Homework 9

1. Briefly explain how the following statements could be true. In your explanations you should include a diagram and a brief discussion of how elasticity is relevant (or is not relevant) to the truth of the statement.

   a) The government imposes a per-unit tax on the consumers of a product, gives all of the tax revenues to the producers and the producers are worse off than they were before the imposition of the tax.
   b) The government provides a per-unit subsidy to the producers of a good and the cost to the government of the subsidy exceeds the benefit received by the producers.
   c) The government imposes a price floor in a market to raise the price of the product and producers are made worse off.

2. Suppose that the current tuition (price) of an elite college education is $40,000 per year and 250,000 students are enrolled at these colleges per year. The government is considering subsidizing education by giving all students a grant of $5000 per year to enable more students to attend college.

   a) Illustrate in a diagram the market clearing price and quantity traded <u>after</u> the government subsidizes education. Indicate in your diagram the net price paid by students (tuition less the grant) and the total price received by the colleges.

The incidence of the benefits on firms is defined to be the proportion of the subsidy received by the firms. The incidence is equal to the difference between the prices received before and after the imposition of the subsidy divided by the total value of the subsidy. Similarly we can define the incidence on consumers.

   b) In your diagram illustrate the incidence of the benefits on firms, on students and the total cost of the subsidy to the government.
   c) If the government budgeted $1.25 million dollars for the cost of the subsidy ($5K per student for 250K students) then did the government over estimate or underestimate the cost of the subsidy? Briefly explain your answer.

We can use the methodology from class to derive the following formula for the incidence of a per unit subsidy on the colleges:

$$\frac{-dQ^D/dP}{dQ^S/dP - dQ^D/dP}$$

   d) Verify that this formula generates values between 0 and 1.
   e) Assuming that $P^S = P^D$ initially show that you can re-write the formula with elasticities as

   $$\frac{-\varepsilon^D}{\varepsilon^S - \varepsilon^D}$$ where ε^S is the own price elasticity of supply and ε^D is the own price elasticity of demand.
   f) If supply is perfectly inelastic then use the formula above to derive the incidence of the benefits on colleges.
   g) In a new diagram below illustrate a perfectly inelastic supply in the market. Illustrate the incidence of the benefits from the subsidy on students and colleges.
   h) If supply is perfectly inelastic then did the government policy succeed at getting more students into college? Did it succeed at making college more affordable?

3. The US domestic supply of lead and domestic demand for lead are given by: $Q_{US}{}^S = .5P$ and $Q_{US}{}^D = 600- 3.5P$. Price is measured in cents per pound and quantity is measured in millions of pounds per year.
    a) Given the domestic supply and demand curves for lead what is the US demand curve for lead imports?

Small Open Economy: The world price of lead is $P^w = 120$ cents per pound and the US is a price taker on the world lead market.
    b) Given the world price of lead how many pounds of lead will the US choose to import? What would be the domestic price of lead in the US? How many pounds of lead would US consumers purchase?

US lead producers successfully lobby congress to place a tariff on the importation of lead of t = 10 cents per pound.
    c) Illustrate the effect of the tariff on the import market in your diagram for part (b).
    d) What will be the effect of the tariff on the domestic price and consumption of lead in the US? In your diagram for part (b) illustrate the following impacts on US total surplus of the tariff :change in consumer surplus, tariff revenues and dead-weight loss.

Large Open Economy: Suppose that instead of facing a perfectly elastic world supply curve, the US faces an upward sloping world supply $Q^S{}_{world} = P$.
    e) Given the world supply curve of lead how many pounds of lead will the US choose to import? What would be the domestic price of lead in the US? How many pounds of lead would US consumers purchase

As above suppose that the US imposes a t = 10 cents per pound tariff on lead imports.
    f) Illustrate the effect of the tariff on the import market in your diagram for part (f). Illustrate the effect of the tariff on the domestic price and consumption of lead in the US?
    g) Use your diagram to show that only a fraction of the tariff revenues are raised from US consumers. What is the source of the remaining tariff revenues?
    h) Is it possible in this case that total US surplus could be higher after the imposition of the tariff. Show that the US surplus is higher after the imposition of the tariff.
    i) Derive the formula that relates the tariff and the price paid by domestic consumers as a function of the slopes of supply and demand.

4. Abe is a bee keeper who sells his honey in a perfectly competitive market. There are 6 identical apiaries (bee farms) in the market and all share the cost curve $C_1(Q_H) = .01Q_H^2 + 3Q_H + 100$ where Q_H is measured in quarts per week. The demand for honey is given by the linear demand curve $Q_H = 1580 - 10P$.
    a) What is the supply curve of Abe's apiary? What is the industry supply curve?
    b) Given the supply and demand curves what is the market clearing price and quantity in the market in the short run?
    c) What is Abe's inverse firm demand curve? Illustrate Abe's inverse firm demand and supply curve. Show that Ape produces 250 quarts of honey. Indicate Abe's producer surplus in this diagram.

Barney has an apple orchard adjacent to Abe's Apiary. Barney sells his apples in a perfectly competitive market where apples are trading at $5 per bushel. Barney's cost curve is given by

$C(Q_A) = .05Q_A^2 + 205 - .5Q_H$ where Q_A is measured in bushels of apples per week and Q_H is the number of quarts of honey that Abe produces in a week.

    d) Given the quantity of honey that Abe produces in part (c) what will be Barney's cost curve? How many bushels of apples will Barney produce?

    e) Does Abe's production of honey generate an external cost or an external benefit for Barney? Illustrate the value of this external cost/benefit in your diagram for part (c).

