I. Introduction: Economic Development and the Environment

A. Environmental economics concerns all matters which directly or indirectly affect the manner and the extent to which human society makes use of nonhuman resources.

i. There are two main areas of analysis in environmental economics.

ii. First, there is the pure logic of externalities and commons problems.

- To to this may be added a logic of transactions costs and information problems.
- Mankind can not sustain itself without relying on nature for fundamental necessities, and any use of natural resources, naturally, alters the environmental balance in discernible ways.
- (The first third of the course focuses on these issues.)

iii. Second, there is the economic properties of the existing pattern of environmental laws and regulations.

- To this may be added the logic of political processes through which those laws are adopted.
- (The existing pattern of laws is largely determined by political and other public sector decisions, and these are analyzed in the second third of the course.)

B. Not all "environmental laws" are environmental in their direct intent.

i. Many laws, regulations and policies directly affect man's relationship with nature, and many other laws and regulations have indirect effects on man's relationship to nature and environmental quality.

a. For example, as we will see, a good deal of property law--especially that which deals with land and water--can be regarded as addressing environmental concerns, namely commons problems.
b. Rules which allow or promote hunting and farming imply that some fauna and flora become more common and others less so.
c. Property rights which encourage mining and manufacturing imply that some minerals become less common and others more so.

ii. Environmental "law" properly understood, thus, includes many new the rules and regulations adopted by environmental agencies, but also a good deal of civil law that stretches back for thousands of years.

- We will analyze both sorts of laws in this class.

C. The importance of laws and regulations implies that the politics of determining such rules is very important.

i. Political decisions have large effects upon the feasible uses of natural resources by defining and enforcing fundamental property rights and entitlements over matters with environmental consequences.

a. Government policies affect population magnitudes and densities through affects on birth rates, mortality rates, land use and patterns of migration.
b. Government policies affect the environment through policies and expenditures which affect the rate of return and thereby the accumulation of new knowledge and technologies.

ii. Many governmental policies emerged to solve problems of conflict over resources and with respect to externalities.

iii. To understand the existing laws and the consequent existing environmental problems, requires understanding essential features of the process through which such laws are adopted and revised.

D. Environmental policy is **a long standing concern**.

i. People have always used natural resources to advance their own private interests.

- Food and shelter are obviously important, and efforts to obtain these necessities has long had effects on the population of plants and animals that exists in a given areas of the world.

ii. Economic development, in the technological sense, tends to increase the extent to which persons understand use natural resources advance private ends.

a. As knowledge of what is possible has increased through time, more and more natural resources have become "economic resources" (scarce resources with positive prices).

- Economic development, thus, often means that natural resources are used more intensively and more extensively.
- That is to say, more and more animals, plants, and minerals are determined to be useful, and this often implies that those "resources" become scarce.

iii. However, improved knowledge about the possible uses of natural resources does not always lead to a more intensive use of natural resources.

- In many cases, improved knowledge leads to less usage, as fishermen realize that if they fish "too much" they will have fewer fish to eat in the future, or farmers realize that if they grow particular crops "too often" their fields will produce less food in the long run.
- For example, for much of recorded history farmers normally left a third of thier fields fallow every year., because this increased farm output in the long run.

iv. An important part of economic development has always been environmental laws of various kinds.

- A good deal of law addresses commons and externality problems.

v. North American environmental rules (in the narrow sense) have a long history.

a. As early as 1626, the Plymouth Colony passed ordinances regulating the cutting and sale of timber on colony lands (Meyer, 1966).

b. In 1652, the first public water supply was constructed in Boston.

c. In 1657, the burgomasters of New Amsterdam issued an ordinance prescribing that the streets be kept clean, and that all rubbish and filth be deposited at certain designated places (Sopper, 1966).

d. In 1681, William Penn required that new land owners leave an acre of forest standing for every five acres cleared in his ordinance for the disposal of lands(Meyer. 1966).

E. Some Past Pronouncements on Environmental Quality:

i. "We are in a position more and more completely to say how far the waste and destruction of natural resources are to be allowed to go on and where they are to stop. It is curious that the effort to stop waste, like the effort to stop forest fires has often been considered as a matter controlled wholly by economic law. I think there could be no greater mistake."

