

Econ 4545 Environmental Economics

Review Questions- Set 2

March 20, 2012

Markets, Market Failure, Efficiency, Inefficiency, Corrections, Equity, etc.

- 1) Assume one has a purely competitive society except for one monopolistic industry which is a heavy polluter. Will the allocation of resources become more efficient if the government can make the monopolistic industry competitive? Discuss your answer.

- 2) Assume that the competitive firms in the widget industry produce excess air pollution from an efficiency perspective because the air is a common property resource. If this inefficiency is eliminated by a Pigouvian tax on air pollution, what will happen to the number of firms in the widget industry? Is this a good or bad thing?

- 3) Ralph needs a kidney and I want to buy a house in Tuscany. He gives me \$250,000 in exchange for one of my kidneys. (One can live with just one kidney.) I use the money as partial payment for the house (houses in Tuscany are expensive).

Is this exchange a potential Pareto improvement (PPI)? A Pareto improvement (PI)? Or neither?

Yes or No and explain. As part of your answer define *Pareto improvement* and *potential Pareto improvement*. Grading: 3 pts max for defining *Pareto improvement*, 2 pts max for defining and *potential Pareto improvement*, 2 pt max for telling me whether it is a PI, a PPI or neither, and 3 points for explaining why.

Answer: A potential Pareto improvement is a reallocation of resources such that the gains to the gainers from the reallocation, measured in some common units, is greater than the loss to the losers. A Pareto improvement is a reallocation of resources such that some members of society are made better off by the reallocation and no member are made worse off.

A potential Pareto improvement has the adjective potential because it is not a Pareto Improvement, but has the potential to be one in the sense that if the gainers compensated the losers for their losses the reallocation would be a Pareto improvement. Whenever, the current allocation is inefficient there is always the potential for a Pareto improvement.

The exchange is a voluntary market transaction that makes us both better off, otherwise we would not have done it – it is therefore a Pareto improvement.

- 4) What is an externality? What is a private good? What is a public good? Explain, in words, why externalities and public goods cause market failure.

- 5) Assume a purely competitive society that has a common property oil field (many drillers have access to the same pool). This society is also characterized by excessive pollution since no one owns the air. Will the allocation of resources become more efficient if the government can correct the C.P. problem in the oil field? Explain.
- 6) a. Define what is meant by the term "market failure" (Don't define market failure by example)
- b. Now define one specific type of market failure that plagues the natural resource/environmental sector of the economy. (Your definition of a specific type of market failure should also be example free)
- c. Explain, as if to another individual in this class, the impact this specific type of market failure will have on the allocation of resources.
- d. Now give an example of this type of market failure in the natural resource/environmental sector.
- e. Now discuss two ways the government might correct your example of market failure. (Your discussion of corrections should consider their distributional implications and their political feasibility.) Answer: It is important to distinguish between a definition and an example.

Answer:

a. A *market failure* is something inherent to the market system that causes the market equilibrium allocation of resources to be inefficient.

An important distinction is the distinction between *market* and *nonmarket* failures. Consider a world of no market failures (externalities, etc), but where the market equilibrium allocation of resources is inefficient, because of a government price control. In this case, the allocation of resources is inefficient, but it is not a failure of the market. If left to its own devices, the market allocation would have been efficient. The inefficiency was imposed on the market by an outside agent (the government), so the market cannot be blamed. This is a nonmarket failure. A lot of people feel the government is the author of many nonmarket failures.

Further note that the market has not failed if the equilibrium allocation is efficient but not fair. Markets did not evolve to achieve fairness. They cannot be deemed failures for failing to achieve something not in their job description.

b. Market failures include: ill-defined property rights (including, but not limited to common property), lack of complete markets (including, but not limited to the lack of futures markets) externalities, excess market power (monopoly and oligopoly power), public goods, and distortions in the capital markets.

I chose externalities as the type of market failure that I will discuss.

Externalities: There is an externality if an economic agent(s) does something that directly influences (not indirectly through market prices) some other economic agent(s) and there is the potential to make one of the parties better off without making some of the others involved worse

off. Or, equivalently, there is an externality if an external effect is produced at an inefficient level.

Examples of externality-type environmental market failures abound.

c. *Ceteris paribus*, an externality causes the market allocation of resources to be inefficient. If an economic agent's actions produce a positive or negative effect on others but the agent producing the effect does not have an incentive to fully take the effect into account, the agent will not produce the effect up to the point where the marginal benefit to society from the last unit produced equals the marginal cost to society.

Individual agents produce things up to the point where the marginal benefit to the agent equals the marginal cost (this maximizes the agent's net benefits from the action). If marginal private benefits equal marginal social benefits and marginal private costs equal marginal social costs, the agent will produce the efficient amount from society's perspective, even though the agent is pursuing only his or her own interests.

When the agent's actions involve an external benefit or costs that he or she is not internalizing, a wedge is driven between marginal private and social benefits and/or marginal private and social costs. In this case, there is a divergence between what is best for the individual and what is best for society.

In part c. it is important that you show that the market allocation will be inefficient in the presence of the externality type you specified. To do this, you need to show that at the market equilibrium allocation, social benefits are not maximized. One could accomplish this by demonstrating that at the market equilibrium, marginal social costs of production (or consumption) do not equal marginal social benefits, implying the commodity is either overproduced (too much consumed) or under-produced (too little consumed).

d. Unregulated and untaxed smokestack emissions are an example of a negative externality.

Note that the presence of pollution does not imply the presence of an externality. There is no externality if the pollution (the external effect) is at its efficient level.

e. One could tax the emissions at the rate which causes the polluter to emit the efficient amount. The tax will be the amount that eliminates, at the efficient amount of emissions, the wedge between the private and social costs of pollution. The tax will internalize the external cost imposed on society by the emitter's actions.

Other actions include requiring the polluter to produce the efficient amount of pollution - no more no less. That is, a regulation that requires the firm to pollute a certain amount.

One could also achieve efficiency with tradable emission permits. Firms would be required to have a permit for each unit of emissions. The government would issue the number of permits that would achieve the efficient amount of pollution. Firms that could reduce pollution on the margin

at a lower cost than some other firms would do so and then sell their excess permits to the higher cost firms. An important equity issue is how the government should initially distribute the permits. Options include selling them to the highest bidder, giving them to the firms, giving them to environmental organizations, etc.

Other Comments:

market failure is not the same thing as *inefficiency*

That is, market failure implies inefficiency, but inefficiency does not imply market failure. Said differently, market failure is sufficient, but not necessary for inefficiency.

necessary vs. sufficient, and definitions

efficiency is not the same thing as *optimality*

optimality implies efficiency, but efficiency does not imply optimality

optimality (efficiency and equity)

As I noted earlier, lack of equity in a market allocation of resources is not a market failure. The market is not designed to achieve an equitable allocation.

7) What is a market failure? Give me an example of an environmental market failure, and explain why it is a market failure. Choose an example that has not been discussed in class. Note that this question has three parts.

Answer: A *market failure* is something inherent to the market that causes the market equilibrium allocation of resources to be inefficient.

Note that it would be incorrect to say “a market failure exists when the allocation of resources is inefficient” because all inefficiencies are not caused by the market. For example, a nonmarket failure is an inefficiency caused by a nonmarket entity such as the government. Also, you would not call an inefficient allocation of resources in a centrally planned economy with no markets a *market failure*. Remember that there are many institutions that allocation resources besides markets.

