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# ECONOMICS

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A **pecuniary externality** occurs when a market transaction affects other people only through market prices.

The example of more people buying a good and thereby causing a negative market impact for others is called a *pecuniary externality*. **Pecuniary externalities** exist when market transactions affect other people, but only through the market price. This defining attribute of pecuniary externalities—that they act only through prices—is critically important. It means that pecuniary externalities do not create market inefficiencies. Here's why.

Remember that negative and positive externalities lead to "wrong" equilibrium quantities. They do so because they create an external cost or external benefit that is not reflected in the market price. Pecuniary externalities don't create these effects. Precisely because their impact is completely embodied in prices, the market price *correctly* reflects the society-wide impact of market transactions. You could say that pecuniary externalities are necessary for efficient markets because as goods become more or less scarce, their price should change. Negative and positive externalities, such as pollution and education, cause market inefficiencies because goods are either over- or under-produced and consumed.



# 9.2 Private Solutions to Externalities

When externalities are present, the free market outcome is inefficient. Exhibits 9.3 and 9.5 in the previous section reveal the inefficiencies of not taking externalities into account. Conceptually, the exhibits show the following two important points:

1. When there are negative externalities present, free markets produce and consume too much.
2. When there are positive externalities present, free markets produce and consume too little.

If, in the presence of negative externalities, too much of a good is being produced, and in the presence of positive externalities, too little of a good is being produced, then how does society achieve a more efficient outcome? Several solutions have emerged—some involve private citizens working it out themselves, while others include government intervention. In this section we consider a number of private solutions.

When agents account for the full costs and benefits of their actions, they are **internalizing the externality**.

One fundamental theme unites the multiple solutions to externalities, and that is that we must *internalize the externality*. When individuals or companies take into account the full costs and benefits of their actions because of some public or private incentive, economists say that they are **internalizing the externality**. When the external effects of their actions are internalized, the general result is that the market equilibrium moves toward higher social well-being.

To understand how internalizing the externality works in the area of private solutions, we'll consider the scenario of a power plant that is currently emitting tons of toxins in waterways, which adversely affects local fishermen. Place yourself in the seat of a city mayor and think about what you would do if the fishermen came clamoring to you for help in curbing the plant's emissions.

Your first thought might be to read the city pollution ordinances to check whether there is a law against polluting the waterways. Suppose you find that there is no such regulation—the power plant has the right to pollute lawfully. Thus, in actuality, the power plant has the right to pollute for free. Amazing!

Your next thought might be to impose laws that establish new regulations on the power plant. This is most people's first instinct because a common misperception is that government is the *only* source of change when, in fact, private organizations have effected change for years. Such private solutions to externality problems usually require parties to negotiate with one another or a social enforcement mechanism to be in place. Let's see how negotiations, or bargaining, can work.

## Private Solution: Bargaining

To gain a sense of how bargaining can work, let us continue with the power plant and fishermen example. Say you discover the power plant can eliminate the toxins that it emits by purchasing and installing scrubbers (a technology that cleans water and air before they are released into the ecosystem). But scrubbers are expensive to purchase and maintain. The best cost estimate is that over the next decade, the cost of the necessary scrubbers will be

$5 million. However, because the power plant holds the right to pollute by law, it does not have to install the expensive equipment.

On the other side of the equation are the fishermen. Their scientists tell them the pollution has gotten to such dangerous levels that there is a chance the entire fishing industry could be shut down within a matter of years. Their analysis further tells them that the power plant is, in fact, the main culprit, emitting tons of toxins into the waterways weekly. The fishermen conclude that if they can convince the power plant to install the scrubbers, they will receive benefits over the next decade of approximately $7 million.

In this case, what is the outcome if the fishermen and power plant do not communicate? Left to itself, the power plant is clearly not interested in spending $5 million on scrubbers because it does not gain from such a purchase. As you can see, this market outcome is not socially efficient because total well-being could be increased. In fact, the amount of money left on the table is $2 million ($7 million − $5 million). You might recall from Chapter 8 that you can think of this as the gains to trade.

