Equity and efficiency in environmental policy analyses

Nijkamp, P.

1985

SERIE RESEARCHMEMORANDA

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SEPARABILITY VERSUS INSEPARABILITY

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Researchmemorandum 1985-4   Jan. 1985

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EQUITY AND EFFICIENCY IN ENVIRONMENTAL POLICY ANALYSIS : SEPARABILITY VERSUS INSEPARABILITY

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Paper presented at the Conference on:
'Distributional Conflicts in Environmental-Resource Policy',
Science Center, Berlin, March, 1984.

1. The Homo Economicus

Since the days of Adam Smith, economic science is addressing itself to an efficient use of scarce resources. Scarcity problems have always made up the heart of economics. The post-war economic growth and its resulting welfare have put economics in a difficult position, however, as in the post-war period the western societies were characterized by abundance rather than by scarcity. Due to the postulate of infinite needs the 'homo economicus' was assumed to orient himself always towards a maximization of efficiency, so that non-market impacts (pollution, e.g.) could not appropriately be taken into consideration in utility and decision analysis.

Problems of environmental decay - first signalled by non-economists - appeared to become so urgent in the past decades, that economists were induced to include environmental issues in their conventional accounting schemes, sometimes even in the framework of economic equilibrium analysis (see for instance, Mäler, 1974).

In contrast with attempts at accomodating environmental issues to traditional economic approaches, several new endeavours were also made to substitute the (neo-classical) maximizing paradigm for refreshing foundations for economics, such as the 'spaceship earth' paradigm (see Boulding, 1966), the 'steady state' paradigm (see Daly, 1973), and the 'Gaia' paradigm (see Margulis and Lovelock, 1976). The major aim of such alternative paradigms for an economic use of scarce resources has been to replace the antroprocentric approach of economics by new approaches focusing on stability and on harmony with nature, in which in addition to theoretical economic reasoning also socio-economic and political ethical postulates could play an intrinsic role.

Although these alternative approaches have provided stimuli for new ways of thinking, the main stream of economics has still concentrated its attention on conventional neo-classical economics as the major viewpoint for dealing with environmental issues. This is also witnessed by terms like 'optimal pollution' and 'environmental capital', indicating that the homo economicus is still regarded as the 'crown of creation' who dominates nature (see Leopold, 1972) and whose deepest motive is 'on and on and up and up' (see Coppock, 1974). Despite the increased interest in environmental issues, the aim of a permanent increase in flows of commodities and services is still dominant, while environmental quality is at best taken into account as a constraint (see for an interesting survey, Fietkau et al., 1982).

Fortunately, in the past decade also several successful attempts have been undertaken to incorporate environmental targets in a more appropriate way in environmental-economic planning models and evaluation analysis. It is then assumed that the economic meaning of choice items (including 'environmental commodities') is to be found in the fact that they have an impact on the satisfaction of needs in so far as these are related to the use of scarce resources (cf. Robbins, 1952). In contrast with neo-classical economics, however, these modern approaches do not take for granted that the social value of a commodity is reflected in its market value, as otherwise unpriced commodities (like the quality of the environment) would be excluded from an operational economic analysis. Especially in the field of conflict analysis, multiple objective choice analysis, multi-attribute utility theory and multiple criteria evaluation analysis much progress have been made in incorporating environmental issues in economic analysis (see for instance, Hafkamp, 1984, Nijkamp, 1979, 1980, and Rietveld, 1981). The major importance of these recent operational approaches is that the postulate of a homo economicus does not imply that rational economic behaviour automatically takes for granted the maximization of efficiency (see later); alternative objectives can in principle be taken into account.

Here we are touching upon another extremely difficult problem: conventional economic reasoning is based on an individualistic value theory, as micro preferences included in disaggregate utility functions ultimately determine the market value and distribution of commodities. Böhm Bawerk has already pointed out that this assumption leads to an overassessment of current needs and of the future potential of the economy, and to an underassessment of future needs (see Hardin, 1968, and Roll, 1973). The distributional problems emerging from the traditional rationality postulate of the homo economicus are indeed rather severe, both over time (intergenerational trade-offs, e.g.), over space (regional disparity profiles, e.g.), or over groups (segmentated welfare profiles, e.g.). These distributional problems are already complicated in a normal market system, but they are really intriguing in case of non-priced commodities (environmental decay, e.g.). Here the efficiency-equity dilemma leads to incommensurable trade-off problems, because normally efficiency criteria can be translated into the 'common measuring rod of money', whereas equity criteria cannot be consistently linked to any common monetary denominator. Especially in current environmental management problems, such trade-off issues cannot easily be solved.

Consequently, distributional conflicts in economic-environmental policy analysis are very hard to solve. And these conflicts tend to increase as objectives of industrial revitalisation caused by the current economic stagnation offers less space for distributional considerations of environmental commodities or policies across different socio-economic groups. Thus the economic costs and benefits of environmental and resource policies tend to become distributed in such a manner that the final outcome is again reflecting the aim of the homo economicus as a hedonistic efficiency maximizer. It should be added however that recently also some refreshing views have been expressed on the rationality postulate for 'the economics of altruism' (Margolis, 1982).

From a methodological viewpoint the question arises whether and how distributional issues of environmental policy can be linked in a meaningful way to efficiency goals, so that environmental and resource management is also taking account of (re-)distributional aspects (see also Pearce, 1982, and Zimmermann, 1981, 1983). In this regard, it is necessary to treat the question of separability and inseparability in equity-efficiency approaches to economic and environmental policy analysis. This will be further discussed in the next section.

2. Separable and Inseparable Distributional Issues in Environmental Policy Analysis

Environmental choices have strongly distributional impacts for two reasons:

- the 'consumption of environmental commodities' is different among individuals and groups in a country due to differences in income and time budgets and in settlement patterns (cf. Freeman, 1972) ;
- the policies to restore the quality of environmental commodities have different benefits and different costs for individuals and groups in a country (cf. Zimmermann, 1981).

Unfortunately, conventional welfare theory has not offered much potential for including environmental equity issues in a practical way in the analysis, as also the notion of externalities was often based on efficiency considerations.

