Instructor's Manual to Accompany

ENVIRONMENTAL ECONOMICS
An Introduction

Eighth Edition

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Preface

Environmental Economics, An Introduction is designed as a text for a one-semester course. It is based on courses we have taught for many years, courses predicated on the notion that the subject is interesting and important enough to be presented to a wide audience of lower-division students, rather than delayed until students have negotiated a set of prerequisite courses. Thus, the book is meant to be used by students *who have not necessarily had any economics yet*. Nevertheless, the book is intended to have a distinctly analytical perspective. Given these objectives it's necessary to focus on a limited number of primary concepts—incentives, efficiency, the equimarginal principle, cost effectiveness, etc. It's also necessary, in the later chapters on domestic and international environmental policy, to concentrate on the main stories, and avoid getting drawn into the endless details that these subjects contain.

After the first two introductory chapters, there are three chapters on the most basic of economic principles. These are probably about the minimum for someone who has never had any economics. In writing these chapters there was a continuing temptation to go for a slightly higher level of sophistication. We tried very hard to resist this, to keep clearly in mind the type of student for whom the book is primarily intended. We would hope that students who have had, say, introductory micro, would find these chapters a useful review.

In this instructor's manual we have worked through each of the chapters, discussing: (a) the objectives of each, (b) main ideas covered, (c) points of discussion (cautions, techniques we have found useful, possible extensions, etc.), and (d) brief answers to each of the questions for further discussion.

The book is 21 chapters long, perhaps too long for students to get through completely under normal circumstances. The book is divided into sections so that different instructors can emphasize the material they find most useful. After having gone through Sections I and II, you may wish to pick and choose chapters from the other sections depending on the relative emphasis you wish to put on: (a) benefit-cost analysis, (b) policy analysis, (c) U.S. environmental policy, and (d) international issues.

The questions at the end of the chapters are called "discussion" questions, but they are perhaps more specific than this label implies. For the most part, they are not meant to lead to open-ended discussion, but have answers which we hope are more-or-less correct. They are designed to lead students toward making modest extensions of the ideas covered, which should help them both review the material and perhaps think more deeply about it.

The "exhibits" presented throughout the chapters are for the purpose of illustrating points in the text. The objective is to show students that the economic ideas we are discussing in the classroom are actually at work in the real world.

In earlier editions we included, at the end of each chapter, a list of "Web Sites." In this eighth edition these are located in the publisher's website for the book: www.mhhe.com/field8e.

The eighth edition of the book preserves the basic structure of the earlier editions. Some of the new material we have added includes:

• Paris Agreement	Chapters 18 and 19
• Economics of Adaptation	Chapter 18
• Paris Agreement and developing countries	Chapter 21
• Climate change and globalization	Chapter 20
• Carbon intensity of trade	Chapter 20
• Greenhouse Gas Emissions	Chapter 20
• Recycling Markets	Chapter 17
• Frank Lautenberg Chemical Safety for the 21st Century Act	Chapter 16
• Emission trading in water pollution control	Chapter 14
• Income Distribution of Emission Charges	Chapter 12
• Community Resiliency	Chapter 21
• Total Maximum Daily Load (data)	Chapter 14

Chapter 1

WHAT IS ENVIRONMENTAL ECONOMICS?

Objectives

The purpose of this chapter is to whet students' appetites, by presenting them with some examples of the types of problems environmental economists work on and some of the approaches they take. Most of the examples are illustrated with short exhibits to increase their immediacy. They are meant to be sketches that are easily understandable by students, without the need of devoting a lot of class time to their deeper interpretation.

Main Points

At this juncture there are just two leading ideas to stress: (a) the critical role of incentives in producing environmental degradation and in designing environmental policies, and (b) the importance of studying the short- and long-run benefits and costs of environmental improvements.

Teaching Ideas

It is especially important to set a positive tone early. Most students will come to the class as environmental advocates. With its attention to costs, tradeoffs, and notions of efficiency, environmental economics can seem to many to lead toward a weakening of the forces of environmental advocacy and to lower aspiration levels for environmental improvements. That is why many environmental advocacy groups look on environmental economics with jaundiced eye. It's important to begin getting the message across that this is incorrect, that, instead, the subject will prove to be very useful in such things as designing environmental policies with more teeth than some of those we have had in the past, getting more environmental improvement from the resources we devote to these programs, and learning more about the real levels of environmental damages and the values people put on improving the natural environment.

Many students will also come to the class with the simplistic notion that environmental deterioration is primarily a result of "capitalism," where decisions are presumably made with reference only to the bottom line, and not to wider social or ecological concerns. The collapse of the former socialist countries, and the nasty environmental conditions this has revealed, makes it easy to combat this notion. So does the fact that some of our worst environmental problems in market economies stem from cases where the profit motive is not at work (e.g., pollution from weapons manufacturing sites). The essential message is

that environmental pollution will occur in any system if the incentive system is not structured appropriately.

