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经济学系列

Frontier Environmental Issues

Edited by Olav Bjerkholt
and Xizhe Peng

復旦大學出版社

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图书在版编目(CIP)数据

环境经济学前沿 = Frontier Environmental Issues/〔挪威〕毕哲浩特(Bjerkholt, D.),彭希哲著. —上海:复旦大学出版社,2005.9
(复旦博学·经济学系列)
ISBN 7-309-04681-1

Ⅰ. 环… Ⅱ. ①毕…②彭… Ⅲ. 环境经济学-英文 Ⅳ. X196

中国版本图书馆 CIP 数据核字(2005)第 097504 号

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出版发行 復旦大學出版社

上海市国权路 579 号 邮编 200433

86-21-65118853(发行部) 86-21-65109143(邮购)

fupnet@fudanpress.com http://www.fudanpress.com

责任编辑 栾 奇

总 编 辑 高若海

出 品 人 贺圣遂

印 刷 浙江省临安市曙光印务有限公司

开 本 787×960 1/16

印 张 20.25

字 数 342 千

版 次 2005 年 9 月第一版第一次印刷

印 数 1—3 000

书 号 ISBN 7-309-04681-1/F·1034

定 价 30.00 元

Introduction

This volume, entitled *Frontier Environmental Issues*, has been written as an introduction to selected modern methods in environmental economics. The articles have been written to be accessible and useful for graduate and doctoral students in economics, specializing in environmental economics. They may also be found useful for researchers on environmental issues of various backgrounds.

The volume has been edited and written by scholars associated with the Department of Economics at the University of Oslo, the Institute of Population Research of Fudan University, and the Research Department of Statistics Norway. It is an outcome of a cooperation between the Department of Economics and the Institute of Population Research established in 1998 as part of the cooperation between Fudan University and a consortium of Nordic academic institutions coordinated by the Nordic Centre at Fudan University.

The Nordic Centre was established as a vehicle for contacts between Fudan University and universities and other institutions of higher learning in the Nordic countries, and it has until now served as an umbrella for such contacts. The Centre was opened in 1995 by the Prime Minister of Norway, Mrs. Brundtland, a few years after she had chaired the UN Commission on Environment which resulted in the report *Our Common Future*. In her opening speech Mrs. Brundtland emphasized the importance of the global environment and thus encouraged environment as one issue to be pursued in the Nordic-Chinese cooperation.

Shortly after the opening of the Centre the Department of Economics and the Institute of Population Research established contact and initiated the discussion of a cooperation agreement, which also comprised 3 to 4 student exchange places each year in an international two-year Master Programme at the Department of Economics in Oslo with emphasis on environmental, resource and development issues. The Research Department of Statistics Norway has over decades maintained closed links with the Department of Economics in research and staff exchange. Several of the students selected by Fudan University for this master programme has played an important role in the link between these institutions. Their master theses typically dealt with Chinese problems, studied and analyzed by methods acquired in Oslo. Some of the exchange students proceeded to the doctoral program and some worked as research assistants in Oslo. Within the exchange and cooperation program scholars and doctoral students at Fudan have also got opportunities of spending visitor stays of some months in Oslo.

The cooperation between the Department of Economics, University of Oslo and the Institute of Population Research, Fudan University may thus be seen as a direct result of the foundation of the Nordic Centre in 1995, and it is on this background entirely suitable that the volume appears at the celebration of the ten years anniversary of the Nordic Centre.

Environmental economics has become a very international field and also a field of fast development. New experiences and new applications give feedbacks to improve and enhance the theory. Environmental concerns, even if they are primarily national concerns, become global concerns. In the part of the Oslo-Fudan cooperation represented by this volume, works have been selected primarily from the viewpoint of being useful for students and young scholars. Some of the chapters present primarily methodological approaches, written to be accessible to students,

although requiring some background. Other chapters demonstrate the methods through applications. Below follows a brief introduction to each chapter.

Xizhe Peng and Yuhui Liu try to outline the serious ecological challenge faced by China in Chapter 1 based on the measurement *Ecological Footprint*. With some brief introduction to the conceptions and methods, this chapter calculates the Ecological Footprint and bio-capacity both at national and provincial level to track the ecological overshoot of China's mainland economy. The results show: ecological deficit emerged in 1980s and continued to grow as a result of the rapid economy progress and huge population. Most provinces in China as a whole are now in a serious unsustainable development state. Necessary changes of the resource intensive production and consumption pattern are imminent.