Example: an inefficient amount of pollution because the private cost of polluting is lower than the social cost of pollution. This discrepancy between private and social costs causes firms to pollute an inefficient amount from society’s perspective; that is, the firms pollute too much from society’s perspective. Each firm pollutes up to the point where its marginal private benefits from polluting equals its marginal private costs of polluting, but because the marginal private cost of pollution is lower than the marginal social cost of polluting, at the equilibrium level of pollution, the marginal social cost of pollution is greater than the marginal social benefits from pollution, indicating that the firms are polluting an inefficient amount from society’s perspective.

That is, net benefits to society would increase if pollution were reduced to the point where its marginal social benefits equals its marginal social costs.

This excess pollution is an externality-type market failure and is typically caused by a lack of well defined property rights for the media (air, land, or water) into which the pollution is being emitted.

Note that: Presence of pollution is not proof of a market failure. For example, just because global warming is occurring does not mean that the market is failing. You have to remember that the efficient amount of pollution, global warming, crime, etc. is not typically zero, so its presence does not prove market failure. The market is failing when it is producing an inefficient amount of pollution. In fact, it might be the case that the inefficient amount of pollution produced is less rather than more than the efficient amount.

Bad weather is not an example of a market failure. It is a state of nature that affects us, it is given exogenously. Therefore, there is nothing to allocate, so it cannot be misallocated. There can be a market failure associated with how we prepare or react to bad weather.

- 8) Discuss the advantages and disadvantages of using criminal law to internalize externalities. Discuss the advantages and disadvantages of using civil law to internalize externalities.
- 9) Excess pollution from wood burning stoves is a major problem in many Colorado mountain communities. Why has the problem arisen? Explain why, without government intervention, there is a market failure. Suggest a government strategy for internalizing, or reducing, the market failure. Discuss the efficiency, equity and political feasibility of your suggested strategy.
- 10) Discuss criminal and civil law as a mechanism for internalizing a negative externality such as the illegal dumping or storage of toxic wastes.
11. What is the difference between a scarce, common-property resource and a public commodity? As part of your answer define both terms (5 pts max for the definitions and why they are different things). Explain why there is a market failure if a resource is a scarce and common property (3 pts max). Explain why there is a market failure if a commodity is a public commodity (2 pts max). Give the reader an example of an environmental commodity that is public in nature, convincing her that it is predominately public in nature (2 pts).

Answer: A common-property resource is a resource for which access is not controlled. That is, anyone can harvest units of the resource for only the cost of harvesting. Said another way, there is not gatekeeper and can keep one from harvesting.

A public commodity, as defined in class and in the notes, is a commodity that is noncongestible in consumption, and that has the property that consumption by one implies consumption by all. In explanation, a commodity is noncongestible (non-rivalous) if one individual's consumption of a unit of the commodity does not preclude other individuals from consuming that same unit of

that commodity. The second condition says that if x units of the commodity are produced everyone in society is forced to consume those x units.

Scare, common-property resources and public commodities are very different beasts. Scare, common-property resources are congestible. Public commodities are, by definition, non-congestible. If everyone considers a public commodity a good, limiting access to it is inefficient.

The market fails in the allocation of scare, common-property resources because the private cost of harvesting an additional unit of the resource, by either an individual or a firm, is less than the cost to society of harvesting that last unit. This results because the private harvester is not required to pay or account for the full loss to society: because of their actions, there is less of the resource for others to harvest either now or in the future.

If access was controlled by a private owner, the owner would require every harvester to pay this opportunity cost; otherwise, there would not get access to the resource. If access was controlled by the government, and the government behaved efficiently, they would either require harvesters to pay a harvest fee equivalent to the opportunity cost of the stock reduction, or allow not harvesting beyond the efficient amount.

The market will not produce public commodities in at efficient levels from society perspective. Efficiency dictates that society produce commodities (private or public) up to the point where the marginal cost to society of producing an additional unit is equal to the marginal benefit. For private commodities the marginal benefit to society is the simply the marginal benefit to the individual that consumes the unit, but for public commodities, the marginal benefit is the sum of the marginal benefits (positive and negative) to every member of society. The problem is that a private producer can not get people to pay their marginal benefit from consumption because there is no way to exclude anyone from consumption once the commodity is produced. Everyone can "free ride" on the consumption of others. Public commodities that are goods for all will be under-produced by the market. A major reason for governments is there ability to produce public commodities in efficient amounts. They have the ability to tax, so can force everyone to pay.

An aside: imagine a public commodity that everyone really hates. The efficient amount from everyone's perspective is zero. If I were a private firm with the rights to produce this commodity, I might threaten to produce it and get people to pay up to get me not to do it. I might say, I am producing x units of the stuff unless I am paid a total of $\$y$ from every individual. I would tell people that they would get their money back if everyone did not pay. In this case, everyone with a WTP of more than $\$y$ dollars would send me a check. I would make a lot of money if I set the price low enough (at or below the smallest WTP for not having the stuff produced). At the end of the day, the commodity would not be produced (the efficient outcome) but there would be a transfer of money from everyone to me. How nice.

An example of an environmental commodity that has a strong component of public-ness: Remember no commodity is purely public or private in nature. I am thinking of environmental commodities that individuals can get benefits from without actually being in contact with or

without consuming in the “using up” sense of the word. These types of benefits are called “non-use benefits”. Such benefits are non-congestible – my enjoying the thought of it does not preclude you from thinking about it. Examples might include knowing that the Alaska wilderness is protected or that a species has been saved in that wilderness. I choose the Alaska wilderness example because most of us will never go to the place, so most of benefits and costs are non-use in nature. A more complicated example would be the re-introduction of wolves in Colorado. For most of us, most of the benefits or costs we will receive are of a non-use, non-congestible nature. However, there are other effects that are not public in nature. For example, if the wolves eat my cows, they are less likely to eat yours, and I suffer the consequences, not you.

12. Explain why a competitive market is incapable of achieving efficiency when there are public goods

13. If the amount those injured by pollution would pay to reduce pollution is less than the amount the profits of the polluting firms would decrease if they reduced pollution, what can we say about the level of pollution?

Answer: Decreasing the level of pollution would be inefficient; doing so would not be a Potential Pareto Improvement. We cannot say for sure that the current level of pollution is efficient, it might be efficient or it might be efficient to increase the level of pollution, but we don't know: not enough information is provided.

14. Does the existence of a common property resource always cause market failure?

Answer: No. As explained in class, the market will only fail in the allocation of a common property resource if the resource is scarce.

If a resource is not scarce, everyone should be able to use as much of it as they desire at a zero price and that is how it will be priced if it is common property.

Remember that all resources basically started out as common property. There is no incentive to develop property rights for a resource as long as there is no expectation that it will become scarce.

15. Argue, on equity grounds, that taxes (i.e., effluent charges) are a good way to eliminate the inefficiency caused by pollution type externalities. Now argue, on equity grounds, that they are a bad way to do it.

16. Assume Boulder has two factories that emit a total of 100 tons of particulates into Boulder air everyday. Further assume that the EPA has decided that total emissions should be reduced to 70 tons. Is it efficient to achieve this level by requiring each factory to reduce their emissions by fifteen tons? Explain why or why not. If equal reductions

are not efficient, what is the efficient way to achieve the 30 unit reduction? As part of your answer, define, in words, efficiency in this context, and mathematically derive the condition for efficiency.

