Cobb, 1989).

The evaluation and management methods used until now have led to an overexploitation of the environment. Renewable resources are being used above their regeneration rate, depletable resources are being exploited without taking into account their limited existences and, even worse, the assimilative capacity of the environment has been seriously exceeded. This overexploitation has seriously affected the life-support function of natural systems, causing global environmental alterations such as the ozone layer depletion, climate change and biodiversity loss. The final repercussions of these changes on human beings is uncertain, although it is obvious that they are far-reaching as shown by the available evidence on global warming (IPCC, 2001).

3.5. Irreversibility, uncertainty, and ignorance

The irreversibility of current decisions can affect the capacity of the environment to provide its functions, seriously harming the natural legacy left to future generations. Thus, sustainable development requires imposing limits on the decisions that may involve irreversibilities.

There are well-developed probabilistic models of expected utility for dealing with risk problems. These are useful tools when the processes that generate risks are well understood and

the probabilities can be statistically defined. Nevertheless, they are of little help in cases of uncertainty where the possible effects of current decisions are not known and it is not possible to assign probabilities. If the effects on future generations are not known, it seems even more unlikely that they can be assigned a correct monetary value. In many cases there is uncertainty about the possible irreversibility of given decisions. This leads to the necessity of considering alternative (or complementary) approaches to conventional cost-benefit analysis in order to incorporate higher concern for resource conservation.[3]

3.6. Substitution possibilities

Although conventional economics assumes infinite substitution possibilities, this is not based on anything but intuition or faith (or simply because it facilitates an easily tractable model). It does not seem feasible to substitute some essential services like those provided by the ozone layer or the carbon cycle. The natural environment has more functions than just providing resources, which are less susceptible of being substituted. While substitution possibilities are greater regarding the function of provision of resources at small scale, when global ecological systems are affected, it is possible to create instabilities and chain reactions with unpredictable effects. There are critical levels of some goods, and thresholds that, if surpassed, may cause important alterations (Muradian, 2001). The equity between generations needs the protection of these critical levels, as well as of certain essential processes of the ecosystems. The ignorance concerning the future about technological capacity, preferences and, above all, the uncertainty regarding the effects that present actions have on the complex dynamics of natural systems suggests that it might not be possible to compensate indefinitely any reduction of the quality or the quantity of natural resources. In any case, ecological, biological and medical sciences (among others) and not just the beliefs of some economists should provide information about the possibilities of substitution.

[3] Woodward and Bishop (1997) show that in case of pure uncertainty the 'precautionary principle' (O' Riordan and Jordan, 1995) and the 'safe minimum standard' (Ciriacy-Wantrup, 1952; Bishop, 1978) arise as rational decisions and not just as ad hoc criteria.

Summing up, following only the efficiency criterion in the management of natural resources (as conventional economics does) leads in all probability to an unsustainable outcome. A commitment for a sustainable development requires paying greater attention to the interrelation between the economy and the ecology in which the former acts. Equity considerations, irreversibility and uncertainty problems, and substitution limitations must all be taken into greater account. All of this requires a thorough modification of current decision-making and management methods and institutions.

4. Sustainability as an equity commitment to the future

4.1. The recognition of rights to the future

Is it legitimate to assume that the possible existence of the necessary conditions to allow life in the future must depend on the preferences expressed in present (real or hypothetical) markets? This section focuses on the intergenerational equity problem by questioning the legitimacy of assuming that present generations have all the rights on environmental goods and services and do not have any obligation towards future generations. First of all, it is necessary to determine from which distribution of rights the analysis begins.

On the one hand there are statements such as: "...past generations are no longer here, and those to come will come because we want them to come. Saying it brutally, the world belongs to those now alive and to nobody else." (Mas-Colell, 1994, p. 200, my translation). In spite of its very strong connotations of inequity and injustice between generations, this is the premise implicitly taken in conventional economics.

