Environmental Risk Economics

Oct. 1 Introduction

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The Goal of This Course

The goal of this course is:

- to acquire the point of view of economists
- so that you can consider environmental issues like an economist

Economics is:

- a *social science* which studies the social problem of *choice* from a scientific point of view
- build on a systematic exploration

Environmental Risks Are Complex (1)

Pesticide residue (残留農薬):

- factors and results
 - economic activity: agriculture
 - consequences: pesticide residue in the soil, water, air, food, etc. and influences on ecosystem
 - damages: adverse reaction (薬害反応) and the environmental degradation
- randomness of
 - how farmers distribute pesticides in their agricultural lands,
 - the pathway of the contaminated water,
 - weather, and
 - rate of cancer from ingesting specific amounts of pesticides through drinking water (ex. age and other characteristics of the consumer)
- uncertainties of causal relationships between the economic activity and the consequences in the environment (natural sciences), and between the consequences and the damages (life sciences and social sciences)

Environmental Risks Are Complex (2)

The pathways of pesticides in our environment:

- The intended pathway of pesticides in the environment is quite different from the actual pathway
- If the pesticide level in the aquatic ecosystem is high enough, the fish may die



Source: Raven and Berg (2006) Environment, John Wiley & Sons, Inc., p. 539

Environmental Risks Are Complex (3)

The pesticide mobility:

- Pesticides do not stay where they are applied but tend to travel into the soil, water, and air, sometimes long distances
 - in 1994 in the U.S., The study of the Environmental Working Group (EWG) reports that:
 - 14.1 million residents drink water containing a small amount of five widely used herbicides (除草剤) which are often used on corn and soybeans; and that
 - 3.5 million people living in the Midwest face a slightly increased cancer risk because of their exposure (Raven and Berg, 2006)
- The pathways through ecosystem are partially uncertain but potentially observable, such as the amount of pesticide residue in the food and drinking water
- The amount of pesticide residue is defined as one of the environmental qualities in environmental economics

Theory and Evidence in Economics

Economists are interested in:

- Theory:
 - Relationship between variables (prices, wages, interest rates, and quantity bought and sold)
- Data:
 - Statistical test of correlations
 - *Example*: interest rate and economic growth; taxation on gasoline and quantity consumed



Figure 1. The science of economics

Theory and Evidence in Env. Economics

Env. economists are interested in:

- Theory:
 - Relationship between variables (prices, wages, interest rates, quantity bought and sold, and environmental qualities)
- Data:
 - Statistical test of correlations
 - *Example*: regulation on pollution and economic growth; taxation on gasoline and reduction of CO₂ emission



Figure 1. The science of economics

Positive and Normative Economics

Positive (実証的) economics aims to:

- <u>explain</u> economic behavior:
 - why markets and institutions have evolved as they have
 - how they work (ex. restriction of output by OPEC and gasoline price)

Normative (規範的) economics aims to:

- <u>design</u> government policies to intervene in the market to improve social welfare:
 - how and to what extent government should intervene in the market (ex. electricity market and the risk of climate change)

Lectures in the Course (1)

- 1. Fundamental Economic Theory:
 - demand, supply, and the market mechanism
 - sources of price changes
 - the impact of a price change on other markets
 - short- and long-run effects of a price change
- 2. Social Choice and Welfare:
 - individual preferences and consumer behaviors
 - social decision-making on an environmental policy
 - individual preferences and an social preference
 - Pareto criterion and social welfare function

A Dam on Baram River in Malaysia (1)

- Malaysia's largest state, Sarawak
 - aims to promote growth of aluminum smelters (精錬所), steelmakers, and other energyintensive heavy industries (重工 業) with the cheap hydroelectric power
- Construction of dam which is expected to begin 2014
 - will submerge 412 square kilometers of rain forest in water, displacing some 20,000 indigenous people
- Indigenous people:
 - the tribes of *Penan*, *Kenyah*, and *Kayan* have strongly opposed to the plan.

Source: National Geographic News, February 27



Rendering of Baram dam. Source: Website of Sarawak Energy



Source: Website of International Rivers

A Dam on Baram River in Malaysia (2)

- Endangered species:
 - Bornean bay cat, Borneo gibbon, Hose's civet, Rajah Brooke Birdwing (one of the world's largest butterflies)
- One of Sarawak's plan on economic development by 2030:
 - growth in economy by 5 times
 - increase in the population by 4.6 million
- Difficulty finding employment for indigenous people
- Conflict of interest between people in the urban area and indigenous people





Photo: Bornean Bay Cat. Source: Jim Sanderson, Mongbay.com



Photo: Borneo Gibbon Source: Website of ARKive

Lectures in the Course (2)

- 3. Cost-Benefit Analysis:
 - the value judgment in CBA
 - time discounting
 - uncertainty
- 4. Environmental Valuation:
 - no price of the environment
 - pathways of impacts of the environmental change
 - use value and nonuse value
 - how to measure the demand for the environment