17. Does the existence of pollution imply the existence of one or more externalities?
18. Is the optimal amount of pollution zero?
19. Consider our example of a firm-firm externality where the widget factory located on a river discharges its wastes into the common property river and causes damage to the down-river resort. In theory, could the inefficiency be eliminated by a merger of the two firms? Explain. How likely is this to happen in practice?
20. Consider our example of a firm-firm externality where a widget factory, which is located on a river discharges its wastes into the river and causes damage to the down-river resort. Was the externality caused by a common property problem? Explain.
21. Consider our example of a firm-firm externality where a widget factory, which is located on a river discharges its wastes into the common property river and causes damage to the down-river resort. We concluded that the inefficiency from the externality could be eliminated by some appropriate per-unit tax rate on the waste dumped into the river. Explain why such a tax would eliminate the externality. Use a graph to support your written explanation. Under what conditions what a tax on widgets, rather than a tax on the waste, also work? When would it not work?

Answer: Consider two different situations: (1) there is a fixed relationship between widget production and pollution (no abatement is possible) and (2) without abatement, pollution increases as widget production increases, but for any level of widget production the firm can reduce pollution by allocating labor and capital to pollution abatement.

For either case, one can eliminate the inefficiency by an appropriate per-unit tax on the pollution. The inefficiency results because by the marginal social cost of polluting is greater than the marginal private cost of polluting. The inefficiency can be eliminated by setting the tax so that at the efficient level of pollution, the marginal private cost of polluting (marginal private cost before tax plus the tax) equals the marginal social cost of polluting. In which case, the tax will cause the private firm to fully take into account the social costs of its pollution when it decides how much to pollute; that is, the tax forces the firm to pay the full marginal cost of its pollution.

Insert first graph

Note that the tax will give the firm some incentive to allocate labor and capital to the abatement of pollution; that is, the firm will have an incentive to reduce pollution not just by reducing widget production, but also be allocating labor and capital specifically to reducing pollution. If such abatement is possible, efficiency dictates that the efficient amount of labor and capital be allocated to pollution abatement. The efficient amounts will, in general, not be zero. The per-unit tax on pollution will achieve this efficient amount of pollution abatement. A per-unit tax on

widget production would not, because while a per-unit tax on widget production gives the firm an incentive to reduce pollution by reducing widget production, it gives the firm no incentive to reduce pollution by allocating labor and capital to pollution abatement (it won't save any taxes).

When there is no abatement technology, then the only way to reduce pollution is to reduce widget production so a tax on pollution or a tax on widgets will work equally well. If abatement is not possible, there is a fixed relationship between widget production and pollution so one only needs to worry about the efficient level of pollution/widget production.

Insert second graph

With the potential for abatement, pollution can be reduced by either decreasing widget production and/or allocating labor and capital to the abatement of pollution. In which case, one needs to worry about the efficient level of widget production and the efficient level of pollution. The problem with the widget tax is that, unlike the pollution tax, it gives the firm no incentive to allocate L and K to pollution abatement.

22. Should the government try to internalize all externalities? When shouldn't the government intervene?
23. Discuss under what conditions a ban on smoking will, or will not, eliminate the inefficiencies caused by cigarette smoking.
24. Discuss under what conditions a ban on mountain biking in Boulder Mountain Parks, will, or will not, eliminate the inefficiencies caused by mountain biking in the parks.
25. Consider a situation where there are no restrictions on cigarette smoking, and where some individuals hate cigarette smoke. In these circumstances, might society end up with the efficient amount of cigarette smoking? Explain. Discuss the conditions under which this is more or less likely to happen.
26. What is a public good? Provide two examples of environmental resources that are public goods. For one of them, explain why a competitive market system will not provide an efficient amount of this public good. As part of your answer, graphically identify the efficient provision of a public good.
27. In what sense is a monopolist the conservationist's friend? If there are no other market failures, will a monopolist produce the efficient amount of the commodity?
28. What would ice cream cones be like if they were public goods?
29. What is a futures market? Are there well-developed futures markets for most natural resources. Explain why a lack of futures markets can cause the market to fail.
30. Explain how, under ideal conditions, a pollution permit system will reduce pollution by some specified amount in the minimum cost way. What are some of these *ideal*

conditions?

31. Argue in equity grounds that pollution permits should not be given to the polluters. Now argue on equity grounds that pollution permits should be given to the polluters.
32. Discuss the regional implications of a national pollution permit system for SO₂ emissions, where abatement costs vary by region. How will such a permit system effect the regional distribution of pollution?
33. Assume the goal is to reduce pollution to some predetermined level. Compare the informational requirements of doing this with a per-unit pollution tax verses a system of pollution permits.
34. What is a potential Pareto improvement? Why is it called a “potential” Pareto improvement?

Answer: A potential Pareto improvement is a reallocation of resources such that the gains to the gains from the reallocation, measured in some common units, is greater than the loss to the losers.

A Pareto improvement is a reallocation of resources such than some members of society are made better off by the reallocation and no member are made worse off.

A potential Pareto improvement has the adjective potential because it is not a Pareto improvement but has the potential to be one in the sense that if the gainers compensated the losers for their losses the reallocation would be a Pareto improvement.

If there is inefficiency in the allocation of resources, is there always the potential for a Pareto improvement?

If the amount those injured by pollution would pay to reduce pollution is greater than how much the profits of the polluting firms would decrease if they reduced pollution, what can we say about the level of pollution?

35. Make a Coasian argument that the market will internalize externalities such that government intervention is unnecessary. Now argue that, in practice, government intervention will sometimes be required to eliminate the inefficiency caused by the externality

Answer: Coase argued that the market would naturally internalize all externalities.

His argument is as follows: If an externality exists and the producer of the externality has the right or ability to produce the externality without restraint, then the recipient of the externality has an incentive to bribe the producer of the externality to reduce the external effect until efficiency is restored. And, if the recipient of the external effect has the right to not be the recipient of the external effect, the recipient can force the stoppage of the external effect, in which case the producer of the external effect will have an incentive to pay the recipient of the

external effect to accept an efficient amount of the external effect.

For example, assume I have no right to smoke without your permission. In which case, I can pay you to allow me to smoke; that is, as long as my wtp to smoke another cigarette is greater than your wta the smoke from another cigarette, I have an incentive to pay you to smoke more and you have an incentive to accept my smoke and the payment. These incentives will bring about the efficient amount of smoke because until the efficient amount of smoke is reached we both can be made better off by a trade of money for acceptance of smoke.

Note that if my wtp to smoke is less than your wta smoke for all levels of smoke, the efficient amount of smoke is zero.

Alternatively, if I have a right to smoke and/or you cannot stop me from smoking, then you will have an incentive to bribe me not to smoke. That is, if your wtp to reduce my smoking is greater than what I need to be paid to smoke less, we can both be made better off if you pay me to smoke less. These incentives will bring about the efficient amount of smoke because until the efficient amount of smoke is reached we both can be made better off by a trade of money for acceptance of smoke.

Note that if your wtp to reduce my smoking is less than what I have to be paid to reduce my smoking, my current level of smoking is efficient. It might or might be fair, but it is efficient.

Such negotiations between parties do occur, in which case the externality is internalized. But often it is impossible and inadvisable for economic agents to enter into such transactions.

Coase's argument depends on either an agent(s) having the right/ability to produce the external effect, or an agent(s) having the right/ability to stop the production of the external effect. Both parties must know and accept these rights. It also requires that there are only a smaller number of producers of the external effect and a small number of affected parties.

In many cases, these rights/abilities are ambiguous and/or unacceptable to one or more of the parties.

For example, the recipient of pollution will be less inclined to bribe the polluter to pollute less if the recipient thinks he can get the rights clarified to his advantage and/or he anticipates the laws/regulations will be changed to ban or reduce pollution. You would not pay someone to smoke less if you thought it would decrease the probability that smoking would be banned. Alternatively, if the polluter thought that the rights of others to reduce or stop the pollution were not definitive, he would be less inclined to pay those parties to accept his pollution.