Gifford Pinchot (1910, *The Fight for Conservation*, reprinted in Nash (1967)).

ii. Also, consider **Aristotle**'s (330 B. C. / 1969 p. 278) discussion, in passing, of policies concerning water and air quality in his characterization of the ideal community.

"I mention situation and water supply in particular because air and water, being just those things that we make most frequent and constant use of, have the greatest effect on our bodily condition. Hence in a state which has [the] welfare [of its citizens] at heart, water for human consumption should be separated from water for all other purposes."

F. Scientific advances often allow us to recognize many externalities and commons problems that were "invisible" or "entirely mysterious" to persons in previous periods of history.

i. This can be said to have begun with efforts to provide "clean" drinking water supplies for urban settlements. These efforts greatly improved as modern theories of disease (germs) were developed in the late nineteenth century.

ii. Another relatively early example includes many of the various wildlife and bird refugees established during the late 19th century as preserves that allow many species of wildlife to survive that might otherwise have perished. In the case of the bird preserves, a good deal of knowledge about the migratory paths of various types of birds was required to develop a series of preserves that birds could fly between on their normal routes north and south, or east and west.

iii. It can also be said to be the case regarding many subtle types of air and pollution, that have only recently been targets of environmental regulation.

iv. Many environmental problems that are addressed today are **very** subtle.

   a. This does not necessarily mean that they are necesarily less important.
   b. But, it does mean that it is easier to make policy mistakes, because subtle processes can easily be misunderstood by regulators, politicians, and voters.

G. On the other hand, it also bears noting that **not** all "environmental regulations" actually address environmental problems.

i. In some cases, regulations attempt to address "problems" that are not really problems, because the risks are misunderstood by voters and policy makers.

ii. In other cases, "environmental regulations," (or at least the intensity of regulations or magnitude of penalties) are efforts to transfer wealth from ordinary persons to a favored group of firms.

H. This course attempts to provide the tools to think systematically about all of these problems using rational choice models from economics and public choice.

i. The first and second third of the course develops the theory of environmental problems, solutions, and policy formation. The last third focuses on environmental problems that have been addressed in the past two or three decades.

ii. The aim of the course is not to persuade you to favor specific environmental policies, but to induce you to think systematically and carefully about environmental issues using the tools from economics, game theory, and public choice.

iii. Sensible persons can disagree about what "good environmental policy" looks like at the margin, but all such persons should take account of effects that become clear using rational-choice based models of the economics and politics of environmental regulation.

II. Positive and Normative Economics

A. In areas dealing with public policy, it is often important to distinguish between the scientific problems of explanation and prediction and the ethical problems of evaluation and recommendation.

i. Prediction and evaluation are two separate activities.

- And it is possible for people to agree about the future (predictions) yet still disagree about the ideal policy (evaluation).

ii. The scope for disagreement is generally larger for the NORMATIVE analysis than for POSITIVE analysis.

B. Many philosophers of science emphasis the distinction between normative and positive statements. (see for example Karl Popper)

i. A **Positive Statement** is a statement about **what is**, has been or will be. It is a statement about the world.

ii. A **Normative Statement** attempts to evaluate the **desirability** of alternative states of the world.

C. Examples of Normative Theories

i. The Pareto Criteria

ii. Utilitarian Social Welfare Criteria

iii. Cost Benefit Analysis / the Compensation Principle

iv. Contractarianism: agreement (or agreement from behind a veil of ignorance)

v. Any other theory or ideology that allows one to determine "the best or worst" policy

a. Green Idealism
b. Libertarian Idealism

D. In contrast, a positive theory is concerned with whether a claim is "true" or "false" rather than whether an alternative is "good" or "bad."

i. Generally, normative statements conclude that a particular policy is good or bad, is Pareto optimal or not, should be undertaken or not, etc. Confusion often occurs because reasoned normative statements often include some positive statements to support their conclusions. E.G. X is a bad policy because X increases unemployment.

