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Digging Deeper: Applied Ecological Economics

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Abstract
This booklet was designed as part of an honors contract for macroeconomics at Johnson County Community College (JCCC) in the spring of 2015. Inspiration for this project came from the author's personal desire to learn more about how one could apply economics to environmental issues.

Cover Page Footnote
Professor Sheryl Hadley was the Faculty Adviser for this Honors contract.

Recommended Reading

- *The Nature Principle*—Richard Louv
- *Eaarth*—Bill McKibben
- *Naked Economics*—Charles J. Wheelan
- *The Wealth of Nature: Economics as if Survival Mattered*—John Michael Greer
- *Ethical Markets: Growing the Green Economy*—Hazel Henderson

About this project

This booklet was designed as part of an honors contract for macroeconomics at Johnson County Community College (JCCC) in the spring of 2015. Inspiration for this project came from my personal desire to learn more about how I could apply economics to environmental issues, a topic I am very passionate about. While it was difficult narrowing down the concepts I wanted to teach, I still felt that I had the flexibility to teach the most important ideas while also presenting emerging ideas such as the collaborative economy and Cradle-to-Cradle®. This project would not have been possible without the ongoing support of my advising professor, Sheryl Hadley. The Honors Program also deserves recognition because the faculty here have always supported me in my academic endeavors and have allowed me to apply my creativity to my academic projects.

JOHNSON COUNTY COMMUNITY COLLEGE

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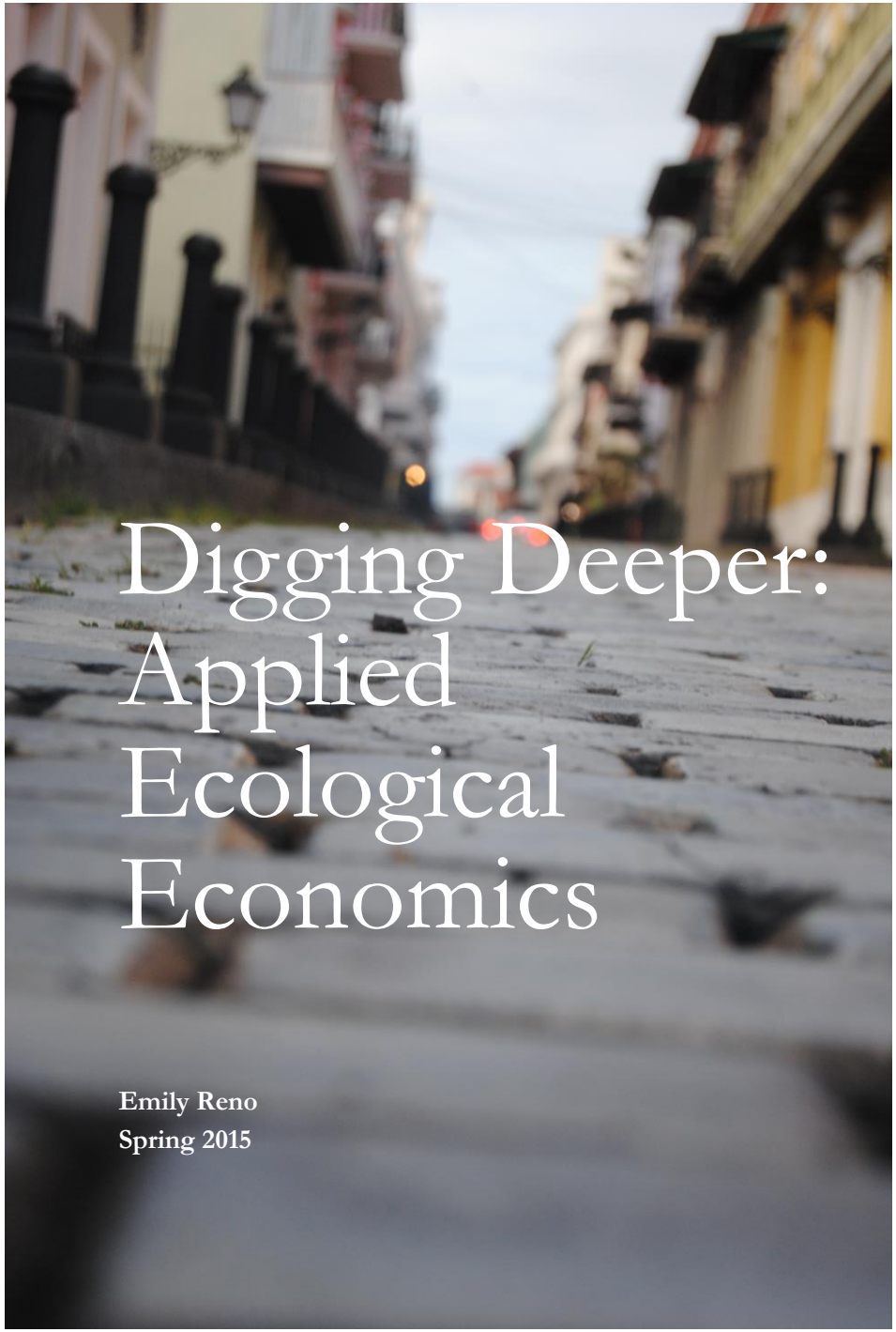
Cover photo courtesy of Emily Reno



Digging Deeper: Applied Ecological Economics

Emily Reno
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Introduction

Vandana Shiva once said in her novel *Earth Democracy: Justice, Sustainability, and Peace*, that "in nature's economy the currency is not money, it is life." For the environmental economist, creating value for an object requires much more than a simple mathematical computation. They strive to incorporate the "human" aspects of life—the variable and indecisive—into their recommendations, which can be quite complicated. For example, how should a company decide *where* to locate their new factory? Do they look solely at profit estimates or consider the impact on water quality of the surrounding residential area? How much should the city charge for trash services, or how should the system of waste collection itself work? Would charging by the bag decrease the amount of waste being produced and increase the demand for recycling services?

