CM14: EXTERNALITIES (4/21/21)

MOST, BUT NOT ALL, OF WHAT YOU SHOULD KNOW

1. What do economists mean by a 'market failure'?

2. What are the three basic types of 'market failure'?

3. How is the term externality defined?

4. What is the difference between an external benefit and an external cost? (You should be able to identify whether an activity fits into the benefit or cost category.)

5. What is the difference between private and social costs?

6. How are MSB and MSC defined?

7. What is the relationship between MSB and MB if there are EBs, and what is the relationship between MSC and MC if there are ECs?

8. Why do EBs lead to *under*production by the market?

9. How is a social optimum defined?

10. Why is the MSB above (and to the right of) the MB curve?

11. Why is Q_M not the social optimum, Q_{SO}?

12. Why do we use a Pigou subsidy when there is an EB?

13. Why does a subsidy cause the supply curve to shift to the right (downwards)?

14. Why do ECs lead to *over*production?

15. Why do we use a Pigouvian tax to deal with external costs?

16. How is a transaction cost defined?

17. Why did Coase argue that if transaction costs were small then there is no need for the government to use Pigouvian taxes to make the polluter pay?

18. How does the Coase "Theorem" show that in the small transaction cost case it does not matter who is allocated the property right?

19. Why do ideas of 'fairness' often cause the parties involved in property rights disputes to refuse to compensate?

20. What is the meaning of the phrase "the polluter pays"?

21. Who causes pollution?

22. What is the 'optimal' level of pollution?

23. What does Command and Control mean?

24. What does Cap and Trade mean?

25. Why does it make sense for the 'new' plant to sell permits and for the 'old' plant to buy them?

1. MARKET FAILURE.

1. In CM6-9 and CM 11 we looked at situations where, on the whole, markets work well, at least in theory, and where government interference with market outcomes may not lead to improvements in social welfare. Now we turn our attention to situations in which markets, *even the economist's theoretical markets*, do not produce socially optimal outcomes: these situations called *"market failures"*. We will examine: (1) Externalities (CM14); (2) Public Goods (CM15); (3) Asymmetric Information (CM16); and (4) Prohibited/Repugnant goods and services – Prostitution and drugs (CM18) (Repugnance is not usually included in the list of market failures).

2. Markets may also fail to coordinate economic activity at the aggregate level, the Great Depression and the Great Recession, but that is something that you will learn about in Econ 207. Topics CM22B-CM22D discuss market situations other than perfect competition: monopoly and monopolistic competition and oligopoly, where the supply and demand model is not strictly applicable and where there are clear divergences from efficiency. But in CM14-CM16 and CM18 our attention will be on situations in which *competitive markets, even the abstract markets of the Arrow-Debreu model that underpins all of microeconomic theory, are known not to generate socially optimal situations.*

The fundamental problem with external effects is that the *prices generated in competitive markets only reflect private costs and benefits, and so the prices generate incorrect signals, an imperfect guide to socially optimal resource allocation.*

2. EXTERNAL COSTS AND BENEFITS.

1. *An* ***external effect*** *occurs when an economic activity (either production or consumption) imposes a cost or benefit on economic agents who are not directly involved in the economic activity.* Economists distinguish between

external production costs and benefits and external consumption costs and benefits, but I will simply refer to external costs and external benefits because the source of the externality is not important from our point of view.

An example of an *external consumption cost* is the person down the hall in the residence who is playing her stereo system when you are trying to sleep or, perish the thought, study. Or the person in front of you on an airline who insists on putting her seat back leaving you with no room to breathe, or the 400 pound guy in the seat next to you who wants to snore on your shoulder, or the couple with the baby who seem to be unable to realize that their "adorable baby" has been screaming for the last nine hours of the flight.

An example of an *external consumption benefit* is the pleasure that passersby obtain when they look at my wife's flower garden, painting and maintaining your house, flushing the toilet, keeping your social distance, washing your hands.

An example of an *external production cost* is the air and water pollution generated by a power plant or a steel mill, or the stink from Georgia Pacific in the bad old days when it operated the paper mill in Bellingham, or the noise pollution from large trucks.

An example of an *external production benefit* is the pollination of orchards when bees collect honey (in Washington state beekeepers move their hives from orchard to orchard charging a fee for the pollination done by their bees), or the trained workforce in Seattle attracted by Microsoft.

2. *External effects cause problems for markets because there is a divergence between private benefits (MB) and private costs (MC), and social benefits (MSB) and social costs (MSB).*

We will assume, that is, make the value judgment, that economic activity should be assessed in terms of its impacts on society as a whole, social welfare for short.

In previous Commentaries I have argued that an optimal outcome is one where marginal benefit, MB, is equal to marginal cost, MC, because I assumed that MB and MC reflected social benefits and costs accurately, but now we must distinguish between MB which measures the private (personal) benefits to the buyer and marginal social benefits, which are the benefits of the economic activity to society as a whole: MSB = MB + EB (external benefit). Similarly, we

need to distinguish between MC, which is the private cost borne by the supplier/seller/producer (the costs of inputs in the firm's production process) and the costs to society taken as a whole, marginal social costs: MSC= MC + EC[1] (external cost). This is just a variation of what I wrote in CM1, that *all* the costs and *all* the benefits should be taken into account when making an economic decision.

3. *If there are external effects then MB is less than MSB and MC is less than MSC. Because participants in market decisions do not take external costs and benefits into account*, the market generates incorrect signals and incentives: *the prices are not generating optimal signals and profits are not generating optimal social incentives*. We will distinguish between a *market optimum*, Q_M, where MB = MC, and a *social optimum*, Q_{SO}, where MSB = MSC. *A social optimum only occurs when MSB = MSC*. In general, it is not socially optimal just to have MSB = MC or MB = MSC.

4. Most economic activities generate both external benefits and external costs, (transit rides reduce congestion but cause noise and air pollution, fireworks are pretty to look at but disturb animals, and Christmas decorations are attractive in both senses of the word – nice to see but cause cars to tour your neighborhood) but, to keep the analysis as simple as possible, *we will only analyze situations in which there are external benefits* ***or*** *external costs but not both*.

