

14.41 Public Economics  
Midterm Exam Solutions

True, False, Uncertain (25 minutes, 5 minutes each; 95% of credit is based on your explanation; limit yourself to one page per part.)

- 1. Since education yields private returns, which are fully captured by the person who makes the investment, the market will provide the optimal level of education and the government should not intervene.**

False. There are several market failures that justify government involvement in education: 1) Positive externalities from education (i.e. less crime, more informed voters); 2) Credit market constraints, which prevent people from taking out loans to invest in human capital, due to the fact that they can't use their education as collateral; 3) Parental misrepresentation of kids' preferences; 4) If the screening model holds, there may be *negative* externalities from each additional year of education.

- 2. The warm glow model says that government provision of public goods will not fully crowd out private provision of the public good.**

True. In the warm glow model, the utility that you receive from a public good depends on both 1) the total amount of the public good, and 2) how much *you* contribute i.e. you feel a "warm glow" when you send your check to your favorite charity. As a result, even if the government provides enough of the public good that, under usual models, your provision would be crowded out, you still continue to contribute and, thus, your provision is not fully crowded out.

- 3. There are 400 risk-averse individuals and 600 risk-loving individuals in a society. The individuals choose among 1000 available jobs: 500 race car driving jobs and 500 museum tour guide jobs. Race car drivers face a 5% chance that they will die on the job, but their wages are no different from the wages for tour guides. In this society, people must place zero value on their lives.**

False. There is no compensating differential (zero wage difference between the riskless and risky jobs) in this scenario, but the lack of a compensating differential does not reflect the fact that people place zero value on their lives. Rather, the lack of a compensating differential reflects the fact that the *marginal* race car driver is a risk-lover.

For the risk-lover, the risk involved in a racecar driving job provides benefits (the thrill and excitement of driving really fast) and costs (the increased risk of death). The zero compensating differential suggests that the benefits and costs are exactly equal to each other, so that the marginal racecar driver is just indifferent between a riskless museum tour guide job and a racecar driving job. However, if the marginal racecar driver had been a risk-averse person, who was bothered more by the risk of

death and didn't derive any utility from the thrill of fast driving, he would not have been indifferent between the two jobs. The risk-averse person would prefer the museum job but, if there weren't enough museum jobs, they would have accepted the racecar driving job if the wage increased enough.

The important point here is that that marginal racecar driver determines the compensating wage differential and, since that person is risk-loving in this question, we shouldn't be surprised that there is no compensating differential.

- 4. Over the summer, the city of Boston needed to conduct a cost-benefit analysis to determine whether or not to provide anti-mosquito spraying in order to protect its citizens from the West Nile Virus. The best way for the city determine the value of anti-mosquito spraying benefits was to directly ask a random sample of Boston residents how much they would be willing to pay for the spraying.**

False. Contingent valuation (or "asking them") won't ever provide a very good estimate. People often don't *know* how much they value the anti-mosquito spraying and, as a result, provide nonsensical answers. Also, people would have an incentive to lie. Knowing that the city was merely conducting a poll for a cost-benefit analysis and that they won't actually have to pay the amount of their answer, people who want mosquito spraying have an incentive to inflate their valuation, just to make sure that the estimated benefits outweigh the costs.

A better way to determine the benefit would be to use a revealed preference or market-based approach. For instance, the city could determine how much more people in the area were purchasing bug spray compared to other summers. Or the city could determine how much more they have to pay their scientists to collect samples of potentially-infected mosquitos than they have to pay scientists who collect other unharmed specimens. Or the city could determine how much the West Nile Virus would increase rate of hospitalization and death in the area and then calculate the value of the lives that were likely to be lost and the cost of health care expenditures that would be required.

- 5. Each electric light adversely affects the ability of astronomers, working as far as 200 miles away from the lamp, to see into outer space. The Coase Theorem says that we can rely on private markets to internalize externalities, so there is no reason for the government to intervene in the market for electric lights.**

The Coase Theorem says that, given *property rights* and *costless bargaining*, externalities can be internalized. In this case, we have neither clear property rights or costless bargaining. There are not clear property rights over the air and outer space that is being contaminated with light. And, because of the diffuse nature of the people who cause the light pollution and who are affected by the pollution, it is implausible that the astronomers and light-owners could come together and costlessly bargain.

