Chapter 1

VALUATION METHODS AND POLICY MAKING IN ENVIRONMENTAL ECONOMICS: RELEVANCE AND SCOPE

HENK FOLMER AND EKKO VAN IERLAND
Department of General Economics, Wageningen Agricultural University,
P.O. Box 8130, 6700 EW Wageningen (The Netherlands)

1 INTRODUCTION

The history of economic thought shows an increasing interest in environmental issues[1]. First, classical and neoclassical theory did not pay attention to environmental problems except to the availability and quality of land for agriculture and for the location of various economic activities in space, as well as to the exploitation of natural resources. The interaction between the environment and the economic process in general, in particular environmental degradation, were not fully recognized. Hence, the environment was mainly viewed as a common property resource i.e. a free good with no price attached to it. Moreover, in as far as the exhaustibility of the natural resources was recognized, it was believed that technical progress and market forces would solve the problem. Governmental intervention was considered to be superfluous or even detrimental.

At the second stage, the exhaustibility of natural resources as well as the existence of external costs resulting from pollution associated with private production and consumption was recognized. Population and per capita income growth as well as the introduction of new polluting techniques were causing substantial environmental damage and a rapid depletion of natural resources. These historical events led to new developments in economic theory. The theoretical foundation for externalities was laid by Pigou (1920), Kapp (1950) and Baumol (1952). Hotelling (1931) paid attention to the optimal rate of exploitation of natural resources. In the realm of economic policy the recognition of externalities led to the imposition of various regulations with regard to production and consumption activities.

---

[1] In the present paper the notion of environment includes natural resource endowments.

The third stage is characterised by the recognition of the need for sustainable economic development and environmental protection as a separate target for economic policy.[2] Moreover, the functions the environment fulfils for other economic activities (i.e. public consumption good[3], production factor and receptacle of wastes) are being more thoroughly understood. In particular, the competition between these functions has become apparent. Finally, the (literally) perilous consequences of the neglect of the role of the environment and the enormous offers to restore environmental degradation have become clear.[4] The irreversibility of ecological damage is recognised as well as the danger that harmful effects, for example climatic change, will only become evident after long time lags. Also the need to preserve the natural environment for future generations is generally accepted.

The recognition of environmental degradation and the incorporation of environmental preservation in the set of goals of economic policy has created an important problem to economic sciences viz. to develop methods to integrate the environment in the decision-making process on the allocation of factors of production and distribution of goods and services among individuals. In this respect the valuation of the environment will play an important role. The fact that the environment was viewed as a common-property resource

---

[2] The difference between the second and third stages can be illustrated as follows. At the second stage, impacts of economic activities on the environment were viewed as externalities and side-effects. This resulted in subordination of environmental preservation to the economic goals of full employment, stable price level, stable exchange rate, etc. This subordination found expression, *inter alia*, in the economic policy of the late 1970s and 1980s which gave priority to employment growth above environmental policy. In fact, pollution control was believed to have a severe impact on the economy, making the production of goods and services more costly and slowing down economic growth, especially because of excessive costs of regulations and regulatory delays. Moreover, the positive effects of environmental policy were viewed primarily in non-environmental terms. For instance, Peskin et al (1981) argues that pollution control improves economic growth because it increases the health and productivity of the population and provides jobs in the pollution control industry that partially or fully offset losses in production. At the third stage environmental preservation is considered as a goal equal to the other goals of economic policy.

[3] It has become quite apparent that the environment satisfies basic human needs (e.g. health) and therefore is of the same order as food and shelter.

[4] Since the late 1960s and the early 1970s it is generally recognized that the environment has become a scarce commodity which corresponds with the visions of the second and third stages distinguished above. It should be observed, however, that elements of neo-classical theory fit quite well into the environmental policies advocated at these stages. As an example we refer to the fact that incentives are viewed as more efficient instruments of environmental policy than regulations in many circumstances.

implied a zero price for the environment. This zero price produced a discrepancy between private costs, consisting of the costs of factor inputs of the individual firm, and social costs comprising all costs (i.e. private costs and negative externalities in other sectors of the economy than the individual firm). The zero price of the environment implies that the prices of goods which are produced with a high pollution intensity do not reflect their environmental nuisance. Consequently, the prices of these goods are too low, which implies that the demand and production of the pollution-intensive goods are too high. This has three different allocation effects:

(i) The distortion of the actual relative prices leads to overproduction of pollution-intensive products.