5. If you want to see the analysis done at a sophisticated level then take the Economics department's environmental and resource economics courses; even better take our joint major in Economics and Environmental Studies. In CM14 I will analyze only *very* simple cases, for example, I will mainly deal with point sources of pollution – pollution generated at a specific point on the earth's surface, such as by a power plant, which means that I will not write much about problems such as the pollution that is generated by your Spring break flight to Florida.

3. CASE A: EXTERNAL BENEFITS BUT NO EXTERNAL COSTS.

1. ***Assumption****: No external cost*, that is, EC = 0 and so MSC = MC because MSC = MC + EC = MC + 0 = MC. Therefore, the only costs are the costs to the producer; payments to labor and capital and natural resources and for

[1] In CM14 EC *does* ***not*** *stand for Explicit Cost.*

entrepreneurial expertise. These are the costs that the firm takes into account when determining its profit maximizing output and which underlie the equilibrium price and quantity generated at the market level. The market **underproduces** if there are external benefits.

2. If I come to class *using the transit system*, the Whatcom Transit Authority (*WTA*)[2] the fare/price that I pay reflects *the MB of the bus ride to me*, and my WTP for the ride (and, of course, my ATP). But when I ride the bus rather than use my car I reduce the density of traffic on the bus route and this generates benefits to other road users – *external benefits* (EB): passenger cars can get from Fairhaven to downtown Bellingham more quickly and commercial vehicles, because they can move faster, need to make fewer trips, which lowers transportation costs and ultimately the costs of goods and services transported by road. Therefore, the *WTA*, because of my decision to ride the bus rather than use my car, generates an external benefit to other road users. But *the WTA* receives only my fare for the bus ride it provides, it *cannot collect a fee from all those who benefit from the bus service indirectly*. This means that the *WTA* will produce too few transit rides from society's point of view, because its profit maximizing decision reflects only the costs and benefits that affect it; the WTA ignores the external benefit because there is no way that it can collect those external benefits. Therefore, although the *WTA*'s MC is equal to my MB, MC (=MSC) is less than MSB: MC < MSB = MB +EB.

3. Consider another case of an external benefit with little or no external cost, flu shots (vaccinations in general). I may have to pay $20 if I get a flu shot from a pharmacy. (Although flu shots are "free" to me if they are covered by health insurance – in fact Haggen gave me a 10% discount coupon to use with my groceries, but there is a time cost involved in obtaining the shot, and there may be minor discomfort from the flu vaccine.)[3] The $20 is the marginal cost that I take into account when deciding whether or not to get a flu shot. These are the *private costs that I evaluate at the margin*. *The MB to me is the reduced risk of getting flu*. When deciding whether to have a flu shot I trade-off the (private) marginal benefit to me of the flu vaccine against the (private) marginal cost to me. But when I get a flu shot I also generate an external

[2] *WTA* not to be confused with Willingness to Accept. Be careful in what follows to distinguish between *WTA* (Whatcom Transit Authority) and WTA (willingness to accept).

[3] Commercial firms selling flu shots have been known to raise the price of a flu shot to $90 during a serious flu epidemic. Think of all the price increases associated with the virus.

benefit, because influenza is an infectious disease[4] and when I reduce the risk to me of getting influenza I also reduce the likelihood that I will transmit the flu virus to other people.[5] At the market level the MBs are horizontally summed to get the market marginal benefit curve, which is also the market demand curve. At the market level the marginal costs are horizontally summed to get the market marginal cost curve, which is the market supply curve. At the market level MSB = MB + EB and, in this case, MSC = MC because EC = 0 by assumption. These are the curves that are shown in Figures 1 and 2.

4. We start in Figure 1 by **assuming** that there are no external benefits or external costs, and so the market equilibrium is also socially optimal because MC = MB $\Rightarrow$ MSC = MSB, where MSB = MB + EB = MB + 0 = MB and MSC = MC + EC = MC + 0 = MC. Consumer surplus plus producer surplus (CS + PS) is maximized at Q_M (= Q_{SO}). The market solution is efficient and Pareto Optimal; the gains from trade are maximized and MSB = MSC.

5. In Figure 2 the good or service (the influenza vaccination) generates an external benefit, EB, and so the MSB from consuming the Q_0 unit is MB_0 (measured by the height of the demand curve) + EB_0 (the vertical distance between the demand curve and the MSB curve). But there is no external cost (EC=0) therefore MC = MSC.

6. ***Assumption****: The external benefit, EB, does not vary with the level of consumption*. In this case the MSB will be the magenta line that is uniformly higher than the red demand curve (MB) curve by the amount EB. Note that the MSB is ***not*** a new demand curve.

7. Figure 2 shows that the market will be in equilibrium at Q_M and P_M (where MB=MC), but that the social optimum is at Q_{SO} and P_{SO} (where MSB=MSC). The market *under* produces, because $Q_M < Q_{SO}$, and generates a price signal that is too low because $P_M < P_{SO}$. This may seem counter intuitive because a higher price would discourage consumption, I might decide not to have my flu shot if

[4] Flu kills between 30,000 and 60,000 mostly elderly persons each year in the US.

[5] At my age the flu can kill me! In 1918 more people died from influenza than had been killed and wounded during WW1. (I wonder how many of the people who would have died from flu will appear as victims of the COVID-19 virus in 2020?)

