ENVIRONMENTAL ECONOMICS

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Contents

Summary

This chapter provides an introduction to environmental economics, the economic analysis of environmental problems and their solutions. This serves as a background for the more detailed treatment of specific themes in *Externalities, Efficiency and Equity; Designing Instruments for Resource and Environmental Policy; International Trade and Policy Co-ordination; Sustainable Development, Growth Theory, Environmental Kuznets Curves, and Discounting; Economic Analysis of Climate Change; Economic Valuation and Cost-Benefit Analysis; An Economic Theoretical Perspective on Green and Sustainable National Income*. The chapter opens with a concise description of the historical context, and a demarcation of the topic. There follows an overview of the main themes addressed by environmental economics. These include: the externality concept; environmental policy and choice of instruments; sustainable development; international trade and policy coordination; spatial aspects of problems and policy; environmental macroeconomics and the growth debate; economic valuation theory and techniques; and, other methods used in environmental economics. Finally, since environmental economics is a field where methodological and ethical discussions are commonplace, a brief assessment is given of major conflicting and possibly

complementary views and approaches in traditional environmental economics and its sister field ecological economics.

1. History and Demarcation

Environmental economics has developed as a branch of economics that is concerned with the economic analysis of the causes and the nature of environmental problems and their solutions. This includes issues relating to markets as well as to public policy. Environmental economics is often interpreted to include resource economics. Although the latter is dealt with as a separate topic in the EOLSS, the former cannot entirely neglect resource issues because these are intricately linked to environmental issues. This is especially true since the notion of sustainable development has become a pillar of modern environmental economics.

Environmental economics has developed during the 1960s out of applied welfare economics, and was influenced by insights from and approaches in agricultural and resource economics. Nevertheless, long before that time, economists had shown an interest in environmental issues, such as those related to agriculture, population and food production (Malthus), productivity of land (Ricardo), depletion of coal stocks (Jevons), theory of depletable resources (Gray, Hotelling), and externalities and environmental taxation (Pigou). The early development of environmental economics was dominated by three themes. First, cost-benefit analysis was applied to investment projects with environmental impacts, and, in line with this, monetary valuation techniques were developed and applied to value environmental changes and damage. Second, environmental policy theory was developed, aimed at the comparison, design and evaluation of environmental policy instruments. Third, economic growth and resource scarcity were examined in theoretical and empirical studies.

Environmental economics uses concepts and models from neoclassical welfare theory (microeconomics). Its core insights are thus critically dependent on the assumptions of rational individual behavior (utility or profit maximization) and market clearing, together guaranteeing an economic equilibrium, that is, unique combinations of prices and traded quantities of products on markets. Recently, during the 1990s, "ecological economics" has developed as an alternative, broader approach. At the same time it functions as a forum for multidisciplinary environmental research in which economics plays an important role. Ecological economics is covered elsewhere in the EOLSS. The main differences between environmental and ecological economics are discussed in the penultimate section of this chapter.

Closely related to environmental economics is resource economics. This covers a number of issues including indicators of resource scarcity, optimal resource extraction, imperfect resource markets, extraction of nonrenewable resources (fossil fuels, metal ores, minerals), and use and management of renewable resources (water, forestry, fisheries, wind and solar energy). These topics are surveyed elsewhere in the EOLSS.

Finally, an area known as 'environmental (business) management' has strong links with environmental economics, since it adopts a business or firm organization perspective in order to understand the firm's responses to environmental problems and policies. This

field of research covers typical business administration topics, such as environmental care systems, environmental strategies, internal organization, environmental accountancy, environmental reporting, environmental cost accounting and green marketing. So far, the textbooks have not integrated environmental economics and environmental management, which is consistent with the fact that these fields develop rather independently. Environmental Management is treated elsewhere in the EOLSS.

2. Externalities

The economic theory of environmental policy starts from the concept of "externality", which can be defined as a direct or physical influence of one economic agent's decision on the utility or production of another agent that occurs outside the market and remains uncompensated. The presence of externalities means that individuals do not have complete control over the set of factors that determine their production or utility level. Environmental economics is particularly interested in negative environmental externalities, i.e. the negative physical effects of environmental pollution, resource use, or other types of environmental disturbance caused by human activities. Externalities have been analytically examined and elaborated with the help of partial and general equilibrium theories. These are consistent with the earlier-mentioned neoclassical assumptions regarding individual behavior and the operation of markets. "Partial" denotes a focus on one (usually) or an incomplete set of markets, while "general" denotes a complete set of interrelated markets (for instance, markets for labor, capital and products). A recent alternative starting point for environmental economics is provided by the notion of "sustainable development", which is discussed below. The latter presents a more explicitly dynamic and ecological perspective on environmental economics than the externality notion. The obvious economic theory to elaborate sustainable development is also different: namely, growth theory. *Externalities, Efficiency and Equity* presents a detailed account of externality and welfare theory, whereas *Sustainable Development, Growth Theory, Environmental Kuznets Curves, and Discounting* summarizes issues surrounding sustainable development and growth theory.

