Environmental Economics: Basic Concepts and Debates

By Ethan Goffman

Economic activity that harms the environment creates present or future losses to humans in the form of damaged health, lower productivity, depleted natural resources, and reduced enjoyment of nature. Environmental economics seeks to quantify these losses and determine the most efficient way to reduce them, as well as to compare the cost of environmental damage to the cost of mitigation. To analyze the costs and benefits of reduced environmental damage, economists must compare changes in economic well being today with changes in economic well being in the future. This involves judging the extent to which future generations will have higher income and better methods for mitigating pollution affects.

Environmental Economics analyzes how to protect common assets, such as air http://www.chattoogariver.org/index.php?req=commons&quart=Sp2002

Introduction

Of the three factors of production in classical economics, land, labor, and capital, land may be the most difficult to define. Does it refer to just the land itself? Or is land a generic term referring to all natural resources? Air, sunshine, and water, necessary to make land productive, are all part of the surrounding ecosystems. While ownership of land itself can easily be demarcated, ownership of mobile, associated resources is trickier.

The problem is that the way owners use their land may affect others. If they dump garbage on their neighbors' land, clearly they are infringing upon others' rights. But how about if they burn garbage and the resulting smoke blows onto nearby properties? What if they pollute a stream and it ends up affecting everyone's water source, or flush sewage

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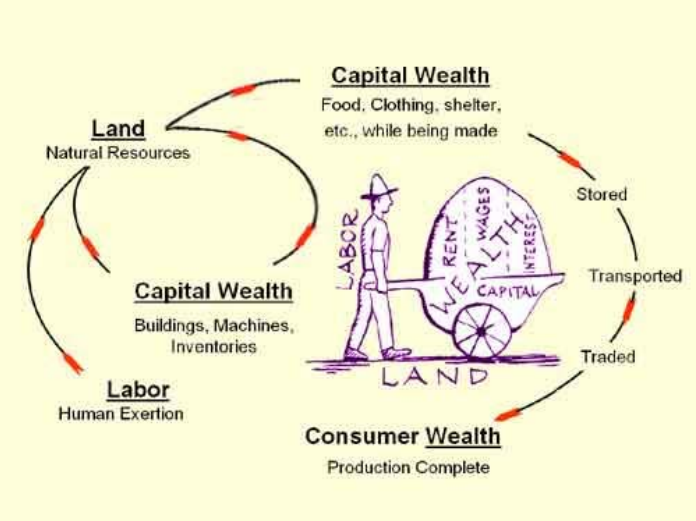


The classical factors of production
http://www.henrygeorge.org/def2.htm

away and it ends up in an ecologically stressed bay? Although the field of economics traditionally likes to deal with items that can be easily demarcated, quantified, and tagged with ownership, this becomes difficult when dealing with our shared ecosystems. Economics has dealt with this largely by labeling such items externalities**,** costs for which the responsible party does not pay. It then becomes up to the community, and usually the government, to decide how to deal with externalities.

Externalities are implicit in Garret Hardin's Tragedy of the Commons. In this scenario, a shared grazing area eventually suffers from overuse and ecosystem collapse. It always benefits each herdsman individually to add another cow to the pasture, and that addition by itself will cause little ecological stress. However, if each does so whenever possible, as economics dictates, over time all will be ruined. As Hardin puts it,

> Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

Similarly, in a purely capitalist system with no government constraints, economic logic compels individual businesses to pollute the environmental commons of the air and the water. If it is possible to save money by doing so, it will happen. Any given business must rationally fear that its competitors are doing so and thereby gaining an advantage. To remain competitive and avoid being put out of business, they must do so themselves. Socialist systems face different problems, being subject to political pressures to maximize short run production that may result in equal or greater environmental damage.

There are several ways to internalize the externalities created by common ownership. One way is to create an ownership interest for the producer. In the example above, a herdsman who owns his pasture has an interest in preserving the land for his own and his family's future income. However, ownership is not always possible, particularly regarding large natural phenomenon such as air or bodies of water. When responsible ownership is impossible or impractical, other solutions must be sought to limit the external costs of production or to compensate those who bear the costs. Determining and enforcing solutions can be extremely difficult because costs are often borne by persons living in different political jurisdictions from the producer or consumer and in different time periods.