In Nijkamp (1978), a typology of external effects has been presented, and it may be interesting to examine in how far these various categories of externalities are able to encompass (separable or inseparable) environmental equity issues.

(1) pecuniary and technological externalities

Pecuniary externalities are price-related indirect effects, while technological externalities are non-market effects. None of these categories however is able to take explicitly account of environmental distribution effects.

(2) separable and non-separable externalities

Separable externalities are caused by environmental effects that do not affect the marginal priorities of actors. These categoriesdo implicitly take into consideration distributional effects, but do not provide an operational contribution in a policy context.

(3) reciprocal and non-reciprocal externalities

These externalities are based on the distinction whether or not environmental decay takes place in both ways. Given the spatial background of reciprocal effects, there are implicitly some distributional issues involved, but this distinction has not led to a more satisfactory treatment of environmental equity problems in a practical conflict situation.

(4) depletable and non-depletable externalities

Depletable externalities emerge, if the 'consumption of environmental deterioration' by one group means a reduction of environmental deterioration for other groups. This distinction implies a clear consideration of distributional aspects, but does not lead to any theoretically-based policy rule.

(5) marginal and inframarginal externalities

This distinction is based on the question whether marginal changes in environmental choices of one group affects the welfare position of others. Also this distinction has some distributional aspects, but does not provide a solution to separable equity problems either.

(6) potentially relevant and irrelevant externalities

An external effect is potentially relevant, if it stimulates the 'victim' of environmental deterioration to undertake actions in order to change the behaviour of the polluter. This distinction is not particularly relevant for environmental equity issues.

Altogether the conclusion can be drawn that the conventional views on externality concepts do not provide a fruitful operational contribution to the separability problem in environmental equity analysis.

It is often assumed that environmental policy has a negative impact on the personal income distribution, as lower income groups tend to benefit much less than higher income groups. Conventional allocation rules for environmental quality management however, do not take into account the distributional impacts, as these rules are only based on on efficiency considerations. Given the efficiency paradigm, one can use the neo-classical marginality rules to achieve a Pareto-optimal situation (cf. Baumol and Oates, 1975, and Dorfman, 1977), but this Pareto optimum is only based on aggregate costs and aggregate benefits. However, when the distribution of costs does not coincide with the distribution of benefits over individuals or groups in society, the social meaning of a Pareto optimum becomes doubtful (see also McGuire and Aaron, 1969). Consequently, a separate treatment of allocation and distribution in a welfare-theoretic policy context is not very meaningful.

Unfortunately, however, many welfare-theoretic contributions are based on a sequential analysis of allocation and distribution, as in the first stage efficiency is maximized, while in the next stage the implication of allocation decisions for equity are examined. The separability implicitly assumed here leads to a preponderance of efficiency criteria. It should be added however, that also the 'dual' approach in political economy emphasizing a primacy of equity considerations followed by an examination of efficiency implications, rests upon the same weak assumption of separability of allocation and distribution.

One may argue however, that in the real world both efficiency and equity are simultaneously determined by the outcome of socio-economic and political processes, so that there is no substantial argument in favour of the separability assumption (except for pragmatic policy reasons).

In principle, three possibilities do exist to link allocation rules to distribution rules in a welfare-theoretic context.
The first possibility is based on a formal welfare theory and regards all items that have an impact on social welfare (including environmental quality, distribution of income, distribution of environmental costs and benefits) as formal arguments of a social welfare function. If information were available on measurable indicators for the abovementioned items, and if information were available on their functional structure (i.e., the way these items are linked to each other), the

normal marginality rules can be used to derive optimality conditions that encompass also distributional indicators as welfare arguments. This approach has two limitations, however:

- it is still based on aggregate rules, so that the interest of individuals and groups is only reflected in one single distribution criterion (a Pareto-α, e.g.);
- it takes also for granted information on trade offs among all arguments of a social welfare function (including distributional issues).

The second approach is based on a more disaggregate view. It takes for granted that it is possible to attribute all benefits and costs of environmental policy to specific groups in society. This means that the distributional problems are attacked by a detailed impact analysis of groups that are affected by environmental costs and benefits (cf. Lichfield et al., 1975).
In this case, however, one can only apply a policy-oriented welfare approach, if a priori the relative importance to be attached to each separate group is known (see also Voogd, 1983). In that case the optimality rule includes directly the distributional issues on the design of environmental policy programs. Of course, also this approach has some limitations:

- the precise assessment of costs and benefits over groups is fraught with difficulties;
- the explicit assignment of importance weights to different groups is, in a policy context, not very operational.

The third possibility emerging from modern conflict analysis, may be based on a mix of both foregoing options, by assuming that social welfare is determined by allocational and distributional impacts at either a micro or a macro level. It is also then assumed that a conflict does exist between allocational and distributional issues without knowing explicitly the weights to be attached to these issues, but on the basis of information on trade offs among efficiency and equity, relevant information on the possibility or efficiency frontier is available. Multiple objective decision analysis is able to indicate how - usually on the basis of a 'satisficer' approach - a compromise solution can be reached in an interactive manner (see among others, Hafkamp, 1984, Nijkamp, 1980, and Rietveld, 1981). This approach will further be taken up in the sequel of the paper.

In each of the abovementioned three possibilities, financial aspects, price repercussions, environmental quality standards, and environmental policy principles (such as the 'polluter pays' principle) can , in principle, be taken into account, either in a general or in a partial equilibrium framework. The disaggregate approach to efficiency-equity problems is once more interesting as in relevant years many advances have been made in the area of discrete individual choice modelling (for instance, based on random utility analysis), so that the utility-based choices of groups can be taken into account in a much more appropriate manner (see for instance, Manski and McFadden, 1981).

In principle, current economic methodology allows the inclusion of integrated efficiency-equity issues in a modern welfare-theoretic framework, though in a practical institutional setting this approach is still fraught with many limitations.