Oil Spill Disaster in Alaska, U.S. (1)

- Alaska's Prince William Sound, US, in March 1989
 - Exxon Valdez dashed against rocks and spilled 11 million gallons of oil into the shoreline
 - the massive death of wildlife, including salmon, 2,800 sea otters (ラッコ), 250,000 birds, and over 250 seals (アザラシ)
 - A majority of the species affected by the spill have not yet been fully recovered even in 2011



Photo taken in 1989 by Erik Hill, *Anchorage Daily News* (2010)



Photo taken in Jul. 1989 by Jim Lavrakas, *Anchorage Daily News* (2008)

Source: William Yardley, (March 3, 2011. The *New York Times.*; Kling et al. (2012, *J. Econ. Persp.*)

Oil Spill Disaster in Alaska, U.S. (2)

- Exxon Corporation (the present Exxon Mobil Corp.)
 - more than \$1 billion spent on correcting the environmental damage
 - more than \$2 billion spent on trying to limit the extent of damage
- Environmental valuation
 - environmental valuation in 1992 by economists who were asked to study by the state of Alaska and the Federal Government
 - environmental damage of \$2.8 billion



Photo by Bob Hallinen, Anchorage Daily News Archive 1989

Oil Spill Disaster in Alaska, U.S. (3)

Year	Event
1989	On March 24, oil spill in Alaska's Prince William Sound happened
1991	The Alaska House of Representative rejected the \$1 billion civil settlement (民事訴 訟の和解金) of the Exxon Valdez oil spill.
1992	A report on environmental valuation that estimated the environmental damages caused by oil spill as \$2.8 billion was released and shared with Exxon Corp.
1994	A Federal jury in Anchorage ordered the Exxon Corp. to pay \$5 billion in punitive damages (懲罰的損害賠償金) to about 34,000 fishermen and other Alaskans who said they were harmed by the Exxon Valdez oil spill
2006	The 9th U.S. Circuit Court of Appeals (控訴裁判所) cut the award to \$2.5 billion ; Exxon appealed to the Supreme Court, which agreed last year to hear the case
2008	The U.S. Supreme Court ruled the punitive damages couldn't exceed \$507.5 million and sent the case back to the appeals court
2009	The 9th U.S. Circuit Court of Appeals this month finalized the punitive damages at \$507.5 million , and ordered Exxon to pay interest of \$470 million with the interest rate at 5.9 percent a year

Source: Carson (2012, *J. Econ. Pers.*) and the articles in the *Anchorage Daily News* and the *New York Times*

Lectures in the Course (3)

- 5. Market Failure:
 - Public goods and externality
 - Regulation
- 6. Economic Incentives:
 - Emission fees (carbon taxes)
 - Subsidies
 - Tradable permits (ex. EU Emission Trading System)
- 7. Land Use Policy:
 - Lands that have special environmental value
 - Zoning (ex. national parks, special protection area)
 - Incentive zoning (ex. transferable development right)

Schedule of Lectures

Period	Date	Торіс
Lesson 1	October 1	(Introduction of the Course)
Lesson 2	October 8	Fundamental Economic Theory
Lesson 3	October 22	
Lesson 4	October 29	Social Choice and Welfare
Lesson 5	November 5	Cost-Benefit Analysis
Lesson 6	November 12	
Lesson 7	November 19	Environmental Valuation
Lesson 8	November 26	
Lesson 9	December 3	
Lesson 10	December 10	Market Failure
Lesson 11	December 17	
Lesson 12	January 7	Economic Incentive Mechanisms
Lesson 13	January 14	
Lesson 14	January 21	Land Use Policy (without assignment)
Final Exam.	January 28	

Note: Oct. 15 is no lesson because of substitute day for holiday of Oct. 14. The lecture schedule may slightly change due to the progress of lectures.

Grading

Assignments:

- I will give an assignment in the last lecture of each topic <u>except</u> <u>the last topic</u>.
- Totally, <u>6</u> assignments will be given.
- Each assignment will be evaluated on <u>10</u> point scale.
- You can download all assignments from the page of "Courses" in my website (http://www.ecn-ito.com/ or google "nobuyuki ito")

Password:

• Password to open files is:

Requirement	<u>Maximum score</u>
Assignments	<u>60</u>
Final Exam.	<u>40</u>

Grade	Score (X)
Excellent (優)	$85 \leq \mathbf{X}$
Good (良)	$75 \leq X < 85$
Passed (可)	$60 \le X < 75$
Not Passed (不可)	X<60

This Course and You

The GSS program:

• This course is one of optional compulsory subject of the GSS program

Your future career:

- Work in a municipality, a government, and an international organization, or as a consultant in a policy think tank
 - a lot of governmental organization introduce cost-benefit analysis into the decision-making process on their policies and projects
- If you don't work at these organizations, you can improve your understandings on
 - reports issued by these organizations, and
 - newspaper articles