(ii) Environmental degradation because of the overuse of the common property resource.

(iii) Incorrect trade-off between the goals of economic policy.

Summarizing, with a zero price for environmental use, the economic system does not include control mechanisms to check an overuse of the environment and a distortion of the sectoral structure. Hence, an important contribution of economics to a solution to the environmental problem would be the transformation of environmental scarcity to signals which would start off this control mechanism. As the environment is a public good, the market cannot provide these signals in the form of prices. Therefore, one has to rely upon alternative methods such as the specification of a shadow price for pollutants and the public goods and property rights approaches.[5]

In the present volume *some* aspects of the transformation of environmental scarcity into signals for the control mechanism viz. the determination of appropriate monetary values for environmental goods and services will be dealt with. Moreover, some related aspects, viz. macroeconomic cost benefit analysis and disequilibrium social cost benefit analysis, will be paid attention to. Finally, multi-component policy making and the international contestation of transfrontier air pollution will be discussed. In the next section the various chapters of this volume will be introduced. In the last section some conclusions will be drawn and some issues for further research will be presented.

---

[5] For an excellent comprehensive treatment of the reduction of the divergence of private and social costs and the introduction of an institutional framework for market economies to attribute all costs of economic activities to the individual unit see Siebert (1987).

2 OUTLINE OF THE VOLUME

This volume is made up of four parts. The first two parts (Part I and II) deal with the problem of valuation of environmental goods and services. It is well-known that social welfare change may be assumed to be expressed through the willingness to pay as revealed through market prices, provided that a market exists. In the case of environmental goods and services, however, there is no market. Therefore, alternative methods to assess the willingness to pay have been developed. The following categories can be distinguished (see also Mäler (1985) and Freeman (1985)):

- Direct market values methods which derive the damages caused by environmental degradation from e.g. relocation cost, changes in productivity, loss of earnings, etc.
- Contingent valuation methods which are based on individual's responses (via questionnaires or experiments) to hypothetical exposure to environmentel changes.
- Hedonic pricing methods which analyze surrogate markets in which environmental quality is indirectly reflected.
- Methods based on observable changes in the non-market behaviour of individuals as a consequence of environmental changes.

In part I attention is paid to the valuation of public goods whereas in Part II the valuation of health and life is dealt with. Moreover, various propositions derived from economic theory which form the underpinning of the contingent valuation and hedonic pricing methods are tested.[6]

In chapter 2 Ralph d'Arge and Jason Shogren compare three different valuation techniques by examining an active and well defined market for water quality in the lakes region of Iowa. Differences in assessed valuations of residences at two glacial lakes are analyzed. The lakes are very similar from a visual and locational perspective, but differ markedly with regard to recreation based water quality. The three valuation techniques are:

- A site valuation based on comparing property values between the two lakes.
- A market valuation by asking a sample of realtors and real estate agents in the area to identify causes for the observed price differential between the lakes.
- A contingent valuation approach using a limited sample of site dwellers to estimate their

---

[6] The first and fourth category of methods are not dealt with in this volume.

willingness to pay for improved water quality and their willingness to accept compensation for a decrease in water quality.

Five measures of water quality are developed and tested. The measures are

(i) realtor's best estimate.

(ii) Imputed value from regression on lake frontage for each lake separately.

(iii) Imputed value from pooled regression.[7]

(iv) Willingness to pay.

(v) Willingness to accept.

On the basis of economic theory five propositions concerning the measures of water quality are derived. In most cases the propositions were confirmed, with substantial qualifications. In particular, the first three estimated measures were found to be rather close, and, as predicted by theory, to exceed the estimated willingness to pay. The willingness to accept compensation was found to be the smallest measure, contrary to expectation.[8]

In chapter 3 by Per-Olov Johansson two basic issues are addressed:

- The willingness to pay for more than a single change in the preservation of endangered species.
- The examination of the possibilities and limitations of questionnaire techniques in determining the willingness to pay for public goods in a risky world.