ii. (X increases unemployment is a positive statement; the conclusions about whether X is a bad policy or not depends on whether you believe unemployment is a bad thing or not--even if you accept the positive claim.)

iii. Positive statements are often confused with operational statements. *Operational statements* are statements that can at least conceptually be tested to determine whether they are true or false. Not all positive statements are testable, and moreover, give a coherent normative theory, some normative statements are testable!

iv. Puzzles/Examples:

a. The moon is made of green cheese. (p, but false)

b. Minimum wage laws always increase unemployment. (p, probably true)
c. Tariffs are a bad policy because they reduce consumer welfare. (n, probably true)
d. Mass transit reduces air pollution. (p, probably true)
e. Mass transit should be subsidized because it reduces air pollution. (n, possibly true)
f. Global warming can only be reduced with a high carbon tax. (p. probably false)

III. The Essential Geometry of Net Benefit Maximizing Choice

A. Nearly all economic models can be developed from a fairly simple model of rational decision making that assume that individuals maximize their private net benefits.

i. Consumers maximize consumer surplus: the difference between what a thing is worth to them and what they have to pay for it. $CS(Q) = TB(Q) - TC(Q)$

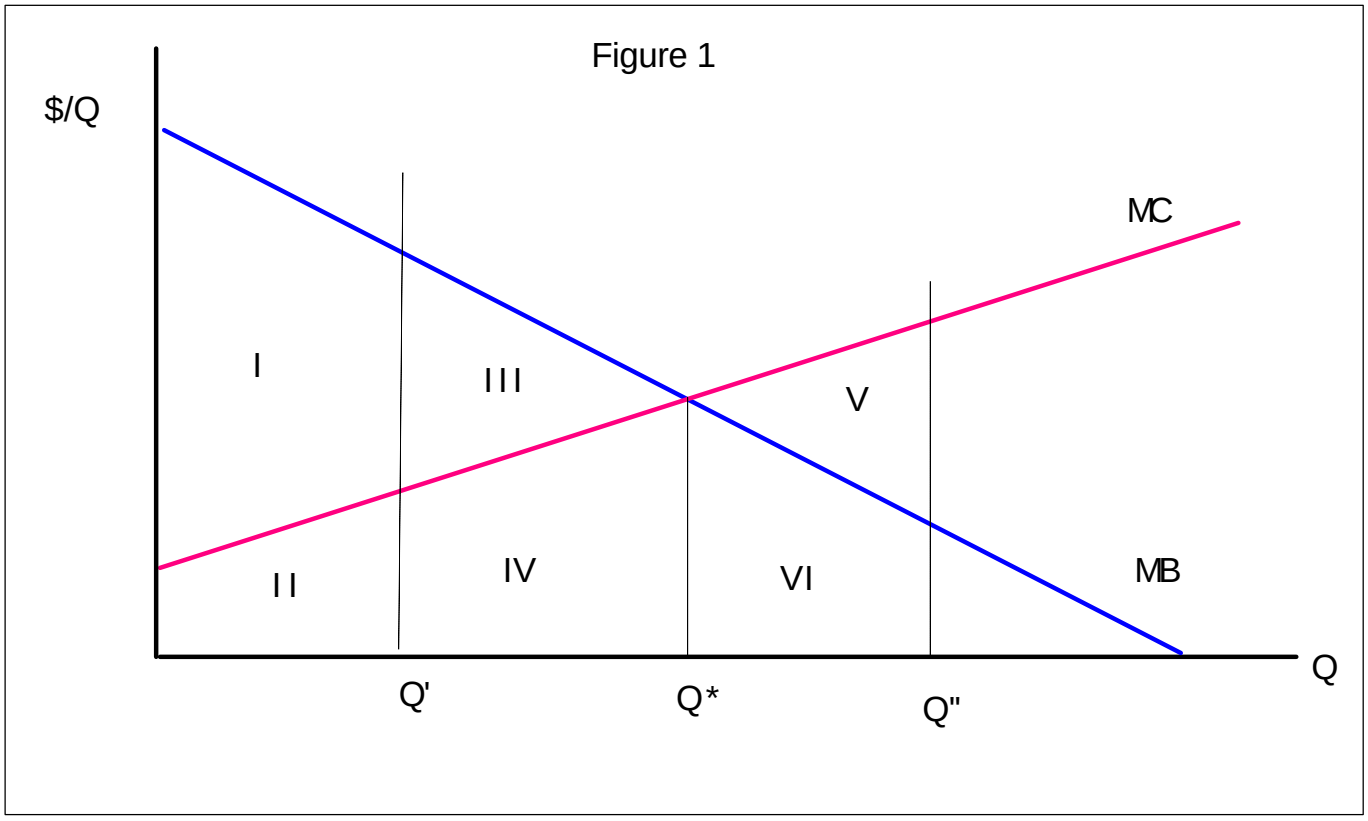
ii. Firms maximize their profit: the difference in what they receive when they sell their products and what it costs to produce them. $\Pi = TR(Q) - TC(Q)$