Michael Hoel deals in Chapter 2 — *Global Warming and Other Transboundary Environmental Problems* — with some important aspects of what is assumed to be one of the most serious environmental problems in the 21st century, namely the climate change caused by emissions of greenhouse gases. The climate problem is a special case of a much more general category of transboundary environmental problems. The need to deal with such problems among sovereign states through international cooperation and agreements should be obvious both on environmental grounds and also for eliminating the potential international conflict in the wake of environmental damage.

Michael Hoel, who is a leading authority in this field, recapitulates the conditions that international environmental agreements have to fulfill the social efficiency in an international sense, e. g. , the Kyoto Agreement is designed to be. Given these conditions, which imply that a potential agreement may make all countries better off than a situation without any agreement, the transboundary problem is far from solved. First, there is a

free-rider problem, namely that each individual country contributing to and affected by the problem typically may be even better off if it does not join the agreement but lets the other countries cooperate to reduce emissions. Since all countries may have such a free-rider incentive it may at the outset be difficult to obtain complete participation.

The analysis of the benefits of environmental agreement as alluded to above is predicated on the assumption of given technology. Improved technology for reducing emissions and thus mitigating environmental problems is, however, very likely to take place and ought to be encouraged and stimulated. Hoel shows that a weakness of a Kyoto type of agreement is that it may give an inefficient outcome when R&D is taken into consideration. The confines of such an agreement will typically lead to too little R&D activities relative to abatement efforts. Hence, the importance of agreements with more focus on the development of new technology. Hoel elaborates on this trade-off between social efficiency and technology enhancement in the design of international agreements and argues also that technology oriented agreements have weaker free-rider incentives and thus, while less perfect in static efficiency terms, may still be preferable to Kyoto types of agreement.

In Chapter 3 Juan Huang's contribution — *The Environmental Kuznets Curve and Income Inequality: An Aggregation Approach* — reinterprets one of the earliest concepts used in environmental analysis to discuss the relationship between economic growth and environmental degradation, namely the Environmental Kuznets Curve (EKC). This curve expresses an inverse U-shaped relationship between per capita income and environmental degradation. The concept is named after Simon Kuznets, who was awarded one of the very first Nobel prizes in economics. His contribution had, however, nothing to do with the environment, the "Kuznets Curve" that he discovered was an empirical

observation that in a process of economic growth and development the inequality tended to increase at first and later on to decrease. The transfer of this observation to the relationship between economic growth and environmental degradation has been a hypothesis which has spawned a great literature, both theoretical and empirical. Juan Huang reviews more recent contributions to this literature.

Juan Huang then goes back to Kuznets' concern with income inequality and considers the interrelation between income inequality and environmental degradation, particularly the effect of income distribution upon emissions. In this context she considers more elaborate relationships between income and environmental degradation than the simple inverse U-shaped curve. She then considers China as a case study and by means of an econometric model she studies the impact of income distribution as an intermediary variable on the relationship between income and environmental degradation. Needless to emphasize China is a particularly important example because of its large size, its rapid economic growth, and its impact upon the regional and global environment.

Juan Huang also points to the importance of policy regimes in this context, and to the regional differences between China's provinces. In a sense her analysis in this chapter scratches only the surface of the huge complex interrelationships of China's development, as seen in an environmental perspective. Her analysis may well turn out to be seminal for further analyses along the same lines.

Chapter 4, 5 and 6 are closely related by presenting the methodology and applications of discrete choice analysis in environmental analysis. Chapter 4 by John K. Dagsvik — *Random Utility Models for Discrete Choice Behavior* — is a comprehensive introduction to the theory and statistical methods of discrete choice analysis by a leading practitioner in the field. Discrete choice means decisions by economic agents when the

choice setting is one of *discrete* choices, rather than the continuous decisions of conventional analysis of demand. When alternatives are discrete, it is not possible to base the modeling of an agent's choice by evaluating marginal rates of substitution, as the utility function will not be differentiable. There is nothing inherently environmental about discrete choice, which has found applications in many areas. But discrete choice methods have been found to be of great value in many environmental applications, as also demonstrated in Chapters 5 and 6.