3. Environmental Equity Issues in Conventional Policy Analysis

Not only in theoretical analyses, but also in practical policy analysis the separability problem of environmental equity and efficiency is of major importance. Pareto efficiency as such does not provide any meaningful support in identifying an acceptable social equity situation as long as the individual marginal rates of substitution between environmental quality and private goods do not coincide with the individual marginal cost shares of environmental management (see also Aaron and McGuire, 1969). The inability of conventional approaches to economics to take into account distributional issues has also had a profound impact on various policy-analytic tools that have been designed to assist public policy-makers in rationalizing complex choices in environmental management problems, as is particularly witnessed in social cost-benefit analysis as the neo-classical tool par excellence in policy analysis.

Cost-benefit analysis aims at judging the 'societal surplus' of public investment decisions, based on an efficiency principle emerging from the maximization of the consumer surplus (i.e., the difference between the maximum willingness to pay and the price actually paid) (cf. Dasgupta and Pearce, 1972). The inclusion of environmental externalities in a social cost-benefit framework is far from easy, as there is in general a wide variety of measures to cope with such externalities:

- negotiations
- moral conviction
- direct policy measures, such as:
  - constructing pollution abatement equipment
  - establishing environmental quality standards
  - assigning a system of waste rationing
  - edicting pollution prohibitions
- indirect policy measures, such as:
  - financial charges
  - subsidies.

Each of these measures has different distributional impacts and the problem of inseparability of environmental efficiency-equity differs for each specific policy measure. Unfortunately, social cost-benefit analysis has only had limited attention for such distributional issues. Only in the area of political economy more attention has been focused on important equity aspects of environmental management issues. A prominent early figure in this field has been Kapp (1950), who - in line with Marx and Veblen - has clearly pointed out that the restrictive scope of neo-classical economics is caused by its own value judgements regarding efficiency in a free market system, as this system induces entrepreneurs to transfer unpriced negative externalities to weaker groups in society (cf. also Galbraith, 1970).

Neo-classical economists have argued that negative externalities can be dealt - at least in principle - by means of a compensation for the loss in individual welfare, so that negative externalities are then internalized (cf. Mishan, 1968). There are however, important theoretical and practical limitations inherent in the compensation method, such as:

- It is often only a two-party model in which the outcomes are determined by the relative power of the parties.
- It is only a partial equilibrium model, as negative externalities can only be transferred to other groups not directly involved.
- The usual 'small numbers' case in theory precludes an application in a complex social context (cf. Baumol and Oates, 1975).
- It takes for granted unambiguous cause-effect relationships which do not exist in practice (cf. the acid rain problem).
- The outcomes of the compensation method are also determined by the jurisdictional system (cf. Mishan, 1971).
- The assessment of revealed preferences and perceptions regarding environmental issues is fraught with difficulties (cf. Ramsay and Anderson, 1975).
- The sometimes high transaction costs may sometimes lead to a continuation of negative environmental externalities (cf. Mishan, 1971).

- The compensation method does not aim to reduce environmental decay, but only to compensate for welfare losses associated with environmental decay.

The compensation has been introduced in order to save neo-classical economic analysis in a situation with non-priced welfare effects. In so far as the compensation model is based on individual welfare compensation, it is able to include distributional issues without falling even in the trap of the separability-inseparability dilemma, as then allocation and distribution (via compensation) are simultaneously taken into consideration. However, two major problems still remain:

- a welfare compensation is a theoretical construct that does not provide any direction regarding the transformation of welfare losses into monetary units;
- the theoretical solution of individual welfare compensation does not provide any direction as to how to include this approach in a social cost-benefit framework.

Consequently, social cost-benefit analysis has not been able to overcome the separability dilemma in policy analysis. Distributional issues could at best be included by means of rather global compensation rules (for instance, based on an average willingness to pay), but general fairness principles (cf. Rawls, 1972) were left out of consideration. Rawls' view that an unequal distribution can only be justified, if this situation means a benefit for weaker socioeconomic groups, could be a good starting point for intergenerational equity analysis, but it has never been applied in this context.
Even the ability-to-pay principle was already hard to incorporate in a social cost-benefit context. In conclusion, conventional policy analysis has not provided operational instruments for an appropriate treatment of distributional issues in environmental management.

4. Environmental Equity Issues in Society, in Space and in Time

In this section a closer look at specific environmental distribution issues will be taken, by making a distinction between equity issues for different groups, for different regions and for different time periods.

As mentioned before, social cost-benefit analysis is unable to encompass environmental equity issues for two reasons: (a) the inability to transform non-market impacts into a consistent and manageable price system, and (b) the inability to integrate distributional aspects of environmental issues in an efficiency context.

There is essentially only one evaluation method for public policy that is capable of dealing with equity issues for socio-economic groups, viz. the planning balance sheet method. This method, originally designed by Lichfield et al. (1975), may be regarded as an extended cost-benefit analysis, in which social aspects and distributional effects on individuals or groups are also taken into account in a detailed manner. The method itself is based on so-called planning balance sheets representing an extensive and detailed account of all impacts of public policy measures and of the extent to which socio-economic groups are affected in their well-being after the implementation of a policy decision. The elements of well-being are not necessarily expressed in a monetary denominator: even qualitative information may be used.

Planning balance sheet analysis may be considered as an improvement of conventional cost-benefit analysis. Clearly, its applicability depends very much on the available information. Another problem is that the socio-economic distribution of plan impacts is assessed, but that no mechanism is developed to arrive at priority schemes for the distribution, so that an integration with the effectiveness principle is hardly possible. Consequently, this method is an important step forward to a consideration of both efficiency and equity aspects of environmental management, but does not lead to a meaningful solution for the separability dilemma.

If we focus attention on regions, the same remarks can be made. The assessment of spatial impacts of environmental management and policy decisions is again in principle possible, but it still is an open question whether the separability problem can be solved by means of a spatially-oriented planning balance method.

Finally, environmental equity issues may also be related to an intergenerational tradeoff over different time periods. Usually, public policy measures in the field of environmental management will have a multi-period effect, so that the judgement of these effects has also efficiency and equity aspects. Here the major problem is whether the future generation should bear the burden of current short-sighted environmental management, or whether they should benefit from deliberate rational environmental policy decisions taken by the present generation.

