Market Failures

September 5, 2022

With the monopoly market, we have already seen one example where the incentives facing the private actor are not the same as those for society. The monopolist pursues profit maximization, but because the monopolist's marginal benefit curve (in the form of marginal revenue) is not the same as society's marginal benefit curve (in the form of market demand), the equilibrium outcome has a quantity less than society would find beneficial. Economists use the broad term "market failure" to refer to outcomes where the market fails to deliver the socially optimal level of a good. Public goods and externalities are two additional examples of market failures. Note that in some cases the market may deliver too little quantity (as in the case of monopoly) while in other cases the market may deliver too much quantity (for an economic "bad" such as pollution). Public goods and externalities are sometimes, but not always, linked together because a public good can produce externalities.

1 Public Goods

A public good is defined as being non-rivalrous and non-excludable; it is *not* defined by which sector (public or private) produces the good. A good is non-rivalrous if one individual's consumption of the good does not preclude another individual from using the good. A good is non-excludable if nonpaying consumers cannot be prohibited from consuming the good, or at least if it is very costly to prohibit them from using the good. It is rare that a good meets both parts of the definition. National defense is used as an example of a public good because it is difficult to protect one house without protecting its neighbor, and also because it is difficult to protect the house of a paying customer without protecting the house of a non-paying neighbor. Another example is AM/FM radio stations – as long as someone is within the range of the signal and they have a device (which are not that expensive) that can pick up the signal, it is difficult to keep them from listening to the radio station.[1] Websites that do not charge a fee to view content are also a public good, unless so many people view the site at the same time that it crashes. A street light is a public good, at least locally, in that once the light is provided it is difficult to keep nonpaying consumers from benefitting from the light provided.

A private good is rivalrous and excludable – a pen is a private good in that if one person uses it another person cannot and it can be easy to exclude someone from using a particular pen. Goods may meet one part of the definition but not the other. Public (not toll) roads are non-excludable and at times they are non-rivalrous. If one is driving on the interstate overnight the road may be (essentially) non-rivalrous, but driving during rush hour traffic the road (likely) becomes rivalrous. While there are few goods that satisfy the strict definition of public good, there are many goods that have some features of a public good.

1.1 Demand Curve

For a private good, we find the market demand curve by summing up how much each individual consumer wants at each price. This method of finding the market demand curve works for a private good because people only get to consume what they purchase. Figure 1 shows the horizontal summation of three individual demand curves, with the red dashed line being the market demand. However, with a public good, the demand curve is summed vertically because individuals cannot be excluded from consuming the good. If one unit of the public good is produced, the value of that first unit is the combined value of the first unit for all

[1] There are signal jammers out there but they seem to either (1) only work over short ranges or (2) be very expensive. Satellite radio is a different type of signal that is more easily blocked, which is why it requires a subscription.