B. The change in benefits, costs, revenue, etc. with respect to quantity consumed or produced is called Marginal benefit, Marginal cost, Marginal revenue, etc..

i. DEF: Marginal "X" is the change in Total "X" caused by a one unit change in quantity. It is the slope of the Total "X" curve. "X" $\in$ {cost, benefit, profit, product, utility, revenue, etc.}

ii. *Important Geometric Property*: Total "X" can be calculated from a Marginal "X" curve by finding the area under the Marginal l "X" curve over the range of interest (usually from 0 to some particular quantity, Q).

iii. This property allows us to determine consumer surplus and/or profit from a diagram of marginal cost and marginal revenue curves.



C. Examples:

i. Given the marginal cost and marginal benefit curves in Figure 1, it is possible to calculate the total cost of Q' and the total benefit of Q' . These correspond to areas under the curves of interest. TC(Q') = II ; TB(Q') = I + II .

ii. Similarly, one can calculate the net benefits of any output or activity level Q by finding total benefit and total cost for the quantities of interest, and subtracting them. Thus the net benefit of output Q' is TB(Q') - TC(Q') = [I + II] - [II] = I.

iii. Use Figure 1 to determine the areas that correspond to the total benefit, cost and net benefit at output Q* and Q".

iv. Answers:

a. TB(Q*) = I + II + III + IV , TC(Q*) = II + IV , NB(Q*) = I + III

b. TB(Q') = I + II + III + IV + VI , TC (Q") = II + IV + V + VI , NB(Q") = I + III - V

c. (It should be clear that a net benefit maximizing individual will prefer Q* over Q' and Q" ! [why?])

D. *If one attempts to maximize net benefits, it turns out that generally he or she will want to consume or produce at the point where marginal cost equals marginal benefit (at least in cases where Q is very "divisible").*

i. All net-benefit maximizing decision makers tend to choose activity levels where **their own marginal costs equal their own marginal benefits**--not because they care about "margins" but because this is how one maximizes net benefits.

ii. There is a nice geometric proof of this. ("C.iv" above implies this; see also your class notes.)

iii. This characterization of net benefit maximizing decisions is **quite general**, and can be used to model the behavior of both firms and consumers.

a. The same geometry can be used to characterize the policies that maximize net benefits for a given society, insofar as "all" relevant costs and benefits can be computed.

b. It is important to realize, however, that the logic of maximizing net benefits is **not always** simply a matter of looking for where MC=MB.

E. One can use the **consumer surplus maximizing model** to derive a consumer's demand curve for any good or service (and marginal benefit curves) by: (i) varying price (the consumer's MC) (ii) finding the CS maximizing quantity of the good or service, and (iv) plotting price and the CS maximizing Q* to trace out a demand curve.

i. Note that when the marginal benefit curve is downward sloping (and MB>0) that the demand curve will go through exactly the same points as the MB curve.

ii. This implies that one can use estimates of individual demand curves as estimates of MB curves.

iii. (Although these curves go through the same points, they are not the same functions. A demand function goes from price ($/unit) into quanity (units); whereas MB goes from quantity (units) into benefits per unit ($/unit). I. E., the functions are inverses of one another.)