On the other hand there is the consideration that future generations have certain rights and, consequently, the present has certain obligations towards the future. These rights can be derived from moral, contractual or deontological approaches. Much of sustainability literature tries to establish different criteria compatible with a development that can be sustained over a

long course of time, in other words, compatible with a minimum of intergenerational equity.[4] The most popular definition states that sustainable development is the "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987, p. 43). This definition implies limiting the present use of resources. Nevertheless, it is open to diverse interpretations because these needs are not precisely defined.

Strong ethical, moral, philosophical, cultural, contractual, or deontological justifications lead to rejection of the premise 'everything belongs to the present' as a legitimate starting point. Conventional analysis takes as the only relevant reality the one reflected by the market, arguing that this is not value laden. But this option implies both denying any right to the unborn since they cannot participate in present markets, and accepting that the present can do whatever it pleases without any limit, which is certainly strongly value laden. In order to respect the interests of future generations, present actions should be bounded within some limits. It would be more appropriate that these were subject to moral restrictions or, following a contractual vision, to assume the sustainable development as an implicit moral agreement between generations (Barret, 1996; Howarth, 1997).

The arguments stated in the previous section stress the necessity of going beyond the efficiency criterion of conventional analysis in order to achieve a sustainable development. However there are different views on this (good reviews of these can be found in Victor, 1991; Munda, 1997; or Neumayer, 1999). From an optimistic point of view, if any time that natural capital diminishes an increment of equivalent manmade capital takes place, then the capacity to maintain the quality of life would not be affected. This is known as the 'weak sustainability' criterion.[5] It goes a bit further than conventional economic tools such as cost-benefit analysis because it denies the validity of the Hicks-Kaldor test in the intergenerational context and demands actual compensation if future generations would suffer from present actions

[4] Pezzey (1989) already presented a long list of differing definitions for sustainable development.

[5] Cabeza-Gutés (1996) stresses that it is just a direct application of the Hartwick-Solow rule of growth theory with exhaustible resources.

(Neumayer, 1999). However, it is based on the assumption of perfect substitution between different types of capital and keeps many of the limitations of conventional analysis. As section 3.6 stresses, a sustainable development requires making the limits to substitution part of the analysis, and not making very uncertain assumptions that might jeopardize future generations. The respect for future generations interests leads this paper to claim for the implementation of the 'strong sustainability' requirement a criterion that requires the maintenance of the quantity and quality of natural capital over time, and of some critical levels of certain types of natural capital.[6] Costanza (1994, p. 394) justifies it as a "…prudent minimum condition for assuring sustainability". The ignorance and uncertainties about substitution possibilities imply that there is not a feasible way of putting into practice the weak sustainability criterion at global scale in order to assure sustainability. Local and regional indicators of weak sustainability can be useful but should be accompanied by global indicators of environmental sustainability. present generations will assure a fair treatment to future generations if the levels of the different types of capital do not diminish.

A sustainable development implies a much more favorable distribution of rights for future generations. In spite of the obvious nature of this statement very few authors have subscribed to it. Page (1983) states that life opportunities of future generations will be undiminished if they inherit the same resource base as present generations inherited. Bromley (1989) analyses the possibility of undiminished stocks of natural resources and environmental quality for ensuring intergenerational justice. Finally, Howarth (1997) asserts that the provision of specific endowments of reproduced capital, technological capacity, natural resources and environmental quality may sustain life opportunities of future generations. Summing up, to guarantee future generations a fair treatment, the analysis should consider their right to a nondeteriorated socioeconomic and ecological capacity. The capacity of the present to alter the conditions of life of the future imposes this responsibility.

[6] Its quantification might be quite problematic; but in any case it is possible to have some indicators of its evolution.

4.2. Recognizing the rights of the future: inalienability and compensation rules

Two relevant rules through which recognizing future generations rights in present actions can be identified: the 'inalienability rule' and the 'compensation rule'.[7] The inalienability rule implies that the present cannot modify certain rights of future generations. The compensation rule implies that if present performance deteriorates the endowment of rights of future generations, an associate compulsory compensation should be carried out. Note that it differs from conventional Hicks-Kaldor criterion in that actual compensation is required. While the application of the first rule impedes a modification of the structure of rights, the second allows modifying it as if there were an exchange between the present and the future.