Five different money measures of the value of preserving endangered species are derived from economic theory. Most of the results are consistent with the theoretical predictions. In particular, the willingness to pay is increasing in the number of saved species. Moreover, an interesting difference in risk attitudes between male and female respondents turns out. For female respondents the data set suggests risk aversion with respect to the considered public good. Male respondents, on the other hand, seem to express risk aversion only if many species become extinct while they are more inclined to accept risky outcomes if just a few species are threatened. The author argues that there is also a possibility that respondents are unable to calculate ex ante compensating variation

---

[7] Assessed valuation by realtors was the dependent variable.

[8] Because of resistance by residents at both lakes to accept compensation, it cannot be concluded that any adequate test was indeed accomplished. For an explication of the substantial discrepancy usually found in empirical studies between willingness to pay and willingness to accept we refer to, among others, Knetsch (1984).

measures and therefore report some other money measure when the situation involves uncertain outcomes.

When the previous two chapters consider valuation aspects as measured by the contingent valuation method, Per-Olov Johansson, Karl-Gustav Löfgren and Karl-Göran Mäler in chapter 4 analyze the problem of the multiple use management of public (and private) forest land i.e. recreation and commercial exploitation by harvesting the trees. Under the assumption that the environmental services can be treated as a public good and that the general equilibrium prices for public goods are known, it is shown that the social optimization problem can be decentralized by adding an environmental component to the ordinary present value problem. Next it is shown how the augmented present value maximizing problem, containing the demand determined shadow prices of forest land in different age classes, can be solved. The properties of the present value function are derived and it is shown when and why an efficiency criterion on the intertemporal supply of timber may be violated. Finally, attention is paid to the problem how to find the shadow or pseudo-equilibrium prices.

The last chapter of Part I is a case study. Ståle Navrud presents a contingent valuation study of the expected marginal increase in the freshwater fish populations in Norway due to reduced acid depositions and a detailed description of the organization of the survey and the questionnaire that was used.

The annual social economic value of marginal increments in the freshwater fish populations in Southern Norway, due to a reduction of 30-70 per cent in the European sulphur emissions, was estimated to be 450 million 1986-NOK. This result was elicited from a national contingent valuation survey of a representative sample of more than 2,000 Norwegian households. Non-use values constituted the major part of this amount, and only 12 per cent was motivated by recreational value of fishing.

The estimate of 450 million 1986-NOK is considered to be conservative, and must be interpreted as nothing else than an approximate size of the values involved. This is due to uncertainties in the valuation method and the dose-response function used to calculate the reduced damage to the fish populations. However, the study provides evidence for the large social economic values of environmental improvements that can be achieved by reductions in long range transported air pollutants.

Part II deals with the evaluation of health and life. Although it is a rather new field in environmental economics, this issue has increasingly been gaining interest since the physical impacts of pollution on health and life have become more evident.

In chapter 6 Mark Dickie and Shelby Gerking present a survey of methods to analyze benefits of reduced morbidity from air pollution control. Three methods are discussed in detail:

- The costs of illness method.
- The contingent valuation method.
- The averting behaviour method.

The essence and the advantages and disadvantages of each method are described. Moreover, some important case studies are discussed.

The valuation of morbidity reduction due to pollution abatement is studied by means of a contingent valuation method and via a hedonic pricing method by Mordechai Shechter, Moshe Kim and Lorette Golan. In the latter case measures of welfare change are derived through an expenditure function (and the associated indirect utility function, presumed to represent preferences for the various market and non-market goods), which underlie the estimated demand system. The empirical application of both approaches is based on individual household data, obtained through a large-scale household survey conducted in Israel during 1986-1987. The results indicate that both approaches yield reasonably close estimates of welfare changes, and thus may provide additional justification and support for the use of contingent valuation methods in dealing with non-market goods, such as air quality.

