Fall 2019 - 14.41 Midterm

SOLUTIONS

1 True, False or Uncertain (30 points)

For each of the statements below evaluate whether they are true, false or uncertain. Provide brief explanations.

1. (5 points) The fact that cigarettes decrease life expectancy of the smoker should be counted as a negative externality.

   Solution: False. It is both a positive fiscal externality and a negative internality. A positive fiscal externality because smoking diminishes the expected amount of Social Security benefits they would receive in the future, without reducing the contributions as much. It is also a negative internality, because in general, young smokers do not take into account all the likely consequences of smoking on their future health.

2. (5 points) One of the main advantages of vouchers relative to direct provision of education in the United States is that they would reduce school segregation.

   Solution: Uncertain. On the one hand they allow children living in poor neighborhoods to attend the same schools as kids living in rich neighborhoods. On the other hand, they allow rich parents to top up their vouchers, paying for a more expensive school.

3. (5 points) To make consistent welfare statements we need consumer choices to satisfy the basic assumptions of rationality i.e. completeness, transitivity and reflexivity. Therefore, revealed preferences approaches are the correct way that we can firmly ground cost benefit analyses.

   Solution: False. Real world consumer choices can violate the assumptions of rationality, for example by choosing to buy packages of goods that are more expensive than the sum of the goods purchased together. Further, sometimes, contingent valuation methods are the only feasible way to proceed.

4. (5 points) The Tiebout model assumes that taxes are raised in a lump sum fashion. In practice, towns in the US rely primarily on property taxation. Thus the Tiebout

model should not be seen as a good approximation for how local public goods are provided in the US.

Solution: False. Land regulations, such as minimum lot sizes and zoning restrictions essentially restore the logic of the Tiebout model, even without lump sum taxes. That is, minimum lot sizes imply that in practice there is a minimum property tax to pay to live in a town, which can be seen as a lump-sum tax plus a variable term starting from this minimum. Therefore property taxation is not the main reason that the Tiebout model may not work in practice.

5. (5 points) Lotteries for charter school admissions provide a natural experiment for estimating the individual return for a student attending charter schools. We can use those estimates, basically multiplying by the number of students, to think about what would be the effects of moving all students to charter schools.

   Solution: False. These are partial equilibrium estimates and as such they do not account for general equilibrium effects. For example, we may be missing the effect that the student that won the lottery would have had on its colleagues in the public school system, or the effects that moving all students to charter schools would have on the labor markets.

6. (5 points) The human capital view on education contrasts with the screening view. However, they have the same implications as to what the return to education would be if we were to randomly assign extra years of education to students.

   Solution: False. The human capital view predicts positive returns, while the screening view predicts no returns, or even negative returns if experience has positive returns.

2 Externalities and uncertainty (35 points)

Consider the market for air pollution reduction in Boston. The social marginal benefit curve of air pollution reduction is given by $SMB_{ap} = 100 - \frac{1}{4}R$, where R is the amount of reduction. Suppose that the government doesn't know the true costs of air pollution reduction. The government's best guess is that the marginal cost of reduction is $MC_1 = R$ for this market. There is a chance however that the actual marginal cost is $MC_2 = 20 + R$.

1. (a) (3 points) If the government wants to mandate a reduction level based on its initial estimate (MC_1), what level of reduction should it choose?

   (b) (5 points) If the actual marginal cost curve is MC_2, what is the deadweight loss?

2. Suppose instead that the government decides to levy a corrective tax.

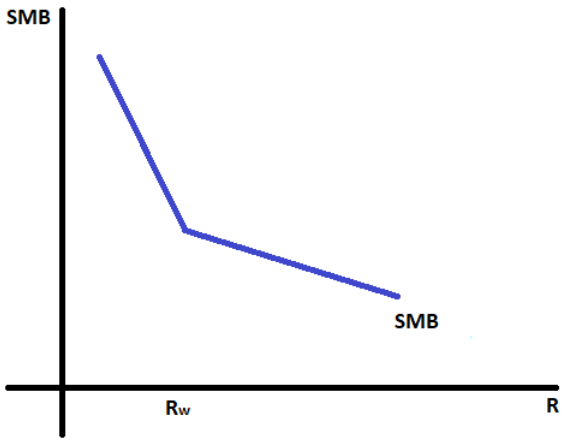
(a) (3 points) At what level should the government set the tax, if it thinks that the marginal cost is MC_1?