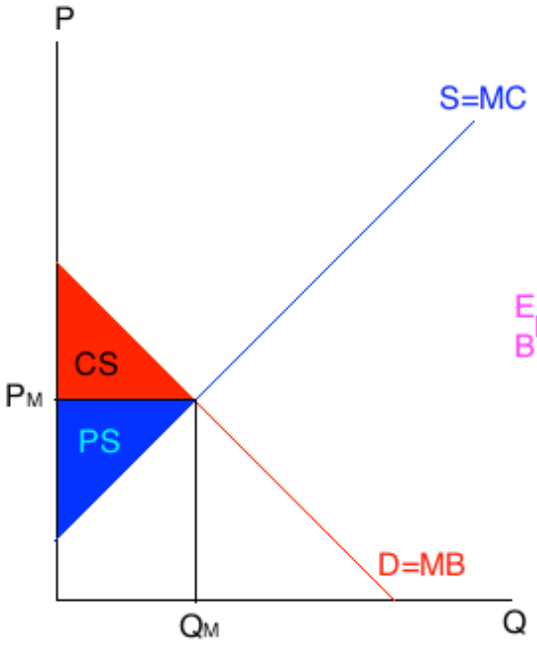

Figure 1

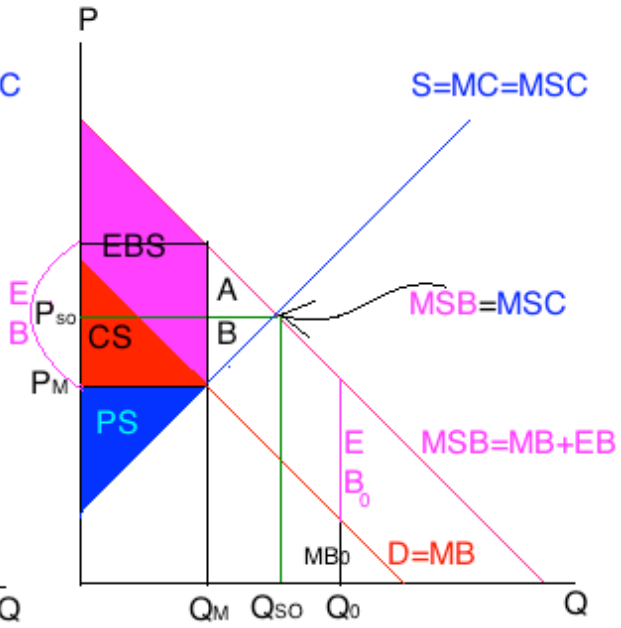

Figure 2

the price was higher, but the price is too low in the sense that it does not signal to potential vaccine suppliers the true value to society of the marginal flu shot (MSB). At Q_M both CS and PS are unchanged but now we have an external benefit, EB, generated by each unit of vaccine up to Q_M. The total external benefit is the magenta oblong shape between the demand curve and the MSB curve, which I will refer to it as the External Benefit Surplus (EBS).

8. Although the market is in equilibrium at Q_M this output level is not socially optimal because at Q_M marginal social benefit, the height of the MSB curve, is greater than MSC, the height of the supply curve, MSB > MSC = MC. Therefore, society would gain from a larger output. The market is operating "inefficiently" because MSB>MC, and Q_M is not a Pareto optimum because an increase in output from Q_M to Q_{SO} would make both consumers and producers better off without making anyone worse off: consumers would be better off by the increased CS (the upper triangle, labeled A) and producers would be better off by the increased PS (the lower triangle, labeled B).

At Q_M there is a DWL equal to the areas of the two small triangles (A+B). Increasing output of the vaccine from Q_M to Q_{SO} would be a pure Pareto improvement, someone would be better off and no one would be worse off. However, firms cannot profitably expand output beyond Q_M because they

would have to lower their prices to persuade consumers to expand along the market demand curve, but that would mean that the firms would be producing units of vaccine whose MCs would be greater than the price. The gain is not realized because the persons benefiting from the EB are not paying for that benefit: I will not pay more for the flu shot than my personal MB, which is my willingness to pay. The price is too low to persuade firms to expand output.

4. A PIGOUVIAN SOLUTION.

1. In "The Economics of Welfare" (1920) Arthur C. Pigou (Pea goo), Alfred Marshall's pupil and the inheritor of Marshall's economics chair at Cambridge (UK), proposed *a solution to this type of market failure: provide the producer that generates the external benefit with a subsidy (SUB) set so that it is exactly equal to external benefit (EB).*[6] In Figure 3 I have shifted the supply curve down (and to the right) from MC to MC – SUB, which becomes the firms' new supply curve (and its new WTA curve).[7]

2. The analysis is quite straightforward. *The market is under-supplying the vaccine and so we give an incentive to sellers to increase supply*. The size of the incentive should be just large enough to increase supply so that the new equilibrium is at the socially optimal output, $Q_{SO.}$ Of course, the trick is to estimate the size of the EB; it is this sort of problem that makes economics challenging.

Beware of economic diagrams they look so convincing but you should always ask, how would I be able to determine where the curves are in real world situations. Often the answer is that you cannot do the estimation.

3. Figure 3 looks really daunting. However, in a multiple-choice exam, I draw

[6] Notice that Pigou was writing in 1920 long before the environmental movement got going in the mid 1960s. In fact, the first edition of the book that was revised and published as *The Economics of Welfare* was published in 1907.

[7] It would be possible to pay the subsidy to the buyers but it is usually not administratively efficient to do so; as in CM8 there are many more buyers than sellers. If you are really keen, or a potential economics major, then do the analysis (use the magenta line in Figure 3) when the subsidy is paid to the buyers and show that you get the same price and quantity, although it is now at a substantially larger administrative cost. In this toy model, it does not matter, from an efficiency point of view, who receives the subsidy, although *there are differences in the distributional effects*.

the diagrams; you just have to remember how they work and recognize which one that applies to your question. (**Ignore the letters A and B!!!**)