Does this mean that pollution will continue at the current rate because the power plant has the legal right to do what it desires? Can economics help solve this impasse? As it turns out, economics *does* play a critical role. The legal rights do not have to be the deciding factor; a private deal can be struck.

How can we be so sure? You know that fishermen are willing to pay up to $7 million to rid the waterways of the power plant's pollution, whereas it costs the power plant only $5 million to abate pollution. Therefore, a deal will be brokered in which the fishermen give an amount of money between $5 million and $7 million to the power plant, and the power plant installs and maintains the scrubbers. What is not clear is where exactly in the $5 to $7 million price range the deal will be struck (as was observed in Chapter 8 about the range of possible terms of trade).

Now let's consider when the opposite case is at work: upon looking into the local ordinances, say that you had found a law against the power plant polluting the waterways. You would have then informed the power plant that it was out of compliance. If it chose at that point not to shut down, it would then have installed the scrubbers, thereby eliminating the water pollution.

The remarkable bottom line is that regardless of whether the law permits the power plant to pollute, the economically efficient outcome is achieved either way—the plant installs and maintains the scrubbers because abating pollution provides the highest social value.

## The Coase Theorem

A **property right** gives someone ownership of a property or resources.

The **Coase Theorem** states that private bargaining will result in an efficient allocation of resources.

This insight—that negotiation leads to the socially efficient outcome regardless of who has the legal **property right** (ownership of property or resources)—is called the **Coase Theorem**, after the Nobel Laureate economist who proposed it, Ronald Coase. The theorem's implication is powerful: private bargaining will lead to an efficient allocation of resources. This means that the outcome will match the preferences of the person who most highly values the property right. In this example, since the value of clean water is higher than the cost of scrubbers, private bargaining will lead to an outcome of clean water.

The end result of the Coase Theorem, then, is that government intervention is not necessary to solve externality problems—private bargaining can do the job. Although we reach the efficient outcome regardless of initial property rights, who holds the initial property rights is not irrelevant. This is because the initial property right allocation is an important determinant of the final distribution of surplus.

That said, we should be cautious about relying too much on private solutions to externalities for the following reasons:

**The end result of the Coase Theorem . . . is that government intervention is not necessary to solve externality problems—private bargaining can do the job.**

**1.** The assumption that the parties involved—those creating the externality and those suffering from it—can negotiate economically is critically important. This means that provided the *transaction costs* associated with negotiating aren't too high, the efficient economic outcome can be achieved.

**2.** Whether the property right is clearly defined is important; in many cases, the law is not clear on who holds it.

3. The number of agents on each side of the bargaining table matters. It's easy enough to imagine that bargaining can lead to an efficient solution with a small number of affected people. But it is more difficult to see how such bargaining could work between, say, a power plant and 100,000 affected fishermen.

The Coase Theorem applied to this situation would say that whether the plant has the right to pollute or the 100,000 fishermen have the right to clean water, the end result will be the efficient amount of water quality. If the plant does have the right to pollute, then 100,000 fishermen must coordinate on how to pay the plant to cut back its emissions. If the fishermen have the right to clean water, then the power plant will have to pay them to be able to emit pollution if that is the efficient solution. But as a practical matter, it is difficult for 100,000 fishermen to somehow negotiate their own agreements with a plant about the allowable level of emissions and who gets compensated. In this case, a governmental rule might be the most efficient means to address the externality. This is because the *transaction costs* associated with bargaining might be too high.

**Transaction costs** are the costs of making an economic exchange.

Hence, even when property rights are perfectly established, the cost of bargaining itself—the **transaction costs** associated with making an economic exchange—might be too high to permit this sort of arrangement from happening. Transaction costs include not only direct expenditures, such as legal fees and your time, but also the cost of an awkward situation: it might be difficult to walk next door and bargain with your neighbor about the amount of dog droppings his pet can leave on your front yard. With this in mind, we turn to a second popular private means to address the market failure of externalities: social enforcement mechanisms.

## Private Solution: Doing the Right Thing

Does the logo to the left look familiar? If you've seen it on your kitchen appliances, your computer, or your windows, you have approved-energy-efficient products. The ENERGY STAR program is a joint program introduced in 1992 by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy to promote energy-efficient products. ENERGY STAR is a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse-gas emissions. The first kinds of products to be labeled ENERGY STAR were computers and monitors. The program now includes over sixty product categories, including major appliances, office equipment, lighting, and home electronics. Today, you can hardly miss the stickers when entering a workplace.

