

Fill in the blanks, and answer in the spaces provided. Show your work.

1. Positive externality. Suppose the market for a certain good (e.g. ‘education’) is perfectly competitive, but that the good causes a *positive* externality. Marginal private benefit, marginal private cost, and marginal external benefit are given by the functions below:

$$MB = 150 - 5q \qquad MC = 30 + q \qquad MEB = 48$$

a) No policy. Given that there is no policy to address the externality, find the equilibrium quantity, price, consumer surplus, producer surplus, external benefit, and total economic surplus.

$$q^* = \underline{\hspace{2cm}} \qquad p^* = \underline{\hspace{2cm}} \qquad CS^* = \underline{\hspace{2cm}}$$

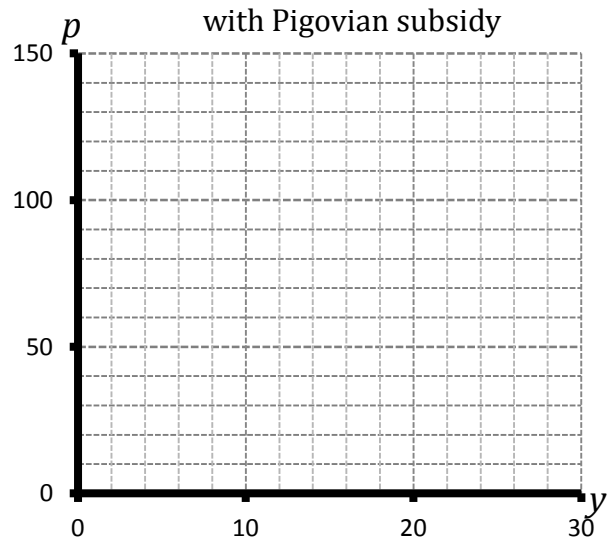
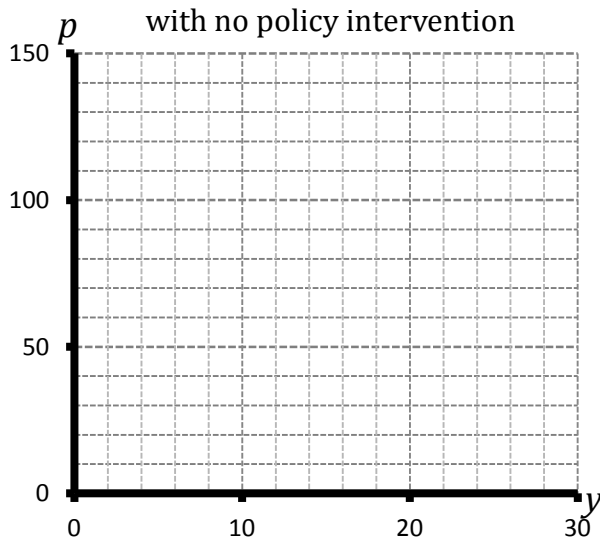
$$PS^* = \underline{\hspace{2cm}} \qquad EC^* = \underline{\hspace{2cm}} \qquad TES^* = \underline{\hspace{2cm}}$$

b) Pigovian subsidy. To maximize total economic surplus, the government should offer a subsidy of $\sigma^o = \underline{\hspace{2cm}}$ per unit to the consumers. Given this, find the equilibrium quantity, price, consumer surplus, producer surplus, external benefit, government expenditure, and total economic surplus.

$$q^o = \underline{\hspace{2cm}} \qquad p^o = \underline{\hspace{2cm}} \qquad CS^o = \underline{\hspace{2cm}}$$

$$PS^o = \underline{\hspace{2cm}} \qquad EC^o = \underline{\hspace{2cm}} \qquad GR^o = \underline{\hspace{2cm}} \qquad TES^o = \underline{\hspace{2cm}}$$

c) Graphing. On the left, graph the market with no policy intervention, labeling CS^* , PS^* , and deadweight loss (DWL). On the right, graph the market with the subsidy, labeling CS^o and PS^o .



2. Optimal government size. Suppose that there is a private good, with a market that is efficient in the absence of taxation, and a public good that can only be provided by the government using revenue from a per-unit tax of τ on the private good. Let the marginal benefit and cost for the private good (with quantity x) be as follows:

$$MB(x) = 90 - x \qquad MC(x) = 10 + x$$

Let the marginal benefit and cost of the public good (with quantity y) be as follows:

$$MB(y) = 120 - 4y \qquad MC(y) = 40$$

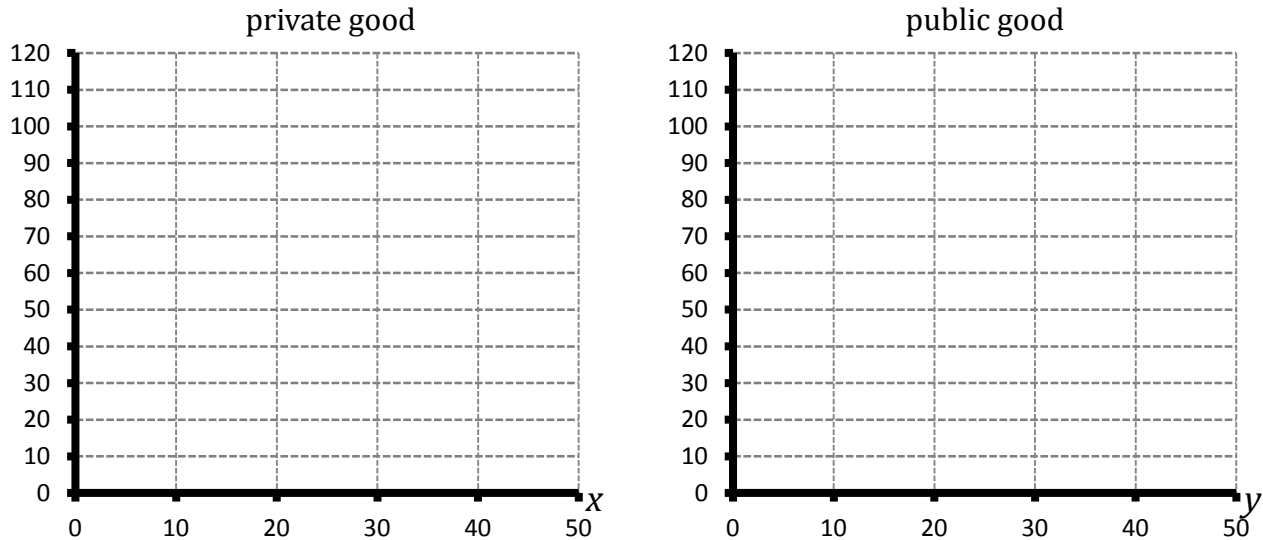
a) As functions of the tax τ , find the quantity of the private good $x(\tau)$, tax revenue $R(\tau)$, and deadweight loss $D(\tau)$.

b) Find the optimal tax τ^o , supposing that the shadow value of spending a dollar on the public good is $\lambda = 3/2$. Also, find the resulting tax revenue, $R(\tau^o)$.

c) Using the value of tax revenue that you found, and information about the public goods market above, demonstrate that the shadow value of the last dollar spend on the public good is indeed $3/2$. That is, find the value of y^o that results from spending the revenue $R(\tau^o)$, and use this to calculate the shadow value $\lambda(y^o)$.

d) Compare the deadweight loss in the private market resulting from τ^o to the gain in surplus in the public market resulting from y^o . How much economic surplus is gained overall from the tax and the spending *taken together*?

e) On the left, graph the market for the private good, with the optimal tax, labeling CS , PS , R , and D . On the right, graph the market for the public good, labeling R (government expenditure, equal to revenue by assumption) and TES_y (total economic surplus from the public good).



3. Common resource. Suppose that there is a pasture somewhere that can be used for goat grazing. In the nearby village, any amount of goats can be purchased, for \$20 each. If the number of goats that people buy and keep in the pasture is x , the revenue that can be derived from the goats living in the pasture (e.g. from their milk, or whatever) is $R(x) = 80x - x^2$. (This function is concave and eventually decreasing in x due to the fact that the goats will be less healthy if they have less grass to eat.)

a) If a profit-maximizing monopolist controls the pasture, they will choose to keep _____ goats there. In this case, the monopolist's goat-related profit is _____.

b) If the pasture is a non-excludable common resource, and the world is teeming with entrepreneurs seeking to profit from goat husbandry, then the equilibrium number of goats on the pasture is _____. (Assume that each goat on the pasture yields the same revenue.) In this case, the total profit gained from the pasture is _____.

c) Suppose that the pasture is still a non-excludable common resource, but that the government wishes to introduce a per-goat tax on the use of the pasture, in order to cause the field to be used efficiently (in the sense of maximizing revenue net of costs). To do this, they should levy a tax of _____ per goat. If they do so, the goat entrepreneurs' profit will be _____, and the government's revenue will be _____.

4. Simple income tax calculation. Suppose a graduated income tax defined by this table:

income bracket	marginal rate	income bracket	marginal rate
\$0 - \$10,000	10%	\$90,000 - \$180,000	30%
\$10,000 - \$40,000	15%	180,000-400,000	35%
\$40,000 - \$90,000	25%	400,000 and above	40%

- a) If your taxable income is \$30,000, your total tax is _____, and your average tax rate is _____.
- b) If your taxable income is \$500,000, your total tax is _____, and your average tax rate is _____.
- c) Is this tax progressive, regressive, or proportional? Explain clearly.

5. Is the FICA (payroll) tax more or less progressive than the US federal income tax? Explain clearly. What differences are there in the way that the revenue of the two taxes are used?

6. What are the cons and pros of allowing various exemptions and deductions to people as they pay their income tax, so that people with the same income may owe different amounts of tax. Construct the 'pros' argument rather carefully, giving two concrete examples.

7. Give two arguments for a tax on the value of land and the use of natural resources: one based on efficiency, and another based on justice.