Surprisingly enough, economics has only provided a 'solution' for intertemporal or intergenerational equity-efficiency judgements, viz. by using the notion of a discount rate (see also Herfindahl and Kneese, 1974, and Marglin, 1963). This discount rate is normally used to transform future impacts into present values, so that future and current streams of benefits and costs can be made commensurate. Usually the assumption is made that in a fully operating market system the discount rate should be in agreement with the marginal efficiency of capital, so that the rate of return in the public sector should be linked to that in the private sector. If the rate of discount would be very high, a consideration of social benefits of a project to future generations would be precluded. If however, the discount rate would be low, private capital (normally having a higher efficiency) would be substituted for public capital (see also Abelson, 1979, and Myers, 1979).

An important but often neglected aspect of the use of a discount rate, is directly related to the present value of a plan, viz. the reinvestment possibilities of the net benefits of this plan (see also Rouwendal and Nijkamp, 1984). By introducing this possibility the remaining net benefits for each future generation can be judged by means of so-called net generation benefits. This also places more emphasis on the question as to how the possibilities of a particular future generation have to be weighted against those of other generations (including the present one).

The existence of a discount rate for multi-period equity problems evokes the question whether it would be possible to imagine also a multi-region or multi-group discount rate. In other words: is it possible to introduce the concept of a spatial and social discount rate? This can be illustrated by using a three-dimensional block representing the social, spatial and time distributions of an (environmental) policy measure.

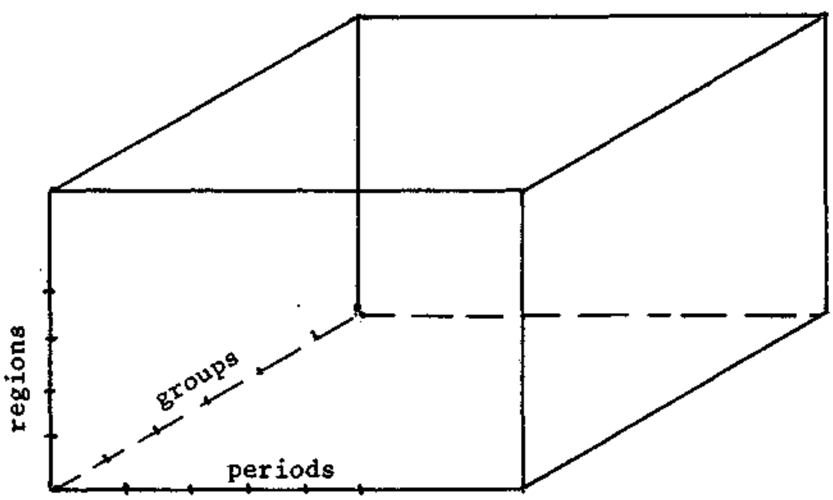

Figure 1. A social-spatial-time distribution block.

Each element from this block reflects the net benefits of a public policy measure. It is clear that the time process is easy to understand: this is an irreversible process and the policy measure generates net benefits in each period. Depending on the marginal efficiency of capital, these benefits can be recalculated into present values by using the time discount rate.

Spatial discount rates have also often been used to represent the decreasing impact of an initial stimulus through space (for instance, in transportation and migration models). This conventional discount rate (for continuous or discrete spatial interaction problems) has however nothing to do with our problem of the judgement of the distribution of net benefits in space and time. It could however be imagined that - in agreement with conventional theory on discount rates - the marginal efficiency of capital investments would be different in each region of the spatial system at hand. Then there is a certain rationale to regard this difference as an indication for the rates of return in successive regions, so that - even within a given time period - the distribution scheme of benefits over different regions could be weighted by means of adjusted discount rates for spatially discriminating effects of environmental policy measures (cf. Nijkamp, 1984).

Social discount rates have never explicitly been used, though in policy practice the existence of different parties and interest groups indicates that implicitly each environmental policy decision is reflecting a social discount rate. The theoretical foundation of such an implicit social discount rate by means of marginal efficiency of capital concept is however an almost impossible task.

In conclusion, the use of a social-spatial-time discount rate is for the moment not a very promising approach for both methodological and practical reasons.

5. Equity Issues in Environmental Economic Models

In the past decades a great many models have been designed to provide mathematical tools for a closer analysis of intriguing linkages between the environment and the economy. Starting off with macro-oriented models, economists have made many efforts to develop complex, multidimensional models for environmental policy analysis. The use of such models has various advantages:

- a concise and systematic representation of impacts of economic behaviour on the environment,
- a consistent definition and treatment of concepts and variables from different disciplines,
- a stylized and surveyable description of complex and intertwined linkages in environmental-economic systems,
- a check on methodological and formal consistency of theories and conclusions in a multidisciplinary research context,
- an empirical validation of real-world patterns and processes in environmental-economic systems,
- a prediction of expected interdependent developments of economic and environmental variables.

Nonetheless, most environmental-economic models have also several limitations such as :

- a strong orientation toward past data neglecting structural changes,
- a neglect of multiple actor situations and of interest conflicts,
- a reflection of the status quo in economic thinking, so that alternative views tend to be disregarded,
- a macroscopic orientation, so that individual and group motives and/or consequences are neglected.