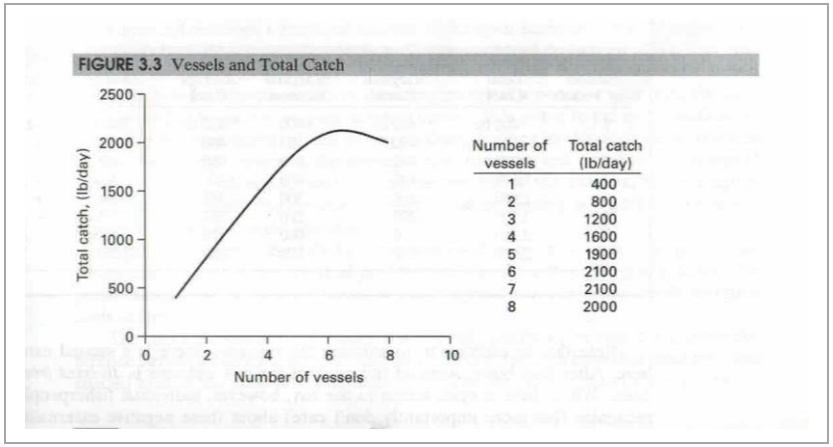
In the past, considering the environment as a part of the decision-making process was not as popular. Why should one think about where their trash is going to end up if they have so much unused space available? As time goes on, however, and our population continues to grow (estimated by the World Health Organization to reach eight billion by 2025), that seemingly endless space to dispose of and develop has become extremely valuable to politicians and environmentalists alike. While economists have always recognized the scarcity of resources and determined how to manage them, the environmental or ecological economist uses the well-being of the physical environment as a prominent factor in decision-making. Today, they might work in fields such as resource management, environmental consulting, project management, and agricultural economics. Indeed the basic economic concepts and models are used in the following pages, but additional content will equip students with the tools for environmental applications and provide subsets of exciting projects and historical notes related to the field.

The Tragedy of the Commons

The open access problem, or the tragedy of the commons, is a concept that Garret Hardin popularized in the 1960's. He created a hypothetical situation in which a herder had control over how many cows they could place on a common plot of land. Adding one more cow to the plot would increase the individual's profit, but a different herder would think the same thing, and soon every herder would be adding as many cows as they could to the plot to maximize their profit. At the same time, though, the amount of grass that the cows could eat would decrease until eventually too many cows would be on the land and either some would die or they would all eat less, produce less, and ultimately earn the herder less money. As noted by Eban S. Goodstein in *Economics and the Environment*, "Hardin suggests a stark and inescapable connection between common ownership of resources and their ultimate exhaustion" (32).

The following example comes from *Economics and the Environment:*

Suppose that fish cost a dollar a pound, and the marginal cost of running a vessel—including the fuel and salaries for crew and owner—is $250 per day. Then the rational response for fishing boats is to continue to fish as long as, on average, the catch exceeds 250 pounds. Suppose that the long-run relationship between the number of vessels and the total catch per day in the New England bay is illustrated in Figure 3.3. The catch level peaks at six boats, and after seven boats, drops off, reflecting fishing beyond a sustained yield level. If eight boats go out on a regular basis, then the breeding stock is harvested, and over time the population of fish declines.



Why don't fishers put limits on the amount that they can harvest? While overall the total catch decreases, each individual fisher only experiences a small decline in their catch. As long as their *own* marginal revenue exceeds marginal cost, the total catch and total revenue in the industry can decline without them realizing the bigger picture.

Did you know?

In 1976 Congress passed the Magnuson-Stevens Fishery Conservation and Management Act to oversee marine fisheries management in the United States' federal waters. This law established a 200-mile fishery conservation zone along with Regional Fishery Management Councils. In 1996, major amendments of the Sustainable Fisheries Act increased the involvement of the Secretary of Commerce by requiring that they take action to identify overfished species, rebuild those specific stocks, and promote guidelines to identify essential fish habitat.

Application 1

Use the table below to answer questions related to the problem of open access.

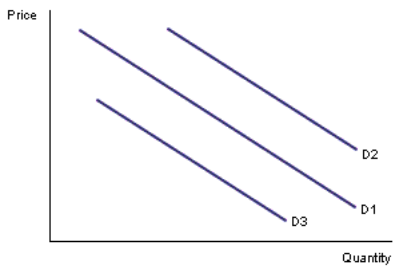
The following data refers to the number of logging operations working in a stretch of tropical rain forest.

