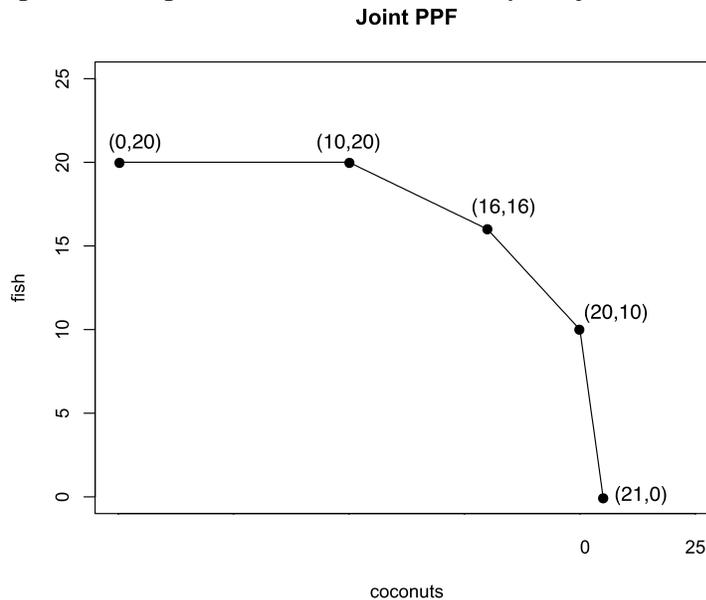


**Economics 101**  
**Fall 2012**  
**Answers to Homework #2**  
**Due 10/9/12**

**Directions:** The homework will be collected in a box **before** the lecture. Please place your name, TA name and section number on top of the homework (legibly). Make sure you write your name as it appears on your ID so that you can receive the correct grade. Please remember the section number for the discussion section **you are registered**, because you will need that number when you submit exams and homework. Late homework will not be accepted so make plans ahead of time. **Please show your work; otherwise you will not receive full credit. Good luck!**

1. Dale, Geraldine, Monroe, and Grover can split their time between fishing and gathering coconuts. Their production possibilities are reflected by the joint PPF below.



- a) What is the opportunity cost of producing the first 5 coconuts?  
 Zero fish - In producing the first 5 coconuts, we shift from (0,20) to (5,20). Fish production does not decrease, so the opportunity cost (and slope on the PPF) is 0.
- b) What is the opportunity cost of producing the first 2 fish?  
 2/10 coconuts - In producing the first 2 fish, we shift from (21,0) to (20.8,2). Coconut output falls by 0.2. The slope of the last segment is -10, meaning the opportunity cost of a coconut is 10 fish. This implies the opportunity cost of one fish is 1/10 coconuts. This opportunity cost doesn't change for the relevant range here, so the opportunity cost of 2 fish is 2/10 coconuts.
- c) If Geraldine has the second lowest opportunity cost of producing fish, what is her opportunity cost for gathering one coconut?  
 3/2 fish - From the labeled points we can construct the table shown below. Each segment on the joint PPF shows one person's productive possibilities. If Geraldine has the second lowest opportunity cost of producing fish, she will also have the third lowest opportunity cost of coconuts. Examining the table, Person B must be Geraldine. Alternatively, the

person with the third lowest opportunity cost of coconuts will give us the segment between (16,16) and (20,10).

d) How many fish can Geraldine catch if she spends all of her time fishing?