Valuation of risk in the workplace is studied by Henry Herzog and Alan Schlottmann within the context of compensating wage differentials. The theory of compensating wages suggests that jobs with disagreeable characteristics will command higher wages, ceteris paribus. Empirical tests of this theory have found such compensation to indeed exist. Studies of compensating wage differentials attributable to risk in the workplace usually assume that workers' willingness to pay for risk reduction is equal to the market price of providing this reduction. Hence, workers and their employers are assumed to possess perfect information regarding work hazards, the cost of providing additional safetey, etc. Thus evaluations of the wage-risk trade-off will vary to the extent that the market price diverges from workers' willingness to pay. Via the analysis of inter-industry mobility in the U.S. the willingness to pay is shown to exceed the market price for incremental safety substantially.

Part III deals with cost-benefit analysis. The two papers which make up this part are surprisingly complementary. Per-Olov Johansson and Karl-Gustav Löfgren derive disequilli-brium social cost-benefit rules for two typical disequilibrium situations: classical and

Keynesianen unemployment. To derive the social cost-benefit rules, an intertemporal multi-sector model with endogenous private invertment is developed. Attention is also paid (probably for the first time in literature) to disequilibrium cost-benefit rules for natural resource projects. Finally, the issue of income distribution is discussed. The commonly employed assumption of a single household is abandoned.

In chapter 10 Andries Nentjes presents a unified approach which combines social cost benefit analysis and macroeconomic evaluation. The strengths and weaknesses of both approaches are described. Extensive attention is paid to the definition of costs and benefits in the context of a macro economic model, to modelling the finance decision and environmental expenditure and the economic regime and opportunity costs. Finally, the potential contributions of macroeconomic cost-benefit analysis to the existing methodology for evaluating the environmenl is discussed.

Part IV deals with two important aspects of policy making. In chapter 11 Alan Randall and John Hoehn analyze benefit estimation for complex policies. Where policy has several components, the benefits of the complex policy are in general not equal to the sum of the independently-estimated benefits of its components: complementary and competitive relationships among components are ignored in independent benefit estimation. As the number of policy components grows large, the error from independent evaluation becomes systematic and benefits of the complex policy are overstated. In a general equilibrium context, it is shown that independent estimation of benefits and costs of the components leads to a systematic break-down of the benefit cost filter: some non-net-beneficial complex policies and some non-net-beneficial policy components pass the filter. Given the invalidity of benefit cost analysis of complex policies by summing independently-estimated component benefits and costs, it is important to define and operationalize valid procedures for benefit cost analysis in a complex policy environment.

Two approaches have been developed in the paper. First, a holistic *ex ante* evaluation of the complex policy is valid and may be implemented via contingent valuation. Second, econometric structures have been developed that permit approximately-valid benefit cost analysis of complex policies using independent estimates of component benefits and costs as the starting point. These approximation procedures facilitate the use of estimation methods based on, for example, weak complementarity and hedonic price theory for evaluating complex policies.

The last chapter by Karl-Göran Mäler deals with policy-making in an international

incomplete information and with many players (nations) with no agreed rules of the game. Some basic concepts of game theory are described and applied in the European context. The simulations refer to the net benefits from the full cooperative solution, the Pareto dominant outcome and coalition formation.

3 CONCLUSIONS AND TOPICS FOR FURTHER RESEARCH

On the basis of the various chapters in this book some important conclusions and recommendations for further research could be formulated.

(i) In the absence of prices, the valuation of environmental goods and services is of crucial importance in the context of environmental policy making. The optimal allocation of the production factors labour, capital and environment depends on the correct valuation of the environment, given correct prices for labour and capital.

(ii) A multitude of valuation techniques has been developed and is presently available. They can be divided into four categories: direct and surrogate market methods, contingent valuation techniques and methods based on observable changes in the non-market behaviour. In terms of reliability, completeness and data requirements no unambiguous ordering of these four categories is possible.

In this volume special attention has been paid to contingent valuation methods. The degree of completeness achievable by this method (e.g. user and non-user values, dimensions of the value involved) is at the disposal of the researcher and is not limited by the (given) structure of the direct or surrogate markets. However, it requires primary data collection and therefore may be costly and time consuming.