To regulate environmental common areas, local, state or national governmental interventions are often required, balancing the interests of one set of producers and consumers with the interests of another set who otherwise bear the costs of the first set. The simplest form of such intervention is to simply prohibit pollution. Unfortunately this is impossible, for all businesses, by their very nature, create some waste products. The trick is how to minimize the harmfulness and/or amount of waste products and the impact of

their disposal. Finding ways to compel companies to do so efficiently, while still maintaining the robustness created by a free market system, is the task of environmental economists. A more thorough and rigorous definition of this task is inherent in the National Bureau of Economic Research Environmental Economics Working Group, which, according to its website

> undertakes theoretical or empirical studies of the economic effects of national or local environmental policies around the world, including effects on pollution, research and development, physical investment, labor supply, economic efficiency, and the distribution of real income. Particular issues include the costs and benefits of alternative environmental policies to deal with air pollution, water quality, toxic substances, solid waste, and global warming. (NBER)

Using Economics to Regulate the Environment

Environmental economics applies the insights of economics to environmental issues, using supply and demand to minimize the impact of the human economy on ecosystems. An older paradigm of environmental regulation placed strict mandates on how much individuals and businesses could pollute, an approach that violated basic economic logic, failing to understand the differing capabilities of different companies:

http://www.blr.com/product.cfm/product/FXX

> Where relative costs of performing an activity differ among individuals, business firms, or regions, there are almost always potential gains from

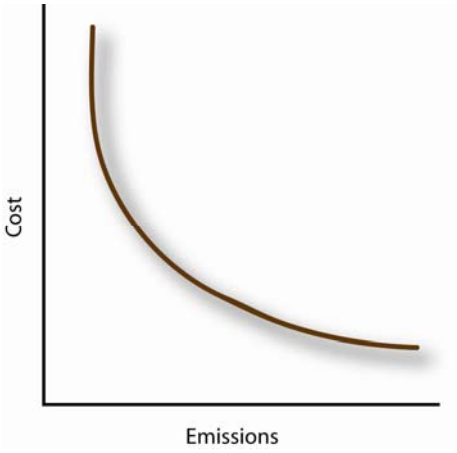
> trade. In today's jargon, trade can always be win-win. Traditional approaches to addressing environmental problems have generally not taken advantage of this potential. Rather, command and control regulatory policy instruments have been the tools of choice. (Edmonds et al. iii)

However, as the *Economist* explains it, the old environmentalist habits of regulation and litigation are changing: "Yesterday's failed hopes, today's heavy costs and tomorrow's demanding ambitions have been driving public policy quietly towards market-based approaches." For some companies regulation can be extremely burdensome, while others need only slight changes and could easily surpass mandates. Inflexible caps are not economically efficient.

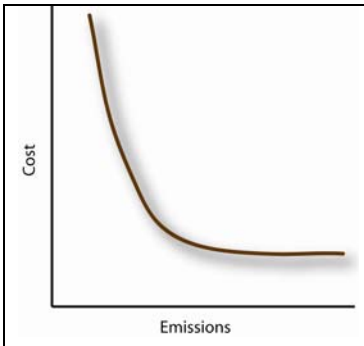
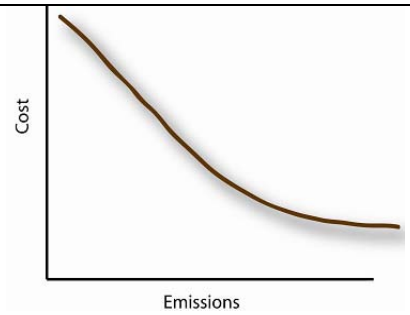
One way to increase flexibility is emissions charges, a straightforward tax on the release of pollutants. "By leaving polluters free to determine how best to reduce emissions" such charges harness individual companies' "energy and creativity and their desire to minimize costs, to find the least-cost way of reducing emissions" (Field & Field 235). There is some flexibility, in that those for whom regulation is most onerous can pay their way out of it, while others will reduce the amount they pollute. Still, this approach cannot meet specific targets. A more sophisticated approach is Cap and Trade, in which "individual sources of pollutants are issued emission permits, which may be bought and sold in transactions with other sources, or with other market permits. A cap on the total number of permits ensures that total air or water pollution will be reduced" (Field & Field 8). Cap and Trade sets an overall limit on the emission of a certain pollutant, but allows companies that can easily reduce emission to sell credits to other companies, essentially selling the right to pollute. Depending on the situation and the way it is implemented,

Cap and Trade can offer the flexibility allow an optimum balance between economic output and pollution control.