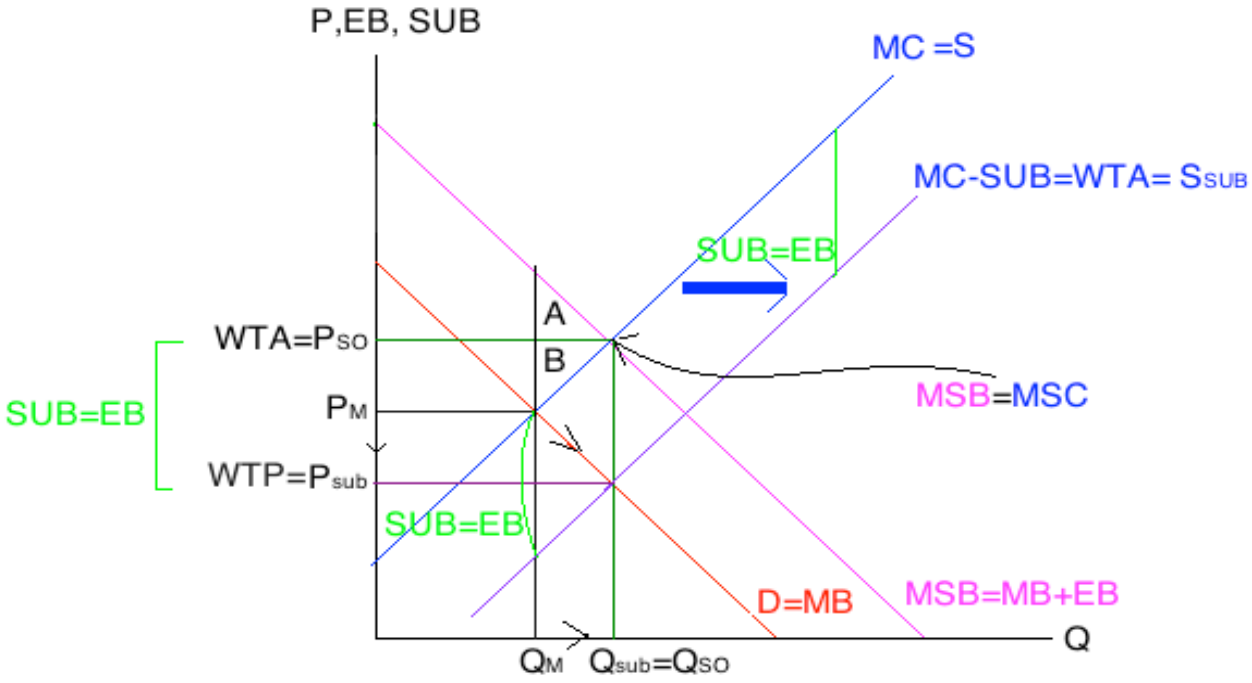

Figure 3

4. We start at the original sub-optimal market equilibrium with $Q=Q_M$ and $P=P_M$. We calculate the size of the EB; *this is the difficult problem in applying the policy*. We give the firms a subsidy, SUB=EB, the firms' WTA drops by the amount of the subsidy, and this shifts the supply curve from S to S_{SUB}. The new supply curve is also the new WTA curve. Because they are receiving the subsidy the firms can now maximize their profits at P_{sub}. The marginal unit still costs MC to produce but the firm receives a marginal revenue of P_{sub}+SUB, and so profit is maximized because MR_{sub} = MC.

Equivalently, if the price drops, then the firms will be compensated by the subsidy, in fact, they will end up receiving P_{SO}, which is equal to the new market price, P_{sub} plus the subsidy, that is P_{sub}+SUB = P_{SO}, which is equal to the firms' new WTA.

5. The subsidy is a supply "shifter" (GOVT) and so the supply curve shifts to the right (strictly downwards by the amount of the subsidy). This shift causes excess supply at the original price and so the price falls causing consumers to increase their quantity demanded. The new equilibrium is at Q_{sub}, with a new equilibrium

price, P_{sub}, which is just equal to the consumers' WTP for the marginal unit Q_{sub}. Note that the price I pay to ride the bus has dropped because the supply has increased. As in the case of a sales tax (CM8) although the subsidy is paid to the *WTA*, I get part of it in the form of a lower bus fare. The new equilibrium is a social optimum because MSB=MSC at that equilibrium, where MSB = MB + EB and MSC = MC (because by assumption there are no external costs).

6. Note that at Q_{sub} consumer surplus and producer surplus are maximized and are larger than at Q_M. The new output is a Pareto Optimum. However, at Q_{sub}, MB is lower than MC but that discrepancy is made up by the subsidy.

At this point that the standard textbooks turn to other things and do not ask: *Who is paying the subsidy?* Taxpayers pay the subsidy and they are worse off. We can only evaluate the subsidy if we know what taxpayers would have done with the taxed income, and what benefits they get from the increased consumer surplus.

Some taxpayers do not ride the transit system and so the subsidy also reallocates income between riders and non-riders.

7. Finally, notice the three little arrows. In order for the market to be at Q_{sub} consumers must buy more but they will only do so if the price falls (from P_M to P_{sub}) (the vertical arrow), which causes the quantity demanded to increase (from Q_M to Q_{sub}) (the horizontal arrow), which means that there has to be a movement down the demand curve (the diagonal arrow on the demand curve).

5. CASE B: EXTERNAL COSTS BUT NO EXTERNAL BENEFITS.

1. Assumption*: There is no external benefit* (EB=0). This is the reverse of Case 1. The classic example of an external cost is air pollution. *Because firms ignore external costs there is* ***over*** *production when there are external costs*; even if the firm is aware of the costs that it is imposing on society, dealing with the pollution will cause the firm's profits to decline. The firm is in business to make a profit for its owners not to be environmentally friendly; the owners can give up some of their profits if they get sufficient satisfaction from their contribution to improving the environment, but don't hold your breath!

2. In this case *we impose a Pigouvian Tax equal to the external costs.* The tax shifts the supply curve upwards by an amount exactly (*if* we have done our empirical work properly!) equal to the external cost. (The tax, a supply shifter,

also shifts the supply curve up and to the left.)

3. In Figure 4a the market will be in equilibrium producing Q_M and charging P_M. At Q_M marginal social cost is larger than marginal social benefit. The social optimum is at Q_{SO} where MSB = MSC, and so *external costs are associated with over production* because the external costs of production are ignored when deciding to produce Q_M; only the private costs are relevant as far as the firm and the market are concerned.