Suppose Barney purchases Abe's Apiary so Barney will now choose both the quantity of honey and the quantity of apples to produce

    f) Given your answer to part (e) would you expect that Barney will increase or decrease the number of quarts of honey sold? How about the quantity of apples? Briefly explain your answer.

For the remainder the price of honey will be constant at 8 and the price of apples constant at 5. Suppose that Barney increases the number of quarts of honey produced by 25 to 275.

    g) By how much will the profits/producer surplus of the Apiary fall? By how much will the profits of the orchard rise?

    h) Illustrate the fall in producer surplus of the apiary in your diagram for part (c). Illustrate the change in the external costs/benefits in the same diagram.

    i) Write an expression for the marginal loss to the apiary of an increase in honey production above 250 quarts. Write an expression for the marginal gain or loss to the orchard of an increase in the production of honey.

    j) Use your answer for part (i) to determine the number of quarts of honey that Barney will produce?

5. Suppose that the demand for zinc (measured in units of millions of pounds) is estimated to be: $Q^D = 1 - .5P^{ZINC} - .25P^{COPPER} + .56Q^{IRON}$ where the price of zinc and copper are both measured in cents per pound and Q^{IRON} is measured in units of millions of tons of iron. The supply of zinc is estimated to be: $Q^S = -.5 + .25P^{ZINC}$. Suppose that the price of copper is initially 80 cents per pound and that the quantity of iron is 100 million tons.

    a) What is the market-clearing price for zinc? What is the quantity traded at this price? Illustrate your answer in a diagram.

    b) What is $\dfrac{dP^{zinc}}{dP^{copper}}$ and $\dfrac{dP^{zinc}}{dQ^{iron}}$?

    c) What is the effect of a rise in the price of copper to 86 cents on the market-clearing price of zinc? What is the effect on the quantity of zinc traded? Illustrate your answer in a diagram.

    d) What is the effect of a rise in iron production to 109,375,000 tons (that is a rise of 9.375 units) on the market-clearing price of zinc? What is the effect on the quantity of zinc traded? Illustrate your answer in a diagram.

    e) If both the price of copper rises to 86 cents and the production of iron rises to 109,375,000 tons what would be the effect on the market-clearing price of zinc? What would be the effect on the quantity traded? Illustrate your answer.

6. The US domestic supply of steel and domestic demand for steel are given by: $Q_{US}^S = -25 + .25P$ and $Q_{US}^D = 182 - .1P$. Price is measured in dollars per ton and quantity is measured in millions of tons per year. The world price of steel is 500 dollars per ton and the US is a price taker on the world steel market (i.e. the US is a "small" open economy in the steel market).

a) Given the domestic supply and demand curves for steel what is the US demand curve for steel imports?
b) Given the world price of steel how many tons of steel will the US choose to import in the absence of trade restrictions? What would be the domestic price of steel in the US? How many tons of steel would US consumers purchase? How many tons of steel will US producers supply? Illustrate your answer on the next page.

US steel producers successfully lobby congress to place a quota on the importation of steel of 11 million tons per year (so a maximum of 11 million tons of steel may be imported).
c) Illustrate the effect of the quota on the import market in your diagram for part (b).
d) What will be the effect of the import quota on the domestic price and consumption of steel in the US? How many tons of steel will domestic producers supply at this price?
e) In your diagram for part (b) illustrate the effect of the import quota on US steel market. In your diagram you must indicate the following areas:
    i.   change in consumer surplus;
    ii.   change in producer surplus;
    iii.   dead-weight loss.
f) What is the dollar value of the loss in consumer surplus?
g) Why did the import quota result in a dead-weight loss to society? (Hint: there are two reasons for the loss)
h) If the quota rights are given (for free) to foreign steel producers then what is the dollar value of the *rents* earned by these foreign producers? Illustrate these rents in your diagram for part (b).
i) If the US government chose to sell quota rights what do you predict would be the free-market price for the right to sell one ton of steel?

7. Among the tax proposals regularly considered by congress is a tax on distilled liquors. The price elasticity of the supply of liquor is estimated to be 3.8 and the price elasticity of demand of liquor is estimated to be -.2. The average price of a bottle of liquor is $20 and 10 units are traded each week where a unit represents one thousand cases.

a) What are the slopes of supply and demand curves? Illustrate the market clearing price and quantity in a supply and demand curve diagram.
b) In your diagram for part (a) illustrate the effect of the imposition of $t per unit tax on a bottle of liquor. In your diagram clearly label P^D, P^S and the quantity traded after the tax (note that you do not need to calculate these numbers for this diagram). Be sure to indicate the following areas in your diagram: consumer's burden of the tax, producer's burden of the tax, total tax revenue and deadweight loss of the tax.
c) What is deadweight loss? Why does a per-unit tax cause deadweight loss? If the government wants to minimize deadweight loss then what markets should it target for taxation?
d) If the per unit tax is $2 per bottle then what will be the price that consumer's pay for a bottle of liquor (i.e. what is P^D)? How much will producers receive? What will be the quantity traded in this market? What will be the deadweight loss?
e) What is the consumer's burden of the tax? What is the producer's burden of the tax? Why are consumers paying such a large portion of the tax?
f) If demand had been perfectly inelastic then what would have been the effect of the tax on P^D, P^S and the quantity traded? Who would have paid the tax? Illustrate your answer in a new diagram.