The inalienability rule involves a much more restrictive use of the power in present decision making. However, although it is a stronger requirement, applying it when compensation is possible and sufficient for sustainability might lead to avoidable inefficiencies. The compensation rule leaves greater freedom to present decision-making. In any case, the compensation possibility should be demonstrated by the present and, contrary to the conventional evaluation, the compensation should be established. Compensation to future generations should at least fulfill the weak sustainability requirement, that is to say, compensating the reduction of natural capital with the increase in another type of capital. But, as was argued above, at a global scale the application of the compensation rule should be consistent with the strong sustainability criterion.

The recognition of rights to the future, with the application in each case of the necessary proceedings, requires new evaluation and management methods integrating the concerns expressed throughout this work as well as a strong institutional support reinforcing it.

5. Evaluation incorporating the sustainability requirement

[7] Bromley (1989) differentiates between property rule, liability rule, and inalienability rule. However, as he asserts "the property rule requires that the two parties arrange an exchange agreement ex ante…a difficult feat indeed." (p. 182). The property rule is thus not considered relevant for this analysis.

This section proposes the application of a new evaluation process incorporating the sustainability requirement. The recognition of rights implied by the sustainability requirement leads to incorporating into the analysis of intergenerational problems the obligation of maintaining the economic and ecological capacity that is currently enjoyed. This requires a different evaluation of policies and projects depending on whether the structure of rights between generations is affected (intergenerational evaluation) or not (ordinary evaluation).[8]

5.1. Ordinary evaluation

In the actions that only affect the generations taking the decision, conventional evaluation and management methods are essential for determining the most efficient allocation of resources. Nevertheless, there can be important distributive, ecological, moral, affective, contractual, deontological, cultural, or political reasons for society. These should also be considered in decision-making. As standard cost-benefit analysis follows only the allocative efficiency criterion, in some cases it could be appropriate to include it just as an element of a more complete decision-making process.

5.2. Intergenerational evaluation

When a project implies effects on generations not participating in the decision process, various cases should be differentiated. There are projects that will not negatively affect future generations, but there are also some that might harm them. This separation cannot be carried out with economic information alone: the necessity of considering geophysical and ecological realities turns the evaluation and management of sustainability into an interdisciplinary task.

On the one hand, intergenerational projects not jeopardizing the capacity of the future, in principle, do not give rise to transaction of rights between generations and therefore do not imply obligations for the present. However, the fact that present generations are (implicitly)

assumed to enjoy any future consumption shows that conventional valuation is quite arbitrary. Following the reasoning of section 2, an intergenerational weighting should be applied that properly shows the preferences of current society regarding the consumption of future generations.

On the other hand, any action jeopardizing the opportunities to be enjoyed by future generations implies a transaction of rights between generations. In each case it will be necessary to consider which form of fulfilling the obligations to the future is least costly to the present. The following relevant options could be considered:

a. *Not to carry out the project:* If a project causes irreversible harmful effects to future generations and these cannot be avoided or compensated, it should be considered outside the choice of possibilities. The rights of the future will then be respected by applying the inalienability rule. This is the case of exploiting renewable resources indefinitely above their regeneration rate or overexploiting the assimilative capacity of the environment. In addition, when there are serious risks or uncertainties, the obligations with the future imply a bigger risk aversion in decision-making. Basic processes and some critical levels necessary for the sustenance of the ecological system should be protected by the inalienability rule. The information of different scientific disciplines should help to determine which goods require this protection.

b. *To undertake precautionary and control measures:* This option also implies the application of the inalienability rule. If the modification of the structure of rights that the original project would imply is avoidable (e.g. enhancing security systems) and it is still profitable, this option is more appropriate than the first one. Conventional computation of costs and benefits (ignoring the future) often leads to ignoring the adoption of security measures or clean technologies, even if they could avoid severe damages to future generations. Present generations obligations imply that these measures should be included within the unavoidable costs of the project.