The total external cost is EC times the over production (Q_M-Q_{SO}), which is the trapezoid (with the faint green outline) made up of the four triangles A, B, C and D. C is the benefit to consumers from consuming the extra output, D is the gain to producers from producing the extra output, but A+B is a pure DWL. The DWL arises because there are costs to society that are not offset by gains to anyone. The market is also generating a wrong signal because the price is too low, $P_M < P_{SO}$.

4. In the case of an external cost the appropriate Pigouvian policy is to *impose a tax on the firm/industry, where the tax is set equal to the estimated EC*. (I am assuming that the EC does not vary with output.) In Figure 4b the Pigouvian tax causes an upward (leftward) shift of the supply curve to S_T and the market now produces at the social optimum output, where $Q=Q_{SO}$ and $P=P_{SO}$ and MSB =MSC.

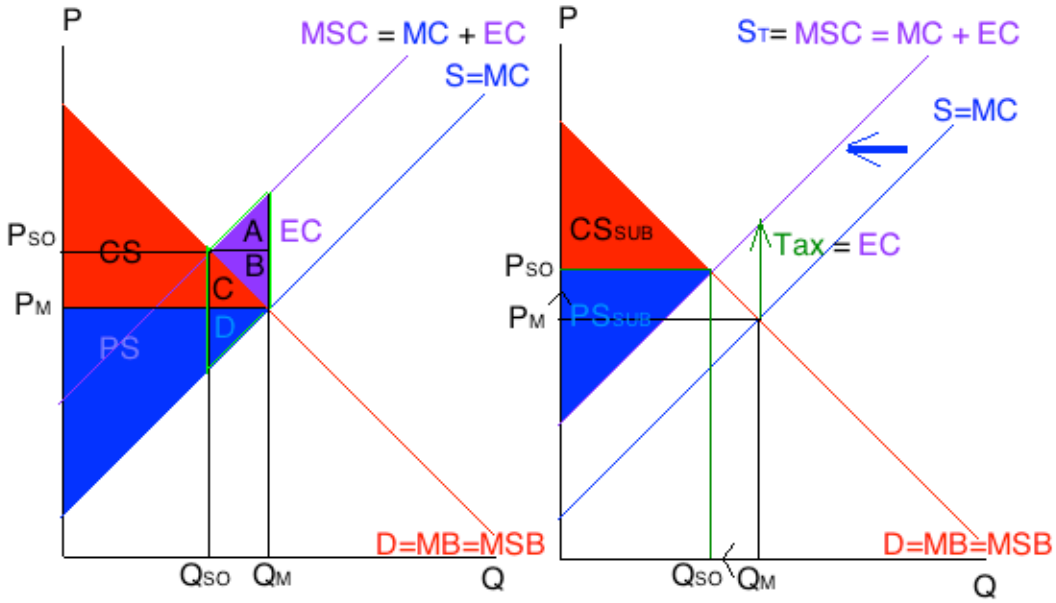

Figure 4a

Figure 4b

[Note that CS_{sub} and PS_{sub} should be labeled CS_{TAX} and PS_{TAX}!!!]

In this case the tax revenues can be used to offset other taxes and so the policy can be "tax neutral".[8]

6. COASE AND THE COASE "THEOREM".

1. Ronald Coase was a Nobel winning economist who had originally trained as a lawyer before becoming an economist. Coase's legal mindset is very obvious if you read his papers.[9]

2. The law recognizes "nuisance", which is harm done to you by someone else's actions. The person harmed by the nuisance can sue for damages. Essentially the law recognizes that *persons* (and firms that are 'legal persons') *have property rights*, and that if you infringe upon those property rights then

[8] Here is a very nice piece on Pigouvian taxes: http://www.nytimes.com/2013/01/06/business/pigovian-taxes-may-offer-economic-hope.html?_r=0

[9] Coase, an Englishman trained at the LSE was a professor at the Chicago Law School and was the founder of what became the law and economics movement. Economics is an excellent pre-law training, especially our PPE major. All law students spend time taking economics classes.

you must compensate the owners of those rights.

3. Coase argued that Pigou in particular, and economists in general, made a mistake when he/they adopted *the "polluter should pay"* rule that *underlies the Pigouvian tax and subsidize policies*. Coase argued that *who should receive the property right depended on who contributed most to social welfare*.

4. The so-called *Coase Theorem* is the idea that in the absence of transactions costs (or when those costs are small) the initial assignment of property rights for the use of some resource is irrelevant to who should bear the cost of dealing with the externality. (This is not a theorem in the usual (mathematical) sense of the word. And Coase objected to the term.[10]) A *transaction cost* is any cost associated with negotiating and enforcing the transaction, for example, lawyers' fees and court costs.

The standard assumption in environmental economics is "the polluter should pay". This assumption captures most people's idea about what is a fair or equitable. But Coase argued that the cost of dealing with the pollution might be better allocated to the persons being polluted if the social gains from the polluters' economic activity is greater than the social gains from the activity of the persons polluted. (We would need to know the Net Social Benefits of the alternative uses of the resource.)

5. Coase also argued that if there were property rights, then there would be no need for government intervention because the polluter and the persons harmed by the pollution would negotiate to settle their differences so long as there were no significant 'transactions costs'.
Remember that in CM 13 I argued that secure property rights are essential to efficient resource allocation. If I own my home then I have a right to sell it or, usually, to rent it to someone else, paint it or modify it or allow it to fall into disrepair or even, under some circumstances, to burn it down.

