Public Economics 14.41

Fall 2009

Midterm

Professor Jonathan Gruber

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Please answer the following questions in your blue book, one question per blue book. No credit will be awarded for answers without explanations. Calculators are allowed, but no points will be taken off if you are unable to simplify a mathematical expression. Point totals are provided next to each question; the suggested number of minutes to spend on each question corresponds to the point allocations. You will have 85 minutes to take the exam.

There are four questions. You are required to answer all questions. Good luck!

Question One (20 Points)

Please write whether the following claims are true, false, or uncertain. No credit will be awarded without a clear, well-reasoned explanation. In the interest of time, be concise!

(a) (5 Points) **Claim:** A tax on pollution is equivalent to a subsidy on pollution abatement.

(b) (5 Points) **Claim:** When a government tries to provide a public good it will inevitably crowd-out private provision of the good one for one.

(c) (5 Points) Suppose the government is planning construction of a new highway. The project will require 1,000 man-hours. At a market wage rate of \$6/hr, the accounting cost of the labor component of the project is \$6,000. **Claim:** A binding minimum wage indicates that the true economic cost of the labor component is less than \$6,000.

(d) (5 Points) **Claim:** A matching grant to the local government will maximize local targeted spending relative to a conditional block grant.

Question Two (20 Points)

McDonald's and Burger King both have a 'special sauce', though they don't advertise that what makes the sauce so 'special' is the inclusion of a specific Mississippi worm, the harvest of which destroys the fertility of the soil. This makes crop production extremely difficult for farmers, and the total damages (D) imposed as function of worm extraction is estimated to be:

$$D(W_{Total}) = 200 \cdot W_{Total}$$

where costs measure the total damages to farmers resulting from the total extraction of worms (W_{Total}) by McDonald's and Burger King combined.

Both McDonald's (M) and Burger King (BK) have alternative formulaes that make use of an ecologically-sustainable ('environmentally friendly') beetle in place of the Mississippi worm. This substitution is available to each firm at the additional cost. The *total* costs of reducing each firm's use of the worm (instead substituting the 'farmer-friendly' beetle) is specified below:

$$C_M(R_M) = 5 \cdot R_M^2$$

$$C_{BK}(R_{BK}) = 2 \cdot R_{BK}^2$$

where costs here indicate the additional cost of production of the 'special sauce' for each firm as a function of the amount of *reduced worms* (R) in the formula (worm 'abatement').

(a) (5 Points) Protestors outside Congress demand that the government force both firms to immediately cease the extraction of the Mississippi worms, stating that the American farmer suffers at the hands of the corporate 'machine'. In what sense are these protectors correct? In what sense are they incorrect?

(b) (5 Points) Determine the socially optimal level of worm 'abatement' for each firm.

(c) (5 Points) Suppose that the state government assigns joint 'custody' of the worms to all of the Mississippi farmers. Will this solve the problem? Discuss one scenario under which it might (cite the relevant course concept), and then provide at least one reason that the 'solution' will fail.

(d) (5 Points) Instead, the state government decides to implement either price or quantity regulation, but is concerned that the cost estimates provided by McDonald's and Burger King may overstate their true costs of reduced worm dependence. Which policy (price or quantity regulation) is optimal in this scenario? Define the optimal policy (calculate τ^* or R_M^* and R_{BK}^*) and defend your choice.

Question Three (20 Points)

Owing to geography and a heavy reliance on automobiles, Los Angeles (California) suffers from air pollution in the form of 'smog'. The Los Angeles Basin is susceptible to atmospheric inversion, which holds in the exhausts from road vehicles, airplanes, locomotives, shipping, manufacturing, and other sources. Recent annual reports of the American Lung Association ranked the city as the most polluted in the country

City	Year	Pollution Level
Houston	1999	10.2
Houston	2003	10.6
Houston	2007	9.2
Other Major Cities	1999	10.7
Other Major Cities	2003	11.2
Other Major Cities	2007	11.5

with year-round particle pollution. Suppose that the city of Los Angeles is considering a mandate on ultra-low emission vehicles. As chief economic council to the governor's office, you have been asked to evaluate whether the proposed mandate is an economically justified.

(a) (3 Points) If ultra-low emission vehicles are in fact justified, briefly discuss why might you not expect to find them being produced/purchased in the Los Angeles area already.

(b) (4 Points) Suppose that after meeting with automotive lobbyists, you are informed that reducing vehicle emissions will require an initial investment of \$100,000,000 in new catalytic converter technology at the factory level in addition to an estimated increase of \$500,000/year indefinitely in increased maintenance costs for owners. Assuming a discount factor of 10%, determine the PDV of costs associated with mandating the ulta-low emission vehicles.

In evaluating potential benefits of mandating the ultra-low emission vehicles, you turn to data detailing year-round particle pollution (measured as 'Micrograms per Cubic Meter of Air', hereafter referred to as 'Pollution Level') within another heavily polluted city, Houston (Texas), as well as all other major Texas cities. Suppose that in 2004, the city of Houston had implemented a similar mandate to that proposed in Los Angeles. Further suppose that all other major cities in Texas did not experience any enviromental legislation over the observed period.

(c) (7 Points) Using the data provided, construct an estimator for the reduction in year-round particle pollution in Houston resulting from the mandate on ulta-low emissions vehicles. Defend your estimator. Explicitly discuss key assumptions underlying estimator validity.

(d) (6 Points) Assuming access to reasonable data, how could you instead translate your finding above into a benefit estimate ($) using a revealed preferences approach? (Clarifying Note: You are asked here to translate the change in pollution level (above) to a $ benefit estimate appropriate for cost/benefit analysis.)

Question Four (25 Points)

The city of Smartsville is deciding how much to spend, E, on public education. There are three types of households (A,B,C) with heterogeneous preferences over the level of spending on E. There are equal number of each household.

(a) (4 Points) Why might an economist classify public education as an 'impure' public good?

(b) (5 Points) Assuming no government intervention/provision, briefly discuss why public education spending may be underprovided if financed exclusively by private contributions. In your response, reply as to (1) public goods generally and (2) educational spending specifically.

Instead, the city decides to provide level E of public education, financed through lump-sum taxation on each household. Three levels of provision are considered: Low (L), Medium (M), and High (H). Household preferences over each level of E are given:

- Household A has preferences: $L \prec M \prec H$

- Household B has preferences: $L \prec H \prec M$

- Household C has preferences: $H \prec M \prec L$

(c) (7 Points) Would pair-wise voting result in a stable (consistent) outcome E^* (cite a relevant concept from the course)? If so, determine provision level E^* and demonstrate that this outcome is indeed stable (consistent).

(d) (4 Points) Suppose that pair-wise voting results in a stable (consistent) outcome E^*. Is this level of provision of E necessarily socially optimal? Explain.

(e) (5 Points) Suppose that in the United States, there are many cities, and each city independently determines its own level of local spending on public education. Explain why each city may establish the (locally) socially optimal level of provision? Discuss two plausible reasons why this may not occur.

14.41 Public Finance and Public Policy

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