Number of Operations	Total Harvest (1000 logs)
0	0
1	40
3	75
4	105
5	130
6	150
7	165
8	160
9	155
10	150

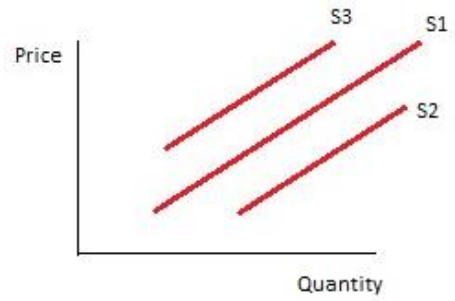
1. Based on the data and using marginal analysis, what is the optimal amount of operations for total harvest? Why might loggers continue to cut down the trees even if the total harvest goes down for everyone in the industry?

2. A new technology in the paper industry revolutionizes the ability to produce recycled paper. Which graph reflects this change in the market?

Graph A



Graph B



3. How does the curve shift?

A. From D1 to D2 B. From S1 to S3

C. From D3 to D2 D. From S1 to S2

All answers to application problems are located in Appendix A: Applications

TAKING ADVANTAGE OF UNDERUTILIZED RESOURCES: THE COLLABORATIVE ECONOMY

No one can deny that the act of sharing existed long before the arrival of desktop computers. The new technology revolutionized the speed and convenience with which we could buy and re-sell objects. Ebay, and then Craigslist became the first iconic symbols of the movement allowing consumers to give new life to old stuff (ranging from furniture to clothing to CDs) by simply photographing it and posting it in an ad online. The movement to share, reuse, and exchange services has increased exponentially to the point that it deserves its own name: the sharing, or collaborative, economy. It consists of startups across the globe connecting people through websites and cellphone applications. As of 2014, the $110-billion dollar industry (Tomalty, 2014) allows travelers to rent out rooms in private homes as opposed to staying in a hotel, drive the car of a lender around the corner from their apartment, and even rent designer purses for a monthly subscription. Participants have found that they can save considerable time and money by taking advantage of the various products and services offered on loan, and the declining number of final purchases suggests a shift in the way society views ownership. It has been argued that "collaborative consumption is becoming the name of the game instead of individual acquisitiveness" (Tomalty, 2014). For a comprehensive summary, scan the QR code:

Market Failures

Within the realm of market failures, there exists two categories: Public goods and externalities. This organization is diagrammed below:

Remember, public goods are products or services that one can consume without reducing its availability and from which no one is excluded. For example, consider a fireworks display. Only the people purchasing the fireworks foot the bill. Aside from this, the viewers do not have to pay to see them. The only costs that people incur are the ones associated with premium viewing spots. Taking advantage of this free service is known as **free riding**, and for the environmentalist it presents quite an issue because they cannot force people pay for the benefits of a clean environment, such as ecosystem services. Examples of ecosystem services include food, medicines, water purification, flood control, or anything else from the environment that benefit people.

Now let's look at the other side of the spectrum, the externalities. These are costs or benefits of a transaction not borne by the buyer or seller. The number of individuals affected varies quite greatly depending on the situation. Say a neighbor decides to mow their yard at 6 a.m. The neighbors are affected by the noise pollution, creating a negative externality. However, what if that same person invests so much into their home's landscaping that they win a lawn and garden award from the city? In this case, the whole neighborhood benefits from his fame by way of increased property values and general aesthetic improvement. In this section we will explore how U.S. legislators have dealt with the consequences of the negative externality of pollution. Beginning in the late 1960's, the U.S. government implemented various laws to keep businesses and local governments accountable for maintaining certain standards, which are summarized in the table to the right.

Major Environmental Laws in the United States

Legislation	Provisions
Clean Air Act of 1970	Established national primary and secondary air quality standards. Required states to develop implementation plans. Major amendments in 1977 and 1990.
Clean Water Act of 1972	Set national water quality goals and created pollutant discharge permits. Major amendments in 1977 and 1996.
Federal Pesticides Control Act of 1972	Required registration of all pesticides in U.S. commerce. Major modification in 1996.
Marine Protection Act of 1972	Regulated dumping of waste into oceans and coastal waters.
Safe Drinking Water Act of 1974	Set standards for safety of public drinking-water supplies and to safeguard ground water. Major changes made in 1986 and 1996.
Toxic Substances Control Act of 1976	Authorized EPA to ban or regulate chemicals deemed a risk to health or the environment.
Resource Conservation and Recovery Act of 1976	Regulated hazardous waste storage, treatment, transportation, and disposal. Major amendments in 1984.
Comprehensive Environmental Response, Compensation and Liability Act of 1980	Created $1.6 billion "Superfund" for emergency response, spill prevention, and site remediation for toxic wastes. Established liability for cleanup costs.
Superfund Amendments and Reauthorization Act of 1994	Increased Superfund to $8.5 billion. Shares responsibility for cleanup among potentially responsible parties. Emphasizes remediation and public "right to know."

From *Environmental Science: A Global Concern*

Application 2

Figure 9.5 illustrates a simple general equilibrium economy in which there are three goods: fertilizer (a private good), clean air (a public good), and water (a nonmarket good—people get it free from the stream). To provide the public good, there is a payroll tax per hour on labor, paid by employers. Finally, to round out the economy, the production of fertilizer leads to increased runoff, polluting the water. S is the supply curve showing only private costs, while S' is the "true" supply curve, including both private and external social costs. Thus C' is the efficient level of fertilizer production—where the true supply and demand curves intersect.