(b) (5 points) Calculate the deadweight loss if the actual marginal cost is MC_2.

3. (a) (3 points) What are the implications for instrument choice based on your findings in the previous questions?

   (b) (5 points) How would the results and the implications change if the marginal benefit curve was very steep? Explain the intuition.

4. (11 points) Suppose that the SMB curve for the toxic waste market is as shown in the following graph. Meanwhile, the government is uncertain about the true costs of toxic waste reduction. Discuss the pros and cons of using a tax versus a regulatory approach here. Can you think of a combination approach which might work best of all given the uncertainty? *Hint: By this we mean an EX-ANTE approach - you need to announce your policy before the uncertainty is resolved, so don't just answer that you will wait until you learn the cost!*



Solution:

1. (a) *The optimal level of reduction is where social marginal cost equals social marginal benefit.*

$$MC_1 = SMB_{ap} \iff R = 100 - \frac{1}{4}R \iff R_{1ap} = 80$$

   (b) *To compute the DWL, we need to find the intersection of the SMB curve with MC_2 and also evaluate MC_2 and MC_1 at R_1.*

$$MC_2 = SMB_{ap} \iff 20 + R = 100 - \frac{1}{4}R \iff R_{2ap} = 64$$

$$MC_2(R_1) = 20 + 80 = \$100 = C_2$$

$$MC_1(R_1) = \$80 = C_1$$

So:

$$DWL^1_{ap} = \frac{1}{2}(R_1 - R_{2ap})(C_2 - C_1) = \frac{1}{2}16 \cdot 20 = \$160$$

2. (a) *The government should set the tax equal to C_1 such that it achieves the optimal level of reduction R_1. So $t_{ap} = 80$*

   (b) *To compute the DWL, we need the intersection of the SMB curve with MC_2 (we have it from before), the level of reduction R_3 implied by the tax and to evaluate the SMB at R_3.*

$$MC_2(R_3) = 80 \iff 20 + R_3 = 80 \iff R_{3ap} = 60$$

$$SMB_{ap}(60) = 85$$

So:

$$DWL^2_{ap} = \frac{1}{2}(R_{2ap} - R_3)(SMB_{ap}(60) - C_1) = \frac{1}{2}4 \cdot 5 = \$10$$

3. *The central intuition here is that the instrument choice depends on whether the government wants to get the amount of pollution reduction right or whether it wants to minimize costs.*

   When the SMB curve is flat, as in the case of air pollution, getting the reduction exactly right is not very important; thus, it is inefficient to mandate a very costly option for firms. Hence, price regulation through taxes is more appropriate than quantity regulation because it protect firms against very high costs of reduction.

   Quantity regulation ensures that there is as much reduction as desired regardless of the cost, which is more appropriate with a very steep SMB curve. Quantity regulation ensures that there is as much reduction as desired, regardless of the cost. So, if it is critical to get the amount exactly right, quantity regulation is the best way to go.

4. *The SMB curve is initially very steep but after R_w it becomes flatter. This means that low levels of toxic waste are not that harmful but beyond a certain point, the damage becomes critical. The government dos not know the true marginal cost and it wants to minimize deadweight loss. Hence, it must use a contingency plan with a combination of taxes and quantities.*

   The optimal plan should have a lower bound for the level of reduction (which is lower or equal to R_w) i.e. quantity regulation to ensure that damage does not become critical in the region where the SMB curve is steep. However, for levels of reduction above the lower bound where the SMB curve is flatter, it should regulate prices through taxes since getting the reduction exactly right is not very important and it protect firms against very high costs of reduction. So the optimal plan uses taxes on firms to reduce waste but also requires that they do not pollute above a certain level.