---

[8] Page (1997) arrives at similar conclusions and differentiates between ordinary and constitutional decisions while Norton (1995) proposes a two-tier interdisciplinary approach.

c. *Compensation through an associated project:* In some projects it is possible to compensate the harmful effects on future generations through an associated project (e.g. reforesting).[9] The cost of the compensation should be included in the calculation of profitability, and the way in which this became effective should be articulated. Thus, the rights would be protected by the compensation rule, an exchange taking place between generations. In order to permit this transaction of rights a sine qua non requirement should be that decision-makers demonstrate that this compensation will be enough and will become effective.

d. *Financial compensation:* This option would clearly modify the composition of the capacity bequeathed to future generations. There should not be doubts about the possibility of substituting the diminished resources and of establishing an investment fund allowing this future compensation.[10] Thus, the damage caused to future generations must be quantifiable in monetary units or, at least, it must be possible to demonstrate that the compensation will, with all probability, be satisfactory. Again, and contrary to conventional methods, it should become effective.

The evaluation process, outlined in Figure 1, should determine in each case which option is more appropriate and, as argued above, economic information is not enough for deciding this. Decision-makers should study whether the different options for recognizing the rights of future generations are more efficiently applied at local or regional scale, for groups of projects or even through macroeconomic policies. While at national or global scale the strong sustainability criterion must be completed, at regional or local scale less restrictive criteria might be applied. The appropriate option will depend on the particular characteristics of each project or group of projects, as well as on the conditions and specific needs of each region. In each case, the most appropriate scale and means of managing sustainability should be determined.

[9] This option coincides with the proposal of Markandya and Pearce (1988) on shadow projects.

[10] Costanza and Perrings (1990) idea of environmental bonds could be seen as a way of coming into operation this compensation.

6. The necessary reform and creation of institutions for a sustainable development

This section analyses the reform and creation of institutions needed for a sustainable development. Conventional economic analysis ignores the interests of future generations and leads to an unsustainable economic performance. Political decisions often follow an even more shortsighted orientation. Moreover, present institutions and laws do not take into account future generations interests either. The recognition of rights to the future implied by sustainability and the consequent application of the new evaluation and management methods propounded in this paper will not be possible unless there is a strong institutional support enforcing them.

6.1. The reform of the institutions that rule society

The recognition of rights and the corresponding obligations need to be incorporated in the basic norms that rule the functioning of societies. As Doeleman and Sandler (1998) state, the sustainable management of the environment needs constitutional protection, in the same way that basic human rights and other institutional foundations of society do. The legislation should recognize the obligation of following management and evaluation processes consistent with sustainability, as stated above. The global impact of many environmental problems causes the need of applying this recognition in all countries in order to become effective, thus avoiding a situation where some free-riding countries or regions put global sustainability in danger. The constitutional imposition of limits to present performance should be determined following the information provided by diverse disciplines. Economics should look for the most efficient way of fulfilling these limits, following the procedure stated above.[11]

6.2. The creation of institutions that watch over the rights of the future

Nevertheless, the simple constitutional recognition of the rights of the future does not guarantee that these will be respected in present practice. future generations do not have representatives in markets nor in political administration. Beyond constitutional recognition, the

adoption of sustainability as an equity commitment (recognizing certain rights to the future), requires institutions acting as representatives, defenders and tutors of these rights. These institutions should have the capacity to impose incentives and sanctions so that these rights are respected. Therefore, the creation of supranational institutions for controlling and negotiating the execution of the sustainability requirement at the global scale is necessary. In addition, there should be analogous institutions in the different countries and regions (acting at the most effective scale in each case). These institutions should have, at least, the following functions:

a. *To control the different variables related to sustainability*: Design and control of physical, biological, ecological, medical, economic and development indicators.

b. *To act as trusteeship and protector of the rights of future generations*: They should watch over whether economic agents follow sustainable evaluation and management practices. These institutions should be given sanctioning power for acting effectively against the practices that jeopardize the rights of future generations.

c. *To articulate the compensations to future generations*: In the event that, in following the new evaluation process, a transaction of rights between generations proves beneficial for everybody, the institutions representative of the future should take charge of the administration of the compensations that the future will enjoy.

d. *To incentivate and finance the change to sustainable practices*: The new institutions should have the capacity to create the necessary incentives so that a change to sustainable practices takes place.