Crimes are a type of externalities and on some occasions potential victims pay protection money (bribes) to the potential criminal to not do the crime, e.g., the store owner paying

protection to the mafia or the parents paying a ransom for their kidnapped child. But, for the most part, these types of transactions do not happen because it is often difficult or inadvisable for the criminal to identify himself before the crime, the contract is not enforceable, there are many potential criminals and there are many potential victims, and potential victims often reject the potential criminal's rights on moral grounds.

External effects often involve many agents, and when many agents are involved, negotiation costs can be sufficiently high to preclude the types of trades that Coase envisioned, even when everyone knows who has the rights.

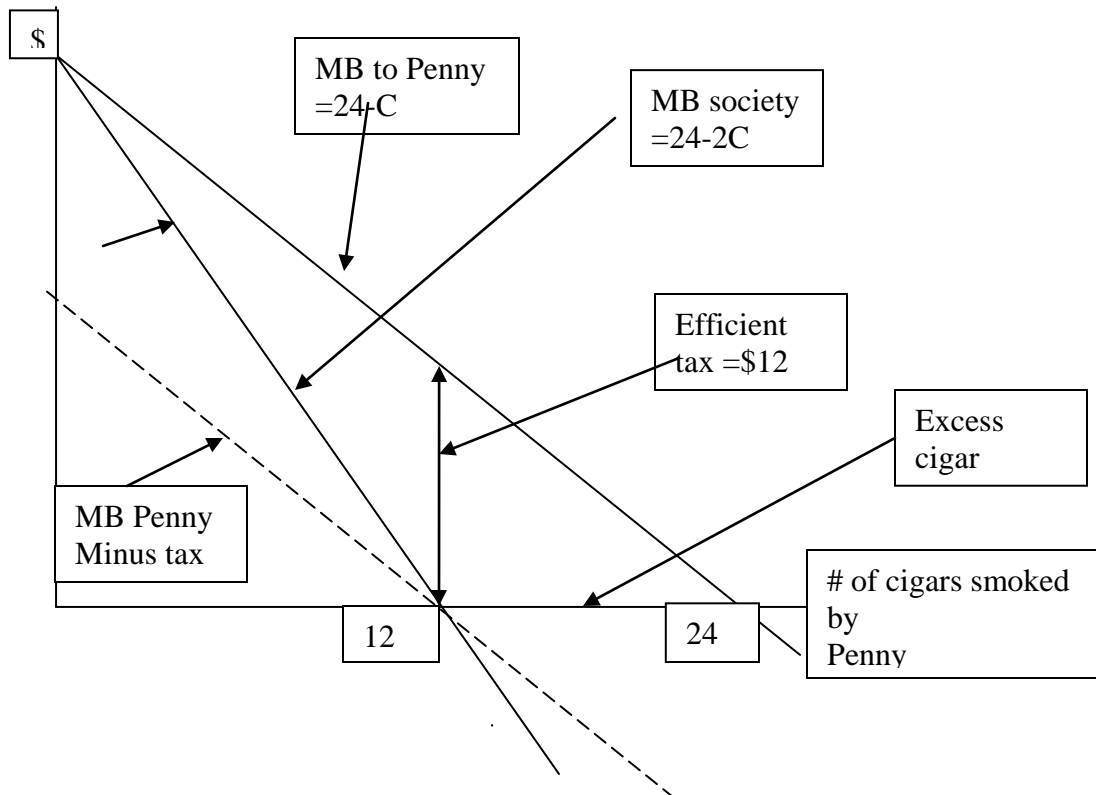
For example, automobile pollution is caused by millions of cars and affects millions of people. Even if the rights/abilities were clearly defined, it would be impossible for all the parties to get together and make an enforceable deal to reduce car pollution to an efficient amount.

In addition, when there are many parties affected by pollution, there is an incentive for each impacted party to free-ride on the payments made by others, and the efficient amount of pollution will not be achieved.

Other factors that complicate implementation of Coasian type arrangements is the ability of firms to enter and exit an industry, the ability for parties to relocate, and income effects.

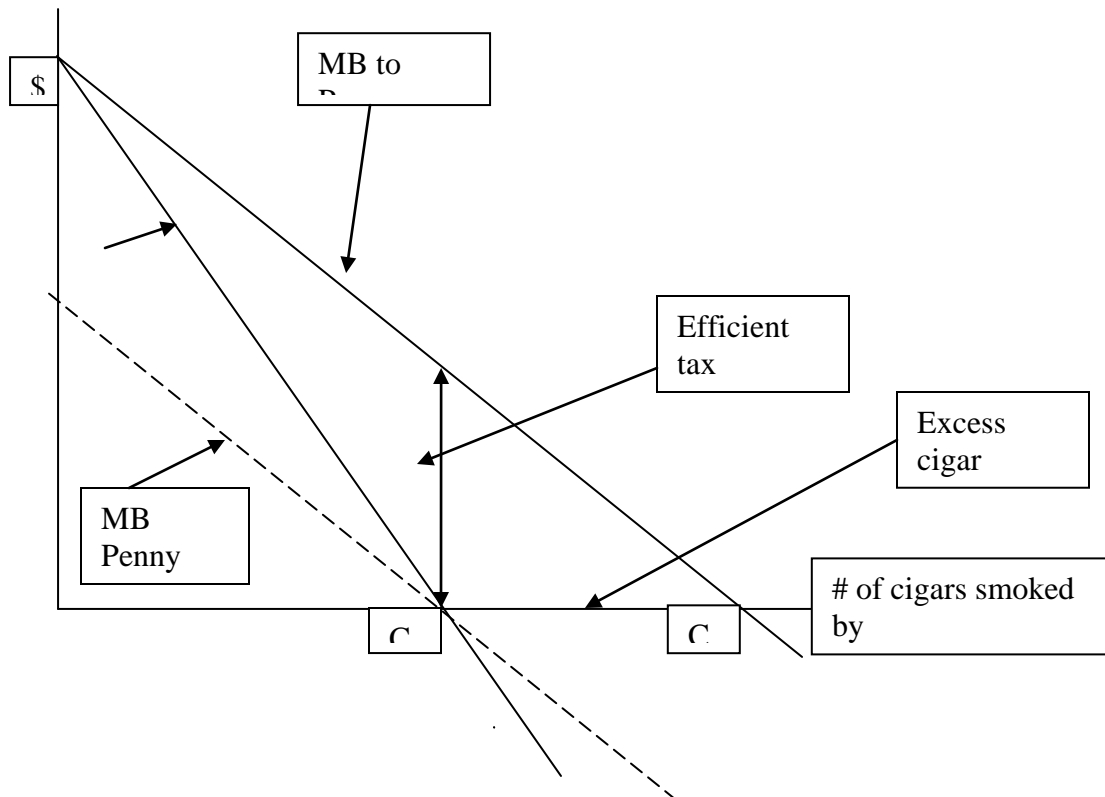
36. Remember Penny the smoker. Assume a two-person world. Penny is a smoker, Fred is not and the smoke makes him sick. Cigars are provided for free by God, marginal cost of cigars is zero for both Penny and society. The marginal benefits Penny gets from smoking, in dollars, are $MB_P = 24 - C$, where C is the number of cigars she smokes. Fred hates the smoke. The marginal cost to Fred of each cigar Penny smokes is an increasing function of the number of cigars Penny smokes. Specifically, $MC_F = C$. Determine the efficient number of cigars for Penny to smoke from society's perspective and the per-unit cigar tax the government might charge to entice Penny to smoke that number of cigars. Draw a graph to demonstrate what you are doing and to help you to figure out the answer.