6 fish

| Maximum production of each good by person |          |      |
|---|----------|------|
|   | coconuts | fish |
| Person A                                  | 1        | 10   |
| Person B (Geraldine)                      | 4        | 6    |
| Person C                                  | 6        | 4    |
| Person D                                  | 10       | 0    |

2. Nowhereland is an island economy with population of 4 – Alice, Bob, Catherine and David. Everyday there are two survival activities under the northerly Sea of Ferocity: catching jellyfish and collecting seaweed. Both activities involve open water diving, requiring the use of an oxygen tank. Thus, a special kind of capital called “oxygen tank” is used in the production of these two goods. Each person possesses a different amount of oxygen tanks. The following table shows how many oxygen tanks each person has and how many are needed to produce each unit of the delicacies:

|                                     | Alice | Bob | Cathy | David |
|-------------------------------------|-------|-----|-------|-------|
| Oxygen Tank Possessed (Tanks)       | 6     | 10  | 8     | 15    |
| Catching Jellyfish (Tank/Jellyfish) | 1     | 2   | 2     | 5     |
| Collecting Seaweed (Tank/Seaweed)   | 3     | 5   | 2     | 3     |

a) If everyone decides to catch jellyfish only, how many jellyfish can all of them produce? If everyone decides to collect seaweed only, how many seaweed can all of them produce?

If all decides to catch jellyfish – Alice, Bob, Cathy and David will catch 6, 5, 4 and 3 jellyfishes, respectively or a total of 18 jellyfish. Similarly, if all decides to collect seaweed – they will collect 2, 2, 4 and 5 seaweeds, respectively or a total of 15 seaweeds.

b) What are the opportunity costs of catching jellyfish for each person? What are the opportunity costs of collecting seaweed for each person? Put your answers in the following table.

|       | Opportunity Cost for a Jellyfish | Opportunity Cost for a Seaweed |
|-------|----------------------------------|--------------------------------|
| Alice |                                  |                                |
| Bob   |                                  |                                |
| Cathy |                                  |                                |
| David |                                  |                                |

The logic is as follows: Alice faces a tradeoff of either “6 jellyfishes and 0 seaweed” or “0 jellyfish and 2 seaweeds.” Hence, for Alice, the opportunity cost of a jellyfish is  $2/6 = 0.33$  seaweed/jellyfish (gives up 2 seaweeds for 6 jellyfishes) and the opportunity cost of a seaweed is  $6/2 = 3$  jellyfishes/seaweed (gives up 6 jellyfishes for 2 seaweeds). The similar logic applies to the rest of the population. Here’s the completed table.

|       | Opportunity Cost for a Jellyfish | Opportunity Cost for a Seaweed |
|-------|----------------------------------|--------------------------------|
| Alice | 0.33 Seaweed/Jellyfish           | 3 Jellyfishes/Seaweed          |
| Bob   | 0.4 Seaweed/Jellyfish            | 2.5 Jellyfishes/Seaweed        |
| Cathy | 1 Seaweed/Jellyfish              | 1 Jellyfish/Seaweed            |
| David | 1.67 Seaweed/Jellyfish           | 0.6 Jellyfish/Seaweed          |

- c) Who has the absolute advantage in catching jellyfish/collecting seaweed? Who has the comparative advantage in catching jellyfish/collecting seaweed?

There is a catch here! (1) Note that the table gives “the number of oxygen tanks required to complete a task, not the amount of task they can do. (2) Notice that each person has unequal amount of oxygen tanks. Hence, we need to normalize the amount of resources each person has, i.e., assuming that each has an equal amount of resources, ask how many they can produce. Let’s choose 60 tanks to equate the number of oxygen tanks each person has, so the following table shows how many jellyfishes and seaweeds can be caught and collected.

|                   | Alice              | Bob                | Cathy               | David              |
|-------------------|--------------------|--------------------|---------------------|--------------------|
| Oxygen Tanks      | $6 \times 10 = 60$ | $10 \times 6 = 60$ | $8 \times 7.5 = 60$ | $15 \times 4 = 60$ |
| Jellyfish Caught  | $6 \times 10 = 60$ | $5 \times 6 = 30$  | $4 \times 7.5 = 30$ | $3 \times 4 = 12$  |
| Seaweed Collected | $2 \times 10 = 20$ | $2 \times 6 = 12$  | $4 \times 7.5 = 30$ | $5 \times 4 = 20$  |

With the same amount of resources, clearly Alice has the absolute advantage in catching jellyfish and Cathy has the absolute advantage in collecting seaweed.