Short Essay (10 minutes)

**In a recent *New York Times* article, Alan Krueger cited evidence that economically disadvantaged children fall behind their more advantaged peers during summer vacation. The study found that children from all backgrounds make similar academic progress during the school year, but that higher-income children continue learning over the summer, while lower-income children don't. To help narrow this "summer learning gap", Krueger suggests that the government should provide vouchers for children to pay for private tutoring services, education-oriented camps, or public school-sponsored summer school. Currently, 9% of American students attend summer school. Discuss the arguments for and against summer learning vouchers.**

To receive full credit, essays should have discussed the following issues:

- Fixing a market failure is a good reason to issue summer learning vouchers. The most obvious market failure, in this case, is credit constraints: low-income children who cannot afford the summer programs would not be able to take out a loan to pay their tuition, because education can't be used as collateral. Another potential market failure is positive externalities from summer program participation (in the form of lower crime, better voters, etc.). Finally, vouchers might solve the problem of parents who misrepresent their children's preferences, by being unwilling to make a good investment in summer learning.
- Vouchers may increase competition between summer programs, which would lead to lower costs and better outcomes.
- It's not clear how vouchers would affect stratification, but they could potentially increase it or decrease it. For instance, vouchers might decrease stratification by sending poor kids to a camp that previously only served rich kids. On the other hand, vouchers might increase stratification by moving all of the highly motivated poor kids to good summer with other highly motivated rich kids, leaving all of the unmotivated poor kids in cheap, bad summer programs. Moreover, it's not clear whether stratification is good or bad; we'd need to know the summer learning production function to make such a determination i.e. if we value school for its "melting pot" qualities, we'd want less stratification. Regardless, stratification is an issue that needs to be considered.
- Summer learning vouchers may be an inefficient use of public resources. In addition to paying for the marginal kid who goes to summer school for the first time, we'll have to pay for all of the infra-marginal kids who would have gone to camp or summer school anyways. One way to get around this problem would be to have income limits for the summer learning vouchers.
- The summer learning voucher program would likely suffer from information failures. People may not receive all the information about their choices and, in fact, parents who misrepresented their children's preferences by not sending them to summer programs *before* the voucher program are unlikely to devote a lot of time to finding the necessary information *after* the voucher program.

Smoking Externalities (30 minutes)

- c) The government has read your answer to part (b) and estimated that the total external cost from smoking equals 2 per pack. It decides to implement a corrective tax. What should that tax be? What will the new equilibrium quantity of packs per smoker smoked be? Draw a graph to illustrate the way that the tax affects the equilibrium in the cigarette market.

Tax should equal the marginal damage, 2 per pack.

$$\text{Max } \log P + \log F \text{ s.t. } 5P + F = 150$$

$$L = \log P + \log F - \lambda(5P + F - 150)$$

$$\text{FOC: } dL/dP = (1/P) - 5\lambda = 0$$

$$dL/dF = (1/F) - \lambda = 0$$

$$\rightarrow F = 5P$$

Substitution from the budget constraint:

$$150 - 5P = 5P$$

$$150 = 10P$$

$$P = 15$$

- d) Suppose that all smokers started smoking at the age of 15, so that their friends would think that they were cool. They all planned to quit when they graduated from high school, but didn't consider the fact that they might become addicted, unable to quit, and die 6 years earlier than they would have died if they had been able to quit. After they graduate from high school, they are fully aware of the risks of smoking and fully account for these risks in their decision-making. Suppose that they all value one year of life at 150,000 (in present discounted value) and that each pack of cigarettes increases the probability that they'll become addicted (and die 6 years early) by 0.0001. Assume that smokers are risk neutral. If the government wants to correct this "externality" with an additional corrective tax on cigarettes sold to teenagers, how much should the special "teenage buyer" tax be? What problems might there be with such a "teenage buyer" tax?

$$\text{Tax} = \text{marginal damage} = 6 * 150,000 * 0.0001 = 90$$

The problem with a "teenage buyer" tax is that teenagers can get around it by asking (or paying) adults to buy for them, by buying from vending machines, etc. Also, as many of you pointed out, it is already illegal for teenagers to purchase cigarettes, so it would be virtually impossible to collect this tax!

e) **Now imagine that taxes are extremely unpopular. What other policies would you suggest to the government to help address the externalities and internalities from smoking?**

- Quantity regulations or trade-able permits are usually alternatives to taxes, but aren't practical in this setting. It would be very difficult to enforce such policies.
- Clean air regulations raise the hassle costs of smoking and reduce externalities from second-hand smoke.
- Further restrict youth access to cigarettes (i.e. get rid of all cigarette vending machines)
- Negative ad campaigns, highlighting things that teenagers care about i.e. acne, bad breath, etc.
- Improve education in schools about the adverse effects of tobacco.