The ENERGY STAR program has worked both because there are financial incentives associated with such products (reduced electricity cost and potential tax savings) and because it involves a social enforcement mechanism: it gives us information about "green products" and invokes a moral code that you should "do the right thing" and purchase them. No official government regulations tell people that they have to buy ENERGY STAR products, but the substantial growth in the program since 1992 is a testament to the power of motivating people to try to do their part for the environment. In economic language, the moral code of doing one's part is internalizing externalities.


Do you buy ENERGY STAR goods?

Once you give it some thought, you realize that social enforcement mechanisms are operating all around us and help us take externalities into account. For instance, later in this chapter we learn that private organizations, such as the Sierra Club, are quite successful at protecting the environment. The charity Smile Train does incredible work with overseas children who have cleft palates. Closer to home, when waiting in line for a ride at Disney World or in a supermarket checkout line, we rarely observe people "line jumping." People generally refrain from that practice not because there is a stiff financial penalty for doing so but because their actions will likely be frowned on by the people who bear the costs of their rudeness. Such socially imposed costs lead to a reduction in the quantity of line jumping to the net benefit of society. Shame, guilt, and the risk that we will be publicly decried are all effective social enforcement mechanisms. In particular, all these social controls help internalize the negative externality imposed on others, leading to less of such behavior.

Although private solutions can prove quite effective, direct government intervention might be necessary when private interventions fail. Such solutions usually take the form of rules that restrict production in some form, taxation, or requiring permits for production. We now consider several examples of government solutions to externalities.

# 9.3 Government Solutions to Externalities

There are many ways in which markets fail, or at least fall short of the ideal competitive market outcomes described in Exhibits 9.1 and 9.4. Whenever markets fail, policymakers need to consider the following question: can the government bring about a particular outcome more efficiently than the market? We have learned that there are potentially important private solutions to externalities, including bargaining over outcomes and relying on social enforcement mechanisms. Yet these also are apt to fall short in certain situations.

Governments respond to externalities in two main ways:

1. *Command-and-control policies*, in which the government directly regulates the allocation of resources
2. *Market-based policies*, in which the government provides incentives for private organizations to internalize the externality

Let's return to the case of the power plant's release of pollutants. Suppose the plant also emits air pollutants that affect millions of households in neighboring states. In such a case, the costs are dispersed in a manner that makes private negotiations impossible. Put yourself in the shoes of the federal regulator and think about what you would do in this case: a situation in which you are certain that curbing the pollutant emissions from the plant will be beneficial to society. You will find yourself relying on the two major approaches just listed, to which we now turn in more detail.

## Government Regulation: Command-and-Control Policies

**Command-and-control regulation** either directly restricts the level of production or mandates the use of certain technologies.

If you know that curbing emissions will benefit society, then you realize that $Q_{\text{market}} > Q_{\text{optimal}}$, and an approach to lower the quantity produced (and thereby reduce pollution) is a step in the right direction. One common approach to solving this problem is by using *command-and-control regulation*. Under **command-and-control regulation**, policymakers either directly restrict the level of production or mandate the use of certain technologies.

Many early environmental regulations, including the landmark clean water and clean air legislation of the 1970s, were command-and-control regulations. In this case, the government required polluters to adopt the best available pollution-reducing technologies. For example, the Clean Water Act stipulated *exactly* the types of technologies that each plant had to install if they were to continue operations. Similar regulations can be found in the various Clean Air Act Amendments. For example, under the 1977 Clean Air Act Amendments, new polluting plants had to install certain abatement technologies.

As you might have guessed, there are many ways to regulate polluters, and the command-and-control technique might not be the most efficient course of regulatory action to curb pollution. For one thing, this type of regulatory action typically provides few incentives for producers to search for more cost-effective ways to reduce pollution. This happens because regulators have directed attention to the wrong target—they mandate the technology that the producer must use. This pushes the producer to develop efficient methods with which to use the mandated technology. Rather than focusing producer efforts on developing cheaper ways to use the mandated technology, the regulator should incentivize producers to find or develop the most cost-effective technologies.