Thus, in general, environmental economic models do not offer many perspectives for dealing with (separable or inseparable) distributional issues. This can also be illustrated by paying attention to various classes of such models (see also Nijkamp, 1984):

- materials balance models (see Ayres and Kneese, 1969).
These models provide a comprehensive picture of physical-ecological flows in an economy, but have never been used to deal with equity issues.
- input-output models (see Leontief and Ford, 1972).
These models have proven to be very operational tools in environmental-economic analysis, but are unable to incorporate distributional aspects (except for the spatial distribution of pollution).
- integrated environmental models (see Arntzen and Braat, 1983).
These more recently developed models aim at providing an integrated picture of all components and interactions in an economic and ecological system. Distributional impacts can in principle be taken into account (land use, mobility, demography, etc.), though only a few attempts have been made thus far.
- dynamic stock-flow models (see Herfindahl and Kneese, 1974).
Such models focus attention on dynamic elements in evolving ecosystems, based on self-organisation and self-regeneration. So far distributional aspects have only received minor attention, apart from the abundance of literature on discount rates.
- spatially-oriented economic-environmental models (see Spofford, 1976).
This class of models includes inter alia urban environmental quality models, local land use and energy models, etc. The majority of these models is capable to take into account equity issues (spatial allocation, pollution impacts, etc.).
- environmental evaluation models (see Nijkamp, 1980).
These models have been designed to take explicitly into account the conflicting nature of environmental-economic issues in a planning context. A wide variety of such evaluation models has been designed in many countries (mainly based on conflict management, multiple criteria decision-making etc.). The latter class of models is also able to encompass equity and efficiency considerations simultaneously (see later).

In conclusion, only a limited number of models has been designed in the past decades that are explicitly able to take simultaneously equity and efficiency aspects into account.

As mentioned before, equity aspects may be related to 3 dimensions, viz. space, time and groups (or individuals). The state of the art in environmental-economic modeling will be examined in greater detail in light of these 3 dimensions, respectively.

Recently, an international study has been published on the results of a cross-national study of multiregional economic models (see Issaev et al., 1982). This survey has explicitly paid attention to the place of environmental aspects in multiregional economic models. The total number of models taken into account in this study amounted to 50. From these 50 models, only 5 models included a mature environmental sector (including energy). A more surveyable picture of these results can be found in the Venn diagram in figure 2.

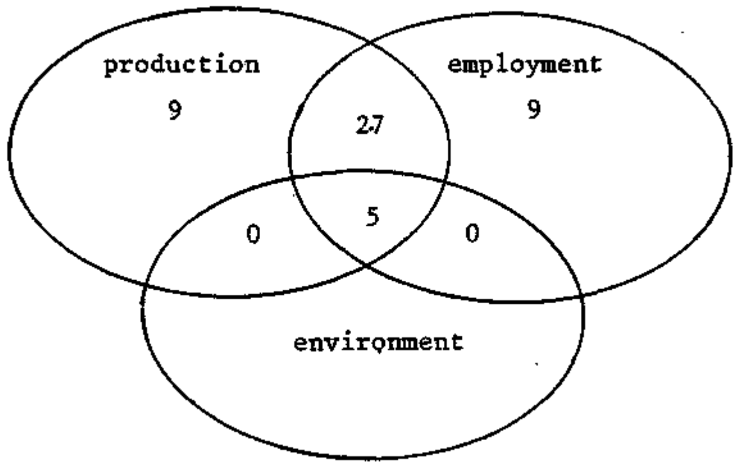

Figure 2. Venn diagram for the number of models with specific components in the international survey.

The 5 models dealing with spatial environmental-economic equity issues originated from West Germany (1), the Netherlands (2), United States (1), and Japan (1).

In conclusion, only in a few countries spatially distributional aspects can be included in the operational framework of multiregional, economic and environmental models.

Next, we will turn to equity aspects in a temporal context. Recently, a new cross-national survey has been held focusing more precisely the attention on a judgement of the state of the art of environmental ecological modeling (see Braat and Van Lierop, 1984).
This study was meant as a critical review of operational models for environmental management in many fields (such as agriculture, fishery, forestry, land use, air and water pollution etc.). The results of this study indicate that equity considerations have never received much attention. Only as far as equity is related to environmental impacts over different time periods, dynamic ecological-economic models may be regarded as tools dealing with distributional aspects. The number of models investigated in the abovementioned survey was 90. The number of models dealing with multiperiod impacts was approx. 50, though only a few of them were explicitly concerned with intergenerational equity.

More or less the same conclusion can be drawn regarding the third dimension, viz. groups. So far, equity aspects for different groups have only received minor attention in ecological-economic modeling: only a few models could be identified that had the explicit aim to deal simultaneously with environmental and (socio)economic impacts for different groups (see for instance Hafkamp, 1984).

For the moment, the conclusion can be drawn that environmental-economic models have not paid satisfactory attention to equity issues in environmental policy analysis. A wide variety of verbal and theoretical reflection has been provided to the international scientific community, but the operational nature of all these attempts has been very moderate.

6. A Property Rights Interpretation of Environmental Equity Problems

Environmental management problems deal with complex judgement problems of impacts of alternative choice possibilities, varying from a binary (zero-one) choice situation to a continuous choice problem (characterized by an infinite number of alternatives). Distributional environmental and socioeconomic impacts are only one specific class of foreseeable consequences of policy actions. The judgement of these impacts on injured individuals, groups or regions is an extremely difficult task, as has already been illustrated in section 3 with respect to compensatory payments. Such compensations aim at making injured individuals, groups or regions as well off as they were before they suffered a loss. Clearly, the identification of a compensation value (either in money terms or in any other meaningful dimension) that will exactly offset the loss they have suffered is fraught with difficulties, while in case of ambiguous property rights this is sometimes even impossible (especially in case of incommensurable effects).

In particular in a situation with a limited public budget - which is the normal situation - a compensation scheme is very hard to use as an instrument for neutralizing incommensurable and non-market impacts of public decisions. Then it is reasonable to incorporate the distribution of the socioeconomic and/or environmental losses as elements in the policy analysis itself.
The social and economic distribution of such losses however are often a result of policy decisions at different policy levels. This also emphasizes the necessity to pay attention to the institutional structure of social evaluation problems in environmental management. It is clear that the kinds of decisions taken depend on the legislative, executive or managerial level of the policy framework. Lack of co-ordination between such different decision levels runs the risk of arriving at suboptimal decisions, especially for complex decision problems which are marked by different responsibilities for various policy levels or in various interest groups.

The institutional structure of environmental policy-making is in most countries extraordinarily complicated, as it is linked to a great many actors in economic, physical, environmental and resource planning. Neo-classical welfare theory has never provided a meaningful methodological framework that is able to explain the results of conditions under which competitive actors or groups on the market for environmental commodities are taking decisions.