Answer: The marginal benefits to society from Penny's smoking is the benefit to Penny, $MB_P = 24 - C$ minus the cost to Fred, $MC_F = C$. That is, $MB_S = MB_P - MC_F = 24 - C - C = 24 - 2C$. Since the marginal cost to society of providing cigars is zero by assumption, efficiency dictates that Penny keeps smoking as long as $MB_S > 0$. That is, efficiency dictates that Penny smoke 12 cigars. What tax rate would entice Penny to smoke 12 cigars. The tax should be set so that the marginal benefit to Penny of a cigar, including the effect of the tax, is zero when she smoke 12 cigars. Without the tax the marginal benefit to her of the 12th cigar is 12 ($MB_P(12) = 24 - 12 = 12$), so the tax would have to be \$12 to get her marginal benefit net of the tax to zero.



37. Consider Penny, Fred and the cigars. Explain why subsidizing the party damaged by a negative externality will not eliminate the inefficiency. We will read your answer as if we do not know the answer and see how much we understand after we have read what you wrote. You can assume we got a good grade in intermediate micro theory.

Answer: In explanation, the market is initially failing because the cost to Penny of smoking an additional cigar is less than the cost to society of her smoking the cigar – she does not account for the damage done to Fred by her cigar smoke. This causes her to smoke up to a point where the marginal social benefit of her cigar smoke is negative. In this graph, it would be where MB to Penny is zero, but, as one can see, at this point marginal benefit to society is highly negative (zero marginal benefit to Penny plus a big negative benefit to Fred)



Simply put, giving money to Fred will make him happier, but it will not eliminate the wedge between the MB to Penny of smoking a cigar and the MB to Society from her smoking that cigar. In explanation, a subsidy to Fred gives Penny no incentive to smoke the efficient number of cigars from society's perspective.

In fact the subsidy might make the wedge larger. Consider the following possibility. A fixed amount of money (independent of the number of cigars she smokes) is taken from Penny and given to Fred. This makes Penny poor and Fred rich, causing Penny to want to smoke more, the despair of being poor. Now that Fred is rich, he has a much larger WTP to stop the smoke, so his marginal damages from cigar smoke, in dollars, is much larger. There is now a bigger wedge between the marginal social and marginal private benefits from cigar smoking. This will make the gap between the number of cigars Penny smokes and the efficient number of cigars from society's perspective even larger than it was before the subsidy.

Paying those injured by a misallocation of resources might be a nice thing to do but it does not eliminate the waste caused by inefficient allocation of resources.

38. Remember our widget producer located on the river that flows into the lake Wungabunga. Assume it is a competitive widget firm, and that $P = MB$ to society from widgets. Also assume there is a one-to-one relationship between widget production and the amount of waste dumped in the river.

Further assume $P=MBs=10$, where MBs is the marginal benefits to society from widget production. Assume the marginal private cost of producing widgets is $MCw=2W$, and that the marginal damage to the resort from the pollution is $MDp = 5T$, where $T=2W$; T is units of toxic pollution and W is the number of widgets produced.

What tax on each unit of widgets produced would eliminate the inefficiency associated with widget production. What if the tax was instead on pollution directly? Explain your result and include all of the steps. As part of your answer, draw the graph for this case.

39. I smoke and you suffer from the second-hand smoke. Property right with respect to smoking are not well defined, there is not regulation of smoking, and I am smoking an inefficient amount (too much) – there is an externality-type market failure. The government feels for you so compensates you for the damages you are incurring from the smoke (pays you a dollar amount such that your total utility ends up being what it would have been if did not smoke). Has efficiency been achieved? Yes or No? And explain your answer.

Answer: the inefficiency remains. The problem is that I smoke too much from society's perspective (the net benefits to society of my last cigarette smoked is less than the net benefits to me (the pleasure I get from the cigarette), so society's net benefits would go up if I smoke somewhat less. Compensating you for my second-hand smoke, while maybe a nice thing from an equity point of view, does nothing to encourage me to take account of the damage to you when I smoke. After the compensation, the net benefits to me from my last cigarette are still greater than society's net benefits from my last cigarette.

Think of it this way. Even after the government gives you a bunch of money there is still the potential for us to enter into an exchange trade (I smoke less and you pay me off) such that both of us will be better off. In fact, after the compensation there is likely more potential for such an efficiency increasing exchange because you now have more money so a higher WTP to reduce the amount of second-hand smoke you incur.

Said another way, even after the compensation, the net benefits to me from my last cigarette are zero, so I gained nothing from smoking it, and you are made worse off by it, not an efficient thing.

Comments on previous answers: A few are still quite confused on how to determine whether an allocation is or is not efficient, and this caused those in the confused group to get things backwards on this question.

First I will state the confusion in general terms and then as it applies in this case.

If it is possible to make someone better off without making someone else worse off the current allocation is inefficient. Everyone seems to understand this.

If an action is then undertaken that makes one party better off and no other party worse off this action is a Pareto Improvement. We all seem to understand this.

However, just because one Pareto Improvement has occurred does not mean there is not the potential for more. Or said differently, things might still be efficient.

Consider, for example, two people on a desert Island, you and me. You have good wine and lots of white truffles (you hate both but I love both). I, on the other hand, have two things I hate but you love: bud light and pickled herring. We trade the wine for the bud light making us both better off (there has been a Pareto Improvement). But at this point the allocation is not efficient because there is still the potential for another Pareto Improvement (we trade the pickled herring and the truffles).

So what does this have to do with the government compensating you for the damages from my second-hand smoke? The compensation makes you better off without making me worse off (OK fine) but things are not efficient after the compensation because there is still the potential to make one or both of us better off without making the other worse off.

Efficiency only exists when all of the potentials have been exhausted.

For those of you still suffering from some confusion, consider the term *fully grown*. It means that one will grow no more; there is no more *potential* for growth. Now consider a small child. That child is not fully grown because she will grow more (potential for growth remains). If between the ages of 6 and 7 the child grows 3 inches, we would say that some of the potential growth has been realized but we would not say the kid is fully grown – potential remains. As long as there is potential to make some members better off and none worse off, the allocation is not efficient. The fact that there have been some efficiency gains, does not mean there is not potential for more gains. As long as potential exists, the allocation is not efficient.

Consider my in-class exchange of chocolates for diet cokes.

40. Jenny B is a rich socialite living on the Upper East Side of Manhattan. Jenny enjoys marijuana smoke but never buys or smokes the stuff. It is against the law and Jenny is a law-abiding citizen. I, on the other hand, am Pierre, the French ambassador to the U.N. I have diplomatic immunity (can't be arrested) and I love weed (slang for marijuana) very much. Jenny follows me around inhaling my second-hand smoke, which she much enjoys – inhaling second-hand marijuana smoke is not against the law. I smoke the efficient amount from my perspective (12 hours a day) but smoke an inefficient amount from society's perspective (too little) because I do not take the benefits of my smoking on Jenny into account when I smoke.

The government is morally outraged that Jenny has found a legal way to use drugs, so decides there should be a Jenny tax of \$100 a month (paid only by Jenny). The tax is levied every month for the rest of Jenny's life, independent of whether she follows me around, she is addicted and the government has no expectation that she will be reformed. They chose \$100 because that is her monthly WTP for my second-hand smoke. Of course, Jenny continues to follow me around – why wouldn't she.

Convince your reader that the tax on Jenny has not eliminated the externality market failure associated with my smoking.

Answer: see my answer to the other second-hand smoke question.

some comments on students' answers: To achieve efficiency we need to encourage Pierre to smoke more (not less). One way to do this is with a subsidy – pay him so much per hour smoked. The tax on Jenny won't eliminate the inefficiency because it does not get Pierre to smoke more (change his behavior in the desired direction).