Using the table in part b), since Alice has the least opportunity cost of catching a jellyfish by forgoing only 0.33 seaweed, she also has the comparative advantage in catching a jellyfish. Similarly, David has the least opportunity cost of collecting seaweed; thus, he has the comparative advantage in collecting seaweed.

- d) Determine the acceptable range of trading price for 1 jellyfish in terms of seaweed. Determine the acceptable range of trading prices for 1 seaweed in terms of number of jellyfish.

The acceptable range of trading price is the difference of the lowest and highest opportunity costs in doing something. Hence, the acceptable range of trading price for 1 jellyfish is between [0.33 Seaweed, 1.67 Seaweeds] and for 1 seaweed is between [0.6 Jellyfish, 3 Jellyfishes].

- e) Label Seaweed (S) and Jellyfish (J) on the x-axis and y-axis, respectively. Give the equations for the PPFs of each person and plot separately.

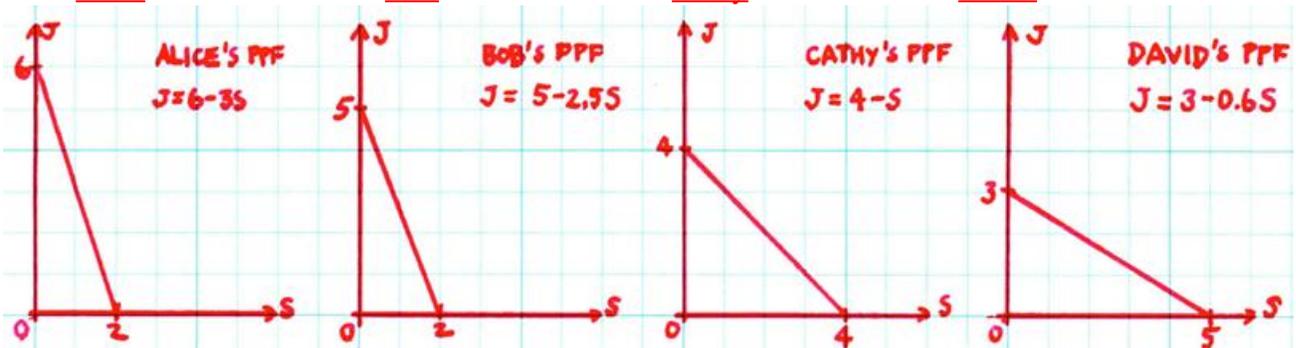
The equations for individual PPF are:

Alice  $J = 6 - 3S$

Bob  $J = 5 - 2.5S$

Cathy  $J = 4 - S$

David  $J = 3 - 0.6S$



f) Draw the joint PPF for Nowhereland. Clearly mark and give the locations of the kink points. Write down the equation for each segment of the joint PPF.

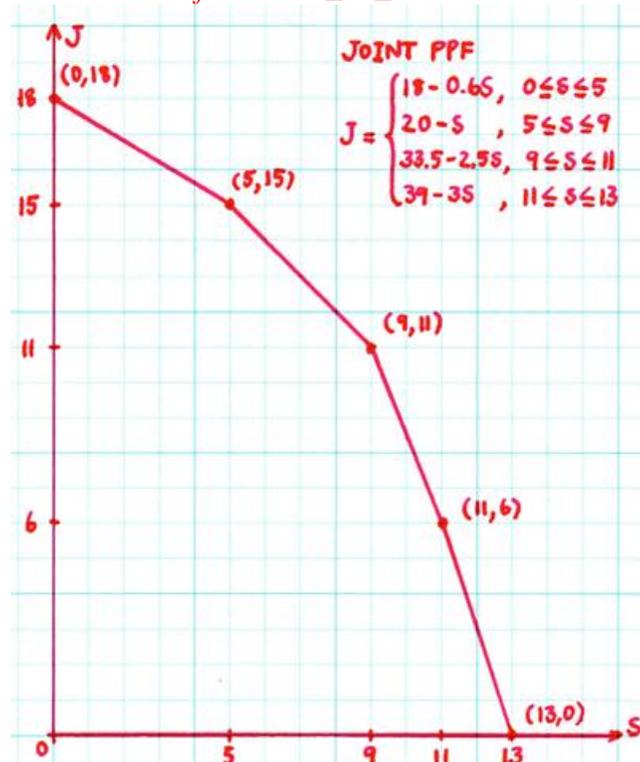
This is not a trick or math question! Just simple economic logic is more than enough.