   If only one of the tools is used, then the DWL might end up being very large. The price regulation might allow a very low level of reduction which will cause critical damage (steep part of the SMB curve). The quantity regulation, on the other hand, might end up costing the firms too much (flat part of the SMB curve).

3 Public goods (35 points)

In a maritime trade route in Great Britain, there are N boats operating. All of them share the same production function and the only input is the total number of lighthouses L in the port at which they are arriving. Each firm can build its own lighthouses l_i at a cost p, thus $L = \sum_i l_i$. The profit function for each boat operating in the route is:

$$\Pi_i = Aln(L) - l_i p$$

1. (7 points) Assuming that lighthouses are non-excludable and non-rival, calculate the number of lighthouses that the boats provide when each boat individually maximizes its own profit function taking as given the decisions of the other boats.

2. (8 points) Define social welfare as the sum of boats' profits. Calculate the number of lighthouses that maximizes social welfare (the aggregate profits of all boats) as a function of A, p and N. Comment on the relationship between what you found in this item relative to what you found above.

3. (10 points) Suppose that boats could form a business association and vote on the number of lighthouses that they will build, financing them with a lump sum tax on each boat. Under what conditions can the voting procedure be expected to result in an efficient allocation? What if boats are heterogeneous with respect to how important lighthouses are for their profits, that is, each boat has a profit function with a different A_i?

4. (10 points) Suppose that there are two countries. In the first country there are many ports, and each of them is almost as good as any other from the point of view of the transportation companies trying to move goods in and out of the country. In the second, there is a single port. Each port is responsible for providing lighthouses around it, so that boats can arrive safely, and they finance them by levying a lump-sum tax on the boats arriving. In which of the two countries can we expect the number of lighthouses to be closer to efficient? Can we expect the number of lighthouses in any of the countries to be completely efficient? Explain using economic models discussed in class.

Solution:

1. *Maximizing profits taking* $L_{-i} = \sum_{j \neq i} l_j$ *as given*

$$max_{l_i} Aln(l_i + L_{-i}) - l_i p$$

$$\frac{A}{L} = p$$

$$L = \frac{A}{p}$$

2. *Maximizing the sum of profits with respect to* L

$$max_L \sum \Pi_i = max_L NAln(L) - Lp$$

$$NA\frac{1}{L} = p$$

$$L = \frac{NA}{p}$$

   The amount of lighthouses built in equilibrium are $1/N$ *of the efficient amount of lighthouses. The higher the number of boats, the further the allocation becomes from the efficient one.*

3. *The business association would need to have the power to enforce contributions from the individual boats, much like a Business Improvement District. If it does, then because all boats have the same profit function, they would unanimously agree on the efficient provision of lighthouses. If they are heterogenous in* A*, the proposal that pleases the most the median voter would be implemented. If the distribution of* A *is such that the median and the mean are the same, then the number of lighthouses would also be efficient.*

4. *Tiebout would say that boats would essentially vote with their feet (tillers?) and pick the port with the right amount of lighthouses, in the case where there are multiple ports. Let's consider the reasons why the argument could fail: i) Regarding*

returns to scale, it does not seem that multiple ports jointly providing lighthouses would be less expensive than each of them providing lighthouses on their own, so returns to scale favor the Tiebout argument. ii) there is a clear tax-benefit linkage for the boats using the port and paying for the lighthouses. iii) Finally, if ports are too close to each other, there may be spillovers, as the lighthouses one port provides could make the other port safer. In sum, as long as ports are not too close to each other, based on the Tiebout model, we can expect the country with multiple ports to supply lighthouses more efficiently. In the case where there is a single port, the Tiebout reasoning above would not work. Boats would use the port almost independently of the quality of lighthouse services provided, and there would be less of an incentive to provide them efficiently. Even in the first case, because ports are not perfect substitutes to each other, analogously to when there is not perfect mobility in the Tiebout model, the number of lighthouses may not be exactly efficient.

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