F. Similarly, one can use a **profit maximizing model** (another measure of net benefit) to derive a competitive firm's short run supply curve. Again, (i) choose a price (which is the firm's MR curve), (ii) then find the profit maximizing output, (iii) and plot P and Q*, (iv) repeat that process with many different prices to trace out a firm's supply curve.

i. Note that when the MC is upward sloping (and MC>0) that a firm's supply curve goes through the same points as his MC curve.

ii. This implies that one can use estimates of a firm's supply curve as estimates of its MC curve.

iii. (As in the case of demand curves, a firm's supply curve is the inverse of its MC curve. Supply goes from prices ($/unit) into quantities; whereas MC goes from quanity into $/unit measures of how costs increase as output increases.)

G. That each person maximizes their own net benefits does not imply that every person will agree about what the ideal level or output of a particular good or service might be.

i. Most individuals will have different marginal benefit and/or marginal cost curves, and so will differ about "ideal" service levels.

ii. Because each individual's "ideal" policy can be represented with marginal benefit and cost curves, these curves can be used to model **both private and political** behavior:

a. What types of persons will be most likely to lobby for subsidies for higher education?

b. What types of persons will prefer progressive taxation to regressive taxation?

c. What industries will prefer a carbon tax to a corporate income tax?

IV. Competitive Markets and Social Net Benefits

A. Market **Demand** can be calculated by **adding up** all the amounts that consumers are interested in buying at given prices. Similarly, Market **Supply** (in the short and medium run) can be calculated by adding up all the amounts that firms are willing to sell at given prices.

i. **Market Demand** curves for ordinary private goods are "horizontal" sums of individual demand curves

ii. **Market Supply** curves for ordinary private goods are "horizontal" sums of individual firm supply curves (in the short and medium run).

B. Having derived the individual market demand and supply curves using the net benefit maximizing model, it should now be clear that:

i. the market demand curve is (approximately) the sum of the marginal benefit curves of the individual consumers

ii. and that the market supply curve (short run) is the sum of the marginal cost curves of individual firms in the market.

iii. **Consequently, market demand and (SR) supply curves can be used to estimate the net benefits realized by all firms and consumers in an industry.**

C. Market prices tend to move to levels where the total quantity supplied by all firms equals the total amount demanded by consumers. (This defines P*, and Q*)

i. This model of price clearing market predicts that output and prices tend to move toward P* and Q* as prices adjust to "ration" the quantities produced to consumers. (Walras)

ii. In equilibrium, prices adjustments cause "markets to clear" at which point supply = demand.

iii. Note that this adjustment process is, in principal, an entirely decentralized process requiring governments to do nothing more than enforce property rights and contracts.

D. In the absence of externalities or market concentration, **markets tend to produce social net benefit maximizing outcomes.**

i. Note that the geometry of "market clearing" price implies that markets to produce the **output levels that set marginal social benefits (demand) equal to marginal social costs (supply).**

ii. **Consequently, competitve markets tend to produce the social net benefit maximizing level of output** (if there are no externalities, e.g. relevant spillover costs or benefits).

iii. This conclusion is one very widely used **normative** argument favoring competitive markets as an "efficient" welfare maximizing form of social organization.

V. Markets, Externalities and Social Net Benefits

A. In cases where **external costs** exist, there are costs imposed on others outside the market of interest.

B. In such cases, competitive market outcomes will (often) fail to maximize social net benefits.

i. In cases where significant external costs exist at the margin (Q*), markets will tend to **over produce** the output of interest.

ii. This is the **normative** basis for government policy in environmental areas.

iii. (Intuitively, the problem generated by air and water pollution is that firms impose costs on individuals living downwind or down stream, that are not captured by market prices.)

C. Figure 2 illustrates the "problem of external costs."

i. In this case, the industriy's marginal cost curve does not include all the true costs of production.

ii. In order to find the socal marginal cost, the "external" marginal costs should be added to the industry's marginal costs (MC = MCi + MCx)

iii. After properly accounting for all of the costs of production, we find that the social net benefit maximizing output, Q**, lies below the market output, Q*.

iv. At Q** social net benefits equal area I, whereas at Q* social net benefits equal I - IV