6. Consider a small office where there are some employees who smoke and some who are allergic to the smoke or are harmed by the 'second hand' smoke. Who should have the property right for the use of the office: the smokers or the non-smokers? If the smokers have traditionally been allowed

[10] Coase was very dismissive of what he called blackboard economics (when we were trained your familiar white boards were black, made of slate, and we used chalk to write on them). Coase would agree with my paragraph in 4.2, page 8.

to smoke then they have an implicit property right to smoke. Here there are no real transactions costs and so it doesn't matter who has the property rights. If smokers value the right to smoke more than the non-smokers value the right to a smoke free environment, then the smokers will exercise their implicit property right and smoke. If the non-smokers value a smoke free atmosphere more than the smokers value smoking, then the non-smokers will bribe the smokers not to smoke. If the office had historically been smoking free then the non-smokers have the implicit property right. If a group of new employees are assigned to the office then they can attempt to bribe the non-smokers to allow them to smoke. So, it does not matter from the point of view of the resource allocation outcome who is given the property right, the decision to allow or ban smoking will depend on who is willing to pay most for the right to smoke or prohibit smoking.[11]

7. In recent years most states, and many European countries, have passed non-smoking laws that assign the property right to non-smokers in public places such as bars, restaurants, offices, and airports. Therefore, the office will be smoke free. But if the non-smokers value a smoke free environment more than the smokers value smoking, then, according to Coase, the same result could have been achieved by negotiation. However, if the smokers value smoking more than the non-smokers value a smoke free office then they would have bribed the non-smokers to put up with the smoke, according to Coase, so the legislation is actually counterproductive! Coase's argument was that if there are no transactions costs then the property rights could be allocated arbitrarily without any effect on the actual resource allocation, because whoever valued the resource most could always bribe the other party to allow the highest valued user to use the resource.
Of course, in the case of airports, restaurants, grocery stores there would be large transactions costs associated with each new set of customers having to use their time to negotiate who can do what.

8. The assignment of the property rights determines who gets to pay. Do the smokers pay the non-smokers or the non-smokers pay the smokers? But Coase, and most economists, dismiss this as a distributional issue not an efficiency issue, and economists are fixated on efficiency and refuse to make

[11] Notice that, as always, we are talking about the ability to pay (ABT), not who 'values' the property right most. One group of workers may end up better off than the other.

overt value judgments about distributional issues.

9. Of course, you see the problems. In the first-place transactions costs may be prohibitively high. Coase did not argue that his approach could deal with all environmental problems, because problems such as air pollution involve transactions costs that make it impossible to arrive at negotiated solutions – there are too many polluters, it is impossible to ascertain which polluter is doing what amount of damage to whom, and the number of people affected by the pollution is too large for them to negotiate as a group, and the amount of damage they sustain varies from individual to individual, which means that the "group solution" will over compensate some members of the group and under compensate others.

I lived in Glasgow for five years and regularly travelled by buses that were filled with cigarette smoke. I have never smoked. How was I going to bribe the forty or so smokers to desist from smoking during a bus journey that lasted less than twenty minutes and during which smokers were getting onto and leaving the bus? Or how would you get 1,200 people in a theater to negotiate whether smoking would be allowed during the performance? The transactions costs would be prohibitive – drawing up and enforcing (legal not by breaking legs) the legal property rights.

10. Secondly, people have deeply held concepts of fairness that must be taken into account when predicting the outcome of the dispute over who has the right to do whatever is generating the external effect. That sense of fairness will depend in part on the historical situation. Has smoking always been allowed in the past, in which case the smokers have an implicit property right, which the non-smokers now wish to infringe. Or, were all the office workers non-smokers and now a group of smokers have been hired. People's sense of fairness may make them refuse to negotiate in the 'rational', cold-blooded, manner envisaged by Coase.

11. Although Coase's paper is one of the most cited papers in the economics literature most economists have chosen to ignore his main point, which is that how we deal with external effects should depend on which use of the resource is most beneficial to society. In practice environmental economists adopt the "polluter pays" principle; Mankiw has even formed a Pigouvian

Club to proselytize the idea of Pigouvian taxes.[12]

12. In my far from humble opinion, there are almost no real world situations in which Coase's solution to externality problems works; Coase's 'solution' is essentially irrelevant to real world externality problems. But that is not the position taken by most economists.

7. WHY IS THERE POLLUTION?

1. It is easy to demonize producers because they pollute the atmosphere and the water supply. But *firms produce pollution only because we generate profits for them by buying their products*. If we didn't consume steel then there would not be any steel plants and no pollution from steel mills. This is another aspect of consumerism (see CM17). Remember the old mantra: *reduce, reuse, and recycle*. There is now a circular-production movement that seeks to supplant our existing linear-production system.

2. Economists argue that atmospheric pollution is a consequence of the fact that *we do not have property rights in the atmosphere*, and there is no market for "clean" air. If a steel mill dumped its waste in my back yard then I would sue it. But if it dumps pollutants into the atmosphere, then since I do not own the atmosphere I cannot sue and, in any case, it would be difficult in most cases to establish who was doing the pollution. (Utilities in the mid-West generate acid rain in the North-east US and eastern Canada, but which ones are the culprits in any specific case?) It would also be difficult to determine the size of the damage, and difficult to get thousands of victims to coordinate their claims.

8. THE "OPTIMAL" LEVEL OF POLLUTION.

1. "If pollution is a "bad" then removing it is a "good" and therefore we should eliminate 100% of all pollutants." That type of argument goes against the rule we established in previous lectures (and especially in CM1) that when evaluating an economic policy both costs and benefits must be taken into account (all of the costs, and all of the benefits).

[12] Why then is the Theorem discussed in micro principles texts and courses? One obvious answer is that it seems to show that government intervention is not necessary to deal with externality problems, which seems to cynical old me to be another example of some economists wanting to place too much reliance on market solutions to economic problems.

2. There is no simple answer to how much pollution should be abated, or how much recycling should be undertaken. The general rule is to *undertake an activity up to the point at which MSB = MSC*, but this tells us nothing about specific cases: between 1970 and 2000 we removed almost 98% of lead, an extremely toxic substance, from the atmosphere, but only 15% of the more benign nitrogen oxide. Two and a half million people die in India each year because of air pollution related diseases, but India is a poor country and Indians will also die, for example, from malnutrition if they do not produce more. Some estimates put worldwide deaths from air pollution at 15 million per year.