It is shown in this volume that the contingent valuation method may contribute to environmental valuation. Various sources of bias, however, need to be taken into account (see chapter 5, section 2). Moreover, results may be obtained which are not consistent with economic theory. The following ways to improve the performance of the contingent valuation method suggest themselves. First, some of the sources of bias might be handled by improving the experimental setting or the design of the questionnaire. In this respect advantage should be taken of recent results obtained in psychology and sociology. Secondly, inconsistencies may not only result from inadequacies of the research methods applied but also from theoretical inadequacy. As suggested by chapter 3, where the empirical results were found to contradict standard utility theory and to be consistent

with the Friedman-Savage theory, inconsistencies could be removed by searching for more adequate theoretical foundations. Finally, if there is the possibility of a choice between direct or surrogate market methods on the one hand and contingent valuation on the other the former should be preferred because they suffer less from methodological weaknesses. Moreover, applying different techniques may provide insight into the robustness of the results.

(iii) In the context of cost benefit analysis the introduction of disequilibrium notions and of frameworks to handle complex policies and multiple and conflicting uses of environmental goods and services proved to be a major improvement of this technique which plays such an important role in environmental policy making. From the chapters 4, 9-10 it follows that a self-evident topic for further research is the integration of disequilibrium, multiple use and complex policies within a comprehensive theoretical framework. Moreover, empirical studies are needed in which the various theoretical issues have been operationalized.

(iv) It has become generally recognized that emissions usually have an international dimension and that efficient and effective pollution abatement requires international cooperation. Various principles of international environmental policy have been developed. In spite of that, international pollution abatement is still in its infancy, partly because of insufficient insight into the international dimensions of emissions and pollution. Therefore, an important issue for further research is the analysis of the relationships between economic activities, emissions and damages in an international perspective.

As shown in chapter 12 game theory may provide substantial insight into the process of environmental policy making. Moreover, the outcomes of simulations on the basis of game theoretical notions may provide valuable information for international negations.

As game theory itself is a field in rapid development an important topic for further research will be the application of new game theoretical results in international environmental policy making. Other important research issues are made up by the specific problems of environmental policy making which are not at the core of mainstream game theory.

The conclusions formulated above refer particularly to the economic valuation of the environment. We are aware of the fact that many environmental problems cannot be dealt with by mere valuation of non-market assets. For example, environmental preservation for future generations and the avoidance of dramatic climatic changes due to human action

require other and in particular additional methods than those discussed in this volume. For example, scenario studies and economic ecological models may contribute to a better understanding of the interactions between the economic process and the natural environment. However, we are convinced that the political process of revealing collective preferences will - and should - play an important role in environmental policy-making. For this purpose we believe the valuation methods discussed in this volume to be useful tools to provide information about the environmental preferences of the public. The obtained information should be taken into account in political decision-making, together with all other suitable information.

REFERENCES

Baumol, W.J., 1952. Welfare Economics and the Theory of the State. London.

Freeman, A.M., 1985. Methods for Assessing the Benefits of Environmental Programs. In: Kneese, A.V. and J.L. Sweeney (Eds) Handbook of Natural Resource and Energy Economics. North Holland, Amsterdam.

Hotelling, H., 1931. The Economics of Exhaustible Resources. Journal of Political Economy, 39.

Kapp, K.W., 1950. The Social Costs of Private Enterprise. Spokesman, Nottingham.

Knetsch, J.L., 1984. Legal Rules and the Basis for Evaluating Economic Losses. International Review of Law and Economics 4, 5-13.

Mäler, K.G., 1985. Welfare Economics and the Environment. In: Kneese, A.V. and J.L. Sweeney (Eds), Handbook of Natural Resource and Energy Economics. North Holland, Amsterdam.

Pigou, A.C., 1920. The Economics of Welfare. London.

Peskin, H.M., Portney, P.R. and Kneese A.V. (Eds), 1981. Symposium on "Environmental Regulation and the U.S. Economy. Natural Resource Journal 21, 441-587.

Siebert, H., 1987. Economics of the Environment. Springer, Berlin.