If Pierre behavior is unchangeable and fixed (something some of you assumed), there is no inefficiency. His smoke is like a sunny day (just part of the world). Something that is fixed is fixed, so can't be at an inefficient level. If something can't be changed, its level of use cannot be inefficient.

There was some mixing up of marginal benefits and marginal costs. The cost to Pierre of his smoking is the cost of the weed. The problem is that marginal benefits to Pierre from his smoking are less than the marginal benefits to society from his smoking.

For efficiency, it does not matter whether Jenny is or is not taxed.

41. Assume the noted environmental economist Doctor Val Useless has determined that the efficient number of cars in Yellowstone is 5000 per day. His recommendation is that there be no entry fee or reservation system, and everyday the park closes the gate after the 5000th car enters. Assume once a car enters it stays all day, and assume he got the number correct. Discuss whether his method of achieving the efficient number of cars is efficient. Discuss how, under his scheme, the benefits and costs of visiting Yellowstone by car will be distributed across the U.S. population (who will and who won't visit the park).

answer: While Val' scheme will achieve the efficient number of cars to the park, it will not achieve the goal at minimum cost to society—it will not achieve the goal of 5000 cars efficiently. Put simply, we could make everyone, or almost everyone, better off by replacing Val's queue with a reservation system. In explanation, every morning there will be a race to the gate (people will likely sleep in their cars). Many hours will be wasted sitting in line, and the time wasted is by people with limited vacation time who have already spent many hours in the car driving to Yellowstone. Some people will drive thousands of miles only not to get in—what a waste. The people who get in will be those with the lowest value of time; that is, those with the greatest willingness to wait. Since kids have trouble sitting for hours in a car without driving their parents crazy, the scheme biases against children, also people with high hourly wages, like lawyers and Finance professors. A lot of the visitors would be retired people with campers or Winnebagos.

Consider an alternative scheme (like the one used for campgrounds in Yellowstone): one goes online and reserves a spot for a particular day – spots are limited to 5000 a day. In this case, there would be the efficient number of cars/visitors and the efficient number would be achieved at a much lower cost: no or little waiting time at the gate, demonstrating that Val's scheme is not efficient.

Note that I am not saying that an online reservation system with free admission is efficient, just that it is more efficient than Val's scheme, so Val's scheme is not efficient. One could increase the efficiency of a reservation system with free admission if one allowed individuals with reservations to scalp them on Ebay. People with high WTP to get in would buy reservations from those with lower WTP and both parties would be better off.

An issue with free admissions, reservations and Ebay is that the park would get no money and a lot of the benefits of Yellowstone would go to scalpers – this is an equity issue, not an efficiency issue. Yellowstone could limit cars to 5000 by charging an admission fee that would make just 5000 cars want to enter (it would likely have to vary by day of week, etc.). This would achieve efficiency, as long as one could buy tickets in advance for the day you want (a reservation system with a price – like buying concert tickets). Entry would go to the 5000 cars with the highest WTP.

Note that if you get in the park and I do not, and my WTP to visit the park is greater than yours, things are not efficient. I could pay an amount to switch places that would make both of us better off, and no one else worse off.

The park could efficiently achieve the efficient number of cars and get even more money if, instead of charging everyone the same admission fee, they ran an auction for each day's visitors. Everyone who wants to go next Tuesday enters into a second-price auction. You state your bid/WTP for a ticket. The top 5000 bids get a ticket but you don't pay what you bid, rather you pay what the next highest bidder paid. For example, if your bid was the highest (\$5000) and the next highest bid was \$20, you would pay \$20 for the ticket, not \$5000. This is how Ebay auctions work.

Note how the Rockies world-series tickets are being sold.

42. Consider the following scenario originally devised by the psychologist Jonathan Haidt:

Julie is traveling in France on summer vacation from college with her brother Mark. One night they decide that it would be interesting and fun if they tried making love. Julie was already taking birth-control pills, but Mark uses a **condom**, too, just to be safe. They both enjoy the sex but decide not to do it again. They keep the night as a special secret, which makes them feel closer to each other. What do you think about that — was it O.K. for them to make love?

In terms of efficiency, how would you describe their having sex?

answer: If one accepts the scenario as described, the sex made two members of society better off and no member of society worse off, so before they had sex the world was inefficient and their having sex was a Pareto Improvement. Interestingly, students I have surveyed on this question overwhelmingly say it was wrong. The implication is that those students do not believe a Pareto Improvement is always a good thing –interesting.

43. Imagine a guiltless economist with the opportunity to painlessly euthanize a poor, friendless unconscious, hospital patient, and have no one find out. Everyone will think he died of natural causes peacefully in his sleep. Further assume that the economist knows that if the guy dies, his organs will be harvested and used to save the lives of five productive, rich and liked members of society who need transplants. Assume the guy is the only genetic match. Should he do it?

Answer: The killing seems to pass a benefit-cost test. The economist suffers no cost; the dead guy has no friends and feels no pain in death; the five rich guys are made better off along with their friends and families. The only cost is the loss in utility to the poor guy because he might have lived longer. Note all the adjectives are used in the question.

44. The city of Boulder has many miles of trails, but bicycles are allowed on only a few of them. On the trails open to mountain bikes, the bikes cause damage to the trails, particularly when the trails are wet. In addition, their presence bothers hikers and other users. (1) Are external effects present? Yes, No, or Maybe, and explain. (2) Are the bikers who use the open trails producing externalities? Yes, No, or Maybe, and explain.

answer: (1) Yes there are external effects. The bikes presence decreases, directly, the utility of other current users and decreases utility, directly, of future mountain-bike riders because they rut the trails, mostly in wet conditions. (2) I do not know whether the current level of use (highly restricted – only a few trails are open to bikers) is or is not efficient. It might be, so my answer is “maybe”. Recollect that there is only an externality when the level of the external effect is at an inefficient level, and, in this case, we do not have enough information to provide whether it is or is not.

45. Discuss the difference between an external effect and an externality. As part of your answer define both terms.

Answer: Put simply, an external effect is when an action of an economic agent **directly** affects one or more other economic agents. An externality occurs when the external effect is produced at an inefficient level from society’s perspective. An external affect is a necessary, but not sufficient, condition for the existence of an externality. Another definition of an externality is... (see the notes for our other formal definition.)

Note that an example is not a definition.

46. Lois Burp, a former CU student, and environmental studies major, is now a CIA operative in Afghanistan. As an undergraduate, she wrote a paper on pollution and the military. She assumed that the military produces a public good (national defense) that is highly valued by all, and a lot of domestic pollution. She further assumed that that the pollution affects some in the U.S. so negatively that they are made worse off by the existence of our polluting military, but assumed that the gains to the gainers from having the military at its current level (with the pollution) is greater than the loss to the polluted losers. Based on these assumptions, she correctly concluded that the creation of our current military is a Potential Pareto Improvement, but not a Pareto Improvement. She then continued on to say “The solution to the problem of all the pollution from the military is for the government to compensate those damaged by the military pollution just enough so they are not made worse off by the existence of the military. No other actions are required.”

As an economist, comment on what she said. Your job is not to question her assumptions. Given her assumptions, was her analysis correct? Complete? If, not complete, what questions did she not address? Possibly make a distinction between the case where there is a one-to-one relationship between pollution and the amount of the good produced, and the case where pollution abatement is possible.