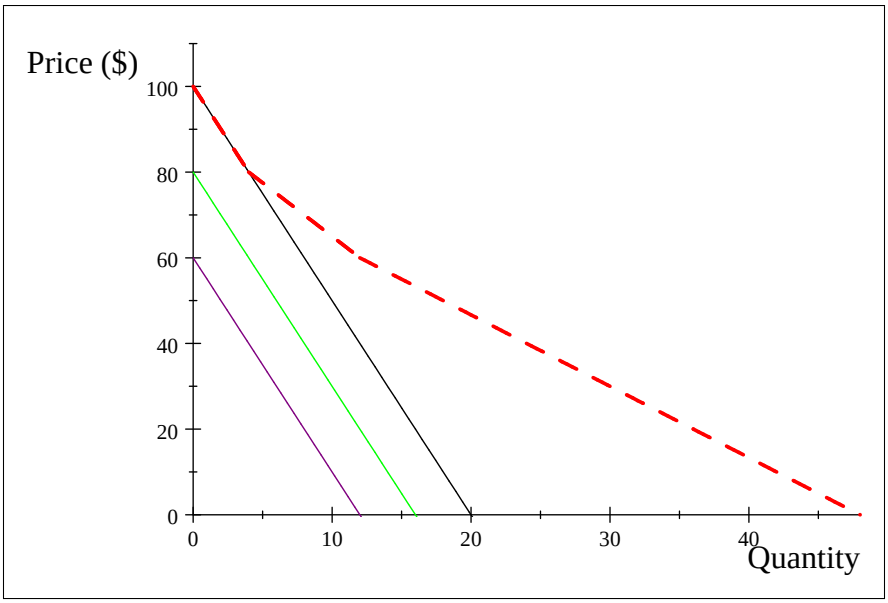

Figure 1: The black, green, and purple demand curves are individual demand curves. The red dashed curve is the summed individual demand curves, where summation occurs by picking a price and determining how many units each individual desires at that price.

individuals; if eight units are produced, the value of the eighth unit is the total value that all individuals receive from the eighth unit. Figure 2 shows the vertical summation of the three individual demand curves, with the red dashed line being the market demand. Comparing Figures 1 and 2, in the case of the private good the market demand curve initially follows the highest valued user's demand curve and finishes much to the right of all demand curves; for a public good, the market demand curve begins much higher than all demand curves and finishes by following the highest valued user's demand curve.

1.2 Efficient Provision

In our Edgeworth box economy, at a Pareto optimal allocation we had the marginal rate of substitution for each individual equal to the price ratio. For a public good, the condition for efficiency will be slightly different. If we add a supply curve to Figure 2, the intersection of supply and demand will be at a point such that the sum of the marginal rates of substitution of the individuals will equal the price ratio.

The question then is, how is the correct amount of a public good provided? The textbook answer is to produce the amount where supply intersects demand, which would be correct, but my concern here is more practical. For a private good, the producer can charge the individual for use of the good and exclude those who do not pay. For a public good, consider the example of a lighthouse. It is non-excludable in that any ship within the right distance of the lighthouse can see the light, regardless of whether the ship has paid for the right to use the light. It is also non-rivalrous in that one ship using the light from the lighthouse does not prevent another ship from using the light. But if an individual can use the lighthouse without paying, how is that lighthouse funded?

The fundamental problem of public goods is the free rider problem, as shown be the lighthouse example. With a pure public good, a nonpaying customer can free ride on the provision of the good by someone else. The free rider problem creates disincentives for individuals to produce a public good – if one individual bears the cost of producing the good but cannot be compensated, why should the good be produced?

There are a few reasons why the good could be produced. One is that a single individual/firm/agency has a private value from the good that is greater than the private cost of producing the good. For instance, many homes have their own outdoor lighting. This private lighting can provide benefit to others on a dark street and there does not seem to be much concern from individual homeowners that neighbors may be using