Marginal Abatement Costs



The basic reason why this approach works is that it's easier for some businesses to reduce pollution than others. Pollution reduction depends on many factors, such as the equipment used by a given business, the item being produced, the availability of new technology, and so on. The graph on the left shows the **Marginal Abatement Cost** in which, as the money spent to reduce pollution goes up the amount of emissions goes down, although not necessarily in a straight line. This graph can be quite different for different companies. Let's assume that there are two companies with very different circumstances that have very different Marginal Abatement Cost functions when it comes to reducing emissions. The first can easily decrease pollution (say through a basic technologi-

	
Company A	Company B

cal investment) but then has difficulty decreasing it further. The second has a more regular Marginal Abatement Cost graph.

To optimize efficiency, that is, to reduce emissions the most for the least cost, Company A should make the investment that allows the initial plunge in emissions, but further investments are fairly futile. The regulating agency may determine that this emission level is sufficient, but if further decrease is desired it is Company 2 that should investment in emissions control for maximum economic efficiency.

Note that regulations requiring a set amount of emissions reduction will usually lead to greater cost than necessary. To illustrate this let's look at the two companies in chart form:

Pollutants Emitted	Company A	8	10	12	14	15
	Company B	4	8	12	16	20
	$ Spent (in thousands)	10	20	30	40	50

The numbers in the grey row represent money spent and the numbers above represent units of pollutants emitted. Assume that studies have shown that emissions need to be reduced by 24 units to allow healthy ambient air quality in the local area. If regulators require each company to reduce emissions by 12 units, the total cost would be $60,000. However if Company A were to reduce emissions by 8 units and Company B were to reduce by 16 units the cost would be only $50,000 for the same amount of reduction, saving $10,000. For a much smaller target reduction of 8 units, it is most efficient for Company A to spend $10,000 and Company B to spend nothing at all. For a larger emissions reduction target of 28 it would make sense to increase company B's share to 20 and leave

Company A at 8, for a total cost of $60,000. Only for extremely large reductions (off of this chart) does it make sense to start increasing company A's load, as each reduction by company B becomes increasingly expensive. Much of environmental economics deals with such situations, figuring out the most economically efficient way to lower environmental impact.

The above is a greatly simplified version of events. Normally there are numerous companies with a great variety of Marginal Abatement Costs (and numerous kinds of environmental impacts) to worry about. Still, by fusing the different companies in an aggregate graph, it is always theoretically possible to find the most efficient—that is the least costly—means of reducing emissions. Figuring out how "to reduce aggregate emissions at the least possible cost" from multiple sources with differing marginal abatement costs is known as the equimarginal principle (Field & Field 104). The math may become far more complicated than in the above example, but the underlying principles are the same.

The Real World

The preceding graphs assume a perfect knowledge of facts that is exceedingly rare in the real world, where "there are very few actual instances of environmental pollution where the marginal damage and marginal abatement functions are known with certainty" (Field & Field 107). The science might not be advanced enough to calculate how much each kind of technology reduces a given kind of pollution. On top of this, companies have an interest in estimating costs of lowering pollution on the high end so that each can argue that it is receiving an unfair burden. In practice, it is not realistic for regulators to name the specific amount of reduction necessary for each company.

Fortunately there is a solution to the problem: the market. The government sets an external regulation in such a way that the market can most efficiently adjust: “most important is that prices must be set correctly. The best way to do this is through liquid markets, as in the case of emissions trading. Here, politics merely sets the goal. How that goal is achieved is up to the traders” (economist). One such regulation mechanism, as mentioned above, is taxes. In the above example, if a tax is levied on each unit of pollution, Company A will invest in emissions reduction where it’s most effective, early in their Marginal Abatement curve, then pay taxes where it would be cheaper than making additional investments. While taxes are the easiest mechanism to implement, they are also the least precise—it’s difficult to predict just how much a given tax will lower pollution.