## EVIDENCE-BASED ECONOMICS

### Q: How did the government lower the number of earthquakes in Oklahoma?

After reading this question, two things may have come to mind. First, this is ludicrous—the government might be powerful, but it cannot control the number of earthquakes. Second, maybe someone in Alaska or California would care about this problem, but why would Oklahomans? Indeed, until the past decade, Alaska and California dominated the earthquake scene: they each had hundreds more earthquakes that you could feel (magnitude 3 or greater on the Richter scale) than all of the other forty-eight states combined.

Yet recently something extraordinary has happened. Oklahoma, traditionally a seismic-free state, witnessed an incredible surge of earthquakes from 2013 to 2015. In 2015, Oklahoma had more than 400 times the number of earthquakes than its annual average from 1973 to 2008. Exhibit 9.6 shows the time series for 2000–2018. The average before 2009 was about 2 quakes per year of magnitude 3 or higher, but by 2015 this number had reached 887. This means that in 2015, Oklahoma had more earthquakes than the rest of the continental states combined! Indeed, California had fewer than one-third the number of earthquakes of magnitude 3 or higher in 2015 compared to Oklahoma.

What is behind this earthquake trend? According to scientists F. Rall Walsh and Mark Zoback, the answer lies with the activities of oil and gas companies—specifically, their wastewater disposal.[3] When an oil rig hydraulically fractures rock layers for oil (typically referred to as "fracking"), it produces saltwater as a by-product. This wastewater is so tainted with chemicals that it cannot be purified; it must be disposed of in a deep disposal zone known as the Arbuckle formation. This process increases pore pressure in this deep rocky layer, causing existing faults to trigger earthquakes, even in locations miles away from disposal wells.

In this way, the oil and gas industry imposes a negative externality on third parties. This negative externality extends broadly—loss of property and financial stability, even loss of life. All things considered, the cost of the earthquake externality can run in the billions of dollars—effectively making the marginal social cost much higher than the marginal cost that firms face. As we have learned in this chapter, one way to tackle externalities of this sort is via command-and-control regulation.

That is exactly what state regulators in Oklahoma did in mid-2015. To reduce saltwater injection rates, they began directing oil and natural gas producers to close some wells and reduce injection volumes in others. As Exhibit 9.6 shows, the regulation worked: since 2015, the number of earthquakes of magnitude 3 or higher in Oklahoma has now decreased for four consecutive years: from 887 in 2015 to 57 in 2019.

Could this approach work in other states? The solution in Oklahoma followed how Kansas tackled its own earthquake problem. In March 2015, the state of Kansas issued an official order reducing saltwater injection rates. The order implemented a system of graduated mandated limits. The mandated cap was 16,000 barrels of saltwater per day, which was to decrease to 8,000 barrels of saltwater per day within 100 days after the issuance of the order. If the goals were not met, each failure would result in a penalty of up to $10,000 per day of continuing violation.