In this regard, the so-called property rights theory may provide some refreshing contributions (see also De Alessi, 1983, Alchian and Demsetz, 1973, and Furubotn and Pejovich, 1974). This theory focuses attention on the institutional and jurisdictorial regimes governing the decisions of actors in a socioeconomic process. A central issue is here the way in which actors are able to use their property rights regarding the use, revenue and transaction of commodities. Thus the market value of a commodity is strongly dependent on its related property rights. Economic dynamics and efficiency is thus influenced by the institutional structure of property rights. This theory aims at providing an explanatory paradigm for economic behaviour of actors operating in different market systems, with imperfect information and with different power groups. The theory is in agreement with neo-classical utility and welfare theory however, in so far as individual utility and welfare maximization is presupposed. In general, it is assumed that public intervention is less desirable: in general deregulation will already create the conditions for economic progress and innovation to emerge.

The abovementioned theory on property rights may perhaps also be applied to environmental management, as it may clarify some dilemma's in the efficiency-equity discussion. Let us assume the existence of an environmental commodity sector, governed by either private or public agencies that are held responsible for environmental quality in a nation and are assumed to deal with environmental property rights. These agencies have one major aim (viz. the protection of the quality of life) and are operating in an uncertain environment. They do not know precisely the strategies and decisions of all actors in this field (such as entrepreneurs, private interest groups etc.). In order to pursue its tasks effectively, each agency has to collect information on new developments and technologies, to handle contracts with all parties involved and to check all agreements. All such transaction costs are necessary to survive as an environmental protection institution.

In addition, however, each agency will sooner or later develop its own goals: continuity, respect, influence etc. This is the result of the aggregate utility maximization of individuals operating in this agency. As a consequence of risk behaviour, the original property rights behaviour regarding environmental protection are evolving into a much broader complex of goals of this agency (cf. the notion of X-efficiency introduced by Leibenstein, 1976). Though formally the objectives of the agency have remained the same (viz. management of environmental property rights), the informal objectives (related to institutional property rights) determining the driving forces of the agency are completely different. In this respect, it is much more plausible for the agency to establish formal contracts or agreements with other parties involved (entrepreneurs, interest groups, consumers etc.), in order to reinforce its position (or to survive) on the environmental commodity market. Thus, property rights within and between environmental agencies are essential for the outcome of environmental management strategies, including the distribution of costs and benefits of such policies. Instead of a system of standards, charges or subsidies, the use of property rights is thus determining the efficiency and effectiveness of environmental policy.

The property rights theory acknowledges the existence of external effects as a basis for public intervention, but claims also that external effects are often a result of a less effective use of property rights. In case of environmental property rights, it may then be more efficient to organize an appropriate market for such rights, so that rights linked to each commodity may be bought or sold on a market.

In case of such property rights attached to environmental commodities (or even environmental pollution), one might assume a market for pollution rights organized by an environmental agency. The current use of the so-called 'bubble'-concept in environmental management is a good reflection of this approach, as it is based on the assumption that entrepreneurs are able to minimize abatement costs in achieving a certain prespecified level of air quality by buying and selling pollution rights on a market within an industrial 'bubble' (see also Bijman and Nijkamp, 1983, and Lakhani, 1982).

In conclusion, rational micro-economic behaviour and complex meso-institutional structures may be linked together by means of the property rights approach. Yet this theory has also some limitations in case of environmental management:

- in case of multiple actors affected by environmental deteriorations the transaction costs may become so high that a Pareto optimal exchange will not be reached, especially if there are also multiple environmental agencies;
- if transaction costs in a property rights context are leading to compensatory payments, the amount of compensatory payments is very much dependent on the relative power of parties (including the environmental agencies);
- the externalities in a property rights context are usually dealt with in a fairly superficial way, as no solution is provided for 'prisonners's dilemma' problems.

Despite these limitations, the property rights theory has also some strong elements. In particular, it offers an explanation for conflict behaviour within and between environmental institutions. In the framework of a property rights approach, equity aspects can be taken into account in two ways:

- by means of the assumption of property rights attached to environmental commodities for which a compensation (via market transactions) may take place;
- by means of the assumption of diverging interests between individuals (and/or groups) in various environmental policy agencies, or between agencies (and/or actors) mutually.

In this regard, separability and inseparability issues in the efficiency-equity dilemma can be dealt with simultaneously in the framework of conflicts regarding property rights. In the next section, some elements of conflict theory will be further discussed.

7. Elements of Conflict Theory

In this section, some aspects of conflict analysis will be illustrated by means of the abovementioned property rights approach. Assume a heavily polluted industrial area, which has an environmental quality below the national average, but a per capita income above the national average. The inhabitants of this area will try to organize themselves in an environmental agency having the task to improve environmental quality, by introducing new technologies and so forth (see McCain, 1978). This implies that the intensity of abatement measures has to increase (by means of charges, standards, 'polluter pays' principles based on property rights, etc.), despite resistance of entrepreneurial agencies. Clearly, the payment of abatement costs means that the area at hand is improving its environmental quality, but is reducing its economic efficiency, so that income and employment will show a declining trend. In the meantime, the environmental agency has reinforced its position, as it is also striving for survival, continuity etc. After some time, a reasonable air quality standard has been attained, so that there is no need for an increase in intensity of abatement measures.

In addition, the inhabitants of the area at hand tend to place now more emphasis on employment and income goals as they choose the national average as their reference pattern;hence,the environmental agency tends to loose power beyond a certain limit of declining economic activities. Then the environmental quality may drastically go down, until a critical lower limit of environmental quality has been reached. Then the whole process may start again as a wave-like phenomenon (see Figure 3). In this figure, q_r stands for the environmental quality in region r, and $\bar{q}$ for the national average. In essence this process reflects an environmental 'keeping up with the Joneses' effect.