Answer: (Note that this question was asked, in a different costume, in the review questions.) See, for example the question about the French Ambassador and the question, “Consider Penny, Fred and the cigars. Explain why subsidizing the party damaged by a negative externality will not eliminate the inefficiency.” See also the question, “I smoke and you suffer from ...the government feels for you...”

Lois’s solution to the problem is to compensate the losers for their losses so that the creation of the polluting military is a Pareto Improvement (she wants to change a PPI to a PI, making at least some better off and making no one worse off). Not, in itself, a bad thing. Her only concern, it seems, was an equity concern, and her solution made the outcome more equitable, in her opinion. She either never thought about efficiency, or, worse, thought her solution would achieve efficiency. So, her analysis is either not correct, or, interpreted more favorably, not complete.

What Lois did not consider was whether the size of the military is inefficient and or whether the amount it pollutes is inefficient. Note that compensating those damaged by the military pollution does nothing directly to influence the size of the military or the amount it pollutes, so will not correct for an inefficient amount of national defense or pollution.

Explaining: Start with the simple case where there is a one-to-one relationship between the size of the military and the amount it pollutes (it is impossible to change the level of pollution holding the size of the military constant). In this case, one might ask whether the military is at its efficient size from society’s perspective, taking account that it produces both national safety and pollution.

The size of the military is determined by Congress and the President, not by the military. The efficiency question is whether the level of the military was set at its correct size. Maybe it is, but probably not. If, for example, the level of military was set at what would be the efficient level if there was no pollution associated with military production, there will be too much military from an efficiency perspective.

In which case, compensating those damaged by the military pollution, and doing nothing else, does not correct the inefficient and excess amount of military and military pollution. (Note that I am not calling the inefficiency a market failure, the problem is internal to the government, not the market.) An economist would likely want to correct the inefficiency. Now consider the more complicated case where the military can reduce its pollution without reducing the size of the military (the amount of national defense it produces). In this case, the efficient size of the military, and the efficient amount of pollution from the military are different things: they are linked, but not linked one-to-one. In this case the goal of achieving efficiency is more complicated, including the achieving the efficient level of national defense taking account the benefits of national defense and taking account of the negative pollution effects associated with its production, and regulating/taxing the military pollution so the efficient amount of pollution abatement is undertaken.

How exactly to get the military to internalize the costs of its polluting is a bit tricky since the size of its budget is determined by the government – it is not a profit maximizing firm. One might fix their budget and then charge the military Pigouvian taxes for the amount they pollute, the taxes coming out of their budget. In a world of no abatement technology, the military would respond by reducing the amount of national defense it produced. In a world with abatement technologies (the ability to reduce pollution without reducing output), the military would both decrease their production of national defense and spend more on pollution control. Or another branch of the Federal government could put restrictions (set at efficient levels) on the amount the military pollutes.

Note that, without regulation or taxes on the amount it pollutes, the military likely produces too much national defense from an efficiency point of view.

Some comments on student answers:

If you are an environmental economist, efficiency and equity both need to be discussed. A good answer to this question requires a discussion of efficiency.

You needed to explicitly say that Lois's solution does nothing to correct any possible inefficiency.

Some of the answers could be described as "You thought the answer complete and never even thought about the efficient level of military or military pollution." With such a response is it difficult for me to tell whether you thought about efficiency and thought the compensation achieved the efficient level of pollution (wrong) or you never thought about it, or simply assumed all was at its efficient level.

Another answer was "compensating the losers leads to the efficient amount of pollution." This is wrong. Compensating the pollutees has no effect on the polluter, so no effect on the amount the military pollutes.

Another possible answer would "efficiency is important but nothing more needs to be done because the level of the military and the level of pollution abatement are both at their efficient levels." If you said this I would expect you to explain why this follows from the

assumptions made by Lois.

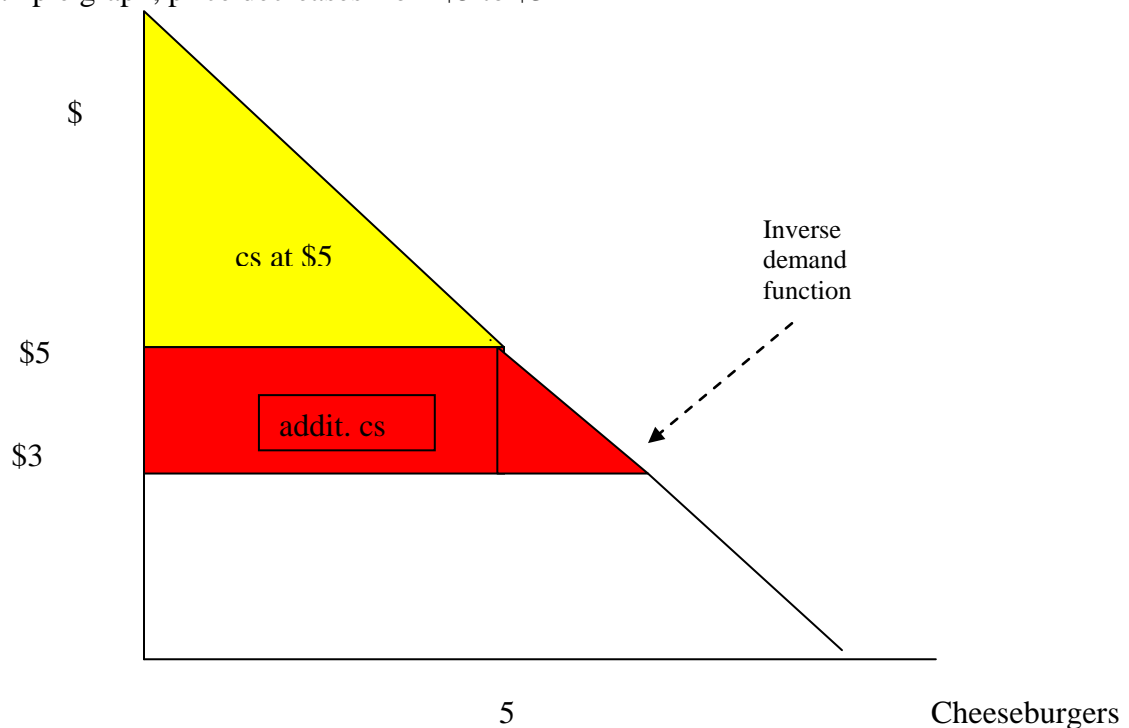
A common mistake was to assume that because creating the military (at its current level) is a PPI, the overall allocation of resources must be efficient.

47. George has a downward sloping inverse demand function for cheeseburgers (dollars on the vertical axis and quantity on the horizontal axis). Assume the market price of cheeseburgers declines. George's consumer's surplus from the consumption of cheeseburgers will necessarily (choose the best general answer)
- a. increase
 - b. not decrease
 - c. There is not enough information to tell.