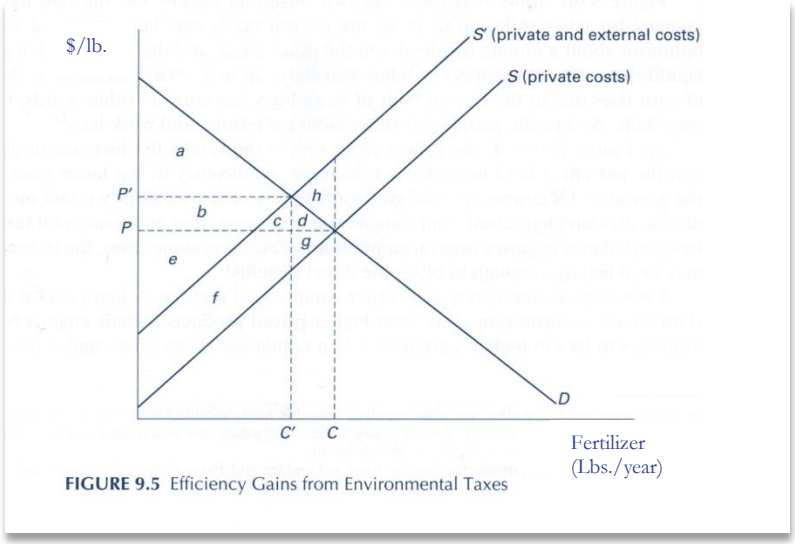


FIGURE 9.5 Efficiency Gains from Environmental Taxes

1. Recalling problems of consumer/producer surplus, what does the letter h represent in this diagram?

2. Which section represents the consumer surplus?

A. (a + b + e + f)

B. (d + g)

C. (a + b + c + d)

D. (b + c + d)

3. Which section represents the externality costs?

A. (h)

B. (f + e)

C. (c + d + g)

D. (f + c + d + g + h)

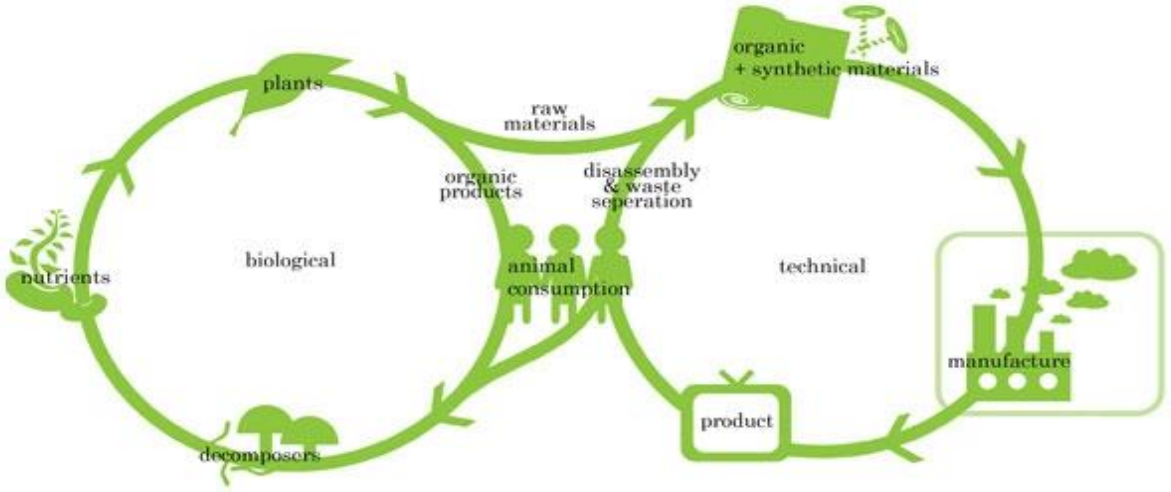
Markets are lethal, if only because of ignoring externalities, the impacts of their transactions on the environment. –Noam Chomsky, philosopher

Our goal is a delightfully diverse, safe, healthy, and just equitably, ecologically and elegantly enjoyed.

world, with clean air, water, soil and power—economically, —William McDonough, Cradle to Cradle® Founder

What is Cradle to Cradle®?

Cradle to Cradle® is a "holistic economic, industrial and social framework that seeks to create systems that are not only efficient but also essentially waste free" ("Cradle-to-Cradle"). In the industrial realm, that would mean designing products and systems that imitate biochemical processes, where the materials are considered nutrients as part of biological and technical cycles. As the diagram on the right shows, the biological cycle includes the natural environment (rivers, forests, etc. unaltered by humans), whereas the technical cycle includes our man-made products. The concept, however, does not limit itself to production and is often applied to economics, our entire built environment (building, roads, and other infrastructure), and social systems ("Cradle-to-Cradle").



In the diagram above, the system of production clearly indicates nonlinear organization. The division of biological and technical are seamlessly connected through the way in which natural resources are integrated into our built environment. Within an ecological system various decomposers, such as mushrooms and bacteria, break down the substances in the soil into forms which can be used and absorbed by plants as nutrients. From there the plants are transformed into raw materials to build products we are all familiar with, like furniture and clothing.

Not all of what is sourced for production can be used and the "leftovers" return to the biological cycle either as a contribution to the earth or as a form of energy for some other production. You will notice that the technical cycle makes use of the end products through disassembly and waste separation, essentially removing the "waste" portion of a traditional product lifecycle. For the economist, this diagram can be extrapolated to entire communities and forces them to reframe the context in which any transaction should take place. Whether deciding how much to supply or how much to tax, with the foundation of a circular system, the boundaries of capitalism will be challenged.

