

## **Econ 4545 Environmental Economics**

Nov 26, 2016

### **Review Questions- Set 5**

Research the facts using Google, Google Scholar, the EPA website, etc.

#### **Mobile Source Pollution**

1. So, the U.S. Government has decided to impose a tax on oil to reduce CO<sub>2</sub> emissions. Note that this tax on oil will raise the price of gasoline and all other products made from oil such as heating oil and jet fuel. Convince me that increase in the oil tax **might** increase, rather than decrease, CO<sub>2</sub> emission. How might one change the policy to make it more likely that the policy will decrease CO<sub>2</sub> emissions?

**Answer:** CO<sub>2</sub> is produced whenever a carbon-based fuel is burned, and oil is not the only carbon-based fuel; coal is a carbon-based fuel. If the government taxes one carbon-based fuel and not another, the tax will cause some users to switch fuels from the taxed to the untaxed carbon-based fuel. For example, they will be more likely to heat their house with coal and propel their car with coal. One can directly heat one's house with coal (when I was little my house was heated with coal) or indirectly heat one's house with coal (electric heat where the electricity is produced by a coal-burning power plant). Coal-fired cars are not common, but one can switch to an electric car where the electricity comes, most likely, from a coal-burning power plant. If the tax on oil were high enough, everyone, in the longrun, would switch to coal. So, most of our power might come from coal and this switch could, in theory, cause an increase in CO<sub>2</sub> emissions. The easy fix is to have a carbon-based tax rather than an oil tax: a tax on fuels based on their carbon content. In this case oil, coal, natural gas, and wood would all be taxed. (A wood-burning car?) If the intent is to tax the use of carbon, tax it directly; an oil tax is not a direct tax on all types of carbon.

Someone email me some info about the carbon content of oil and coal, so I can make the answer more specific. It might be worth your time.

2. Make three arguments that the U.S. emissions standards on new cars are too stringent.

**answer:** (1) there should not be any standards for cars driven in places where there is effectively no mobile-source pollution, e.g. North Dakota. (2) Any standard is too stringent. Drivers should be given the correct incentives to internalize the externalities produced by their driving, and then allowed to choose the cheapest way for them to comply. For example, if the appropriate pollution tax was imposed on emissions, everyone would not necessarily choose to drive a car with lower emissions. Some, for example, might choose to drive their high emissions car less. (3) Once the manufacturer meets the standard, they will have no incentive to develop cars that will emit even less. (4) Standards are difficult to change as circumstances change. (5) A problem is old cars; they pollute way more; high emission standards on new cars makes them more expensive and causes people to drive their old highly-polluting clunkers longer.

3. Devise a plan for controlling automobile emissions. Discuss the efficiency and equity implications of your plan. Is it politically feasible?

4. What do you think of vehicle inspection and maintenance programs for as a method to reduce emissions? Should they be mandatory in non-attainment regions?

5. Imagine an emissions charge that is a function of the amount of emissions measured by inspection and the number of miles driven. Should the rate be a function of where the car is registered?

6. Why should vehicles that will be driven in states like North Dakota and Montana have to meet the same emissions standards as vehicles that will be driven in places like Denver, L.A. and New York? Make your best argument.

7. Are automobiles a significant contributor to the production of greenhouse gases? If so, how and why? What would need to be done to reduce their contribution? Suggest a feasible method

of reducing the amount of CO<sub>2</sub> emissions produced by cars. Why are car makers concerned about policies to reduce the rate of global warming?

8. What are the CAFE (Corporate Average Fuel Efficiency) standards?

9. Is it feasible to tax vehicles on the basis of the amount of pollution that they generate each year?

10. Why does the auto industry like the EPA's mandate to reduce the amount of sulfur in gasoline?

11. What are the equity/distributional implications of reducing pollution with an emissions tax or a gas tax?

12. Write a brief critique of the ideas and facts presented in the article by Ian Parry at Resources for the Future. **Old article**

13. When one considers reducing pollution with a gas tax what is the relevance of the price elasticity of demand for gasoline. As part of your answer define the price elasticity of demand for gasoline. What determines this elasticity? Is it likely to be smaller in the long run, and why is that relevant?

