

Public Policy 558: Economic Analysis in the Practice of Public Policy
Winter 2025, Professor Kevin Stange
Problem Set 2

Instructions

Hand in an electronic PFF copy via Canvas. Please write your full name and the names of any collaborators (people you worked with) on the top of the assignment. No late assignments will be accepted. Answers should be typed or printed clearly; graphs can be drawn by hand and pasted in if that is easier. DO NOT spend a ton of time making your assignment look beautiful!

Topics covered:

- Externalities
- Social marginal benefit vs. social marginal cost
- Taxes as a means to address externalities

Question 1

Consider a vehicle miles traveled (VMT) tax—a policy of charging motorists based on how many miles they have traveled. For example, an onboard vehicle device might be used to capture the distance driven by a vehicle through GPS or other technology, and then the government collects from drivers a specific tax per mile driven.

In the market for miles driven by car, the private marginal benefits of miles driven by car are $PMB = 80 - Q/200$, and the private marginal costs of miles driven are $PMC = Q/200 + 20$. Here, the vertical axis is in terms of cents (US currency) and the horizontal axis (quantity) is in miles.

a) There are several different types of externalities associated with driving. First, let's focus on pollution. The marginal external costs to the environment per mile driven are estimated to be: $MEC = Q/500$. Calculate the competitive (Q_c) and socially optimal level of driving taking into account the externalities from pollution (Q_s). Draw a well-labeled graph including all relevant lines ("curves").

b) Shade in the total social surplus from driving the socially optimal number of miles. Shade in the deadweight loss (DWL)—the negative social surplus—when the equilibrium level of driving does not take into account the external costs.

c) If the government were to implement a specific VMT tax (this is a tax per mile driven), what is the optimal amount of the tax using only the information in this problem so far? Include the tax in your graph (by drawing the new supply curve with the graph). What happens to the negative surplus from the externality with this tax in place?

d) Some state or city VMT tax proposals charge higher taxes during rush hour. What driving-related externality would charging rates at different times of day help? Answer in just a few sentences.

e) Conceptually, how would you determine how much higher the tax should be during rush hour relative to other times of day? Answer in just a few sentences.

f) Would it make sense from the standpoint of a corrective tax to charge more for larger vehicles? If so, briefly explain and include the specific externality story you have in mind. Answer in just a few sentences.

Question 2

Before answering this problem, you should read (skimming much of it is ok) the 20 page report by the Congressional Budget Office (CBO) "Alternative Approaches to Funding Highways" (March 2011) linked on the course outline page. The CBO is a nonpartisan agency that produces economic analysis to support the US Congressional budget process.

a) In a few sentences, state why a vehicle miles travelled (VMT) tax is theoretically more efficient than a gas tax—particularly in terms of reducing externalities related to driving.

b) The report assesses the extent to which fuel taxes and VMT taxes are regressive—or disproportionately burdensome to lower income people relative to resources. (A tax is regressive when the percentage of income spent paying for that particular tax is higher for someone in a lower income bracket compared with someone with a higher income). Briefly summarize the report's findings on how the two types of taxes compare in terms of level of regressivity. Note that part of this assessment involves comparing the differential impact of each type of tax on rural and urban people.

Question 3 (Excel-related)

Recall the proposed runway extension at the Ann Arbor Airport we discussed in class (and read the article "Ready for Takeoff?" if you haven't already). Suppose that with the current runway the marginal private cost (MPC) is equal to $10 + 0.1Q$, where Q is the number of operations (take-offs + landings) measured in thousands. The runway extension should improve safety for the pilots and allow larger planes to operate at capacity (more fuel, passengers, and cargo), which can be thought of as reducing the MPC to $5 + 0.05Q$. Suppose demand is given by the inverse demand curve $P = 25 - 0.2Q$ and that demand is unaffected by the runway. [Throughout don't think about pilots who fly with no passengers – they are both consumers and producers in the market.]

a) Calculate the price, quantity, consumer surplus, and producer surplus both before and after the runway extension.

Parts (b), (c), (d) and (e) should be done in Excel. Use as inputs all the parameters described below and the quantities and surplus before and after that you calculated in part

- (a). You should include a print out of your spreadsheet showing your work for all three parts. We are providing a sample spreadsheet you can use/modify as you see fit.
- b) Neighbors who live near the airport are concerned about several externalities associated with the airport (and its expansion), particularly added noise, more fatal accidents, and more collisions with Canadian geese. Using the following parameters, determine the total externality cost both before and after the runway extension. Assume that these features are not part of the MPC curves and also assume (for now) that these parameters are the same before and after the runway extension.
- Number of collisions with geese: 1 goose for every 10,000 operations
 - Number of human fatalities: 0.001 for every 10,000 operations
 - Number of “noise disruptions”: 100 for every 10,000 operations
 - Value of a goose life: \$5,000
 - Value of a human life: \$1 million
 - Cost of every noise disruption: \$10
- c) What is the value of the tax per runway operation that would result in the socially efficient level of runway operations?
- d) The runway extension will cost the government \$300,000. Calculate the Benefits minus Costs of the expansion (relative to no expansion). Benefits include any change in CS/PS in the market for takeoffs/landings (part a) and any change in externalities (part b). The only cost to consider is the direct project construction cost. You should find that the project passes a cost-benefit assessment.
- e) There is a lot of uncertainty about the parameters in part (b). In particular, residents are worried that the number of human fatalities per 10,000 operations might actually go up because of the new runway’s proximity to homes. Determine if the project benefits still exceed the costs if this rate increases as in the following scenarios:
1. 0.01 for every 10,000 operations
 2. 0.02 for every 10,000 operations
 3. 0.03 for every 10,000 operations
 4. 0.04 for every 10,000 operations

Do this by creating different scenarios with different values for this parameter.