## ENVIRONMENTAL ECONOMICS

This intermediate-level undergraduate textbook in environmental economics builds on the microeconomics courses students take in their first year. It intentionally does not survey the whole field or present every possible topic. Instead, there is a clear focus on the theory of environmental policy and its practical applications. Most of the applied parts of the book deal with the economics of environmental policy in the European Union (EU) and in the United States. The book combines basic environmental economic analysis, such as the internalization of externalities, with recent developments in the field, including induced technical change and coalition theory. Moreover, topics from daily policy debates such as global warming are put into economic perspective. This is done in an intelligible form for advanced undergraduate students of economics, business administration, and related fields. Each part of the book contains a set of exercises and suggested solutions.

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# Environmental Economics

## Theory and Policy

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# Contents

# Preface

*Die Wissenschaft, sie ist und bleibt,*
*Was einer ab vom andern schreibt.*
*Doch trotzdem ist, ganz unbestritten,*
*Sie immer weiter fortgeschritten . . .*

*Our scholarship still is, and always will be,*
*rewriting what someone's already written;*
*yet all the same, it's progress that we do see,*
*whenever someone puts another bit in.*

– Eugen Roth's Tierleben
[*Eugen Roths Animal Life*]
Munich, 1948–1949; tr. ILF, 2008

There is no doubt that environmental economics has greatly progressed since the appearance of the second edition of this book in 2000. In fact, it is these advances that persuaded me to thoroughly revise the text and extend it considerably. However, it is not necessary to establish whether environmental economics progressed in the manner cited previously or quite differently, nor do we need to go into the variances between the previous edition and this one in detail. For most readers of this book, the developments that led to the present state are not terribly important. (This is particularly so because the second edition is written in German.) Let us instead take this book as it is.

I investigate environmental pollution and environmental policy using the methods of microeconomics. The aim is to work out the economic structure that underlies the manifold practical problems and the attempts at solving them. Special attention goes to the incentive structure to which those making decisions of relevance to the environment are exposed because of market mechanisms, state regulation, and international institutions. A detailed discussion of the national or global environmental situation, individual environmental laws, or international environmental agreements is not the central concern of this book. So as not to let the fundamental

discussion become detached from reality, however, connections with practical problems and approaches to solutions are continually made.

This book endeavors to go into the latest developments in the scientific and political debate. All the same, it is intended to be accessible to readers knowing "only" the very basics of economic theory – as conveyed in the first three semesters of a university economics program. I make no claim to have achieved this difficult combination of objectives, but keeping them in mind was always helpful while doing the work. Even "noneconomists" with the courage to skim confidently over the passages they cannot comprehend ought to, on the whole, be able to profit from the text. (I hope those passages are not too numerous or lengthy.) If so, the book may contribute to bridging the language barriers between "hard-core economists" and the "rest of the world." Particularly in the environmental sphere, where communication among different disciplines is indispensable, a "translation aid" would be extremely important.

Because environmental economics is firmly rooted in traditional microeconomics, the foundations of economic theory are dealt with in some detail in Part One. In my years of participation in the academic and political environmental debate, I have formed the impression that many communication difficulties are attributable to the failure to convey the basis of environmental economics in economic theory. The center of the first part is accordingly a presentation of the nature and optimality of market equilibria, fitted to the needs of the subsequent environmental economics analysis. The externalities that from the economic viewpoint are characteristic of environmental problems appear here as disruptions of the capacity of the market mechanism to bring about "socially optimal" results. The central environmental policy theme of "internalization of externalities" constitutes the attempt to restore the lost social optimality of the market system. In this presentation, particular weight is attached to developing the optimality concept as used in economics and, along with it, the value judgments underlying the concept of internalizing externalities. This part of the book is aimed particularly at the "noneconomists" among the readers. However, it may also be useful to "hard-core economists" because in their constant preoccupation with technical details of models, they may have lost sight of the fact that economics is not a natural or engineering science. In particular, it turns out that the optimality concept used in economics is not at all suited to formulating environmental policy objectives "objectively" over and above the jungle of divergent interests in a society. The locus of economically optimal environmental states instead depends *inter alia* on the preferences and incomes of those who are affected (in the broadest sense) by the state of the environment. It is also influenced by the state of technology. It, too, is shaped in a host of ways by social processes. Optimality is a social science concept.

