Econ 131: Practice Midterm Spring 2010 - Problem 2 Solution

UPDATE: While the setup, approach, and final graphs of the initial solutions were correct, this version corrects for some minor errors in the arithmetic calculation of total surplus and adjusts the answer in part D to say that achieving a wedge of 20G requires a tax of "$ 20G per unit" rather than "$20 per unit." Sorry for any confusion that this may have caused.

(a) What is the market equilibrium (price and quantity) and what are the surplus of consumer and oil tankers.
   Steps:

   - Determine equilibrium by equating price and marginal cost
   - Marginal cost is how much total cost changes with G increases by one unit, so take a derivative of TC with respect to G to get $MC = 10G$
   - Plug in P from problem and this MC to solve for $G^*_{Private}$

$$P = MC$$
$$1000 - 10G = 10G$$
$$G^*_{Private} = 50$$

   Surplus:
   Total surplus is the sum of surplus of consumers and producers (i.e. oil tankers).

$$TS = CS + PS$$
$$= .5(1000 - 500) * 50 + (Rev - TC)$$
$$= 12500 + (500 * 50 - 5 * 50^2)$$
$$= 25000$$

(b) Social Costs

   - **Pros & Cons of Contingent Valuation:**
     - Recall that contingent valuation is determined by asking individuals to value an option that they are not now choosing (or that is not yet available to them).
     - **Pro:** Under some circumstances, it is the only feasible method for valuing a public good
     - **Con:** People may lie or overstate how much they value something if they don't have to (fully) pay the costs of lying. The structure of how the question is asked can materially change the answer as well.
     - See page 212-213 for more info.
   - **Pros & Cons of Revealed Preference:**

- Recall that revealed preference is a method with which we infer how much people value things from their actions. We did this in section for the park valuation problem where we looked at how many times people who lived 10 minutes away went to the park versus those who had identical preferences but lived 20 minutes away.
- **Pro:** Actions speak louder than words, i.e. it is more likely that inference based on peoples actions comes closer to the true value than what people say their value is.
- **Con:** Ideally we need a clean controlled experiment that varies the attribute or good that we are valuing while keeping everything else constant. Sometimes there are no suitable natural experiments for hypotheticals under consideration, so we can't use peoples' actions to infer their preferences.
- See page 214-215 for more info.

Total Damages:
Contingent Valuation has damages $10G^2$ so at $G^*_{Private} = 50$, damages are 25,000. Using revealed preferences, the damages are half as large, i.e. 12,500.

(c) Suppose Contingent Valuation is correct.

Steps:

- Determine equilibrium by equating price and marginal social cost
- Marginal social cost is how much total social cost changes with G increases by one unit, so take a derivative of $TC + ExternalCost$ with respect to G to get marginal social cost.
- Plug in P from problem and this MSC to solve for G^*_{Social}

Contingent Valuation:
External Cost is $10G^2$ so total social cost is $15G^2$ and marginal social cost is $30G$.
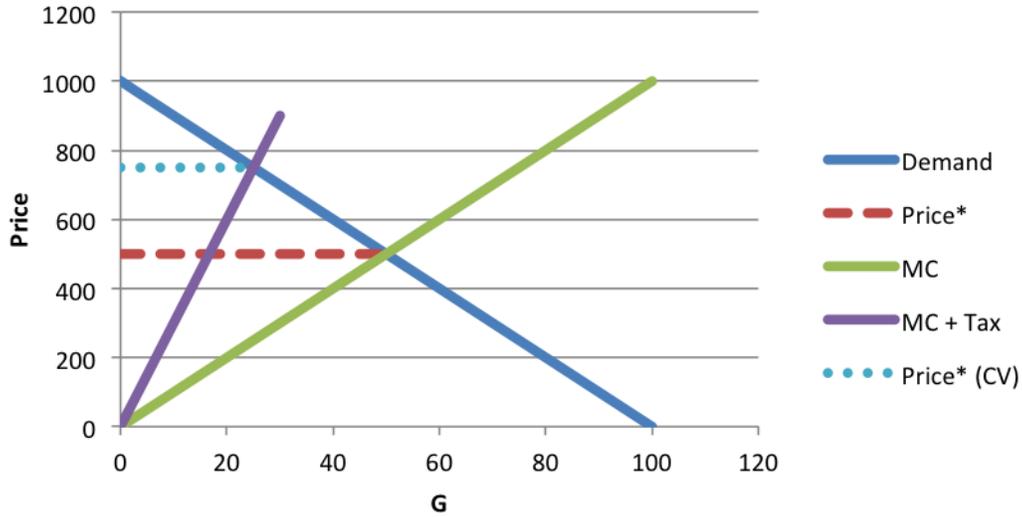
$$P = MSC$$
$$1000 - 10G = 30G$$
$$G^*_{Social} = 25$$

Total Surplus:

$$
\begin{aligned}
TS &= CS + PS + ExternalBenefit \\
&= .5(1000 - \underbrace{(1000 - 10*25)}_{P_{social}}) * 25 + \underbrace{(Rev - TC)}_{\text{Producer Surplus}} -10G^2 \\
&= .5(1000 - 10(25)) * 25 + (750 * (25) - 5*(25)^2) - 10(25)^2 \\
&= 9375 + 15625 - 6250 \\
&= 18750
\end{aligned}
$$

Note that total surplus is 18750, which is smaller than the 25,000 we got in part a before accounting for external costs. However, 25000 net of damages (based on contingent valuation) becomes a total surplus of zero. Thus, this represents an improvement relative to the private market equilibrium of $18750 - 0 = 18750$.

(d) Pigouvian tax

Effectively we want to use taxes to make the marginal cost equal to the marginal social cost. Based on contingent valuation, the optimal G^* is 25 so we want to set taxes to achieve this. We can do so by making marginal cost $30G$, which requires an additional tax of $\$20 \times G$ for every unit of G.

(e) **Revealed Preference:**

External Cost is $5G^2$ so total social cost is $10G^2$ and marginal social cost is $20G$.

$$P = MSC$$
$$1000 - 10G = 20G$$
$$G^*_{Social} = 33.\bar{3}$$

The pigouvian tax would need to be 10 per unit to make the effective marginal cost 20. Finally, surplus would be the following:

Total Surplus:

$$TS = CS + PS + ExternalBenefit$$
$$= .5(1000 - \underbrace{(1000 - 10*33.3))}_{P_{socialRP}} * 33.3 + \underbrace{(Rev - TC)}_{\text{Producer Surplus}} -5*33.3^2$$
$$= .5(1000 - 10(33.3)) * 33.3 + (666.6 * (33.3) - 5 * (33.3)^2) - 5(33.3)^2$$
$$= 22211.1$$

Notice that the roughly $22K total surplus exceeds that in part c. This makes sense for two reasons. First, the external costs are lower using revealed preferences. Second, lower social costs mean that we can produce more, which increases CS by giving people who like like the good (i.e. those who value it between 750 and 666) but weren't enjoying it before when G=25 and P was 750 and also increases PS as well for similar reasons (i.e. they were willing to produce the good for less than the price). The extra production was from 25 to 33.3. You can see this graphically by comparing the following picture to the one from part c.