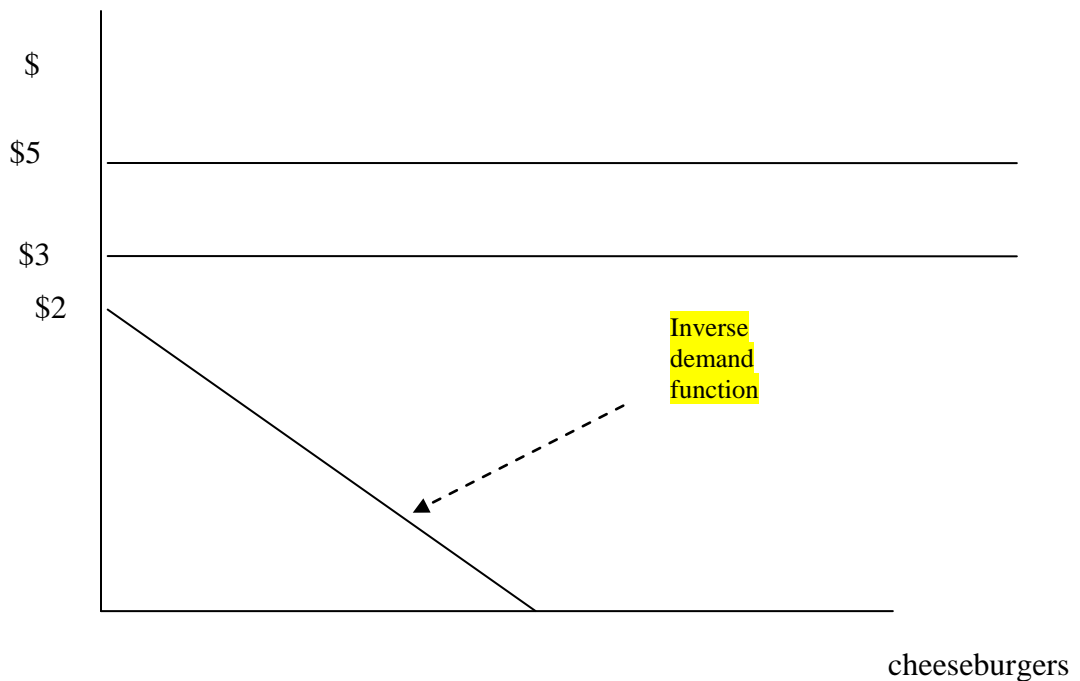
Explain your answer. As part of your explanation draw one or more example inverse demand function.

Answer: Not decrease

In my example graph, price decreases from \$5 to \$3



Or alternatively,



With the first example demand function, George purchases a positive amount at \$5, at \$3 he consumes more and his CS has increased. In the second example, he purchases no cheeseburgers at either the initial price or the lower price. His CS at \$5 is zero, and it remains zero at \$3. So CS increases is possible, but so is not decrease.

It is also the case that a price decrease cannot make a potential buyer worse off, so CS cannot decrease. If a price decrease, at a minimum I can keep consuming my current bundle, so my utility cannot go down.

So the general answer is increase or stay the same = not decrease. This is a question we discussed in class. Steven answered it correctly on the board about a week before the midterm.

48. Can bad weather be a market failure? First argue no. Then argue yes. What is the critical determinant of whether it can be a market failure?

Answer: What is exogenous to mankind is exogenous and it makes little sense to discuss the efficient level of things that are given: stuff we cannot change, such as the fact that the sun rises and sets, and that there are mountains in Colorado. Efficiency is only a relevant concept for things that mankind can influence. We do not discuss the efficient speed of the moon around the earth, the efficient number of earthquakes, or the efficient number of mountains in Colorado. “Acts of God” are beyond our control. The fact that you will die is sad, but not inefficient—we all must die.¹

For things we can affect we are concerned with the efficient amount or rate: What is the

¹ One could take about the efficient time to die.

efficient number of cigars to smoke, the efficient rate to extract minerals from the ground, etc.

So, the issue with the weather is whether we can influence it. In the olden days (when I was a kid) the weather was considered beyond man's control. However, we now have man-induced weather/climate change: the man-created emission of green-house gases is changing the climate (or so scientists believe). So, I would say that too much bad weather **can** be a market failure—global warming being the prime example. But that often the weather is simply the weather, and not a market failure.

Some of you said weather cannot be a market failure, but it could be a nonmarket failure. If we are completely unable to affect the weather it can be neither, if we can affect the weather it can be either.

49. (10 points) Assume the current level of CO₂ emissions from mobile sources (cars, trucks, etc.) is inefficient. George, the famous environmental economist, has come up with a scheme to reduce CO₂ emissions. The first part of his proposal is a ban on car air-conditioners, car heaters, and convertibles. The second part of his proposal is if the outside temperature is above 70 degrees one must drive with one's windows closed, and if the outside temperature is below 60 degrees one must drive with one's windows open. Discuss, from an efficiency perspective, George's plan for reducing CO₂ emissions. Assume your reader is someone whose only economics course was principles micro, for which they received an A.

Answer: The scheme will likely reduce CO₂ emission from mobile sources because the plan greatly increases the private cost of driving. (To further increase the misery of driving and reduce driving even more we could, in addition, shock you every few minutes you are behind the wheel.) However, the goal is not simply to reduce CO₂ emissions. It is to reduce CO₂ emissions to the efficient amount and achieve this reduction in the minimum-cost way from society's perspective.

Whatever the amount CO₂ emissions are reduced, one wants to achieve the CO₂ reduction in the minimum-cost way to society. These restrictions on driving will not do this. For example, for many, reducing CO₂ emissions in the least-cost way will involve driving a car with higher MPG – they prefer buying a more fuel-efficient car to freezing, sweating, or driving less. But George's scheme does not give them this option – they are forced to either drive less or be miserable while driving. George's scheme will reduce CO₂ emissions but gives drivers little flexibility in how they will achieve the goal. A better policy would penalize them directly for the amount of mobile-source CO₂ they emit and then let them figure out the least-cost way for them to adjust to the penalties. A necessary condition for George's scheme to be efficient is that it is the minimum cost way to reduce CO₂ emissions. Highly unlikely. To convince your reader that George's plan is likely inefficient you need to convince your reader that there are other ways to achieve the same reduction in CO₂ emissions and that some of these other ways have a lower cost. If you were told to reduce your CO₂ emissions by x% would you voluntarily adopt George's scheme to achieve the result? No. You would not tear out the air and heater in your car and adopt his windows rule to entice yourself to drive less. If the goal is to make you drive less, driving less with heat and air when you drive costs you way less than driving less and suffering when you are driving. "I could drive 50 miles a week and not be miserable or drive 50 miles a week and be miserable? Let's see, which should

I choose?”

There is an additional major problem with the scheme of George. We have to make a distinction between reducing CO₂ emissions from mobile sources to their efficient level and achieving the reduction in the minimum-cost way. The last paragraph convincingly argues, I hope, that the reduction in CO₂ emission, whatever the amount achieved by this plan, will not be achieved in the minimum-cost way. The additional problem is that it is highly unlikely that his scheme will reduce CO emissions to their efficient level – it will likely under or over correct. Did George do some complex calculations to determine that his scheme would reduce CO₂ emissions by just the right amount from an efficiency point of view? Probably not.

George’s scheme reminds me of when I was a fisheries economist in Norway. The government wanted to reduce the cod catch in some coastal regions. They did it by restricting the fisherman to small boats with small engines, and not letting them fish on Sundays. (You would not want to be in the North Sea during a storm in a small boat with a small engine.) This plan did reduce the total catch, assume by x%. However, if the government had simply required each fisherman to reduce their catch by x%, few would have chosen to do it by getting a smaller boat with a smaller engine, and some of them would have likely fished on Sundays, demonstrating that the government plan was not the least-cost way of achieving the goal.

An additional comment: Some asserted that the scheme is inefficient because the benefits to society in terms of the resulting reduction in CO₂ emissions will be smaller than the increased suffering of drivers. You do not know this. If this is true, it does not mean CO₂ emissions are at the efficient level or that George’s scheme is the minimum cost way to reduce emissions.

Some thoughts on some of the answers: Some answers say that the scheme is inefficient because directly taxing CO₂ emissions is more efficient. This, by itself, is not convincing or explaining.

Some people argued, sometimes creatively, that the scheme would increase, rather than decrease CO₂ emissions. I did not think this deserved full credit. See my comments above.