# EVIDENCE-BASED ECONOMICS

*(continued)*

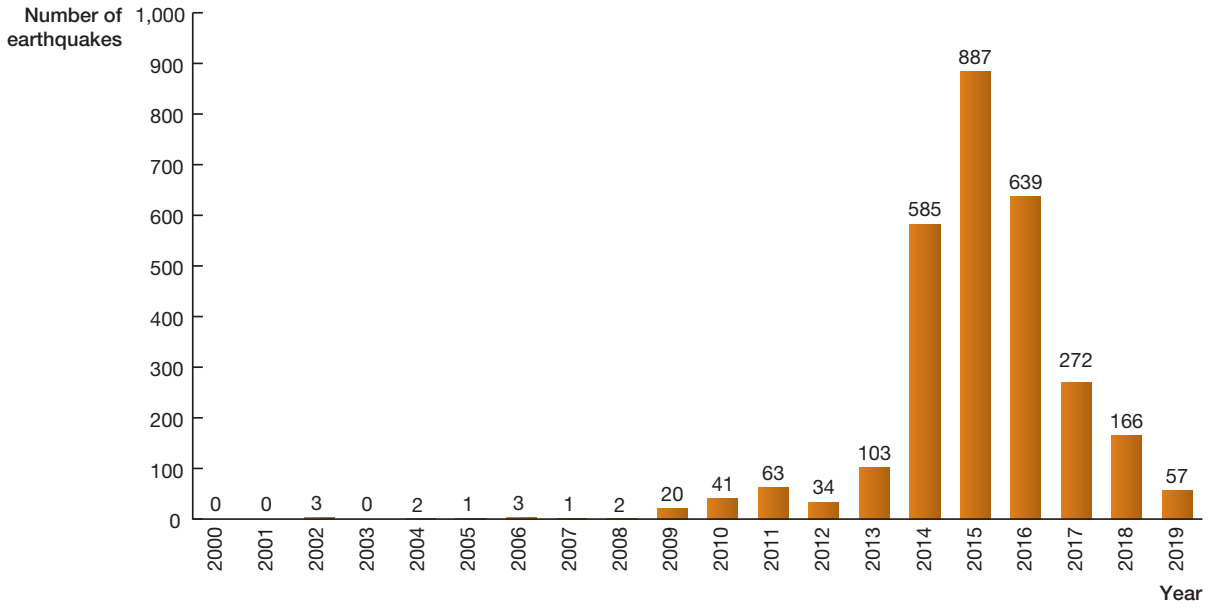


**Exhibit 9.6 The Number of Earthquakes in Oklahoma**

Since 2008 the number of earthquakes of magnitude 3 or higher in Oklahoma first grew from an annual average of about 2 to 887 in 2015, but government regulation has caused a decrease since 2015.

*Source:* United States Geological Survey 2020.

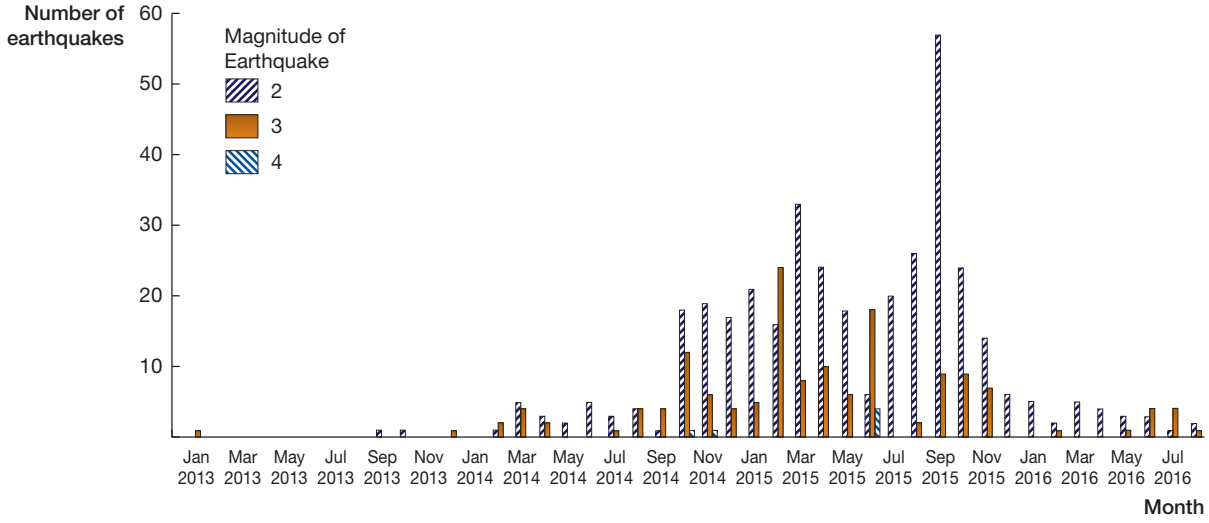


**Exhibit 9.7 Results of the March 2015 Command-and-Control Regulation in Kansas**

Comparing the number of earthquakes after the March 2015 policy took effect to the number of pre-policy quakes, we find a significant decrease in earthquakes of magnitudes 2–4. These trends suggest that, much like in Oklahoma, the Kansas command-and-control regulation helped achieve its goal.