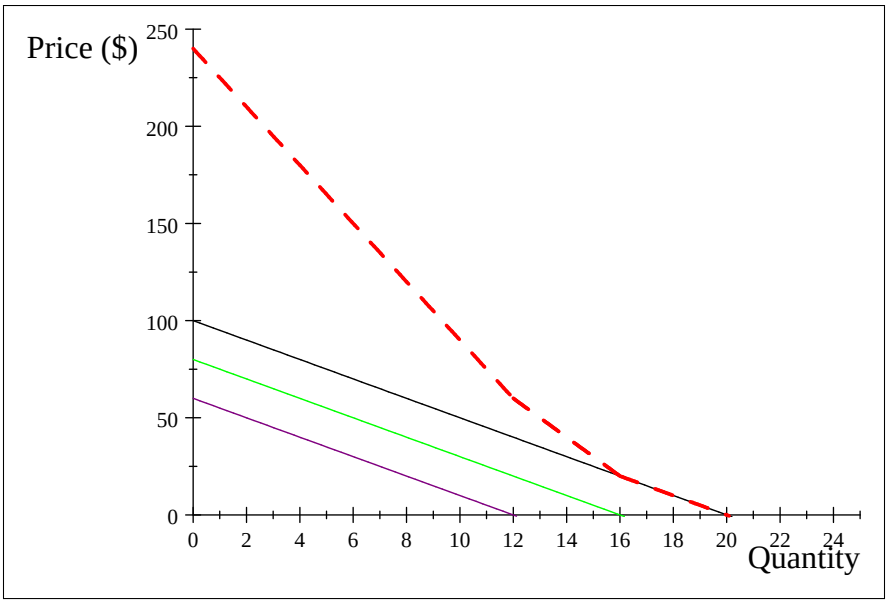

Figure 2: The black, green, and purple demand curves are individual demand curves. The red dashed curve is the summed individual demand curves, where summation occurs by picking a quantity and determining how much each individual values that amount.

some of their light without paying for it. Another is that as a society we recognize there are certain goods that have these public good properties and we use some government authority to provide the good, with funds coming from taxes or fees. Though there is private lighting from individual homeowners on a street, many times there is also publicly provided street lights. Another is that a firm has found a way to turn a public good into a private good – for instance, AM/FM radio vs. satellite radio.

2 Externalities

Externalities may be either positive or negative. Positive externalities provide benefits to those who are not part of the market transaction, while negative externalities impose costs on those outside the market transaction. Some examples of positive externalities are rose gardens in the front yards of houses (increase home prices in the area by making the neighborhood look better), vaccines (decrease the chances that others will contract a disease), and street lamps (increase visibility for all). Note that all of these items have private benefits to the purchaser of the goods; rose gardens are pleasing to the homeowner who plants them, vaccines protect the vaccinated person from catching the disease, and the person who installs the street lamp gets the benefit of light at night. However, these goods tend to be *underproduced* as the providers of the goods do not receive all the benefits (the rose garden planter does not receive a check when a neighbor sells a house, the vaccinated person does not receive a check from the unvaccinated, and the street lamp installer does not receive a check from the neighbors). How might this problem of underproduction be solved? One solution would be for these activities to be subsidized by the government (plant a rose garden, get a check; get a vaccine, get a check; install a street lamp, get a check). Another would be to bargain with those who are affected by your actions and attempt to reach an agreement; perhaps the two individuals could sign some sort of contract that stipulates if Consumer J plants and maintains a rose garden Consumer K will pay Consumer J a specified sum of money if Consumer K sells his house.

The primary example used for negative externalities is pollution, be it air pollution or water pollution or some other kind of pollution. The person/firm who pollutes does not bear the full cost of pollution (that person does not send a check to those being harmed by the pollution), and thus pollution tends to be *overproduced*. A slightly less serious example would be the case of the quadruple onion and garlic burger. Suppose your friend ordered a quadruple onion and garlic burger from his or her favorite burger