To draw a joint PPF, one needs to know the total seaweeds and jellyfishes everyone can produce if they join together. The maximum amount of seaweeds collected is  $2 + 2 + 4 + 5 = 13$ . The maximum amount of jellyfishes caught is  $6 + 5 + 4 + 3 = 18$ .

Now, the intuition - start off at the position of 18 Jellyfishes and 0 Seaweed. If the economy wishes to obtain the first unit of Seaweed, they must ask who has the least opportunity cost of forgoing the jellyfish to collect seaweed. Clearly David has the least opportunity cost of collecting seaweed since he needs to forgo only 0.6 Jellyfish, so he should be the first person to collect seaweed. You have the first portion of joint PPF and he can continue to collect up to 5 seaweeds, at this point, the economy has 5 seaweeds and 15 jellyfishes. However, if the economy wants the 6<sup>th</sup> seaweed, David cannot collect anymore since he has exhausted all his capacity; thus, the next person in line to collect seaweed must be Cathy since she has the second lowest opportunity cost of collecting seaweed. She can collect at most 4 seaweeds. At this point, combined with David's seaweeds, the economy has 9 seaweeds and 11 jellyfishes. The analysis for the rest repeats the same intuition until the economy arrives at 13 seaweeds. The joint PPF is shown below:

The equation of joint PPF for each portion is simply equations of lines. One may simply derive from  $y = mx + c$  where  $m$  is the slope of each portion of individual PPF (as aforementioned, representing the opportunity cost) and  $c$  is a constant term determined by substituting each production combination. Hence, the equation of joint PPF is:

$$J = \begin{cases} 18 - 0.6S & \text{if } 0 \leq S \leq 5 \\ 20 - S & \text{if } 5 \leq S \leq 9 \\ 33.5 - 2.5S & \text{if } 9 \leq S \leq 11 \\ 39 - 3S & \text{if } 11 \leq S \leq 13 \end{cases}$$



3. Use the demand and supply framework to qualitatively analyze the market in each of the scenarios given in a) through f). How would the demand and/or supply curves shift? (Leftward/rightward/no shift) What are the effects on equilibrium price and quantity? (Increase/decrease/ambiguous) Summarize the result in the following table format:

|    | Market              | Demand Curve | Supply Curve | Equilibrium Price | Equilibrium Quantity |
|----|---------------------|--------------|--------------|-------------------|----------------------|
| a) | Bubble Tea          |              |              |                   |                      |
| b) | Fruit Smoothies     |              |              |                   |                      |
| c) | Microwave Meal      |              |              |                   |                      |
| d) | Wisconsin Cheese    |              |              |                   |                      |
| e) | jPhone 6 Smartphone |              |              |                   |                      |
| f) | Exotic Cars         |              |              |                   |                      |