One other preconception that students sometimes have is that environmental quality issues are exclusively issues of the natural, biological and medical sciences. In this view, the best decisions will become manifest as a result of the application of these sciences with enough diligence. The idea that human preferences should have anything to do with decisions about environmental quality will very often strike them as curious, if not downright wrong. It is never too early to start discussing this.

Answers to Discussion Questions

We have not included discussion questions for this first chapter.

Chapter 2

THE ECONOMY AND THE ENVIRONMENT

Objectives

This is also an introductory chapter, the primary aim of which is to provide a simple conceptualization of the economy in relation to the natural environment and to establish some definitions and perspectives that will be used throughout the book.

Main Points

A leading idea presented in the chapter is the *materials/energy balance relationship*; it helps to establish the basic relations between economy and environment and locates some of the major "pressure points" for developing environmental policy. Since the book is limited to environmental economics, the chapter also contains a very brief discussion of issues in *natural resource economics;* the close relationship between the two needs to be emphasized.

The materials balance model does not focus on the handling of residuals at the end of production/consumption, so Figure 2.3 is meant to shift emphasis to this part of the problem. It is also useful for bringing up the major problem of control: When two or more sources contribute to a pollution problem, how much should we control each source?

You may wish to postpone the discussion of production possibility curves until later. The ideas of short-run vs. long-run may be presented fairly intuitively without the diagram, and students who have had no economics may be put off at this stage if you take simple ideas and make them technically complex. Whether you present this material at this point will depend on where you wish to place emphasis in the course. The idea of sustainability is presented here, with a simple interpretation in terms of impacts on future production possibilities curves.

Teaching Ideas

This chapter is bound to have a "grab-bag" flavor, because it includes a variety of topics which, in the nature of things, have no underlying theme. There is probably no way around this; some basic terminology and perspective are essential.

Answers to Discussion Questions

1. Investment in new physical capital, infrastructure or otherwise, creates a difference between M and ($R_p^d + R_c^d$); as long as long-lived physical capital is accumulating some portion of the material inputs will be incorporated in this capital rather than ending up back in the environment. Ultimately (and this may take a long time) everything that goes in will come out.

2. A pollutant is a residual that causes damage. Thus, a residual that is emitted into the environment but causes no damage is not a pollutant. An airborne pollutant, if it were emitted downwind from anything that could potentially be damaged, would not be a pollutant. The same principle applies to noise and junked automobiles. It would be difficult for an ugly building not to lead to damage, as this would imply that nobody views it; of course, when aesthetics are involved the issue of damage is much more problematic than when classic damaging emissions are involved.

3. A short-lived, noncumulative pollutant does its damage and then disappears, so if we want to reduce damages, we need only reduce current emission levels. But a cumulative pollutant stays around to cause damages in the future, so foresight is needed to manage damages, and that is usually difficult to get. It's hard because the science becomes more difficult—having to predict effects that are a long time in the future, and it's hard because people ordinarily discount the future.

4. The problem is how to divide the total emission reduction among the sources. This can be done in any number of ways, and different pollution-control policies do it in different ways (equiproportionate cutbacks vs. cost-effective cutbacks, for example). In later chapters this is a very substantial issue.

5. Materials used to produce a single-use plastic bag (M) enter the system and flows to G with excess heat, energy and plastic remnants from the production process flowing to R_p, then to discharge. G (single-use plastic bag) flows to the consumer and then to residual (R_c) and immediately to discharge (R_c^d) by the definition of single-use. Some consumers reuse a single-use plastic bag in which case the bag circles among consumers but the form does not change and the entire product is discharged eventually.

   For a paper shopping bag, materials used to produce it enter the system (M); however, any recycled paper used for a portion of the bag would enter from another processor already in the system. Some of the remnants from the production process flow to R_p, then to discharge. G (paper bag) flows to the consumer and then to residual (R_c). Here the consumer has a choice, and here is where incentive structures can influence greatly the path of the residual. Either the paper bag could be discharged immediately (R_c^d) like the single-use plastic bag, or the paper bag could be placed in recycling (R_c^r) to circulate back to producers and into the production process, possibly

to be part of future paper bags. Without an incentive to recycle, the paper bag will add to landfill quantities just as the disposal of plastic bags; however, the former will compost and disintegrate at a much faster rate than the latter.

6. A very brief and, at this point, intuitive foray into the idea of social efficiency. The optimal level of expenditures depends on preferences, the costs of control technology, and assimilative capacity of the environment of the political entity in question. In an honors section we sometimes ask students to give us two pages on this type of question during the first week of classes. Near the end of the semester we ask them again to give us two pages on this or a closely related question. Most students are astounded at how far their thinking has evolved during the term.

7. With technological change that allows firms to produce goods and services with less pollution, the slope of the PPC would increase so that at every level of e (environmental quality), the corresponding level of c (market goods) will be higher. Conversely, at every level of c (market goods), the corresponding level of e (environmental quality) will be lower.

8. Composting has the effect of preserving the nutrients in discarded food items. These can be recycled into animal food and into land fertilization thus maintaining the productivity of these resources. Composting can certainly lead to residuals if not done properly, and these residuals could potentially become pollution, e.g., through water contamination.