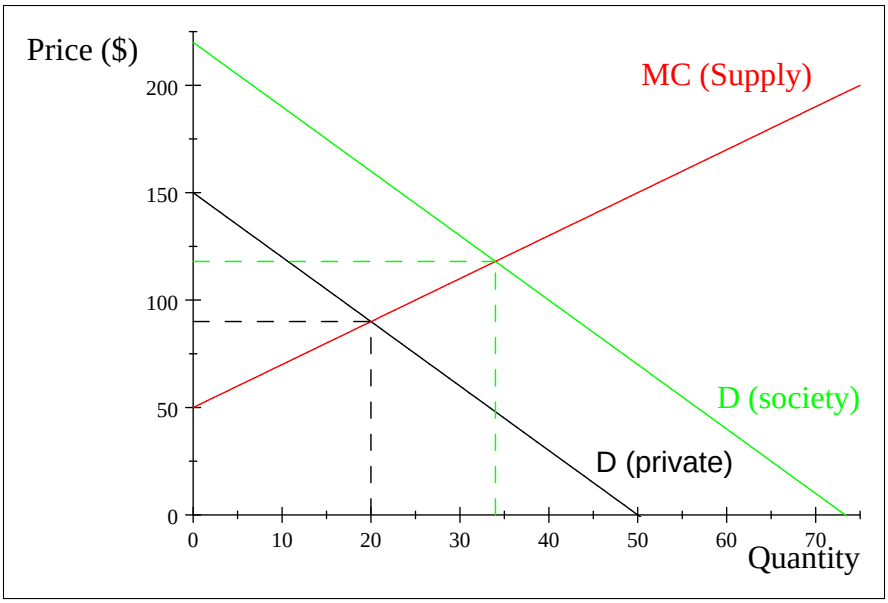

Figure 3: The market equilibrium (given by the black dashed lines) and the societal equilibrium (given by the green dashed lines) under a positive externality.

establishment. Your friend eats the burger, getting the private benefit of eating the burger, then your friend decides to have a conversation with you, providing you with a negative externality. How do you solve this externality problem? There are a variety of options. You could forbid your friend from eating quadruple onion and garlic burgers, or at least tell them you will no longer be friends if this habit persists. This solution seems harsh. Or I suppose you could give your friend a breath mint and hope they get the hint about the burgers. But after giving away 20 breath mints, maybe you would need to start selling them to your friend. These are all possible solutions to this problem. But what if it was someone (a firm) who you did not know? How well would they respect your wishes?

2.1 Externalities and Gains from Trade

We begin by analyzing externalities from the perspective of gains from trade. With a positive externality, individual demands, and ultimately market demand, do not reflect society's demand for the good. For negative externalities, individual costs, and ultimately market supply, do not reflect the true cost to society. While the method of analysis is similar, it is instructive to review both cases.

2.1.1 Positive Externalities

The starting point is a standard supply and demand model, with market supply and private market demand. The private market demand only reflects the benefits that accrue to the individuals, and we will also have a societal market demand, which reflects the external benefits that are not captured by the private market demand. The societal market demand will, necessarily, be similar to an increase in the private market demand.[2] Figure 3 shows this market, with the private market demand given by the black line, the societal market demand given by the green line, and the societal marginal cost (supply) given by the red line. The equilibrium price is \$90 and the equilibrium quantity is 20 in this market; those are shown by the dashed black lines. However, we can see from Figure 3 that if the societal demand curve is used to determine equilibrium price and quantity that the price would be higher and the quantity greater. In this market, the

[2] In the example the societal market demand will be a parallel shift of the private market demand, but the shift does not have to be parallel.