- a) A recent study claims that the tapioca pearls in bubble tea are linked to increase risk for cancer, creating fear among consumers.
- b) In addition to the study report in a), you are also told that fruit smoothies are good alternatives to bubble tea. At the same time, you know that the extended summer has invigorated fruit harvests.
- c) Teaching assistants consider microwaveable meals an inferior good. This semester, they are greeted with bad news as the Department of Economics cuts their stipends by 15%.
- d) Wisconsin produces fine cheese using cow's milk; however, mad cow disease has wiped out half the population of cows in Wisconsin.
- e) Banana Inc. introduces the latest incarnation of its smartphone, the iPhone 6. A flood of consumers rush to order this famous smartphone. At the same time; however, the production line of Banana Inc. is plagued by riots, cutting production in half.
- f) The economic slump and oil shocks have caused consumers to delay excessive spending, particularly, the purchase of exotic supercars. Automobile firms correctly anticipate the economic crisis and cut down production of exotic models.

**Answers:**

|    | Market              | Demand Curve | Supply Curve | Equilibrium Price | Equilibrium Quantity |
|----|---------------------|--------------|--------------|-------------------|----------------------|
| a) | Bubble Tea          | Leftward     | No Shift     | Decrease          | Decrease             |
| b) | Fruit Smoothies     | Rightward    | Rightward    | Ambiguous         | Increase             |
| c) | Microwave Meal      | Rightward    | No Shift     | Increase          | Increase             |
| d) | Wisconsin Cheese    | No Shift     | Leftward     | Increase          | Decrease             |
| e) | jPhone 6 Smartphone | Rightward    | Leftward     | Increase          | Ambiguous            |
| f) | Exotic Cars         | Leftward     | Leftward     | Ambiguous         | Decrease             |

4. Consider the market for gasoline in Dane County, Wisconsin. Units of quantity and price are in Thousands of Gallons and \$/gallon, respectively. Suppose the gasoline demand is given by:
- $$Q^d = 2000 - 200P \quad \text{where } Q^d = \text{Quantity Demanded and } P = \text{Price}$$

We have the following information about the linear supply function:

- Market research shows that for an increase in price by \$1/gallon, quantity supplied increases by 100 thousand gallons;
- In addition, when the price is \$1/gallon, 900 thousand gallons of gasoline are supplied to Dane County.

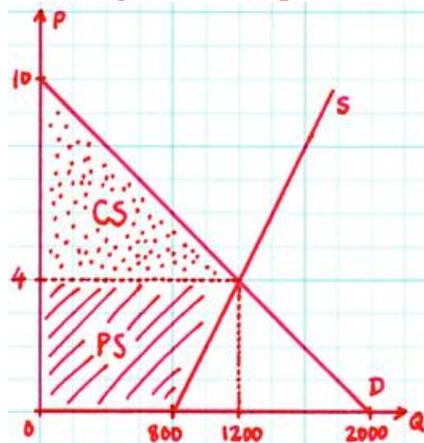
- a) Use the information to find the supply function, i.e., determine  $a$  and  $b$  in  $Q^s = a + bP$  where  $Q^s$  is Quantity Supplied and  $P$  is Price. (Hint: What is the equation of a line?)

We have a slope and a point, determine the line from  $Q^s - 900 = 100(P - 1)$ , so the supply function is  $Q^s = 100P + 800$ , so  $a = 800$  and  $b = 100$ .

- b) Plot the demand and supply curve with Quantity on x-axis and Price on y-axis. Clearly write the intercepts on both axes, and denote the area of consumer surplus and producer surplus.

We have demand and supply function, rewrite the equations to draw the demand and supply curve as:  $P = 10 - (1/200)Q^d$  and  $P = -8 + (1/100)Q^s$ , respectively. Consumer surplus is the area under demand curve above the equilibrium price.

Producer surplus is the area above supply curve **above zero-axis in both quantity and price (i.e. it is not the usual triangle but a trapezoid!)** under the equilibrium price.



- c) Find the equilibrium price and quantity and the value of consumer and producer surplus.

From the demand and supply functions, quantity demanded and quantity supplied must be equal at equilibrium. Equate the two to have  $Q^d = Q^s$ , so  $2000 - 200P = 100P + 800$ , the equilibrium price is  $P = \$4/\text{gallon}$ . The equilibrium quantity follows from  $Q = 2000 - 200(4) = 1200$  thousands of gallons.