Where a definite target is sought, one common method is Cap and Trade. Companies may sell, on an open market, their right to pollute. Under a Cap and Trade system, the above mentioned Company A would be likely to buy emissions from Company B once it rose above its inexpensive, high-impact initial investment of $10,000. In the far more complicated real world, companies buy and sell the right to emit until the most efficient price level is found. There’s no need for regulators to attempt to calculate the best level for each company and no need for companies to obfuscate.

Under either tax or Cap and Trade systems, essentially each company is paying for its right to harm the environmental commons. While some might regard this as intrinsically bad, it is far better than the previous situation, not paying to pollute the environmental commons. All economic activity involves some environmental cost, without which human life as we know it would come to an end. However, the environmental

commons is an enormous system capable of self-repair, and the idea is to collectively keep this system from approaching any dangerous thresholds while maximizing economic growth. This, at least, is the theory derived from classical economics; ecological economists operate from different assumptions.

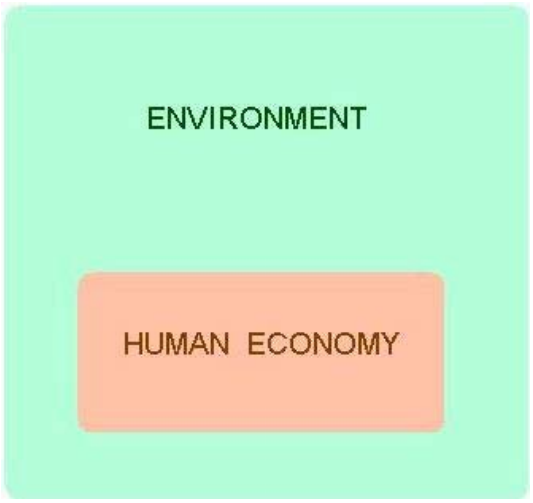
Ecological Economics: Altering Assumptions

The field of Ecological Economics was founded in the 1970s, based on critiques of classical economics as making the environment an extension of economics, just another factor of production, a cost of doing business. If Environmental Economics starts from classical economics and extends it to apply to environmental matters, Ecological Economics considers the earth and its ecosystems as the larger system, of which the human economy is just a subset. In this paradigm there is an economy of nature, a distribution of goods and services, in which human activity is merely one aspect of natural activity. Humans, like all living creatures, draw sustenance from the environment and create "waste," although our waste products may be other creatures' (animal, plant, or single-celled organism) food sources. In the long run, the system will find uses for all "waste" products, evolving and regenerating, although humans will not necessarily be part of the picture.

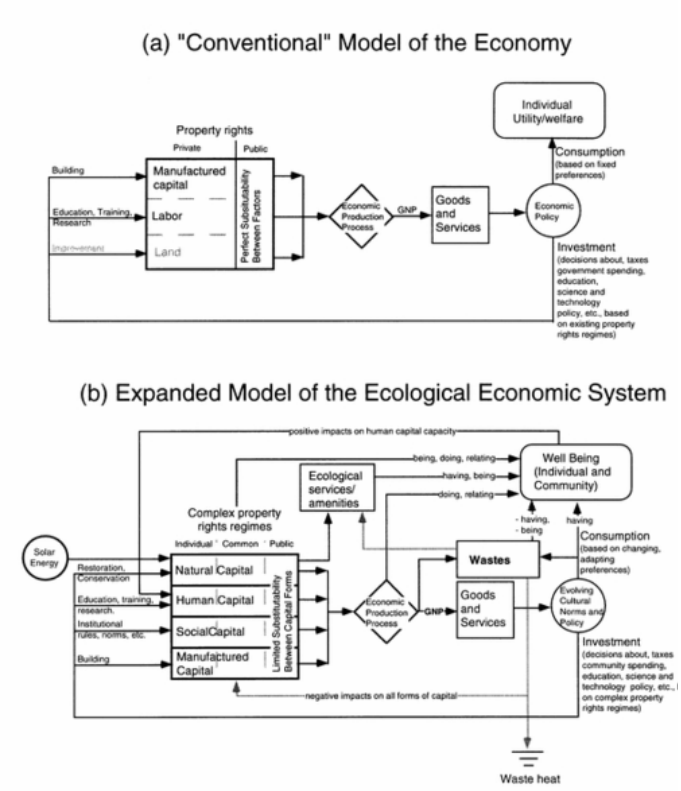
Ecological economists point out that humans are part of an environmental system that follows the first law of thermodynamics, the conservation of mass and energy. Thus the economy can never grow beyond the limits of the environment. This does not mesh

with the classical economic schemata in which land—which stands in for the environment—is a subset of the entire economy, which can grow forever:

In contrast, for ecological economists the economy functions as part of a larger ecosystem. Human activity is simply part of a larger—and finite—flow of energy, goods, and services. Given its emphasis on larger ecological systems, ecological economics "generally assumes a longer time horizon than" environmental economics and "pays more attention to cause-effect chains, interactions and feedback between natural and human-economic systems" (van den Bergh 6).