14. Do old cars pollute significantly more than new cars? Discuss the implications of this for efficiently reducing the pollution from cars. As part of your answer, discuss vehicle buy-back programs. How do the State of Colorado emissions standards for old cars differ from those for new cars (think about the vehicle inspection program)?

15. Should emissions from snowmobiles be regulated uniformly across the country? Argue it both ways.

16. Do you think it is possible to reduce auto emissions to their efficient level by moral suasion and making driving of highly polluting gas guzzlers un-cool?

17. Discuss the advantages and disadvantages of a tax on gasoline as a way to reduce the amount of pollution produced by cars. Make a distinction between CO<sub>2</sub> emissions and other pollutants. As part of your answer, discuss the general principles that theory suggests one follows in the use of taxes to internalize negative externalities.

**Answer:** The salient facts are that for most types of exhaust emissions there is not a one-to-one relationship between the amount of gasoline burned and the amount emitted. That is, it is possible to reduce emissions per gallon of gas burned, what we call abatement technology. The exception is CO<sub>2</sub> emissions where the relationship is one to one. Theory tell us that the most efficient way to reduce emissions with a tax (a Pigouvian tax) is to tax the emission directly rather than taxing an input (in this case gas) in the production of the emissions.<sup>1</sup>

For example, if one wants to reduce particulate emissions from mobile sources the cost of achieving a given reduction in emissions will be lower if the one taxes the mobile source in terms of the quantity of particulates emitted rather than taxing the gasoline, the car or the miles driven. The previous statement is based on the assumption that one can cost-effectively tax the emissions.

If the intent is to reduce CO<sub>2</sub> emissions from mobile sources a tax on gasoline is cost minimizing because it is equivalent to a tax on CO<sub>2</sub>. For other types of emissions the argument for a gas tax is a second-best argument. It is easier to tax gasoline than it is to tax emissions directly.

However, think of why a tax on gas is inferior to a tax on emissions. The tax on gas gives the driver no incentive to reduce emissions holding gas consumption constant. For example, with a

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<sup>1</sup> If there is a one to one relationship between the level of emissions and another commodity (input or output) taxing the other commodity is equivalent to taxing the emissions.

gas tax there is no incentive to keep your car pollution equipment in working order, to purchase a car that get the same mpg but pollutes less, to purchase pollution-control devices.

The technology for measuring emissions from mobile sources has been changing drastically making it more cost effective to tax emission directly or at least closely approximating a tax on emissions. The government knows the type and age of our vehicle. They can also easily find out miles driven per year. Given the two, they can estimate how much your car produces of each taxed pollutant in a year and then send you a bill with your registration. Of course, this estimate will not account of how well tuned you keep your vehicle or how you drive it (slow, fast, stop and go). The above estimate can be significantly improved upon by testing the car once a year for the amount of emissions it actually produces, something we currently do. Of course, this would also not be perfect. One might imagine that in the future there will be some device that will directly measure your car's emissions. Such devices exist; it is just a question of costs.

An issue with both gas taxes and emission taxes is that we only want to tax emissions that cause damage. If I go on vacation to South Dakota I am doing no damage so the gas burned on the trip should not be taxed, neither should the emissions. Gas taxes can easily vary from place to place but how would Boulder know how many of my miles driven last year were in the sticks (would I send them a postcard from all of my trips?)

My answer to here has compared gas taxes with direct taxes on emissions. In a perfect answer one would compare gas taxes with other methods of reducing pollution from mobile sources such as mandatory pollution control devices.

18. Why is everyone, including me, driving around in a SUV if they are so bad for the environment? Argue that what is individually rational and optimal is not optimal from a societal perspective.