The new institutions should not disturb the normal operation of ordinary evaluation and decision-making processes that do not negatively affect the recognized future rights of a nondeteriorated economic and ecological capacity. Nevertheless, in intergenerational projects they should impose an intergenerational evaluation consistent with sustainability, such as the one stated in the previous section.

---

[11] E.g. finding the most efficient way to avoid "dangerous anthropogenic interference with the climate system", the ultimate objective of the United Nations Framework Convention on Climate Change.

The severity of current environmental problems causes the urgent need of adopting commitments, both at international scale and in regional and local communities, in the sense indicated in this section. Unfortunately, the current situation is far from the recommended scenario (a clear example is the fiasco of The Hague 2000, and the later abandonment by the USA government of the final modest agreement of Berlin 2001 for the application of the Kyoto Protocol). There are major difficulties as some countries or communities may feel they have incentives to free-ride and ruin the timid advances made.

As for the financing of this institutional framework, the current benefits gained by using the resources belonging to everybody (present and future) should finance the protection of these resources for the enjoyment of their future owners. The institutions representative of future generations should guarantee this, and the same institutions should study the most efficient financing mechanisms to fulfill the proposed objective (e.g. energy and carbon taxes, tradable pollution permits, etc...). Most global environmental problems have been mainly caused by industrialized countries, while the most susceptible receivers of their worst effects are the third world countries. The abatement of the accumulated costs imposed on the global environment should be financed mainly by the richest countries, because they have been the beneficiaries of its overexploitation through appropriating the property rights and making a destructive use of goods that belong not only to all present individuals, but also to the unborn.

7. Conclusions

Conventional economic analysis treats future generations unfairly. The alternatives usually suggested in the literature do not incorporate the complexity of intergenerational problems either. This paper argues that a coherent alternative needs to introduce the existence of different generations in the analysis and to take appropriately into account the preferences concerning future generations consumption. However, this does not ensure a sustainable development. To deal with intergenerational problems it is essential to overcome the strong limitations that mainstream economics embodies (e.g. the unequal distribution between

generations or the assumption of infinite substitution possibilities). The present study concludes that, in order to ensure a fair treatment to future generations, we should recognize and protect their right to enjoy at least the same capacity of economic and ecological resources that present generations enjoy. Sustainability would then be assumed as an equity commitment with future generations. With this purpose, the paper proposes an alternative evaluation process coherent with the sustainability requirement. In this process, the information of different disciplines is of critical importance in order to follow the most efficient way of respecting the rights of future generations. Some economists' assumptions about uncertain and unknown questions should be substituted by the integration of interdisciplinary information and more prudence.

Finally, as future generations do not have representation in present markets and institutions, if their rights are to be respected, and the proposed evaluation process applied, the appropriate mechanisms and institutions should be established. The paper stresses some of the functions and powers that these institutions should have in order to reinforce the recognition of rights claimed above in order to achieve a sustainable development. The benefits that (part of) present society obtains from the use of resources that (also) belong to the future should finance the institutional structure that allows its sustainable administration.

Acknowledgements

I appreciate the very helpful comments from Joan Pasqual, Jordi Roca, Joan Martínez-Alier, Federico Aguilera-Klink, Vicent Alcántara, Giuseppe Munda, Jesús Ramos, Jeroen C.J.M. van den Bergh and two anonymous reviewers. I also appreciate financial support from Ministry of Science and Technology, project BEC 2000-415. An earlier version of this paper was presented at the "VII Jornadas de Economía Crítica", Albacete, Spain, 3-5 February 2000.