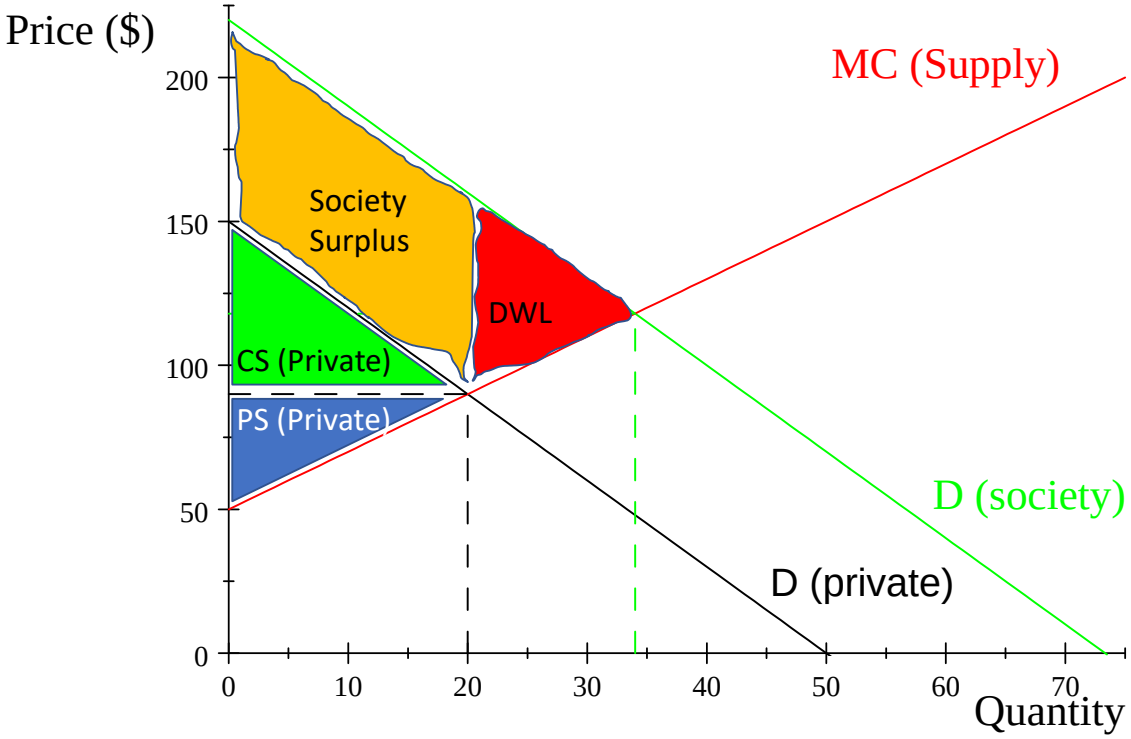

Figure 4: The gains from trade in a positive externality. The private demand leads to consumer and producer surplus (green and blue areas, respectively). The orange area is the additional consumer surplus sociey receives from the good; the red area is the deadweight loss.

green dashed lines in Figure 3 show that, according to societal demand, the equilibrium price should be $118 and the equilibrium quantity should be 34.

Figure 4 shows a breakdown of the gains from trade in this market. Even without considering the additional benefit to society, there are gains from trade present in the private market. Those gains accrue to both the consumer (green area) and producer (blue area). However, because there are additional benefits to society, each unit of production also provides additional benefit beyond those found in the private market. The orange shaded area shows the additional gains to society from production of the good, which accrue even though the individual consumers and producers are not considering them in their decision-making. When viewing the market from society's perspective, there is deadweight loss (DWL) present, given by the shaded red area. Society would prefer that 34 units of the good be produced, but only 20 are.

2.1.2 Negative Externalities

We can construct a similar picture for a negative externality. Figure 5 shows the demand in red, the marginal cost (supply) to the private market in black, and the marginal cost (supply) to society in green. Notice that in the private market, the equilibrium price is $90 and the equilibrium quantity is 20. Because there is an additional cost to society, the marginal cost (supply) curve decreases, leading to a lower equilibrium quantity (14) and a higher equilibrium price ($108) that is socially optimal.

Figure 6 shows a breakdown of the gains from trade in this market. The gains from trade break down a little differently than in the positive externality case because there is overproduction of a good that creates a negative externality. In this case, all the gains from trade from the private market transaction (where the quantity is 20 and the price is $90) are assigned to either the consumer or producer because those individuals value those units at the prices given by their private demand and supply curves. However, there is deadweight