**Answer:** when I look at the benefits and costs to me of driving an SUV; it is the perfect car. I

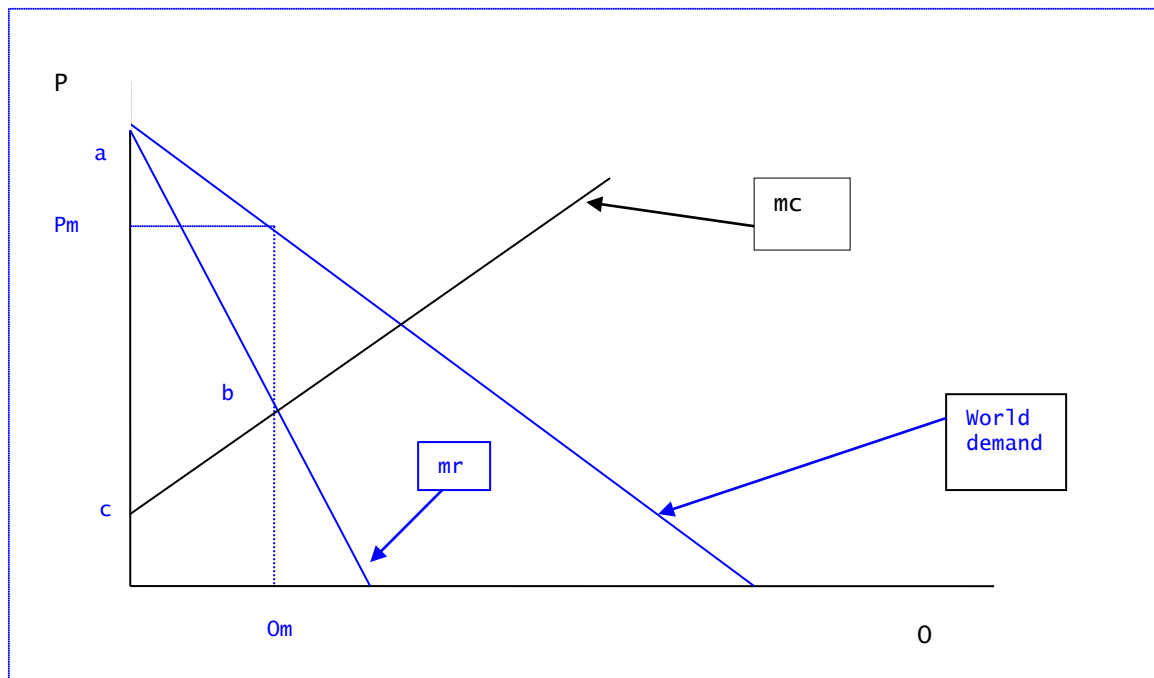
live down a dirt road that gets a lot of snow, drive in a lot in snow, have a wife, kid, and big dog, carry around a lot of stuff, and it safe, at least for those in it. I also know that my driving an SUV has little effect on the total amount of pollution in the Denver/Boulder area. Simply, put, I don't pay the full costs of my driving an SUV, so have no reason to take those costs into account. If society wants me to drive what is best for me to drive from society's perspective, the government needs to give me the correct incentives, which they do not – a classic externality-type market failure. Everyone driving an SUV is not efficient from society's perspective because the social cost of driving them is higher than the costs to the operators. I impose a burden on others that I don't have to pay for – lucky me, but I wish the cost of the burden was imposed on everyone else who imposed such a burden. In fact, I would prefer the cost of polluting was imposed on everyone, including me, but, until it is, I will do what is optimal for me in the present situation.

