

Introduction to Externalities

Introduction to Environmental and Resource Economics, October 3, 2004

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1 Externalities as missing property rights

A well-functioning market requires the following:

1. (From Hacket) “There are well-defined and enforceable property rights that define ownership of resources, goods, and services.” (p. 39) (Not from Hacket:) Property rights have four key characteristics:
 - (a) *Universality*: All resources are privately owned
 - (b) *Exclusivity*: All benefits and costs accrue to the owner
 - (c) *Transferability*: Property can be transferred from one owner to another
 - (d) *Enforceability*: Property is protected from involuntary seizure
2. “There is a well-functioning market institution that is made up of the various rules governing how buyers and sellers interact, particularly how price and other terms of trade are set.”
3. “Neither buyers or sellers have market power due to collusion or monopolization”
4. “There is the potential for low-cost entry by new sellers or buyers, which further limits the potential for collusion or monopolization. Exit is also low-cost, which reduces the risk of entering the market.”
5. “Transaction costs, such as legal fees, taxes, or regulatory requirements sufficiently low that they do not choke off mutually satisfactory transactions.”
6. “Information on characteristics such as the quality, availability, prices, and location of goods and services is available at low cost to market participants.”

If the second characteristic of property rights, exclusivity, is violated, externalities emerge. By definition, an externality is a violation of exclusivity. In the case of a negative externality, marginal social costs are higher than marginal private costs since the private cost doesn't include the marginal *external* damages, but the social costs do. Therefore, too much of the damaging activity will occur. For instance, if I am a firm and my production produces pollution that I am not required to compensate society for, I will produce more output and therefore more pollution than is socially optimal. Pollution is an example of a negative externality.

Examples of positive externalities:

- Bees and orchard
- Education

- Vaccinations
- Landscaping and open space preservation
- More?

Examples of negative externalities:

- Air pollution from coal-fired power plants
- Effluents into waterways (example: ag runoff containing nutrients, herbicides, pesticides, eutrophication in the Gulf of Mexico)
- Neighbor's cattle invading farmer's fields
- Rowdy neighbors playing loud music late at night

2 Externalities: formal theory

What does economic theory have to say about free market outcomes under externalities? We can begin by adding the idea of external costs and benefits to our framework for analyzing market equilibrium from last week. Recall that our market equilibrium framework is based on interactions between supply and demand. We will recast these concepts here in terms of marginal *private* costs and marginal *private* benefits. (This makes a lot of sense if we put ourselves in the role of the benevolent social planner from the Mathematica example last week, whose role is to maximize the net benefits from market interactions.)

1. *Marginal Private Costs:* We have established that producers incur costs in the production of most goods, and that these costs tend to increase as production increases (in the short run in the range of production most relevant for market equilibrium). We have described these costs in terms of a “willingness to accept” price for the good produced. Equivalently, we can describe the resulting upward-sloping supply curve as a *marginal private cost* curve. Again, the difference between the prevailing market price and the marginal private cost curve represents total benefits for the producer (short-run profits) or *producer surplus*.
2. *Marginal Private Benefits:* We have also established that consumers gain benefits from consumption of goods, and that these benefits generally diminish at the margin as the amount consumed increases. We have described these benefits in terms of the consumers’ “willingness to pay” for the good produced. We can further describe this downward-sloping demand curve in terms of a *marginal private benefit* curve. The difference between the prevailing market price and the marginal private benefit curve represents total benefits for the consumer, or short-run *consumer surplus*.

Now, we add two more concepts that reflect positive and negative externalities.