The theory and methods expounded by Dagsvik are closely related to the lifetime work of Daniel MacFadden, for which he was awarded the Nobel Prize in economics in 2000. The random utility modeling approach set out by Dagsvik is based upon an axiomatic approach to the behavior of the economic agent and a probabilistic interpretation of the observations of agents' decisions, due to variables that are unobservable by the econometrician. Dagsvik's presentation is a self-contained, comprehensive, and compact introduction to a field of methodology that has had an almost explosive growth in applications over the last couple of decades. It requires a prior background in probability theory. In addition to setting out the methodology, Dagsvik provides a brief historical background and also examples of applications to labor supply, transportation, potential demand for alternative fuel vehicles, and oligopolistic competition with product differentiation.

Chapter 5 by Gang Liu — *What Is Important in China's Car Market* — offers a lucid application of discrete choice analysis to the oligopolistic competition in the Chinese car markets. Prior to the econometric analysis Gang Liu gives an insightful characterization of the Chinese car market and points out its quite peculiar features, and reviewing very briefly the historical development since China produced its first car in 1958. The discrete choice analysis assumes at the outset that

various attributes of the products under consideration, *in casu* cars, count in the potential buyers assessment apart from the price. The attributes considered are size, maximum speed, and fuel consumption. Applying part of the methodology of Chapter 4, Gang Liu demonstrates the kind of results that can be derived from using these methods by establishing an econometric model and applying it to a rather limited data set for the Chinese car market 1993 - 2000. Here the point is more to point out the power of the methods applied than the substantive results. Taking into consideration the rapid development of the Chinese car market in recent years and the vast consequences of a rapid growth in the use of cars over the next few decades for China, the approach demonstrated in Chapter 5 may well be found worth pursuing, if not already being applied, by research institutions and authorities in the transportation field.

Chapter 6 by John Dagsvik and Gang Liu — *The Demand for Conventional and Alterative Fuel Cars in Shanghai: An Application of Discrete Choice Theory* — is another and quite different application of discrete choice theory to the car market, or to be more precise, the future car market, of Shanghai. The chapter demonstrates the application discrete choice methods to another large application area, namely to *stated preferences*, that is to hypothetical questions about preferences among discrete choices. In this case the question is about whether to buy a car, and if so, a conventional car or an alternative fuel vehicle. Alternative fuel vehicles (electric cars) have until now not been commercially available in China. The cars are characterized in a small number of parameters which then enter the stochastic model.

The empirical investigation demonstrating the method is by itself only an exemplification, but nonetheless helpful to show the power of this approach. Only 100 persons, perhaps not even randomly selected, have been interviewed. As for Chapter 5, and perhaps even more so, the point

of the paper is to explain and demonstrate the method, hoping it will reach research institutions and authorities who might be interested in applying such methods to ensure the best possible information as basis for large-scale investments to be undertaken in Shanghai, and indeed in China, for a fast increase in the use of personal cars.

Chapter 7 and 8 also are closely related as comprising a state-of-art theoretical presentation of methods for valuing environmental goods, as well as a concrete application of one such method to a study of the air quality in Shanghai. Jon Strand sets out in Chapter 7 — *Stated-Preference Methods for Valuing Environmental Goods* — by way of introducing a motivation for such methods, namely the unavoidable need to evaluate the environment to conduct social planning and progress in a rational way and the unavoidability of using direct, especially designed, methods rather than relying only on market data. Jon Strand, who is well known for his work in this field, then proceeds to survey such methods emphasizing the ramifications we get into when sorting out such value questions. The latter part of the article deals with the Contingent Valuation Methods (CVM), setting in out in a fairly detailed way the major steps in designing a CVM investigation.

In Chapter 8 — *Valuing Reduced Air Pollution Costs by the Contingent Valuation Method: Shanghai as A Case Study* — Jon Strand, Xizhe Peng and Wenhua Tian report the results of a CVM investigation which has been part of this cooperative project. The aim of the project has been to estimate the air pollution costs in Shanghai though its effects upon health. The chapter reports the results of a pre-test survey for this investigation. Hence, it is a research in progress rather than a completed investigation. Also in this empirical investigation the sample is small, only 100 persons. The pre-test survey serve primarily as a demonstration of the kind of information that can be derived from a carefully designed

questionnaire, comprising questions of the willingness-to-pay, in this case for improved air quality in Shanghai. To elicit people's willingness-to-pay requires a sophisticated procedure and Chapter 7 and 8 together provide both theoretical discussion and empirical testing of the methodological issues involved. Annexed to the chapter is the questionnaire, which serve to exemplify several of the principles of CVM studies set out in Chapter 7.