References

Azar, C., 1998. Are optimal CO_2 emissions really optimal?. Environmental and Resource Economics 11, 301-315.

Azar, C., 2000. Economics and distribution in the greenhouse. Climatic Change 47, 233-238.

Azar, C., Sterner, T., 1996. Discounting and distributional considerations in the context of global warming. Ecological Economics 19, 169-184.

Barrett, C.B., 1996. Fairness, stewardship and sustainable development. Ecological Economics 19, 11-17.

Barry, B., 1991. Liberty and Justice: Essays in Political Theory 2. Clarendon Press, Oxford.

Baumol, W., 1952. Welfare State Economics and the Theory of State. Harvard University Press, Cambridge.

Bellinger, W.K., 1991. Multigenerational value: modifying the modified discount method. Project Appraisal 6, 101-108.

Bishop, R., 1978. Endangered species and uncertainty: the economics of a safe minimum standard. American Journal of Agricultural Economics 57, 10-18.

Bromley, D.W., 1989. Entitlements, missing markets, and environmental uncertainty. Journal of Environmental Economics and Management 17, 181-194.

Broome, J., 1992. Counting the Costs of Global Warming. White Horse Press, Cambridge.

Cabeza-Gutés, M., 1996. The concept of weak sustainability. Ecological Economics 17, 147-156.

Chapman, D., Khanna, N., 2000. Crying no wolf: why economists don't worry about climate change, and should. Climatic Change 47, 225-232.

Ciriacy-Wantrup, S.V., 1952. Resource Conservation: Economics and Policy. University of California Press, Berkeley.

Cline, W.R., 1992. The Economics of Global Warming. Institute for International Economics, Washington DC.

Cline, W.R., 1993. Give greenhouse abatement a chance. Finance and Development 30, 3-5.

Collard, D., 1981. Altruism and Economy. The Pitman Press, Bath.

Costanza, R., 1994. Three general policies to achieve sustainability. In Jansson, A., Hammer, M., Folke, C., Costanza, R., (Eds.) Investing in Natural Capital: the Ecological Economics Approach to Sustainability. Island Press, Washington DC, pp. 392-407.

Costanza, R., Perrings, C., 1990. A flexible assurance bonding system for improved environmental management. Ecological Economics 25, 55-57.

Daly, H.E., Cobb, J.B., Jr., 1989. For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future. Beacon Press, Boston.

Doeleman, J.A., Sandler, T., 1998. The intergenerational case of missing markets and missing voters. Land Economics 74, 1-15.

Fankhauser, S., 1994. The economic costs of global warming damage: a survey. Global Environmental Change 4, 301-309.

Fischer, A.C., Krutilla, J.V., 1975. Resource conservation, environmental preservation, and the rate of discount. Quarterly Journal of Economics 89, 358-370.

Hasselmann, K., 1999. Intertemporal accounting of climate change-harmonizing economic efficiency and climate stewardship. Climatic Change 41, 333-350.

Howarth, R.B., 1997. Sustainability as opportunity. Land Economics 73, 569-579.

Howarth, R.B., Norgaard, R.B., 1990. Intergenerational resource rights, efficiency and social optimality. Land Economics 66, 1-11.

Howarth, R.B., Norgaard, R.B., 1993. Intergenerational transfers and the social discount rate. Environmental and Resource Economics 3, 337-358.

IPCC, 2001. Climate Change 2001: The Scientific Basis: Contribution of Working Group I to the Third Assessment Report. Summary for Policy Makers. In http://www.ipcc.ch

Kula, E., 1988. The Economics of Forestry: Modern Theory and Practice. Croom Helm, London.

Marglin, S., 1963. The social rate of discount and the optimal rate of investment. Quarterly

Journal of Economics 77, 95-111.

Markandya, A., Pearce, D., 1988. Sustainable future. Natural environment and the social rate of discount. Project Appraisal 3, 2-12.

Martínez-Alier, J., 1991. Environmental policy and distributional conflicts. In: Costanza, R. (Ed.), Ecological Economics: The Science and Management of Sustainability. Columbia University Press, New York.