One important project to arise from ecological economists' emphasis on the larger environment is the attempt to evaluate the total value of all the world's ecosystems. A notable 1997 paper by Costanza, et al. estimated a total worldwide annual value of between US$16 and 54 trillion on crucial natural services, defined as "flows of materials, energy, and information from natural capital stocks which combine with manufactured and human capital services to produce human welfare" (254). The paper included 17 services provided by Mother Nature yet often overlooked by economists, such as climate regulation, nutrient cycling, crop pollination, and recreation. The authors qualified their argument by noting the problematic nature of many of their estimates, which rely on a number of assumptions, and the difficulty of quantifying nature. At the extreme end, they point out, "It is trivial to ask what is the value of the atmosphere to humankind, or what is



Different visions of the economy based on disparate world views. Conventional economics model (a) and expanded ecological economics model (b).

the value of rocks and soil infrastructure as support systems" (255). While employing the quantification techniques common to economists, the article shows a skepticism, common to ecological environmentalists, regarding the over-reliance on such techniques.

Environmental economists and ecological economists, then, use many of the same concepts, trying to figure out interactions between the human economy and the environment, trying to evaluate mechanisms by which our economic choices will allow for better human lives in the long-term, to enhance sustainability. Still, ecological economists question the tendency of many economists to quantify as much as possible so that they can fit heterogeneous matter into a system easily graphed, and measure costs and benefits. As Daly and Farley put it, the attempt "to put monetary values on nonmarket goods such as ecosystem services not only compounds . . . ethical issues with serious methodological problems, but also implicitly assumes that natural capital and manmade capital are perfect substitutes, a position that most ecological economists strongly reject" (236). While this critique might simplify the views of many economists, it points to mutual mistrust between ecologists and economists that may lead each to feel that the other is naïve. Sonia Conly, a retired federal financial

economist, sees "ecological economics as a special case of environmental economics in which the social rate of discount is assumed to be zero and technological progress is also assumed to be zero" (Conly). In this perspective, ecological economists underestimate the ability of future generations to react to environmental changes.

Artist Gilberta Daniels Goodwin depicts the Gross National Product
http://www.si.umich.edu/Art_History/demoarea/details/SC065.html

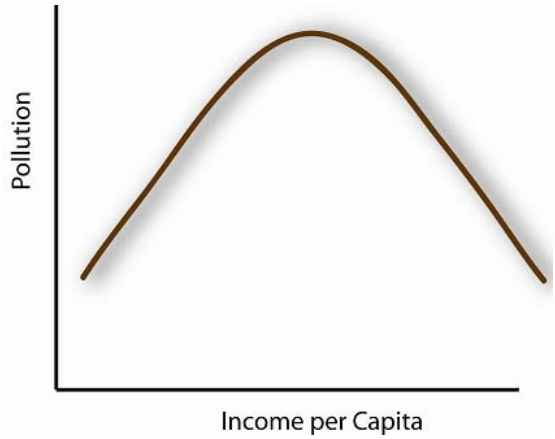
Ecological economists, conversely, question traditional economists, for whom "sustainable development is usually regarded as being identical to sustainable growth" (van den Bergh 5). By contrast, many ecological economists believe in more radical change, toward a steady state economy that "undergoes neither growth nor recession. To be more specific, it has constant populations of people . . . and constant stocks of capital" (Czech & Daly 599). It also has a constant level of throughput, defined as "the flow of natural resources from the environment, through the economy, and back to the environment as waste" (Daly & Farley 7). Ecological environmentalists believe that the idea of incessant growth is no longer viable and that, since we are depleting long-term stocks of natural resources, we have already reached an unsustainable crisis state. Rather, they argue, we must concentrate on improving quality of life in ways apart from increasing Gross National Product (GDP).