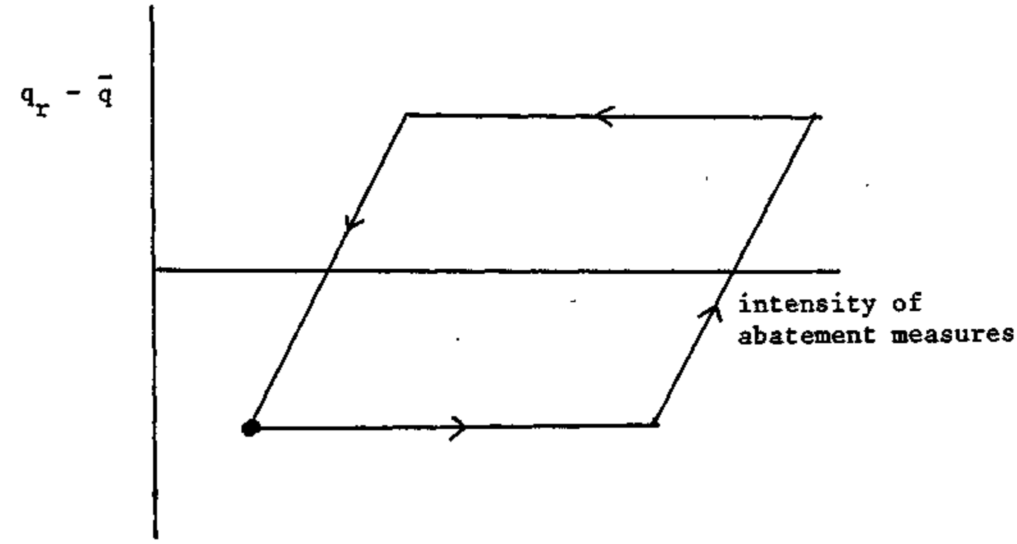

Figure 3. Relationship between pollution abatement and environmental quality difference.

The outcome of the abovementioned process very much depends on the way environmental property rights are organized and institutionalized, and on the way individual and collective preferences regarding socio-economic and environmental objectives are digested in the environmental management system at hand.

Thus altogether the outcome of the environmental-economic system concerned is dependent on conflicting options of individuals (or groups) and agencies in the area at hand. Such problems have in the recent past especially been studied in conflict analysis (see among others Chankong and Haimes, 1983, and Isard and Smith, 1983). Conflict analysis aims at providing an integrated judgement framework for private and public policy choices with different groups and/or interests by considering simultaneously private economic, socio-economic, environmental, energy and equity criteria. The basic assumption of conflict theory is that relevant welfare components governing a choice situation cannot be transformed into a common denominator. Consequently, a multidimensional evaluation framework is necessary. This multidimensional approach is based on the following features (see also Despontin et al., 1984, and Nijkamp, 1979):

- There is no unambiguous decision-maker who maximizes his welfare (utility, profits, etc.); on the contrary, many decision problems are rather vague due to the great number of decision groups or action groups and due to the existence of conflictual options.
- Almost all decisions have so many external effects falling outside the realm of the traditional market system, that a pure single-dimensional account of costs and revenues would certainly lead to biased decisions.
- The specification of a generally accepted and representative social welfare function is normally an impossible task due to the heterogeneity of goals, the conflicts among policy objectives, diverging political preferences among decision committees or interest groups, the learning character of political choice processes, the multilevel structure of many decision processes, and spillover effects from decisions taken elsewhere.

Many applications of conflict analyses can be found in the field of modern multi-objective programming and multicriteria analysis. An interesting application to efficiency-equity problems in an environmental context can be found in Hafkamp (1984), who has designed a model for environmental conflict analysis. This model is based on a so-called multilayer projection which indicates that each module of an environmental-economic model may be regarded as a formal homomorphic projection of a complex real-world system on a particular field of scientific or policy interest (see Figure 4). The distributional aspects of policy decisions can then be analysed through the impacts on the successive interest groups $V_1,\ldots,V_6$ (socioeconomic classes, residents of specific cities etc.) (see also Nijkamp and Rietveld, 1984). As indicated already in Figure 1 , the distributional aspects can be dealt with in greater detail by using a matrix (or block) structure for all impacts.