Closing the Gap

Where? Oakley, Kansas

Who? Through the collaboration of three companies—Himark BioGas, Pioneer Feedyards, and Western Plains Energy—hundreds of pounds of feedlot manure are no longer being trucked off to cropland and instead head to an Integrated Biomass Utilization System (IMUS) system to be turned into biogas.

What? Originally an ethanol-only plant, Western Plains Energy had been looking for a company which could construct a digester to process manure containing large amounts of sand and debris that often clogs up other digesters, increasing operating costs. Himark BioGas, having already implemented such system in Alberta, Canada, offered to take on the project. Manure from Pioneer Feedyard's open feedlot pens is removed, placed into the digester, and the biological activity from the manure is transformed into biogas. In exchange for the manure, Pioneer Feedyard gets to use the byproduct of the process, which is an organic fertilizer free of seeds, pathogens, and odors. It is estimated that as a result of the new addition to the energy plant, the company will save about $5 million annually in energy costs. If they choose to use some of the biogas to produce power, it would generate another $3.3 million in annual savings (Kryanowski).

When? Construction began the summer of 2012 and the system began producing biogas in January of 2013

How? The construction was funded with grants from the U.S. Department of Agriculture and the Kansas Department of Commerce.

Economic impact? This case study shows how a perceived waste can be transformed into a source of revenue or savings. This idea of closed-loop systems has become imperative to company designs because the costs of transporting goods across the globe are no longer as low as they used to be. For companies to stay competitive, it no longer makes financial sense to continue to be a part of the linear lifecycle. Additionally, consumers now demand conscientious products (those that keep in mind the environmental impact of its production), establishing a new avenue for marketers.

Utility: the satisfaction or pleasure one gets from consuming a good or service

Within the field of economics, utility is divided into two categories: total utility and marginal utility. **Total utility** is the total amount of satisfaction or pleasure a person derives from consuming some specific quantity, whereas **marginal utility** is the *extra* satisfaction a consumer gets from an additional unit of that product. One can also think about marginal utility as the change in total utility that comes from the consumption of one more unit of a product ("Utility Maximization"). Remember that according to the **law of diminishing marginal utility**, the satisfaction of a customer is indirectly related with the nth product that they have consumed after a certain point. For example, a person will be happy eating a cookie, but the third or fourth cookie that they eat will not bring them as much satisfaction as the first one did. One of the characteristics of this concept that ecological economists focus on is the fact that utility is difficult to quantify. They must assign a value to each item and then be able to compare those values on a scale. This can be difficult because not everyone will give the same value to an object. Ultimately, consumers will choose to make a series of purchases which gives them the most bang for their buck. This is known as the utility-maximizing rule. It happens when the consumer allocates their money so that "the last dollar spent on each product yields the same amount of extra (marginal) utility" ("Utility Maximization"). At this point the consumer is in equilibrium, and no incentive exists to change spending patterns. For the ecological economist, determining a method to change spending patterns in a way that is not disruptive is the most challenging task of all. Taxes and subsidies are just some of the methods used to do this.

Application 3

The Diamond-Water Paradox (From ***Microeconomics: Principles, Problems, & Policies)***

Early economists such as Adam Smith were puzzled by the fact that some "essential" goods had much lower prices than some "unimportant" goods. Why would water, essential to life, be priced below diamonds, which have much less usefulness? The paradox is resolved when we acknowledge that water is in great supply relative to demand and thus has a very low price per gallon. Diamonds, in contrast, are rare. Their supply is small relative to demand, and as a result, they have a very high price per carat.

Moreover, the marginal utility of the last unit of water consumed is very low. The reason follows from our utility-maximizing rule. Consumers (and producers) respond to the very low price of water by using a great deal of it—for generating electricity, irrigating crops, heating buildings, watering lawns, quenching thirst, and so on. Consumption is expanded until marginal utility, which declines as more water is consumed, equals its low price. On the other hand, relatively few diamonds are purchased because of their prohibitively high price, meaning that their marginal utility remains high. In equilibrium:

$$\frac{\text{MU of water (low)}}{\text{Price of water (low)}} = \frac{\text{MU of diamonds (high)}}{\text{Price of diamonds (high)}}$$

Although the marginal utility of the last unit of water consumed is low and the marginal utility of the last diamond purchased is high, the total utility of water is high and total utility of diamonds quite low. The total utility derived from the consumption of water is large because of the enormous amounts of water consumed. Total utility is the sum of the marginal utilities of all the gallons of water consumed, including the trillions of gallons that have far higher marginal utilities than the last unit consumed. In contrast, the total utility derived from diamonds is low since their high price means that relatively few of them are bought. Thus the water-diamond "paradox" is solved: Water has much more total utility (roughly, usefulness) than diamonds even though the price of diamonds greatly exceeds the price of water. These relative prices relate to marginal utility, not total utility.

According to the United Nations, it is estimated that more than a billion people worldwide lack access to safe drinking water (Cunningham 381). Often times the issue is not whether the water supply exists but a matter of sanitation facilities being accessible to the general public. In some places, drinkable water is so expensive that people cannot afford it, creating massive humanitarian issues. Do you know how much water costs in the area where you live?

Find the prices of the following items and fill in the table below:

	Kansas	Kenya	Australia
Bottled water (Ex. Dasani, Aquafina, etc.)			
Tap water			

Discussion

Were you able to find data for tap water in Kenya? What economic factors affect the availability of clean water? How can the face value of water differ so greatly from country to country? What costs aren't being incurred in what we pay for our water?