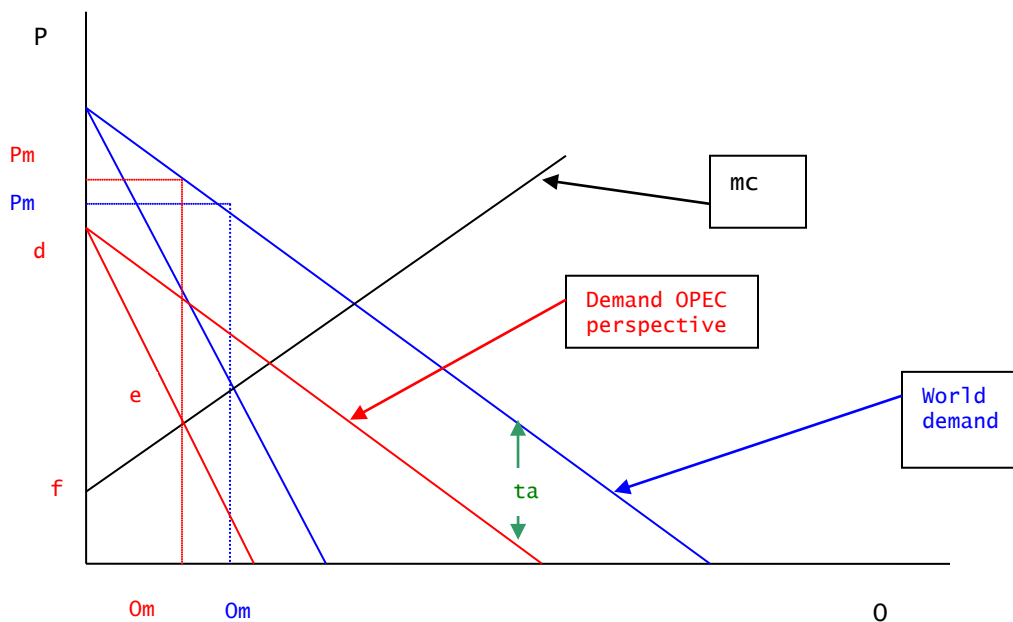
Some philosophers have trouble with the above logic. I, the individual, would prefer a world where everyone, including me, is penalized for polluting (prefer a world where pollution is taxed to the current state), but rationally choose to do what will lead to our collective demise, if I am not penalized. I do not find this logic troubling, but many other do. Most economists would simply say that what is rational for each individual to do is not necessarily rational from a collective perspective– the social equilibrium is not socially efficient, even though it is individually efficient, so an equilibrium. It is like the Prisoner's Dilemma.

19. Explain to an intermediate micro student why raising the Federal tax on gasoline by 50 cents is will cause the price of gasoline to rise by less than 50 cents. What is going on? What determines how much the price increase will fall below 50 cents?

**Answer:** Much of the oil we consume is extracted and sold to us by entities with excess market power (e.g. OPEC and the big oil companies). Given this, they act almost like a monopolist when they make their pricing decisions in that they face a downward-sloping demand curve for their product. Their goal is to maximize their profits. When the gas tax is raised by the largest

consumer of oil (us) it shifts OPEC's effective demand curve for oil in (to the left). In explanation, at  $x$  dollars a barrel they now can sell less because the price for the consumer is  $x$  plus the tax. Their profits will drop because of the tax, and, profits max implies that they will not want to raise their price by the amount the tax increases – doing so would not be profit maximizing. The steeper the demand curve for oil (the more price elastic it is) the less they will raise their price. Look at the standard monopoly pricing graph and then shift in the effective demand function.





For

more details, see the notes

<http://www.colorado.edu/Economics/morey/4545/auto/OPECandGasTaxes.pdf>

20. Explain why increasing the gas tax is probably not the best way to reduce traffic congestion.

**Answer:** To deal with the inefficiencies associated with congestion, one would want to make the private cost of driving on congested roads equal to the social cost. Since all roads are not all equally congested, and the amount a road is congested often varies by time of day and day of week, the wedge between the private and social cost of driving that is due to congestion effects varies greatly. Many roads are never congested, other very congested, but only at certain times of the day. Therefore the tax or restriction on driving needs to vary by time and place. A gas tax will not do that, it will reduce overall driving but it will have no influence on where and when people drive. It is a very blunt tool if used to address congestion externalities.