3. Sustainable Development

Since the Brundtland report by the UN World Commission on Environmental and Development (WCED) was published in 1987, the notion of sustainable development has slowly entered the research and publications of environmental economists. This has meant a shift in emphasis from externalities to the intergenerational equity and stability of ecological systems that support human welfare. Various definitions of sustainable development are available. Notably, the opposition between strong and weak sustainability viewpoints has received much attention in the last few years. Weak sustainability has been defined on the basis of the concepts of "economic capital" and "natural capital". Economic or human-made capital comprises machines, land, labor and knowledge. Natural capital covers natural resources, environment and nature (including ecosystems). Under weak sustainability, the object is to strive to maintain "total capital", defined as the "sum" of both types of capital. This allows the substitution of natural capital by economic capital, as is analyzed in the theory of economic growth with natural resources. Strong sustainability, by contrast, requires that every type of

capital be maintained separately. Environmental economics starts from weak sustainability, which emphasizes a large degree of substitution of inputs both in production and in the economy as a whole.

Frequently, another aspect of (un)sustainability is pointed out: namely, the stability and resilience of ecosystems. Two alternative interpretations have been offered: one is directed at the time necessary for a disturbed system to return to its original state; the other is directed at the intensity of disturbance that a system can absorb before moving to another state. Due to the latter interpretation, resilience (also known as "Holling sustainability") has been opposed to weak sustainability (also known as "Solow-Hartwick sustainability"). For further discussion of sustainable development, see *Sustainable Development, Growth Theory, Environmental Kuznets Curves, and Discounting.*

4. International Issues

Since the late 1980s, in the wake of the popularity of the notion of sustainable development, the international dimensions of environmental problems and policy have received much attention in environmental economics. A first question here concerns how environmental policy in open economies can best be designed. This depends on the type of problem: local (solid waste, urban pollution), transboundary (acid rain, river pollution) or global (greenhouse gas emissions and climate change). Local problems can be addressed locally. Transboundary and global problems require international coordination of environmental regulation. Harmonization of policies is required in the case of global problems that concern "uniformly mixing pollutants" – meaning that the ultimate environmental impact of emissions originating at different locations is the same everywhere, so that only the total amount of pollutants matters, not the location of their origin. Another consideration is whether polluting goods are traded. Many theories have been used to clarify the link between foreign trade, environment and policy: based on partial equilibrium models, imperfect competition (firms with market power), strategic trade policy by countries, general equilibrium models, and statistical-econometric analyses (see *International Trade and Policy Co-ordination*). Perhaps the most important insight of traditional trade theory applied to environmental externalities is that it is desirable to use environmental source measures rather than trade measures, as the latter are usually second-best. Moreover, free trade is Pareto-efficient when environmental externalities have been optimally addressed by environmental policies. An interesting, though not widely supported, recent view states, however, that traditional comparative advantage theory no longer holds since all production factors (capital and labor) are immobile in the globalized economy.

Special attention has been given to the impact of (lack of) policies in developing countries and the role of international institutions, notably the WTO/GATT. In this context, theoretical models have considered environmental policy coordination in terms of strategic games among governments that, through lax or strict policies, might attract or deter polluting firms. Empirical research has found little evidence that international trade and location of firms respond negatively to relatively strict national environmental regulation. Moreover, according to some authors, a strict policy will actually induce firms to innovate (cleaner production), thus allowing them, as well as the country, to

enjoy a first-mover advantage that can compensate for the negative trade effects of the strict policy. This is also known as the Porter hypothesis. Rigorous and systematic empirical research in support of this hypothesis is, however, also scarce.

International agreements have been examined with game theoretic models of environmental conflict, agreement formation and agreement stability. In line with the theoretical findings that the linking of agreements creates new options, many authors have claimed that WTO activities should be integrated with international environmental agreements. This would then stimulate significant progress in international policy coordination. Transboundary environmental problems like acid rain have traditionally been a focus of attention. Since the early 1990s, the attention has been broadened to include global environmental issues, notably global warming and climate change, stratospheric ozone depletion, and loss of and threats to biodiversity. See *Economic Analysis of Climate Change*. There is detailed coverage of the various aspects of Biodiversity elsewhere in the EOLSS.

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Biographical Sketch

Jeroen van den Bergh is ICREA professor in the Institute of Environmental Science and Technology (ICTA) and the Department of Economics and Economic History, at the Autonous University of Barcelona, and professor of Environmental and Resource Economics in the Faculty of Economics and Business Adminstration,and the Institute for Environmental Studies, at the Free University in Amsterdam. He is an elected fellow of the Tinbergen Institute and NAKE. He has a Master's degree in econometrics from the University of Tilburg (1988), and a PhD degree in economics from the Free University (1991). His research interests cover environmental, resource and energy economics, evolutionary economics and innovation studies, and spatial economics.

He is a member of the editorial board of various international journals. He is editor of the *Handbook of Environmental and Resource Economics* and of the book series *Advances in Ecological Economics* (both Edward Elgar Publishing, UK). He has been chairman of various committees on social, economic, climate and environmental research within the Netherlands' Organization for Scientific Research.. He is the author or editor of more than 10 books and over 70 articles in international journals. In 2002 he received the prestigious Royal/Shell Prize for his work on integrated economic-environmental modeling.