Clearing the Air

Looking at the photo above, can you guess where in the world these people are located? If you guessed China, then you are correct! Home to sixteen of the most polluted cities in the world (Wu), China is in the midst of a huge undertaking: Controlling its environmental impact. Not only does China currently rely on coal (a non-renewable resource) for 70% of its energy, but as a result of the toxic air, roughly 300,000 residents die every year prematurely due to respiratory diseases (Wu). It is the country with the highest sulfur dioxide emissions, a chemical that has been linked to lung cancer, cerebrovascular and heart disease, pulmonary disorders, increased morbidity, and low birth weights ("Health Effects"). Due to a rapid increase in industrial development, China has seen the standard of living increase, but at a cost—literally. According to the State Environmental Protection Agency, environmental damages decrease the country's Gross Domestic Product by 8-13% annually (Wu). To deal with the issue, the Chinese government continues to set new standards for businesses, including mandates about sustainability, in its 12th Five-Year Plan, a trajectory outline of how the government would like to improve its economy. Scan here for a summary of the Plan:

Efficiency & the Polluter Pays Principle

What are the first things that you think of when trying to determine how to regulate or decrease an environmental pollutant? Implementing a ban? Or perhaps taxing the pollutant to have less of it? While these methods have been known to be effective, other options exist which avoid both taxation and a complete ban. Negotiation between private parties before it becomes a governmental problem functions as a solution to the problem. The polluter-pays principle reassigns liability from the consumer to the producer. Take, for example, the construction of landfills. Ordinarily this would be paid for by taxpayers, without incentive to reduce the amount of waste produced. However, consider the flip side of this situation, in which families are charged for each bag of trash that they have hauled away from their home. In this case, an incentive to produce less is created. Important notes about this concept:

- Determining liability has long-term effects
  - If polluters are being subsidized to reduce the pollution levels, their production costs decrease. This means that in the long run entry into the market would be encouraged, increasing pollution.
- A public good is inherent in pollution cleanup
  - Requiring polluters to pay for the privilege of polluting is more likely to generate an efficient outcome than a policy that legalizes pollution and requires victims to pay polluters to reduce emissions. Additionally, having the polluter pay reduces free riding and transaction costs associated with the latter policy

Application 4

The Great Debate: Should Pollution Be Put to the Market Test?

The following arguments are borrowed from *Taking Sides: Clashing Views on Controversial Economic Issues.*

As discussed earlier externalities, both positive and negative, present problems for environmentalists and economists because they must determine the most effective way of internalizing (accounting for) the costs not borne by consumers and/or producers. The following discussion presents two sides of the classic argument of whether the government should intervene when it comes to regulating pollution or whether the market should be allowed to decrease its emissions using its own devices.

A few terms to be familiar with before examining both sides include non-point and point-source pollution as well as permit trading. **Non-point source pollution** refers to contamination that cannot be pinpointed to a specific location. Examples might include polluted water due to the fertilizer run-off coming from an entire neighborhood or, on a larger scale, a whole water shed. Regulating this type of pollution is nearly impossible because the contamination comes from so many places. Conversely, **point-source pollution** is easily identifiable because the contamination comes from a single location. A classic example would be a paper factory that emits its waste-water into the stream running next to it. Because the water is not required to be cooled when disposed of, the heated water kills the fish in the area due to low levels of oxygen. Usually, when an industry is isolated from others, the pollution is easily identifiable.

Additionally, an understanding of market-based solutions will help to examine the following debate with further clarity. Permit trading, specifically, often comes up in discussions of how to deal with pollution. Under this system, countries, or specific companies, are given a limit to the amount of pollution that they are allowed to emit. Initially, they are given so many permits, or credits which account for an allotted amount of pollution. For example, say Business A is given 70 permits based on how much they had been discharging in years previous. In order to discharge any more than this amount, Business A would either have to purchase more permits from the government or from a business that had extra permits to spare. How could a company have extra to spare, you ask? If Business B decided to become more efficient so that their initially allotted permits more than accounted for their particular pollution, then they could sell them to Business B and make a profit. This system has been criticized, because with the ability to transfer credits, bigger companies could just buy more permits without lowering their pollution levels. On the other hand, if prices of permits were high enough, that in itself might be incentive to lower pollution levels to avoid having to buy more permits.

Pro: Pollution Should Be Put to the Market Test

Alan S. Blinder, from *Hard Heads, Soft Hearts: Tough-Minded Economics for a Just Society*

Employing a market-based approach to handling pollution may be tackled a variety of ways. Aland S. Blinder suggests using taxes as a way to reduce costs to business while also decreasing pollution levels. Another option could be to mandate that companies reduce emissions/discharge by a certain percentage. He recommends the former strategy because a profit motive exists for the businesses. There is an incentive to reduce emissions and not pay the tax. The difference between what the business would have had to pay and what they actually pay (potentially $0) becomes profit, whereas for a business that continues to pollute, extra costs—in the form of a tax—are incurred. To argue against the permit system, Blinder claims that taxes require less work on the part of government because as opposed to running periodic auctions for permits, they just have to send a bill. Blinder concedes that this system only works when the infrastructure to monitor pollution levels exists. In poorer countries, without a way to assign a number to a company, the process would be impossible to implement.