One either needs road-specific taxes (tolls) or other road-specific access restrictions if wants to achieve the efficient pattern of congestion



21. Many students of the environments feel that we all should be required to drive a car that uses an alternative fuel (electricity, bio-fuel, ethanol, French-fry grease, etc.). Make your best argument that they are misguided. The issue is not whether they are or are not misguided; the issue is you need to argue, on economic grounds, that they are misguided.

Answer: Put simply, we want drivers to take all of the environmental costs of their driving into account when they decide what, where, and how much to drive. If they are given the incentive to do this, they will minimize the cost to them of the tax or regulation; that is, they will minimize the cost of the policy on them – this is good: they are part of society.

The question is would everyone choose to drive a particular type of car if they had the correct incentives to internalize the external costs of their driving. The answer is probably no.

Think of it another way. If the correct pollution tax was imposed, would everyone choose to drive a hybrid? If the answer is no, then forcing everyone to drive a hybrid will not be an efficient outcome.

If there was for example a pollution tax, different individuals would adjust to the tax in different way: some would drive less, some would tune their car, some would buy a different car, and some of those who would have bought a different car would buy a hybrid.

Requiring everyone to use the same pollution-reducing device is very restrictive – much like saying to reduce crime everyone has to go to bed at 9:00 p.m.; it will reduce crime but not in the cheapest way – lots of people like to stay up late.

Requiring that everyone has to use the same device is also dynamically inflexible. What if a better device is invented? Will there be an incentive to develop better pollution-reduction devices? A pollution tax gives manufacturers an incentive to develop cars that pollute less; requiring everyone to drive a certain type of hybrid does not.

22. George Tailpipe, the famous “mobile-source” economist, has come up with a scheme of reduce CO<sub>2</sub> emissions from mobile-source pollution to their efficient level. 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.” Convince your reader, someone whose only economics course was principles micro, for which they received an A, that this is not an efficient way to reduce CO<sub>2</sub> emissions from mobile sources.

Answer: The scheme will likely reduce CO<sub>2</sub> emission 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, electrically shock you every few minutes you are behind the wheel.)

However, the goal is not simply to reduce CO<sub>2</sub> emissions. One wants to achieve the CO<sub>2</sub> reduction in the minimum-cost way to society. George’s proposals will not do this. For example, for many, reducing CO<sub>2</sub> 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 CO<sub>2</sub> emissions, but gives drivers little flexibility in how they will achieve the goal. A more efficient policy would penalize them directly for the amount of mobile-source CO<sub>2</sub> they emit and then let them figure out the least-cost way for them to adjust to the penalties. George’s scheme is efficient only if it is, in fact, the minimum cost way to reduce CO<sub>2</sub> emissions. This is highly unlikely.

To convince your reader that George’s plan is inefficient you need to convince your reader that there are other ways to achieve the same reduction in CO<sub>2</sub> emissions and that some of these other ways have a lower cost. If you were told to reduce your CO<sub>2</sub> 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 problem with the scheme of George. We have to make a distinction between reducing CO2 emissions from mobile sources to their efficient levels 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 from mobile sources to their correct 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.

**Some additional comments:**

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. (Could you convince the reader that this is true?) If true, this implies that one would not want to reduce CO2 emissions if this were the only way of doing it. While interesting, I don’t this an informative way to assess George’s policy. Why does this point convince the reader that the

scheme is not the minimum-cost way to achieve the reduction? I am not sure.

Consider a counter-example to your “logic”. Imagine the **only** way to get you to stop wearing those ugly green Italian boy pants is to shoot you. In which case, the minimum cost way of stopping you from wearing them is to shoot you. It is likely that the cost to society of shooting you (you are a member of society) is probably greater than the benefits of not having to look at your pants. If so, shooting you is the minimum cost way of achieving no ugly-pants-wearing even though it is not worth doing from society’s perspective.

Applying this logic to the George example, If George’s plan is the only way of reducing CO2 emission, it is the minimum cost way. If so, it is the efficient way to achieve “the goal”, but that does not imply the goal is correct from an efficiency point of view. .

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.