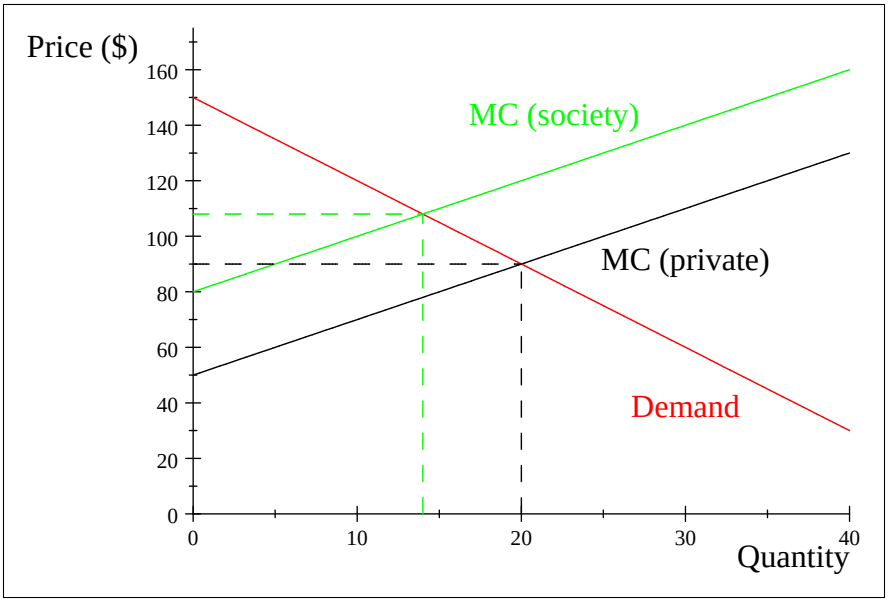

Figure 5: The market equilibrium (given by the black dashed lines) and the societal equilibrium (given by the green dashed lines) under a negative externality.

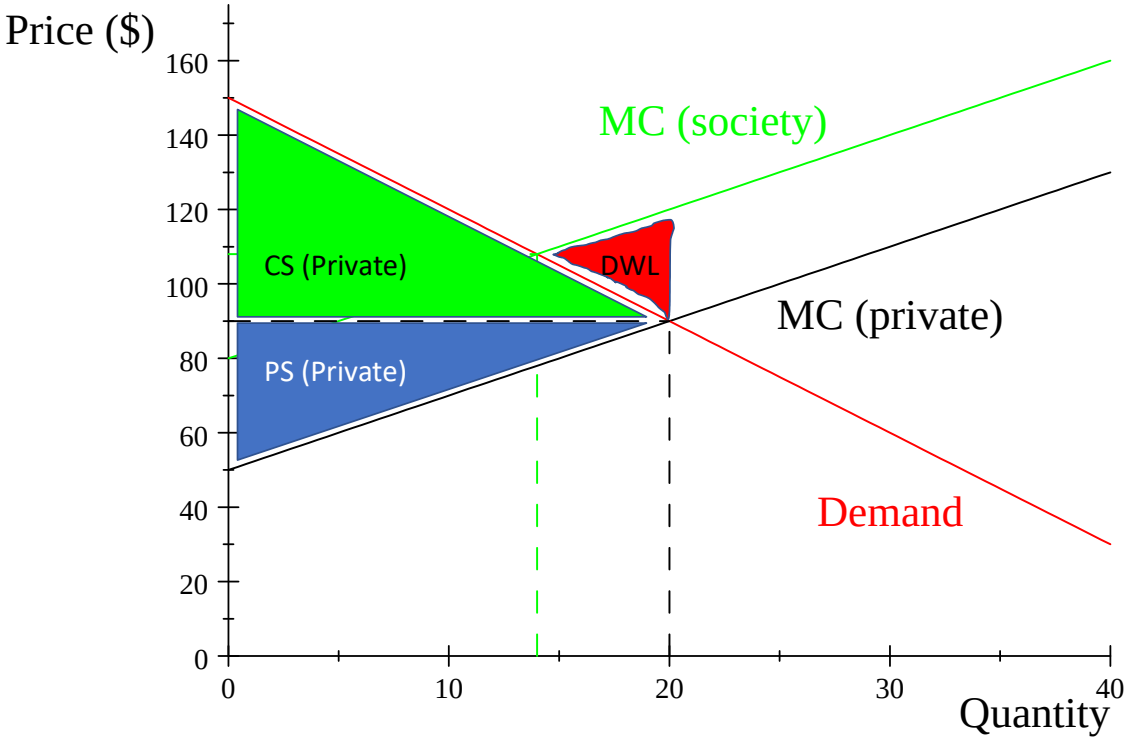

Figure 6: The gains from trade in a negative externality. The private demand leads to consumer and producer surplus (green and blue areas, respectively). The red area is the deadweight loss.

loss in the red shaded area because the market is producing too much of the good and not accounting for societal costs.