Snowplows in Iceland (25 minutes)

a) **There are two residents, A and B, in the town of Reykjavik, Iceland. Their utility is defined over two goods, warm coats (C) and total snowplow services (S). Explain why snowplow services are likely to fit the formal definition of a public good.**

Public goods, by definition, are non-rival and non-excludable. Snowplow services are likely to be non-rival, because your enjoyment of the fact that the roads are plowed does not decrease my enjoyment of the fact that the roads are plowed (ignoring congestion issues). Snowplow services are also likely to be non-excludable, because I can't easily prevent you from using plowed roads (unless I set up a toll booth at every street corner).

b) **Not assume that the utility functions take the following form:**

$$U_A = \log(C_A) + 3\log(S_A + S_B)$$

$$U_B = \log(C_B) + 3\log(S_A + S_B)$$

**Both A and B have an income of 100. The prices of coats and snowplow services are both equal to 1. Note that total snowplow services, S, equals  $S_A + S_B$ . What is the total amount of snowplow services, S, that will be provided?**

Let's start with person A:

$$\text{Max } \log(C_A) + 3\log(S_A + S_B) \text{ s.t. } C_A + S_A = 100$$

$$L = \log(C_A) + 3\log(S_A + S_B) - \lambda(C_A + S_A - 100)$$

$$dL/dC_A = (1/C_A) - \lambda = 0$$

$$dL/dS_A = (3/(S_A + S_B)) - \lambda = 0$$

$$\rightarrow \frac{1}{C_A} = \frac{3}{(S_A + S_B)}$$

$$S_A + S_B = 3C_A$$

Substituting from the budget constraint:

$$S_A + S_B = 300 - 3S_A$$

$$4S_A = 300 - S_B$$

By symmetry, we know that person B has the following response function:

$$4S_B = 300 - S_A$$

Plugging one response function into the other, we find that:

$$4S_A = 300 - ((300 - S_A)/4)$$

$$16S_A = 1200 - 300 + S_A$$

$$15S_A = 900$$

$$S_A = 60, S_B = 60, S = 120$$

- c) **What is the socially optimal quantity of snowplow services? Why does the socially optimal quantity differ from the quantity that was provided in part (b)?**

To find the socially optimal quantity of snowplow services, set  $\Sigma MRS = MRT$ .

$$\text{In this case, } MRT = 1, MRS_A = \frac{dU/dS}{dU/dC_A} = \frac{(3/S_{A+S_B})}{(1/C_A)} = \frac{3C_A}{S_{A+S_B}}$$

$$\text{Substituting from A's budget constraint, } MRS_A = \frac{3(100 - S_A)}{S_{A+S_B}}$$

$$\text{Likewise, } MRS_B = \frac{3(100 - S_B)}{S_{A+S_B}}$$

$$\text{So } \Sigma MRS = MRS_A + MRS_B = \frac{600 - 3(S_A + S_B)}{S_{A+S_B}} = \frac{600 - 3S}{S}$$

Set this equal to the MRT to find,  $600 - 3S = S$  or  $600 = 4S$  or  $S = 150$

This differs from the private provision solution because, under private provision, people did not account for the positive externality from their provision of the public good, the fact that their provision of a public good provided utility to the other person. In the socially optimal solution, the utility provided to both people is considered.

- d) **Now suppose that there are two types of people in Iceland, young people (who live and work all year in Iceland) and old people (who spend the snowiest months in the Riviera). Suppose that the young people prefer  $S=40$  and the old people prefer  $S=0$ . There are two towns, Reykjavik and Njarovik; Reykjavik has 60% young people whereas Njarovik has 60% old people. The governments in Reykjavik and Njarovik want to provide the optimal amount of snowplow services for their constituents. Explain a solution that will make everyone happy with the level of snowplow services provided by their government. Why might your solution not work in the real world?**

A solution that will make everyone happy is Tiebout sorting. Notice that, if each town votes for the amount of snowplow services, under the median voter theorem, Reykjavik will provide  $S=40$  and Njarovik will provide  $S=0$ . Then all of the old

people will move to Njarovik and all of the young people will move to Reykjavik, everyone will be satisfied, and the optimal provision of public goods will be provided. This is the Tiebout sorting solution.

Tiebout sorting may not work in the real world, however, because moving is not costless, people have imperfect information, there may be other factors in a person's decision to live in a town (i.e. convenience of airport to take flights to the Riviera), etc.