Martínez-Alier, J., 1998. Ecological debt – external debt. In http:// www.cosmovisiones.com/DeudaEcologica/

Martínez-Alier, J., Roca, J. 2000. Economía Ecológica y Política Ambiental. PNUMA, Fondo de Cultura Económica, México DF.

Mas-Colell, A., 1994. Elogio del crecimiento económico. In: Nadal, J. (Ed.), El Mundo que Viene. Alianza Editorial, Madrid.

Munda, G., 1997. Environmental economics, ecological economics, and the concept of sustainable development. Environmental Values 6, 213-233.

Muradian, R., 2001. Ecological thresholds: a survey. Ecological Economics 38, 7-24.

Neumayer, E., 1999. Weak versus Strong Sustainability. Exploring the Limits of Two Opposing Paradigms. Edward Elgar, Cheltenham.

Nijkamp, P., Rouwendal, J., 1988. Intergenerational discount rates in long-term plan evaluation. Public Finance/Finances Publiques 43, 195-211.

Nordhaus, W.D., 1994. Managing the Global Commons: The Economics of Climate Change. MIT Press, Cambridge, Massachusetts.

Norton, B.G., 1995. Evaluating ecosystem states: two competing paradigms. Ecological Economics 14, 113-27.

O'Riordan, T., Jordan, A., 1995. The precautionary principle in contemporary environmental politics. Environmental Values 4, 191-212.

Page, T., 1983. Intergenerational justice as opportunity. In MacLean, D., Brown, P.G. (Eds.), Energy and the Future. Rowman and Littlefield, Totowa, NJ.

Page, T., 1997. On the problem of achieving efficiency and equity, intergenerally. Land Economics 73, 580-596.

Pasqual, J. 1999. La Evaluación de Políticas y Proyectos: Criterios de Valoración Económicos y Sociales. Icaria Editorial and Universitat Autònoma de Barcelona, Barcelona.

Pearce, D.W., Turner, R.K., 1990. Economics of Natural Resources and the Environment. Harvester Wheatsheaf, London.

Pearce, D.W., Markandya, A., Barbier, E., 1989. Blueprint for a Green Economy. Earthcan Publications Ltd, London.

Pezzey, J., 1989. Economic Analysis of Sustainable Growth and Sustainable Development. World Bank, Washington DC.

Price, C., 1993. Time, Discount, and Value. Blackwell, Oxford.

Rabl, A., 1996. Discounting of long-term costs: what would future generations prefer us to do?. Ecological Economics 17, 137-145.

Ramsey, F.P., 1928. A mathematical theory of saving. Economic Journal 38, 543-559.

Sagoff, M., 1988. The Economy of the Earth: Philosophy, law, and the Environment. Cambridge University Press, Cambridge.

Sen, A.K., 1961. On optimising the rate of saving. Economic Journal 71, 479-496.

Sen, A.K., 1982. The choice of discount rates for social benefit-cost analysis. In Lind, R.C. (Ed.), Discounting for Time and Risk in Energy Policy. Resources for the Future, Washington, DC, 325-352.

Spash, C.L., 1994. Double CO_2 and beyond: benefits, costs and compensation. Ecological Economics 10, 27-36.

Tol, R.S.J., 1994. The damage costs of climate change: a note on tangibles and intangibles,

applied to DICE. Energy Policy 22, 436-438.

Turner, R.K., (Ed.) 1993. Sustainable Environmental Economics and Management. Principles and Practice. Belhaven Press, London.

Victor, P.A., 1991. Indicators of sustainable development: some lessons from capital theory. Ecological Economics 4, 191-213.

Weitzman, M.L., 1994. On the environmental discount rate. Journal of Environmental Economics and Management 26, 200-209.

Woodward, R.T., Bishop, R.C., 1997. How to decide when experts disagree: uncertainty-based choice rules in environmental policy. Land Economics 73, 492-507.

World Commission on Environment and Development (WCED), 1987. Our Common Future. Oxford University Press, Oxford.