The final Chapter 9 — *Acid Rain in China: Applications of the RAINS-ASIA Model* — by Finn R. Førsund and Yan Qin has a somewhat different character as it introduces an internationally available model tool. The RAINS model was developed by the International Institute for Applied Systems Analysis (IIASA) in connection with the early agreements in Europe on reduction in emissions to air. It was an obvious need for a tool which made it possible to monitor the emissions flows across borders. It started with SO2 emissions, but was soon extended to cover the major air pollutants.

The RAINS model became a success both for environmental monitoring and for international cooperation in the field. Later on IIASA started to develop a similar tool for Southeast Asia and called it RAINS-ASIA. Finn R. Førsund, who for a long time has been an outside associate at IIASA, has investigated this, still early, version of RAINS-ASIA, assisted by Yan Qin, and found it highly applicable and useful for the study of acid rain problem in all or parts of China. The RAINS-ASIA model is a highly complex tool. The chapter explains the logic of the model and the various ways in which it can be used, illuminated by examples applied to China. The model itself can be acquired from IIASA at a relatively modest cost.

It is the hope of the editors that the volume will be found both inspiring and helpful for students and researchers of environmental issues and that it will encourage further cooperation between the two universities

in environmental research.

ACKNOWLEDGEMENT

The research, on which this volume is based, has been supported by a grant from the Research Council of Norway which has facilitated the arrangement of workshops, exchange of scholars and other research cooperation activities, upon which this volume has depended and which is heavily acknowledged.

Needless to say, we thank the team of authors for their willingness to take part in this endeavor and for the quality of their contributions. We also express our appreciation of the support of various kind given by the staff of our respective institutions, and not least by the Nordic Center and its coordinator Maria Henoch.

Finally, we express our gratitude to Fudan University Press for accepting the volume for publication. Last, but not least, the final stage of the preparation of this volume owns much to Yuan Cheng who has worked both in Oslo and at Fudan as editorial assistant and Danqiong Chen, meticulously transforming imperfect message into edited chapters, for which we are most grateful.

Oslo/Fudan, May 2005

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CONTENTS

1 The Relationship Between Population and Natural Resources in China: An Ecological Footprint Analysis 1

1.1 INTRODUCTION 1

1.2 ECOLOGICAL FOOTPRINT: CONCEPTION AND METHOD 4

1.3 ECOLOGICAL FOOTPRINT TIME SERIES OF MAINLAND CHINA 1961 - 2001 7

1.4 CASE STUDY TWO: ECOLOGICAL FOOTPRINT CALCULATION AT PROVINCIAL LEVEL 17

1.5 CONCLUSIONS 33

REFERENCES 34

2 Global Warming and Other Transboundary Environmental Problems 37

2.1 INTRODUCTION 37

2.2 TRANSBOUNDARY ENVIRONMENTAL PROBLEMS 38

2.3 ABATEMENT COSTS AND ENVIRONMENTAL COSTS 41

2.4 THE NON-COOPERATIVE EQUILIBRIUM 42

2.5 PARETO OPTIMALITY WITH AND WITHOUT SIDE PAYMENTS 43

2.6 INTERNATIONAL COOPERATION 46

2.7 THE DESIGN OF AN INTERNATIONAL ENVIRONMENTAL AGREEMENT 47

2.8 INTERNATIONAL CLIMATE AGREEMENTS 49
2.9 TECHNOLOGY DEVELOPMENT 52
2.10 TECHNOLOGY SPILLOVERS 53
2.11 THE NON-COOPERATIVE EQUILIBRIUM WITH ENDOGENOUS TECHNOLOGY 55
2.12 THE SOCIAL OPTIMUM WITH ENDOGENOUS TECHNOLOGY 56
2.13 THE INEFFICIENCY OF A KYOTO TYPE AGREEMENT WHEN TECHNOLOGY IS ENDOGENOUS 57
2.14 CONCLUDING REMARKS 60
REFERENCES 61