3. Figure 5 shows the MSB and MSC of removing different types of pollution, what environmental economists call pollution abatement. To make life easy I have drawn the MSB and MSC curves as straight lines. *The MSB curve is assumed to be downward sloping, that is, the benefit from removing an additional unit of pollutant diminishes as the total amount of pollution removed increases. The MSC curve is assumed to be positively sloped; removing the next 1% of pollutant is almost certainly more expensive than removing the previous 1%*. Note that the cost of removal includes the value to consumers of the product whose output is being cut back. Pollutant A is very toxic (for example, lead or nuclear waste) and so the marginal social benefit from removing an extra 1% of this pollutant is very high, which is true even for the last 1% removed. But we cannot just look at the benefits; we must also look at the costs. In my example the cost to society of removing lead or nuclear waste is also high, but since the MSB of removing the last 1% of this pollutant is greater than the MSC, we should still attempt to remove all of it. The previous president's EPA recently relaxed lead paint regulations; I expect that the current president's EPA will restore the old standards. I have no idea whether this is a correct policy; to determine if it is, we need to know the MSB and MSC of the regulation. But it is also possible that the MSC of removing the last 1% of asbestos is greater than the MSB, in which case we would stop short of total removal. As noted above we have already removed most of the lead from our atmosphere but not all of it, nor would we attempt to remove the last speck of the type of asbestos that is toxic even if it were very toxic.[13]

[13] There is a debate about whether it is really a good idea to totally eradicate malaria because the cost of doing so, especially the cost of not spending the money on more prevalent diseases, may be too high.

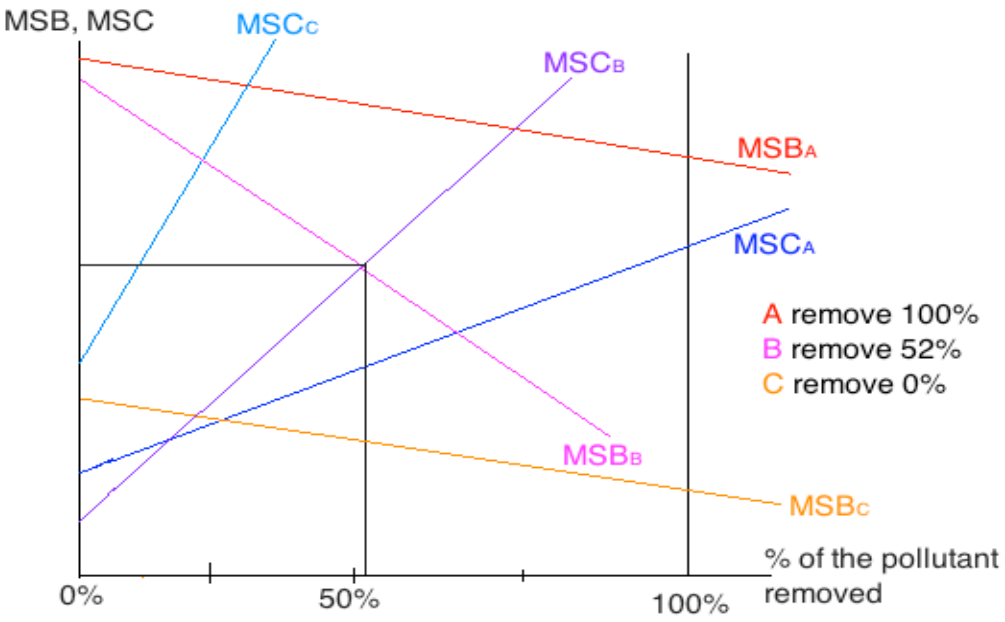

Figure 5

Pollutant B is something that we would like to get rid of but in this case the MSB equals the MSC when we get to the 52nd percentile. Beyond that point the MSC is greater than the MSB. In the case of pollutant C, the MSB of removing the pollutant is positive even at the 100% level. But the MSC of removing C is always higher than the MSB, even for the first unit removed, and so the optimal strategy is not to remove any of this type of pollutant.

4. You should be able to see that this argument means that *economics cannot say anything in general about the merits of recycling*. Each case has to be treated on its merits and those merits may change as supplies of the "virgin" product, and the recycled product, change over time. What is needed in every case is a very careful empirical investigation of the costs and benefits of any particular policy.

5. MSB depends on our ability to pay. The costs and benefits of pollution removal depend on the incomes of the people who live in the polluted area. Therefore, the most heavily polluted counties in the US are the poorest ones, often the ones with large black and brown populations.

9. HOW SHOULD WE REDUCE POLLUTION?

1. When the EPA was first set up it had almost no economists, the agency staff were almost exclusively lawyers. For many years the EPA relied on what

economists call "command and control" (C&C) regulation, essentially central planning. Legal limits on pollutants were established and the EPA enforced the standards by litigation. Such policies as the Clean Air Act of 1970 have caused huge improvements in environmental quality over the last fifty years. According to EPA data on particulate matter in the atmosphere, between 1980 and 2010, atmospheric lead declined by about 98%, carbon monoxide and sulfur dioxide by about 80%, and nitrogen dioxide by about 60%. In the same time period GDP increased by about 125%, vehicle miles traveled increased by about 95%, and our population increased by about 35%. (See the link to the Timothy Taylor blog below.)

2. C&C does not provide incentives to go beyond the minimum requirements set. In the last twenty years the EPA has paid more attention to economics, to providing firms with incentives to do more than the bare minimum and to come up with innovative technological fixes for dealing with their polluting by-products.

3. Economists have suggested what we call a "Cap and Trade" (C&T) policy. Under a C&T policy we first determine the "cap", the total amount of pollution to be removed (say, 200 tons), which is the *same* as in the C&C system. The EPA then allocates a number of tradable (sellable) permits to each firm (the new and the old); each permit allows the firm to emit one ton of pollutants; if the firms do not use a permit then the plant still has to remove 100 tons of pollutants.