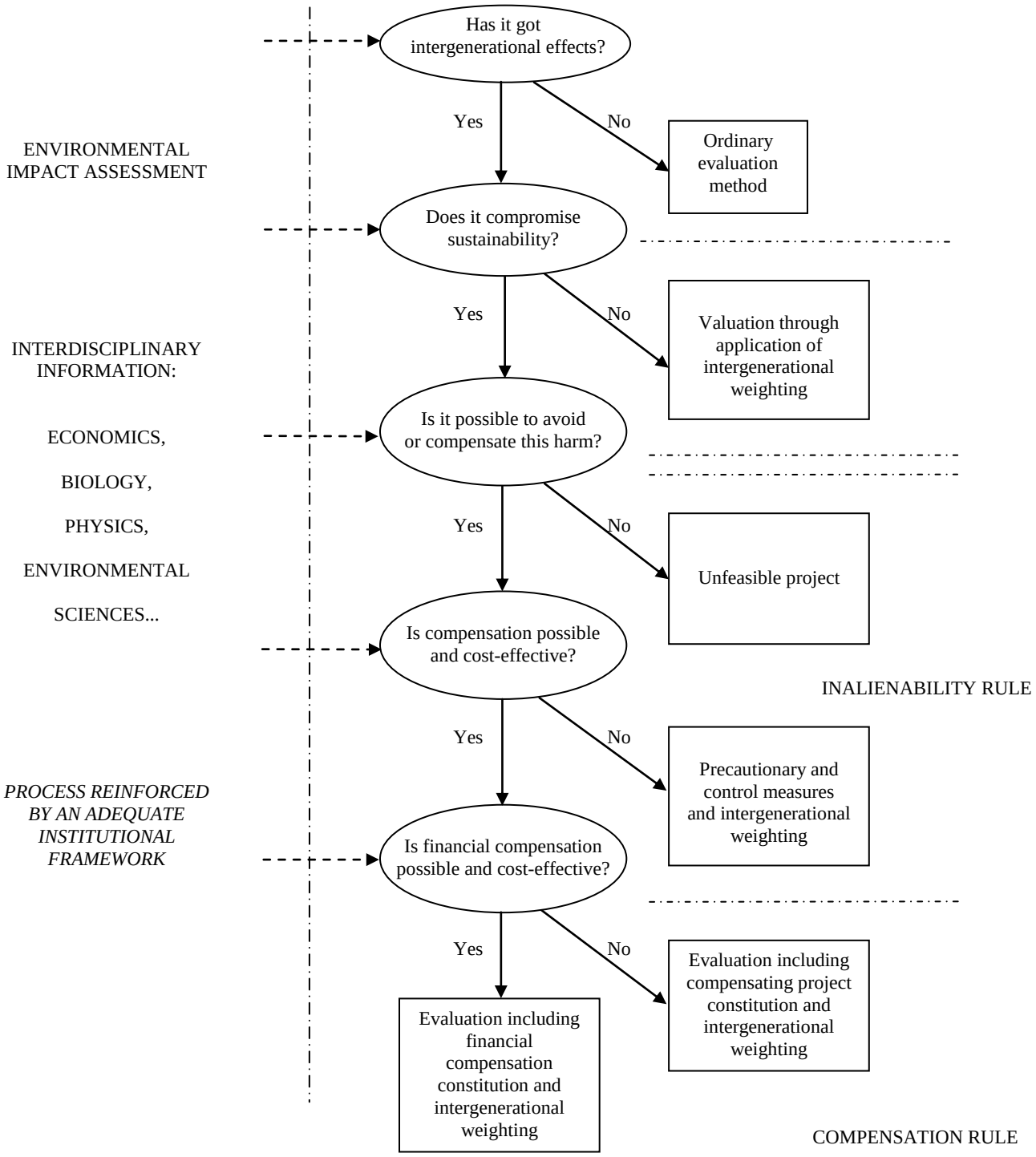

Figure 1. The evaluation process.