The relationship between lowering throughput and GDP is a problematic one. While historically GDP and throughput have correlated strongly, it is unclear whether they must continue to do so. As Daly and Farley put it, "Better technologies, as well as a

better ordering of our priorities, can reduce the throughput without lowering the quality of life" (33). Ecological economics also question "strict and fixed assumptions in traditional economic theory with regard to individual behavior," tending toward the belief that behavior is largely motivated by social expectations, and that these can be altered. Humans, then, are not seen as motivated strictly by self interest, but as beings shaped by, and interacting with, social and natural environments.

Growth and the Environmental Kuznets Curve

The Kuznets curve represents the theory that economic inequality increases as a country develops industry, then begins to decrease as an economy approaches maturity. A variant on this idea is the environmental Kuznets curve (EKC), which holds that as countries develop they generate large amounts of pollution, but this shrinks as they approach economic maturity. This occurs "because at low incomes people tend to value development over environmental quality, but as they achieve greater wealth they are willing to devote greater resources to environmental quality improvements" (Field & Field 12). As Conly puts it, "One way to think about this is that clean air, water, etc. provide an enjoyment that is income elastic. So as income increases above a threshold individuals and society will want to spend a larger share of their incomes on these goods, reducing the pollution per unit of output and perhaps even total pollution." In addition, developing countries tend toward highly polluting heavy industry, while developed economies rely on relatively clean advanced technology as well



as service-sector businesses. The EKC, however, is a contested notion, particularly by ecological economists, who believe that good environmental stewardship is possible at different levels of development.

Studies done on this are complex and contradictory, and the relevance of the Environmental Kuznet curve seems to vary according to situation. Theodore Panayotou argues that much depends upon whether pollutants are local—whether polluters are essentially fouling their own nests—or are externalities paid for by those far away, polluting a larger commons:

> In the case of pollutants such as SO2 and particulates, where the damage is more evident to consumers and, hence, pollution prices are near their marginal social costs, turning points have been obtained at relatively low-income levels. In contrast, turning points are found at much higher income levels, or not at all for pollutants such as CO2, from which damage is less immediate and less evident to the consumers (8).

Panayotou qualifies his support of the EKC, believing that transfer of technology plus good policy can minimize environmental impact at differing levels of development.

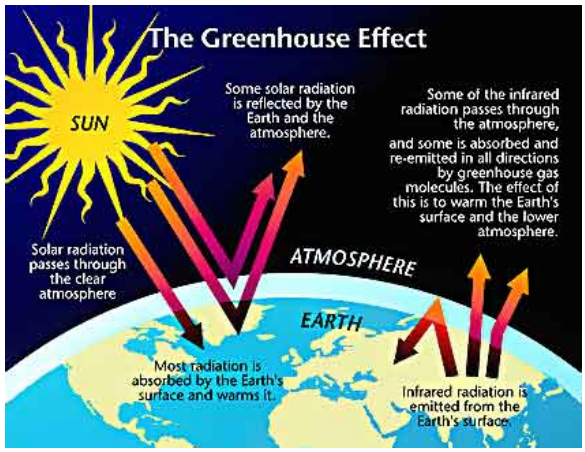
David I. Stern, writing for the International Society for Ecological Economics, attacks the very idea of the EKC. His analysis shows that countries rich and poor tend to reduce pollution relative to economic output over time, but that since developing countries grow at a rapid rate their overall pollution grows rapidly: “in rapidly growing middle income countries the scale effect, which increases pollution and other degradation, overwhelms the time effect. In wealthy countries, growth is slower, and pollution reduction efforts can overcome the scale effect” (3). In other words a fast-growing economy will

produce more pollution despite technological advances. A more recent study, using other methods, finds evidence that the Environmental Kuznets curve does in fact exist, while stipulating that it "still remains a very fragile concept" (Galeotti et al. 16). Another current study, of Latin American countries, shows "significant evidence of an EKC relationship for deforestation" (429), a result consistent with the theory that highly visible local conditions are most susceptible to the EKC. Still, the study cautions that "environmental policies and institutional arrangements" also need to be accounted for (436).

Scale, specific situation, and type of environmental degradation are some of the variables that must be carefully examined when evaluating the EKC. Still it's clear that, particularly in countries such as China and India, where growth is far outpacing improved environmental efficiency, simply allowing development to take its course is insufficient.