What do you think? What has Blinder not addressed in his argument?

Con: Pollution Should Not Be Put to the Market Test

David Moberg, from "Environment and Markets: A Critique of 'Free Market' Claims," *Dissent*

As a solution to pollution control, David Moberg believes government intervention and regulation will be more effective than letting companies decide how to reduce their emissions in a "free market" approach. He argues that consumers and many industries do not know enough about pollution reduction or payback (how long it takes from the time of an initial investment to earn that amount in savings) to make the right kind of changes. In essence, the market cannot make accurate calculations on its own. For example, when a company decides to mine the side of a mountain, they are not paying for the depletion of nonrenewable resources. Furthermore, he claims that pollution control comes down to a question of social values: How much are we willing to spend to protect certain physical environments or species over another? At what point will we be satisfied with the amount of protection we have created? In this sense, it becomes very difficult to equally represent everyone's input. Additionally, when markets are left to their own devices, Moberg points out that the government will not know which companies will decide to take shortcuts or use the regulation as an opportunity to set standards for socially responsible business practices.

Which argument sounds more plausible to you? Did Moberg leave out anything in his pitch for government intervention?

Put Your Money Where Your Mouth Is

If you thought you knew everything there was to know about investing, think again. What started mainly with food, the global Slow Movement has turned its attention to the ways in which we choose to spend our dollars. In fact, a chapter in the Midwest, called Slow Money NE Kansas, became active as of 2014. The volunteer-led organization connects farmers and food entrepreneurs to potential investors within the area ("Slow Money"). To learn more, visit www.slowmoneynekansas.org

Below is a list of the Slow Money Principles ("Slow Money Principles"):

I. We must bring money back down to earth.
II. There is such a thing as money that is too fast, companies that are too big, finance that is too complex. Therefore, we must slow our money down -- not all of it, of course, but enough to matter.
III. The 21st Century will be the era of nurture capital, built around principles of carrying capacity, care of the commons, sense of place, diversity and nonviolence.
IV. We must learn to invest as if food, farms and fertility mattered.
V. Let us celebrate the new generation of entrepreneurs, consumers and investors who are showing the way from Making A Killing to Making a Living.
VI. Let us begin rebuilding our economy from the ground up, asking:
• What would the world be like if we invested 50% of our assets within 50 miles of where we live?
• What if there were a new generation of companies that gave away 50% of their profits?
• What if there were 50% more organic matter in our soil 50 years from now?

Measuring the Benefits of Environmental Protection

In order to determine the efficient pollution level, one must first understand how to measure of the benefits and costs of decreased pollution. This section will focus on measuring the benefits, employing the concepts of **willingness to pay** (WTP) and **willingness to accept** (WTA). When faced with the issues of measuring nonmarket benefits (such as increased recreational use of river, reduction of premature death due to diseases, etc.), economists use **consumer surplus** (Goodstein 76). Remember that this is the difference between what one is willing to pay and what they actually pay for a product or service. The following example is taken from *Economics and the Environment,* 7th edition.

Let's say that Mrs. Lily has a private demand for the preservation of a local prairie. Initially, 7 acres of prairie have already been preserved. Assume Mrs. Lily did not pay for this public good. Nevertheless, she still benefits from it. Her consumer surplus from the first acre preserved is her willingness to pay ($100) minus the price ($0), or $100. We can portray this consumer surplus graphically as the area *A*, lying below the demand curve and above the price (zero) for the first unit. Consumer surplus from the second unit is represented as area *B*. Below is a graph to represent the demand curve for this situation.

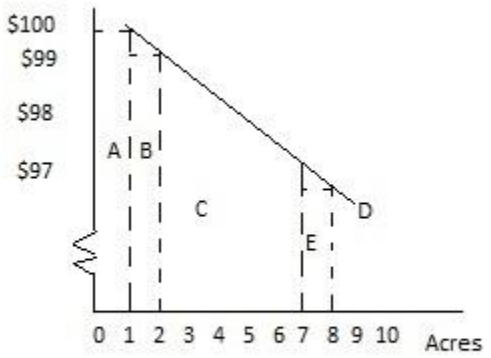


Figure 5.1 Consumer Surplus from Preservation

Each of the letters represents the consumer surplus per acre. For the first acre preserved, Mrs. Lily's consumer surplus would be $100, while for the second it would be closer to $99. What would her total consumer surplus be? Graphically, the area A + B + C. "For small increases in the stock of a public good enjoyed at no charge to the consumers—such as [prairies] or clean air or water—the price that people are willing to pay is a close approximation to the increase in consumer surplus that they enjoy" (Goodstein 77). This example shows just one side of how benefits to environmental improvement can be measured. On the other hand, what would Mrs. Lily have been willing to accept to see her prairie destroyed? This would employ the WTA approach.

Interestingly, economists have found in their experiments that "WTA values are typically seven times as high as WTP" (Goodstein 77). Why such a discrepancy? Some hypothesize that people are more willing to sacrifice to protect the environment than to improve environmental quality above what is already being experienced. Why would we pay to improve something that is bearable as is? Other reasons could be a matter of following the status quo or the substitutability of environmental quality and other consumer goods (Goodstein 77-78). If one is weighing the costs and benefits of reduced risk of death from mercury poisoning, for instance, what good substitutes exist for reducing the risk? Income plays a huge role here because someone who doesn't earn much would not be able to contribute as much as a person with a larger income. On the flip side, the compensation the poorer would be willing to accept could be much greater than anything income would allow for. The following application delves into the subject further.