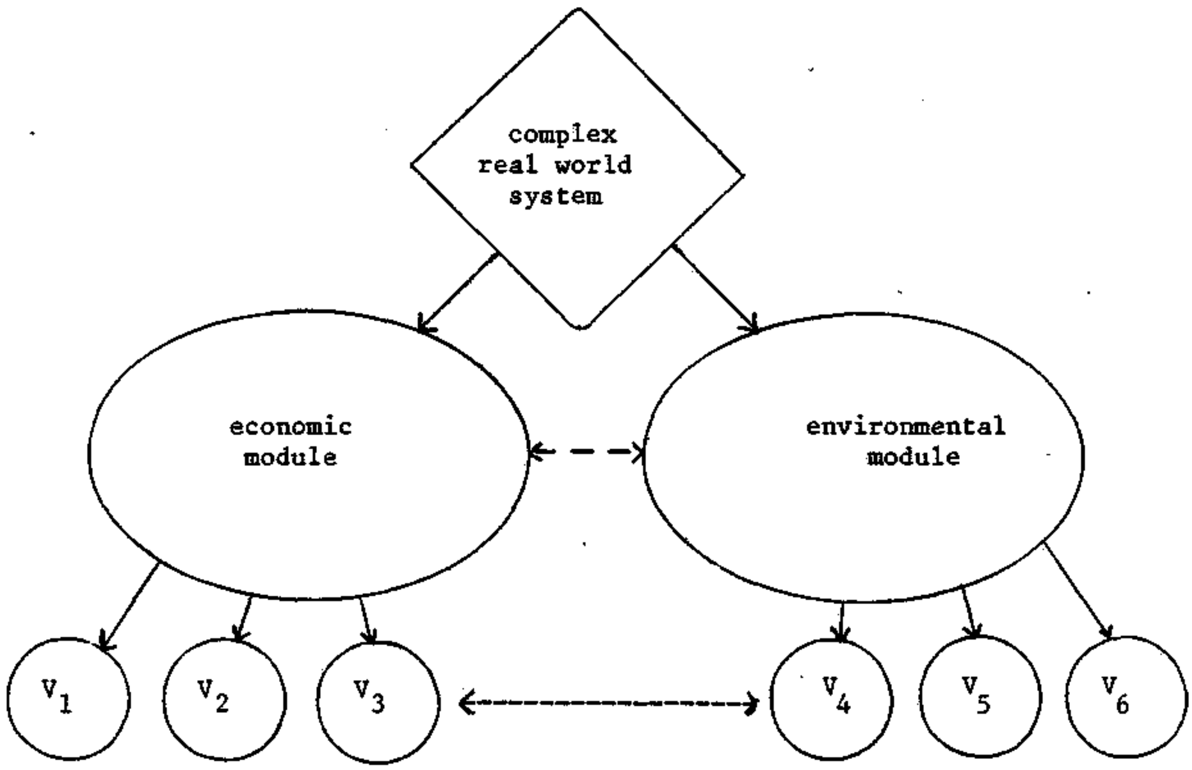

Figure 4. A multilayer projection of a complex system on relevant modules.

Such a multilayer model is based on a comprehensive multiple-module model describing all relevant interactions between the economic sector (production, consumption, investments, income formation and distribution, productivity etc.) and the environmental sector (pollution, energy supply and demand, density etc.), while also the spatial dimensions have to be taken into account.

Conflicting interests may be taken into account by specifying objectives for specific groups in either module, viz. income maximizers (I), employment creators (L) and environmentalists (E). Each of these three objectives may be present in both the economic (Y) and the environmental (N) sector (albeit with different policy weights), so that the following typology of objectives may be assumed (see Figure 5):

	I	L	E
Y			
N			

Figure 5. Typology of various conflicting objectives.

Each element of figure 5 reflects a specific objective function (I, L, or E) in a particular sector (Y, N). In addition, a spatial dimension may be added (for instance, a subdivision into areas), so that a block structure may emerge.

In a formal sense, a model of this type can be operationalized by introducing alternative environmental policy scenarios, while all aspects (efficiency and equity at a spatially detailed level) can be taken into consideration by means of interactive programming (based on the 'displaced ideals' theory, e.g.) (see for further details, Hafkamp, 1984, and Nijkamp, 1980).

In a more illustrative and less formal way, the abovementioned conflict analysis may be represented by means of a physical 'flask model', in which the two conflicting criteria of efficiency and equity are measured on the two necks of the flasks. The multiple layer structure is reflected in the hierarchical structure of this flask model, viz. the <u>areal</u> subsivision (into areas R_1 , R_2 , ...) and <u>objectives</u> subdivision (into I, L, and E). The water level in the necks of this flask model may vary according the relative importance attached to the successive objectives. Distributional aspects at each spatial level and for each objective function can be analysed simultaneously. Differences in pressure (i.e., differences in policy priorities) on the water in any neck will have efficiency and equity implications for each other subsystem, based on a 'tatonnement' process. Interactive policy strategies based on various policy scenarios can then be used to arrive at a compromise solution among conflicting objectives. In a formal sense,

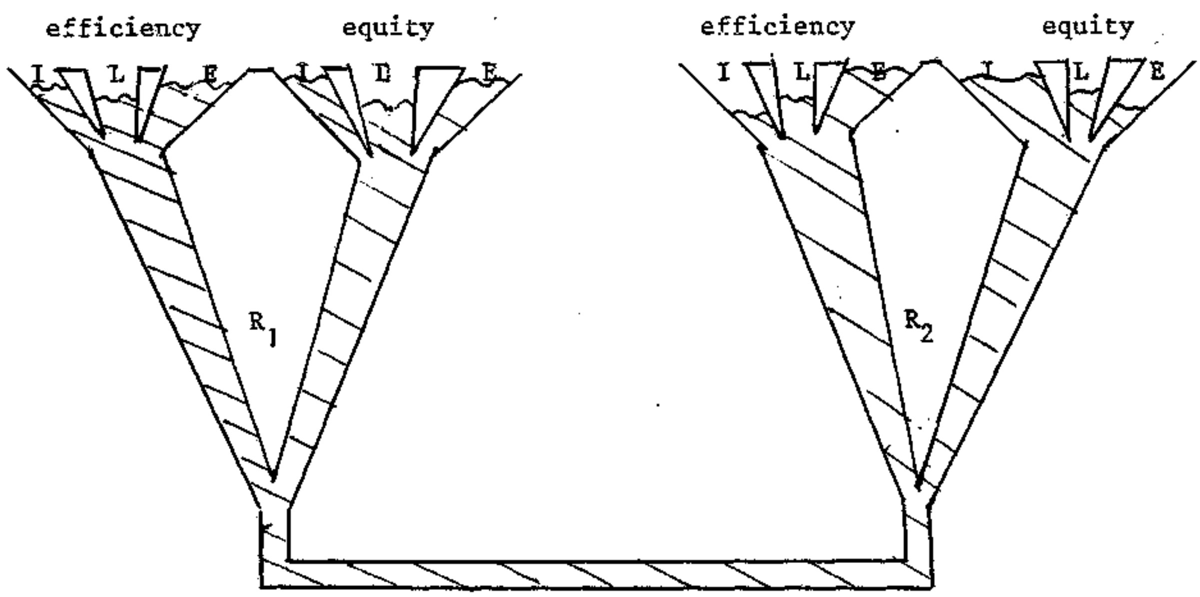

Figure 6. A 'flask model' for conflict analysis.

this compromise solution is then essentially the result of a 'satisficer' paradigm for environmental-economic behaviour.

Adaptive behaviour (cf. Day and Cigno, 1978) based on evolution or structural changes in the system concerned (formally represented by changes in the systems parameters) can also be described by means of the flask model by assuming that the width of the neck or the water level therein may vary. This implies of course a change in the efficiency frontier of the whole system, but the equity and efficiency effects can be analysed in a similar manner.

In conclusion, interactive learning strategies in conflict analysis may be able to treat efficiency and equity considerations simultaneously in environmental-economic planning models.

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