The Kyoto Treaty and Environmental Economics

The emission of greenhouse gases presents a paradigmatic Tragedy of the Commons. A country that emits a large proportion of the world's greenhouse gases may derive disproportionate economic benefits while bearing a relatively small share of the environmental damages caused by their emissions. As Sir Nicholas Stern explains it, "Greenhouse gases are, in economic terms, an externality: those who produce greenhouse-gas emissions are bringing about climate change, thereby imposing costs on the world and on fu-



The basic science behind global warming
http://www.ucsusa.org/global_warming/science/global-warming-faq.html

ture generations, but they do not face the full consequences of their actions themselves" (xviii).

> The situation can be considered
>
> a typical 'prisoner's dilemma.' The worst outcome would arise if no move were made by any global player. This situation would aggravate the greenhouse effect and make later adjustment more drastic and more costly. The best outcome would be obtained in the case of full cooperation between the players. (Bouzon 15)

To move toward the best outcome, by 1997 much of the world had signed the Kyoto Treaty, the primary international accord attempting to regulate global climate change. Although the United States and Australia never ratified the treaty, by 2005, when Russia finally signed, enough countries has ratified for it to come into force.

Integral to the Kyoto Treaty are mechanisms taken from environmental economics. The treaty is driven by the need to balance differences between countries in an economically efficient way:

> Countries and regions differ in their degree of dependence on production activities that emit GHGs [greenhouse gases], the efficiency with which they produce goods and services per ton of GHGs emitted, and the ease with which they can change their current dependency and efficiency (for example, their relative ease of access to coal and natural gas resources or combined cycle combustion technology). Therefore, it is only natural that they would experience different marginal (incremental) abatement costs when they attempt to limit their emissions of GHGs. (Edmonds et al. 2)

The Kyoto Treaty therefore applies flexible economic instruments, notably Cap and Trade, to climate change emissions. Under Kyoto Cap and Trade, countries are granted emissions credits, which they may then buy and sell on a free market. This means that banks, brokers, and other market instruments are involved in the trading of such credits, which should eventually arrive at the best price for efficiently meeting conservation goals. Europe has led the way with a "cap-and-trade scheme intended to enable the EU to conform to its Kyoto targets in 2008-12" (Bouzon 3).

Kyoto appears to present a textbook case for Cap and Trade. A simpler scheme, such as taxing greenhouse emissions, may lead to problems: "The authorities set the amount levied arbitrarily and it can be either too high or two low" so that "the result in terms of emissions control is rather uncertain" (Bouzon 16). Particularly among a large number of countries, emissions trading by contrast will make it likely "that the production of emissions allowances and resulting allowances will be relocated in the zone presenting the lowest production costs" (15).

One of the issues in the Kyoto treaty is who should bear the cost of changes in production and consumption intended to reduce environmental damage. The distribution of climate change costs among nations and regions and between groups is only one among a number of distributional questions engaging economists. Kyoto divides countries into developed and developing. Because the wealthier, developed nations are responsible for a large majority of the greenhouse gases, only they are expected to satisfy emissions targets. Although not subject to these targets, developing countries may nevertheless participate in the process by selling credits to reduce their emissions. Besides the moral aspect of requiring those most responsible to take action first, the lack of en-


Sir Nicholas Stern, whose report calls for drastic action on climate change
http://en.wikipedia.org/wiki/Nicholas_Stern

forceable reduction targets for developing countries also has an implicit basis in the Environmental Kuznets Curve, according to which developing countries are not yet ready to decrease greenhouse emissions. This assumption is a key factor in the United States' rejection of the treaty; America questions whether China and India, with their greatly increasing their greenhouse emissions, should be exempt.

Traditional economic approaches may also undercut Kyoto. Discounting, a common economics formula, may lead to the conclusion that the costs of Kyoto outweigh the benefits. Discounting means that some formula is applied to future events to lower their value based on distance in the future. This is because any money spent on environmental improvements could be invested elsewhere, and the potential interest on that investment must be considered lost. Theoretically, if we were to invest money spent on meeting Kyoto targets in economic growth, our stronger future economy would be more capable of paying to mitigate future effects of climate change. So the lost growth from following Kyoto would be a higher cost than the environmental damage the treaty alleviated.