2.2 Solutions to Externality Problems

There are a few methods for mitigating inefficiencies that arise from externalities, some of which have already been mentioned. One major issue with externalities is that the property right to the externality is not assigned. The Coase Theorem[3] states that if property rights are assigned to either of the affected parties, and if transactions (negotiation) costs are negligible, then the private parties should reach a mutually beneficial agreement. In essence, the goal is to "internalize the externality" by allocating either the external benefit or external cost to some party of the transaction. Throughout the discussion the focus will be on pollution as an example of a negative externality. Note that these methods are unlikely to be price-neutral (meaning the price of the externality producing good will remain the same). The general idea is that there is some external benefit or cost that society should be paying to obtain or mitigate, and achieving the goal of more or less production will increase costs. For a good with a positive externality, the increase in demand should increase price; for a good with a negative externality, the decrease in supply should increase price.

2.2.1 Coasian Bargaining

A first solution is to consider private parties negotiating. Consider the case where a manufacturing plant is emitting pollution that is causing harm to the neighboring residents.[4] The problem is that the right to the air in the neighborhood is not assigned to either the residents or the producer. If the property right over the air is assigned to the residents, they could negotiate with the manufacturer and strike a deal such that they would be compensated by the manufacturer depending upon the level of pollution caused by the plant. The manufacturer could then decide the optimal level of emissions, which could mean shifting to cleaner production methods, based on both the internal and external costs. Alternatively, if the manufacturer was assigned the property right over the air, then the manufacturer could charge the residents for cleaner air. These payments from the residents could help offset costs of cleaner production methods.

While this method seems straightforward, and should lead to improvements in efficiency, there is the caveat in the Coase Theorem that transactions costs be negligible. The residents could potentially have difficulty organizing, and that difficulty would likely increase as the number of residents increases. The organizing costs are a significant barrier to resolving the externality problem. Also, large manufacturers tend to have lawyers on the payroll. A law firm's job is to protect its client's interests and the firm is unlikely to grant concessions easily. Depending upon the externality, the transactions costs could be so large that they overwhelm the benefit of internalizing the externality.

Earlier we had discussed the Hicks-Kaldor compensation principle, in which the individuals who gained from a policy proposal could (theoretically) compensate those who lost from a policy proposal. If more was gained to society than lost, then implementation of the policy could be justified based on efficiency. Coasian bargaining is similar to the Hicks-Kaldor compensation principle, except now (1) we are trying to resolve an existing externality problem privately and (2) the transfers between the parties are not theoretical, but actually occur.

2.2.2 Market Solutions

Similar to private bargaining, market solutions seek to provide incentives for producers of externalities to reduce the production of goods that create negative externalities and increase production of goods that create positive externalities. In energy markets, there are systems in place where producers purchase permits that allow them to create a specific amount of pollution (release emissions into the air). The total amount of pollution is capped, and producers are able to trade pollution permits. This system is oftentimes called "cap

[3] This theorem is named after Ronald Coase, who developed the framework for assigning property rights in his 1960 *Journal of Law and Economics* paper.
https://www.jstor.org/stable/724810

[4] Lest you believe this problem does not arise close to home, there is a case in 2021 of a paper mill in Catawba, SC, being sued for exactly this issue.
https://www.charlotteobserver.com/news/business/article251535653.html

and trade." While we will discuss market mechanisms for achieving policy goals more generally later in the course, the ability for producers to trade (or sell) permits to other producers is an important aspect of this system in incentivizing the adoption of pollution reducing technologies. The permits themselves cost money, but if the producer can find an alternative production technology that creates less pollution, the ability to trade (or sell) their permit to another producer allows them to recoup some of the cost of the permit and apply it towards implementing the less polluting technology. Without the incentive to trade the permit, the producer may delay implementing pollution reducing technology. While the cost of the permit has already been incurred and can be treated as a fixed cost, the cost of the new technology has not and is treated as a marginal cost. Recouping money from the sale of the permit provides additional revenue, which can help offset the additional cost.