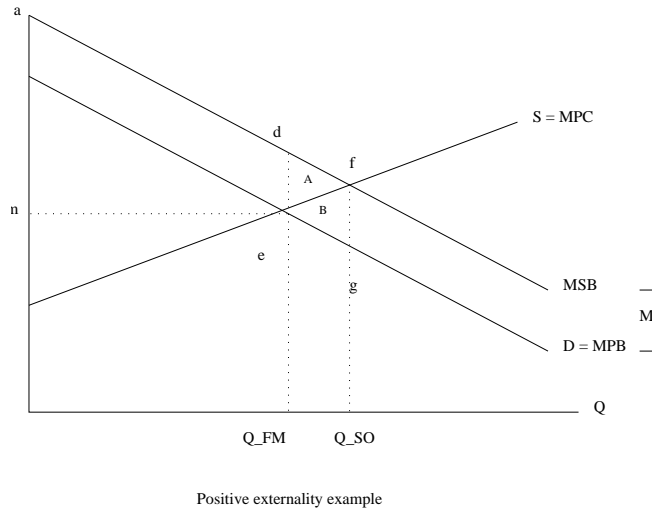
1. *Marginal External Benefits:* To keep things simple for now, we discuss cases where positive externalities affect consumers only. *Question: Of our examples, which might affect consumers and which might affect producers?* For every unit of a good produced or consumed by other consumers, consumers will gain some extra utility, or benefit. This function may be constant at the margin (resulting in a parallel upward shift in demand), or upward-sloping (in which case it will shift the demand curve upward and also change the slope). The sum of the marginal private benefit and marginal external benefit functions results in a *marginal social benefit* function.
2. *Marginal External Costs:* Again, to keep things simple for now, we will discuss cases where external costs are generated by producers, and depend on how much production occurs. *Question: Again, would producers or consumer be responsible for the external cost examples discussed above?* These costs may be constant for each unit produced (and thus shift the cost curve up in parallel), or become larger as production increases (resulting in a shift upward and increase in slope). The external cost curve is often referred to as an increasing *marginal damage function*. The sum of marginal private costs and marginal external costs produce the *marginal social cost* function.

When there were no external costs or benefits, life was simple for the social planner. She could sit back and let the market work, as she believed (in theory) that the market on its own would maximize the net social benefits possible from market interactions. (Notice that the social planner takes a *normative* role.) With externalities present, her life becomes more complicated. As we will see from examples below, the free market on its own can't be expected to balance social costs and benefits so as to maximize the net benefits from market interactions. However, first let's note what would be the ideal outcome from the social planner's perspective. Not surprisingly, her goal is to balance social costs and benefits at the margins. By equating marginal social benefits and marginal social costs, she will be choosing a level of market activity that puts the economy at the top of the net benefit "hill". So the condition she wants to achieve for the economy is:

$$\underbrace{MPB}_{\text{marginal private benefit}} + \underbrace{MEB}_{\text{marginal external benefit}} = \underbrace{MPC}_{\text{marginal private cost}} + \underbrace{MEC}_{\text{marginal external cost}} \tag{1}$$

Question: What does this condition look like if there are no external benefits and costs? Let's look at some specific examples, and see why a possible divergence between net social and private benefits in free-market outcomes can make the social planner's life complicated.

3 A positive externality example



Many residents of Fairfax City cultivate flowering plants in their front yards. Since so many commuters drive through Fairfax City on their way to work or at home, and since the traffic tend to move very slowly, their commute is enhanced by the pleasant views of front yards on their commuter route. Many of these flowering plants are supplied by the Plant Lady, who sells plants at the Fairfax farmer’s market. For simplicity, for now, we’ll assume that she is the sole supplier of flowering plants in the city of fairfax. Therefore, her marginal cost curve represents the supply of flowering plants. Residents have a downward-sloping demand curve for plants, representing the marginal private benefit curve. Each plant produces a constant external benefit to commuters who pass by Fairfax city front yards each day. Combining the marginal external benefit and marginal private benefit curves, we get a marginal social benefit curve that is above the marginal private benefit curve.

4 Free-market vs. socially optimal outcomes

What will happen in a free market? As we saw last week, the free market equilibrium will equate consumers’ marginal willingness to pay with producers’ marginal willingness to accept, resulting in a market equilibrium at Q_{FM} , P_{FM} . Does this result in enough production and planting of flowering plants? I argue that it doesn’t. Notice that at Q_{FM} ,

marginal social benefits exceed marginal social costs by de . This means that if we increase the number of plants sold, net social benefits will increase. So, the current level of plant sales is too low from a social perspective. Just as we did for the market equilibrium, we can argue that we should increase plant production until the marginal social benefits equal the market social costs. This point occurs at f , where the functions intercept one another. It corresponds to output level Q_{SO} . Notice that this level is higher than Q_{FM} . As well, the plant lady would require a higher per-unit price to be induced to bring that many plants to market and sell them. *Question: What price would consumers be willing to pay for that higher level of plant provision? Would consumers and the plant lady be likely to come to an agreement to exchange that many plants as things now stand?*

What would be the net gain to society if we were able to induce a higher level of plant production and consumption? A move from Q_{FM} to Q_{SO} would increase external benefits generated by areas $A + B$. However, it would increase the plant lady's costs by area B . So the net gain to society from the move would be equal to $(A + B) - B = A$. Notice also that at Q_{SO} $MSB = MPB + MEB = MSC$.

Next week we will talk about how we can change incentives so that the regulated free market might reach the socially optimal level of production on its own.