Following clarification of the basic theoretical economic principles, Part Two presents and discusses the main strategies for internalizing externalities. It starts (in Chapter A) by discussing the model proposed by Ronald Coase (1960) of *negotiations* among the parties involved in an externality. Coase's ideas are fundamental

to an understanding of the theory of externalities. They fit seamlessly into the economic theory of markets. Externalities appear as gaps in the market system, which can be closed by appropriately extending the scope of the market. In Coase's world, it is conceivable for someone causing an externality to compensate the damaged party and for the latter to allow the damaging activity. In contrast, though, an arrangement is also conceivable whereby the injured party pays the responsible party to reduce the externality. With this symmetrical treatment, Coase breaks the traditional role allocation in which the responsible party is *a priori* an offender and the injured party a victim. In that sense, this provocative approach by Coase has enlivened the welfare economics debate enormously. Related to Coase's thinking is the internalization of externalities through *liability law*, dealt with in Chapter B of Part Two. If the responsible party can be held liable for the damage caused to third parties, then it will take that into account correspondingly in decisions on the size and nature of its activities. The conditions on which the responsible party is liable to pay compensation for damages are laid down in detail in the "liability rule" in force. In this book, because of its high environmental policy relevance, the *strict liability rule* is covered in particular detail. For comparison, however, the *negligence rule* is occasionally brought in. As well as negotiations and liability rules, the Pigovian tax as an internalization strategy is also dealt with in Chapter C. According to this idea, the responsible party (polluter) must pay a levy per emission unit of the amount of the external marginal cost (estimated in the social optimum). To date, this "classical" strategy is influential in the "green tax" debate.

Internalization of externalities in a pure form is, for various reasons (set out in the text), very difficult in practice. The economics literature, accordingly, also deals exhaustively with the use of instruments serving less ambitious goals than the viewpoint of economic theory rather than internalization. The object in this connection is to see how far environmental policy instruments are suitable for attaining some set emission standard (not necessarily meeting the economic optimality criterion). The relevant instruments are accordingly termed "standard-oriented" instruments.[1]

The question addressed here is dealt with in Part Three. The extremely numerous "pragmatic" environment policy instruments discussed academically and politically are summarized in terms of three "prototypes," namely, *command and control* regulations, *emissions taxes*, and *transferable discharge permits*. They are considered in regard to their cost-effectiveness, their incentive effect in relation to the advancement of environmental technology, and their capacity for meeting the environmental policy objective precisely.

The presentations in the first three parts of this book explain the welfare economics foundation of environmental economics, its elementary building blocks, and the outlines of its architecture. This sets up the *basic model of environmental economics*.

1 Correspondingly, the internalization strategies might be termed "damage-oriented" instruments.

Of course, there are a large number of real problems with the environment and environmental policy that are not, or not adequately, depicted in this model. They are accounted for in the literature with corresponding extensions of the basic model (oriented to the explanatory objective of the given presentation). The question as to what representatives of the immense range of variants should be given consideration in an environmental economics textbook is, of course, difficult to answer. Ultimately, the selection will be determined by how the author rates their political relevance and scientific interest. Part Four of this book presents a motley group of enlargements to the basic environmental economics model. The pollutant interactions discussed in Chapter A give an example of how many ecological complications are ignored in the basic environmental economics model. We show by examples how ecological details can be "built in" to the economic model and how much this changes the results of the model. Another class of extensions consists of departures from the basic model, taking into account other reasons, apart from externalities, for "market failure" in one and the same model. This happens with environmental policy under conditions of imperfect competition and with the analysis of environmental policy with asymmetrical information, dealt with in Chapters B and C. A "broader broadening" lies in the way the social policy debate often looks at environmental policy, treated separately in the basic economic model, together with other policy areas. This interdependence is particularly telling in the debate on the interactions between environmental protection and employment. We take up this type of complication regarding the basic environmental economics model in Chapter D, with a discussion of a "double dividend" of green tax. Things are different again with the analysis in Chapter E of induced advances in environmental technology. In the basic economic model, this is rudimentarily dealt with under the concept of "dynamic incentive effect." However, the dynamic modeling of this in Part Four takes on so much of a life of its own as to break the bounds of the basic textbook model and may thus be termed an "extension." This estimation also applies to the analytical method used in Chapter E, which requires more technical knowledge on the part of the reader than the more illustrative presentations in the first three parts.

How far any particular area belongs to the basic model or to the extensions is ultimately a question of subjective assessment. Anyone may reasonably find some other assignment than the one chosen here more appropriate or more comfortable.

Much the same is true of the answer to the question of how the *economics of international environmental problems* is to be classified. Undoubtedly, they could also be seen as a broadening of the basic model and thus located in Part Four. However, we enter "another world" when the viewpoint shifts from the dichotomy between a (more or less well-informed) regulator and a host of the regulated to looking at the interaction among independent actors. This occurs systematically when analyzing international environmental policy. Here the construction of the nation-state, laying down and applying environmental law, is ultimately of no more use. Instead,

account is taken of the fact that international environmental policy must be agreed to by (more or less free) sovereign states. The shift in the object of study corresponds with a change in analytical method. Traditional microeconomic regulatory theory is replaced by game theory. These considerations were decisive in not allocating international environmental problems to Part Four, as one of many extensions to the basic model but instead devoting Part Five exclusively to them. Other factors were the overwhelming importance of international environmental problems for current environmental and social policy debates, as well as the (correspondingly) large space allotted to the relevant discussions in this book. Because of the high topicality of the debate on global environmental problems, in this part we also pay special attention to not letting the theoretical economic considerations stand alone, instead adducing them for the assessment of practical international environmental policy. This is done specifically with the examples of an environmental economics analysis of the Kyoto agreement, the European Union's emissions trading scheme, and the vision of a U.S. greenhouse gas emissions trading system.