Application 5: Plover Protection

In your consulting job, suppose you are analyzing the value of a public beach. Controlling for income, age, preferences, and everything else that might affect beach visits, you have gathered the following data.

If travel costs are… ($)	Number of Day Trips/Yr
0	40
20	20
39	1
40	0

1. If there are 1000 people in each of the three travel-cost categories $0, $20, and $39, what is the approximate total consumer surplus arising from day trips to this beach?

2. Your boss needs help evaluating a decision to close this particular beach in order to preserve habitat for an endangered sea bird called a plover that inhabits only this stretch of beach. A study determined that U.S. citizens are WTP $1,500,000/yr to preserve the plover. Based on your analysis, conclude whether or not protecting the plover is efficient. Remember, at the efficient outcome net monetary benefits produced by the economy are maximized. What could be some limitations to this benefit analysis?

3. Under the Endangered Species Act, could your analysis have any legal bearing on the decision to protect the plover?

APPENDIX A: Applications

Application 1:

1. 7 operations. After that the total harvest decreases. However, at the point of 9 or 10 operations, a logger might still have a marginal benefit that's greater than their cost and individually make a profit on their product. Overall, though, the total harvest is going down while they continue to cut down the trees.
2. Graph B
3. D. From S1 to S2

Application 2:

1. The deadweight loss, or the costs to society of the overproduction of fertilizer, in total surplus from the unregulated pollution. How do we know this? If the fertilizer price is at P, instead of P', then people from C' to C are getting fertilizer but are not willing to pay the full cost of production, including the externalities.
2. C. (a + b + c + d)
3. E. (f + c + d + g + h)

Application 3:

Answers vary

Discussion

Possible economic factors affecting the availability of clean water: Low supply, high demand—people in water scarce areas face limited options when it comes to water, let alone clean water. Especially with regards to agricultural production, which serves as the main source of revenue in many countries worldwide; the ways in which water is diverted from human consumption affects supply greatly. Consider any supply or demand determinants, such as income, expectations, technology, the number of buyers, etc.

Costs not being incurred: Environmental degradation (loss of natural habitats, decreased biodiversity, pollution of water and air), humane working conditions (livable wages, safe working conditions, etc.)

Application 4:

Additional arguments supporting Alan S. Blinder's stance:

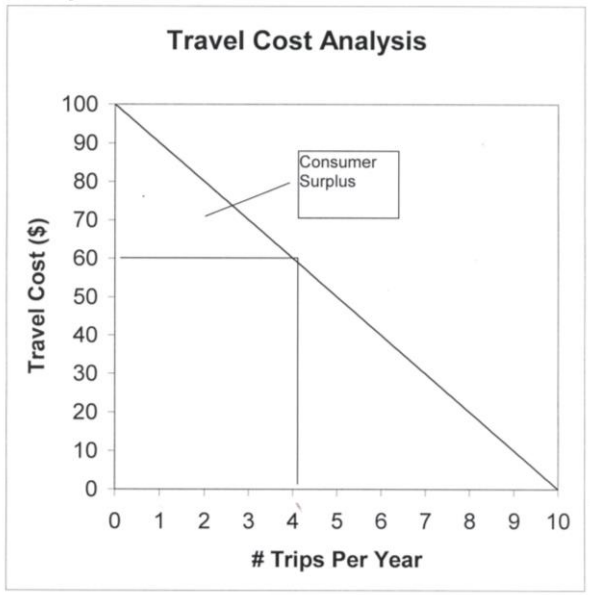
- Market-oriented approaches can reduce abatement costs by 90% in some cases. Abatement costs are the costs borne by businesses for the removal and/or reduction of an undesirable item they have created.
- Using government regulation means that the laws will have to go through the process of being passed, formally written, and then enforced.
- Investment, in a government-intervention approach, would rely solely on what the government deems worthy. Innovation would be limited because only the technologies the government supported would have substantial financial backing.
- In a system of mandatory standards, firms that are already in compliance have to incentive to reduce emissions

Additional arguments supporting David Moberg's stance:

- Even in a major transition, markets are sticky, chaotic, and inefficient
- Regulation can help competition
- Markets must come secondary to considerations of social value and have a limiting framework
- Market-oriented regulations are likely to disadvantage the poor, especially with energy or carbon taxes
- If the market were to establish a permit trading system, the price of the permits might not incentivize businesses to decrease pollution levels

Application 5:

First you need to graph the "demand curve" for this one—showing the relationship between travel cost and beach visits:



The net benefits to the three groups are the three triangles showing their consumer surplus from beach travel after paying travel costs:

NB = Value to those who take: 1 trip + 20 trips + 40 trips =

(1/2 * 1 * 1 * 1000) + (1/2 * 20 * 20 * 1000) + (1/2 * 40 * 40 * 1000) =

500 + 200,000 + 800,000 = $1,000,500

2. Protection is efficient. Benefits from endangered species protection (1.5 million) outweigh the lost value of beach recreation (1 million). This is especially true because the travel cost overestimates the value of this stretch of beach—people can substitute onto neighboring beaches for recreation.

Protection may not be efficient. Some significant costs of beach closure are not included—impact on local economy from reduced visitors.

3. No. The Endangered Species act is based on ecological sustainability, not efficiency.

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