Because the pollution permits are tradable, the EPA has effectively set up a market for pollution, or a market for clean air depending on your point of view, a market that does not exist naturally but has to be brought into existence by the government. The government is using the virtues of the market, efficient allocation and good incentives, to solve the pollution problem. In fact, it is possible for you, or an environmental group, to purchase the permits on the C&T market and force the utilities to remove more pollutants – something that is not possible under a C&C policy. Such markets have been in existence for a number of years, although the oldest of these, the SO_2 market, was modified in 2012.

4. In Figure 6 we have two power plants, a new plant and an old plant, both of which emit pollutants into the atmosphere.

From left to right we plot the marginal cost, MC_N, of removing pollutants (what environmental economists call abatement) for the new power plant; the one with the modern technology.

From right to left we plot the marginal cost, MC_O, of removing pollutants for the old power plant, which has an out of date technology.

The EPA calculates that it would be optimal if the two plants reduced pollution by 200 tons per year. Under a typical C&C approach it seems fair and politically expedient that both plants should reduce their pollution by 100 tons per year. But to remove the Q_{100}th ton of pollutant costs the old plant, MC_O = \$90, whereas the Q_{100}th ton of pollution removed by the new plant has a marginal cost of MC_N = \$40.

From society's point of view a ton of pollution is a ton of pollution, whether it is removed by the new plant or by the old plant, and so the MSB_N= MSB_O=MSB. Further, it should be clear, after a little thought, that this means that a socially optimal outcome requires that MSC_N = MSC_O = MSB. But if both firms remove 100 tons of pollutant then MSC_N < MSC_O and that cannot be socially optimal irrespective of the MSB.

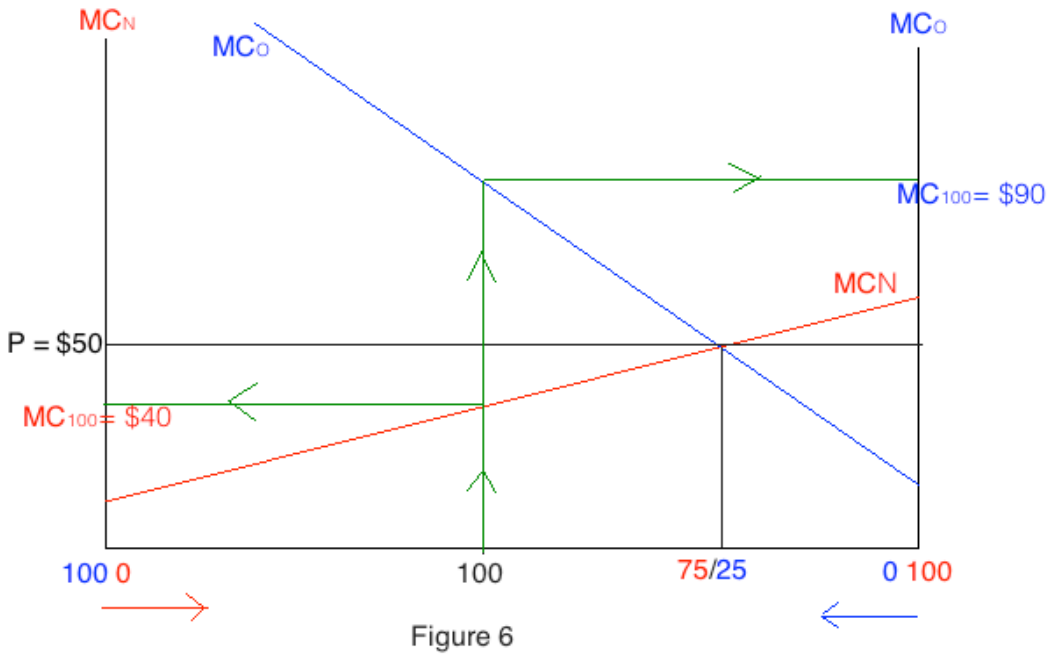

Figure 6

5. It is profitable for the new utility to sell permits to the old utility, as long as the price is above its MC of removing a ton of pollutant.

It is profitable for the old utility to buy a permit to pollute from the new plant, so long as the price of the permit is less than the old plant's MC of removing a ton of pollutant.

The firms trade until the price (a measure of the MB to society) equals the marginal costs of the two plants, where $MC_O = MC_N$. At that price the new plant clears up 175 tons of pollutant and the old one 25 tons.

Both utilities have incentives (higher profits) to lower their costs of removing pollutants and to come up with new technologies to do so – at which point we can change the rules by issuing fewer permits!

6. However, C&T is not a universal panacea for all environmental, or even all pollution, problems. Between 1995 and 2007 the SO_2 trading program was considered a great success and SO_2 emissions fell by 50% during this period. The Obama Administration proposed using a C&T system to control greenhouse gas emissions as many European countries do. The proposal was very controversial and was subject to many design problems. Cap and Trade was renamed Cap and Tax by conservatives and Cap and Fade by liberals. In 2010 The EPA replaced the original program by four new programs. (6,898)

http://virus.stanford.edu/uda/

http://www.latimes.com/business/hiltzik/la-fi-mh-antivaccination-movement-20140120,0,5576371.story - axzz2uJZzkzfD

http://taxfoundation.org/blog/raising-gas-taxes-pigou-club-vs-coase-club

http://bigthink.com/dangerous-ideas/14-recycling-is-a-waste

http://www.env-econ.net/2011/02/what-good-is-the-epa-anyway.html

http://conversableeconomist.blogspot.com/2015/04/manufacturing-up-pollution-down-how.html

http://conversableeconomist.blogspot.com/2011/11/costs-of-air-pollution-in-us.html

http://conversableeconomist.blogspot.com/2014/04/air-pollution-worlds-biggest-health.html

http://www.env-econ.net/2012/09/thats-160784-worth-of-trees.html

I urge those of you who are interested to take 300 level courses in Environmental Economics.