It was even easier than with international environmental problems to decide to deal separately in Part Six with *natural resources and sustainable development*, instead of putting them in Part Four as extensions of the basic model. Here the perspective clearly differs from the one taken previously in this book. Despite various departures and differentiations, the basic concept in the first five parts of the book is that alongside economic activity an undesired by-product (externality, emission) is produced, the amount of which is to be favorably influenced by regulatory or procedural policy action by the state (or a coalition of states). The *leitmotiv* of this influence is the internalization of externalities – whether in its pure form or in the "slimmed-down" version of standard-oriented environmental policy. Part Six of the book supplements this output-related viewpoint with an input-related one. The fact that every economic activity must take resources from nature becomes the focus of consideration. The problem lies in the exhaustion of resource stocks or in the damaging (if not indeed destruction) of the resource basis of human existence. The question that then arises is "What are the conditions for the durability of human existence?" The associated political *leitmotiv* is that of sustainable development.

So much for the overview of this book's program. Allow me, though, to present three more general considerations that are close to my heart:

- In educational and scientific policy debates, the "unity of research and teaching" is often dismissed as an outdated model that modern trendsetters leave to a few "dyed in the wool" old Humboldtians (likewise outdated models). Particularly in relation to Parts Four and Five (or to numerous other textbooks), it can be shown that this judgment is wrong. It is both possible and necessary to let the choice of themes dealt with in a basic book be determined by current research. The object and methods of this research can be conveyed within reasonable limits well this side of the cutting edge of active researchers, without

expecting less specialized readers to put up with the indigestibilities of the research discourse.

- In the social policy debate, the place of ecological issues has in recent years been subject to rapid cyclical fluctuations. After a phase of *eco-hype*, such topics fell into an irresistible downswing, reaching a nadir toward the end of the twentieth century with the diagnosis of "environment is uncool."[2] More recently, the trend shifted again. We hear of the "return of ecology,"[3] and those who were too hasty in consigning environmental economics courses to the rubbish heap now look very passé. Given the present deep crisis in the world economy, and specifically in international financial markets, environmental issues are likely to slip further down the agenda of social policy debate. Of course, it would be desirable if the profession were not to respond quite so strongly to where the pendulum happens to be on its swing between ecoromanticism and ecoignorance. The efficient and responsible management of the scarce resource "environment" is an ongoing social task. Particularly in a sober view, it follows that environmental economics is due a prominent place on the priority list of economics teaching and research themes.[4]
- (Almost) in conclusion, we give one more word on the ways in which the environmental economics material is presented in various places in the book. Unquestionably, not everyone has to like my kind of humor. However, I do not share the oft-upheld (although mostly implicit) view that the personality of the author of an academic essay must completely disappear behind the subject matter. After all, in the course of cultural history, many have written on the function of irony in creating texts. To represent them all, here is Hanif Kureishi:

> We decided the film was to have gangster and thriller elements. . . . And the film was to be an amusement, despite its references to racism, unemployment and Thatcherism. Irony is the modern mode, a way of commenting on bleakness and cruelty without falling into dourness and didacticism. And ever since the first time I heard people in a theatre laugh during a play of mine, I've wanted it to happen again and again. – *My Beautiful Laundrette*, London, 1986

2 Headline in *Die Zeit* No. 11, March 11, 1999, p. 1. (*Die Zeit* is a weekly highbrow newspaper published in Hamburg, Germany.)

3 Headline in *Die Zeit* No. 33, August 10, 2006, p. 1.

4 After all, 69.8% of economist respondents in a major survey by the *Verein für Socialpolitik* (German Economic Association) and *Financial Times Deutschland* (*FTD*) answered "yes" to the question "Should environment issues have a special place in economics, and should economic-policy measures always be tested for sustainability?" ("no": 21.3%, "don't know": 8.9%) (*FTD*, September 27, 2006, p. 2).

Let me add a final remark on style: In this text, not every actor has the same gender as the term by which the actor is referred. It should also be noted that entities such as "the polluter" and "the regulator" are thought of as companies, factories, political or administrative institutions, and so on. Referring to them as "he" is merely to avoid inelegant wording (e.g., "he or she," "his or her") and does not mean that the entity referred to is male.

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