2.2.3 Regulation

Legislation has also been used to mitigate negative externalities. There are a number of legislative actions, both domestic and international, taken to reduce pollution. The U.S. has any number of regulations targeting environmental goals: Clean Air Act in 1963 (amended later), National Environmental Policy Act in 1970, Corporate Average Fuel Emission (CAFE) Standards in 1975, etc. Internationally, recently the Paris Agreement on climate change in 2016 is a major treaty targeting reduction of greenhouse gas emissions and sustainable production. Unlike the bargaining and market solutions, which tend to rely on voluntary decisions, governments have the ability to legally compel individuals and organizations to comply with the standards set forth in regulation. Noncompliance can result in penalties, which could be financial or loss of freedom. While there might not seem like much room for economic analysis, there are still tradeoffs to be made. Returning to our concepts of risk and uncertainty, individuals can estimate the expected cost of punishment by estimating the likelihood of being caught and the punishment for each violation. If the expected cost from violating the standards is greater than the expected benefit, the individual should obey the regulation.

2.2.4 Subsidies/Taxation

Finally, subsidies and taxation can be used. A subsidy is a payment from the government to an individual or firm to undertake an activity. Taxes are payment demanded by government for engaging in certain activities.

Positive Externalities For goods that produce positive externalities, subsidies can be provided to the producers of those goods to incentivize them to produce more of the good. However, just because a good creates a positive externality does not mean that it should be subsidized. As with all decisions, costs and benefits must be weighed. If the marginal cost of the additional production (which is the subsidy) outweighs the marginal benefit from the positive externality, then the subsidy should not be provided. Returning to the street light example, subsidies could be provided to incentivize homeowners to install outdoor lighting. However, given that the private benefits to installing such lighting likely already exceed the cost of the lighting, it seems unlikely that the subsidy would induce more lighting. Rather, it would just offset the cost of the lighting the homeowners were already going to purchase.

We have recently seen one example where producers were provided subsidies to create a good that had large private and external benefits. Vaccines confer both private benefits (individual is protected) as well as external benefits (reduced transmission among the population).

Negative Externalities For goods that produce negative externalities, taxes can be used to increase the cost of production. From our basic supply and demand model, when production costs increase supply should decrease, leading to an increase in price and decrease in quantity. The next set of notes will be a discussion of various types of tax policies, so I will not go into great detail about specific tax policies and externalities. Specific to energy markets, a debate exists about whether a carbon tax, which would tax manufacturers based on how much greenhouse gas their production process emits, or a market solution (like cap and trade) is preferable.

3 Summary

Typically I would end with a commentary on criticisms, but these notes primarily define the concepts of public good and externality. One common misunderstanding is that a public good is a good provided by the public; as mentioned earlier, public goods may be provided by either the public or private sector. However, there are goods that do not meet the strict definition of public good but still have some public good qualities and oftentimes produce external benefits. Three major goods of this type are security, education, and healthcare, which are provided by both the public and private sectors. When provided privately, it is easy to observe the private benefits that accrue to the individual paying for the service. A private security detail (like bodyguards) provides protection for the individual under protection; a private tutor provides instruction directly to the pupil; a private medical professional provides medical services directly to the individual who is paying for those services.

But these goods all have some feature of a public good as well. In protecting taxpayers, law enforcement officials often end up protecting nontaxpayers (non-excludable). Knowledge (provided through education) is non-rivalrous (my knowing something does not preclude others from knowing that same thing). Medical professionals treat people first (at least to stabilize them) without checking to see if they can pay for the services (non-excludable). That these goods also tend to have external benefits leads some to question whether they should be provided privately or by the public sector.