Critics of this method argue that environmental impacts are not easily reducible to monetary amounts, that "for 'non-market goods' like human life (or the inherent value people place on the existence of other species), the assignment of a monetary value is much more controversial" than for market goods. (Farber & Hemmersbaugh 2). We also don't know the effects of certain climate thresholds, such as at what point the Greenland

ice shelf is likely to collapse, or whether and when changes in ocean circulation will bring a new ice age to Europe. In a prominent report, Sir Nicholas Stern argues that "uncertainty is an argument for a more, not less, demanding goal, because of the size of the adverse climate-change impacts in the worst-case scenarios" (xvii). Stern sets an extremely low discount rate on the future; that is he values future problems nearly as much as current ones. The Stern report calls for immediate, drastic action, warning that to do otherwise "could create risks of major disruption to economic and social activity, later in this century and in the next, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century" (ii).

Economist William Nordhaus, working from more conventional economic assumptions about discount rate, came up with very different conclusions:

> The [Stern] *Review* proposes using a social discount rate that is essentially zero. Combined with other assumptions, this magnifies enormously impacts in the distant future and rationalizes deep cuts in emissions, and indeed in all consumption, today. If we were to substitute more conventional discount rates used in other global-warming analyses . . . the *Review's* dramatic results would disappear (Stern review 6).

Nordhaus argues that "efficient or 'optimal' economic policies to slow climate change involve modest rates of emissions reductions in the near term, followed by sharp reductions in the medium and long term" (Stern review 2,3). Certainly, a more gradual introduction of greenhouse gas reductions would be politically easier to introduce than the extreme change Stern calls for.

The question of how to discount our responsibility to future generations is inherently difficult. Some scholars who favor Kyoto argue that, as more countries submit to Kyoto standards, the comparative advantage of those who abstain lessens. Regarding emissions trading, “the extension of this scheme beyond the EU creates a level playing field in which international competitors are confronted with similar constraints and costs associated with greenhouse gases” (Bouzon 9). The problem of the commons is reduced when enough countries sign on to protecting global environmental resources. A further argument is that conforming to Kyoto will benefit employment in those countries that develop new technology.

The centrality of Cap and Trade in the Kyoto Treaty, and in recent U.S. congressional proposals by Senator John McCain, among others, illustrates how ideas advanced in Environmental Economics have become the norm. Yet Nordhaus disagrees with this newly conventional wisdom, arguing that a simpler mechanism, such as carbon taxes, would work better. Kyoto Cap and Trade mechanisms use a 1990 baseline relative to which developed countries must regulate their emissions. Yet, as countries circumstances change, picking a specific year rewards some countries and penalizes others: “Base year emissions have become increasingly obsolete as the economic and political fortunes of different countries have changed. The 1990 base year penalizes efficient countries (like Sweden) or rapidly growing countries (such as Korea and the United States)” (after). Of course another base year could be picked, but this would just lead to another set of countries penalized or rewarded, depending upon which already had state of the art emissions control by that year, among other factors. Cap and Trade, then, leads to difficult choices in creating a set of standards, while a simpler carbon tax system impedes attainment of

definite targets. The best way to regulate climate change emissions remains unsettled, even as the world struggles to deal with a mounting crisis.

Urbanization in coastal areas presents an example of how climate change interacts with other issues to create a difficult series of challenges. Developing and developed countries have experienced population movement toward the sea in recent years. Some argue that coastal urban development exposes increasing numbers to weather hazards and creates conditions for even more severe flooding by damaging natural protections (ScienceDaily). Among the questions likely to engage economists are: who will pay for the mitigation of rising sea level and possible migration coastal residents? How should water rights be distributed among regions and internationally? How do alternatives such as Cap and Trade, non-price rationing, and carbon tax affect the distribution of income within nations and between nations?

Environmental Economics has made an important contribution to questions raised be environmental changes, finding ways to add free market incentives that increase environmental efficiency. These mechanisms must be implemented through a process of adaptive management that struggles to define best practices, and ultimately through the political process. In addition, the debate over discounting and global climate change may point to some weaknesses in the over-reliance on classical economic thinking to solve complex environmental—and related social—problems. Certain basic philosophical questions, many of them regarding underlying values, remain a subject of debate.

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