3 The Environmental Kuznets Curve and Income Inequality: An Aggregation Approach 65
3.1 INTRODUCTION 65
3.2 THE EKC AND INCOME INEQUALITY 67
3.3 THE EFFECT OF INCOME INEQUALITY ON AGGREGATION POLLUTION 71
3.4 HYPOTHESES OF THE EFFECT OF INCOME INEQUALITY 78
3.5 EMPIRICAL ANALYSIS 79
3.6 CONCLUDING REMARKS 90
REFERENCES 91
A PROOF OF LEMMA 1 98
B FIGURES & TABLES 99

4 Random Utility Models for Discrete Choice Behavior 106
4.1 INTRODUCTION 106
4.2 STATISTICAL ANALYSIS WHEN THE DEPENDENT VARIABLE IS DISCRETE 108
4.3 THEORETICAL DEVELOPMENTS OF PROBABILISTIC CHOICE MODELS 116

4.4 APPLICATIONS OF DISCRETE CHOICE ANALYSIS …… 138
4.5 MAXIMUM LIKELIHOOD ESTIMATION AND TESTING OF MULTINOMINAL PROBABILITY MODELS …… 146
REFERENCES …… 150
5 What Is Important in China's Car Market? …… 153
5.1 INTRODUCTION …… 153
5.2 CHARACTERISTIC FEATURES OF A CAR MARKET …… 154
5.3 THE CAR MARKET IN CHINA …… 156
5.4 THEORETICAL MODELS …… 159
5.5 EMPIRICAL RESULTS FROM CHINA'S CAR MARKET …… 167
5.6 CONCLUSION …… 171
REFERENCES …… 172
6 The Demand for Conventional and Alternative Fuel Cars in Shanghai: An Application of Discrete Choice Theory …… 175
6.1 INTRODUCTION …… 175
6.2 THE MODEL FOR RANK ORDERED ALTERNATIVES …… 177
6.3 SURVEY METHOD AND DATA …… 180
6.4 EMPIRICAL RESULTS …… 182
6.5 CONDITIONAL AND AGGREGATE DEMAND AND ELASTICITIES …… 186
6.6 THE VALUE OF ALTERNATIVE FUEL VEHICLES …… 187
6.7 CONCLUSIONS …… 189
REFERENCES …… 190
APPENDIX: SURVEY QUESTIONNAIRE …… 191
7 Stated-Preference Methods for Valuing Environmental Goods …… 196
7.1 INTRODUCTION: WHY DO WE NEED TO VALUE ENVIRONMENTAL GOODS? …… 196

7.2 OVERVIEW: METHODS AND PRINCIPLES FOR ENVIRONMENTAL VALUATION 199
7.3 THEORECTICAL FRAMEWORK FOR VALUATION OF ENVIRONMENTAL GOODS 205
7.4 BASICS: STATED-PREFERENCE METHODS FOR VALUING ENVIRONMENTAL AND RESOURCE GOODS 209
7.5 THE CONTINGENT VALUATION METHOD (CVM) 212
REFERENCES 226
8 Valuing Reduced Air Pollution Costs by the Contingent Valuation Method: Shanghai as A Case Study 232
8.1 INTRODUCTION 232
8.2 THE SURVEY AND THE QUESTIONNAIRE 233
8.3 SAMPLE CHARACTERISTICS AND RESPONSES 237
8.4 WILLINGNESS TO PAY RESULTS 241
8.5 CONCLUSIONS 252
APPENDIX: SURVEY QUESTIONNAIRE CV SURVEY QUESTIONNAIRE FOR IMPROVING AIR QUALITY IN SHANGHAI 253
9 Acid Rain in China: Applications of the RAINS-ASIA Model 261
9.1 INTRODUCTION 261
9.2 THE RAINS MODEL OF TRANSBOUNDARY AIR POLLUTION 263
9.3 STRUCTURE OF RAINS-ASIA 274
9.4 RELATED ACIDITY STUDIES USING RAINS-ASIA 280
9.5 APPLICATIONS OF RAINS-ASIA TO CHINA 286
9.6 CONCLUDING REMARKS 301
REFERENCES 303
Contributors 307