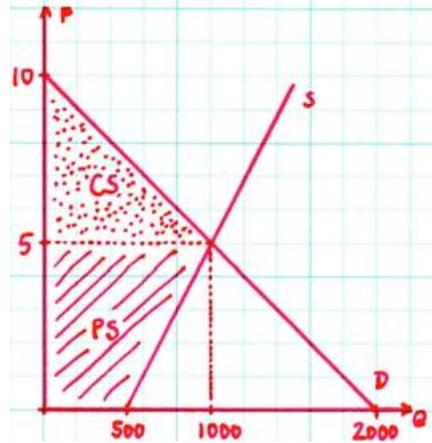
The consumer surplus is calculated from the triangle  $\frac{1}{2} \times (1200) \times (10 - 4) = 3600$  thousands of dollars. The producer surplus is calculated from the trapezoid  $\frac{1}{2} \times (1200 + 800) \times 4 = 4000$  thousands of dollars.

Suppose there is a pipeline rupture in the Midwest, causing a gasoline shortage. Engineers have determined that pipeline capacity is reduced by 300 thousand gallons – meaning that, at every price level, there are 300 thousand fewer gallons of gasoline supplied to Dane County.

- d) Which curve (demand or supply) is shifted? Which direction (leftward or rightward)?

Since the quantity supplied at each price decreased, this means that the supply curve is shifted leftward.

- e) Determine the equation (demand function or supply function) of the shifted curve.  
 Take the supply function from part a), since at every price, quantity supplied is decreased by 300 thousand gallons. So  $Q^s = 100P + (800 - 300) = 100P + 500$ . The shifted supply curve is given by:  $P = -5 + (1/100)Q^s$ .
- f) Draw the demand and supply curve after the pipeline rupture, clearly compare the shifts.



- g) Determine the equilibrium price and quantity and calculate the value of consumer and producer surplus after the pipeline rupture.  
 From the demand function and the shifted supply function, quantity demanded and quantity supplied must be equal at equilibrium. Equate the two to receive that  $Q^d = Q^s$ ; hence,  $2000 - 200P = 100P + 500$ , the equilibrium price is  $P = \$5/\text{gallon}$ . The equilibrium quantity follows from  $Q = 2000 - 200(5) = 1000$  thousands of gallons.  
 Consumer surplus is calculated from the triangle  $\frac{1}{2} \times (1000) \times (10 - 5) = 2500$  thousands of dollars. Producer surplus is calculated from the trapezoid  $\frac{1}{2} \times (1000 + 500) \times 5 = 3750$  thousands of dollars.

5. The market for coffee beans is described by the following equations:

$$Q^s = 2P - 8$$

$$Q^d = 16 - P$$

- a) Suppose the government sets a price ceiling at \$10. Is there a shortage? Is there a surplus?  
 No shortage, no surplus - The price ceiling (a maximum price) is set above the market price, so it does not change the market equilibrium, which is  $P = \$8$  and  $Q = 8$ .
- b) The government lowers the price ceiling to \$5. Describe the changes in shortage/surplus.  
 Shortage of 9 - With a price ceiling of \$5, producers supply only 2 units of coffee beans. Consumers demand 11 units.
- c) Now suppose a price floor/ceiling has been instituted, which causes a surplus of 9 units. Is this a floor or a ceiling? What specific price would create this surplus?  
 Price floor,  $P = \$11$  - We must find the price at which the horizontal distance between quantity supplied and quantity demanded is 9. Supply must be greater than demand for this to be a surplus.

$$Q^s - Q^d = 9 = (2P - 8) - (16 - P)$$

$$3P - 24 = 9$$

$$3P = 33$$

$$P = 11$$

6. Consider a pumpkin market where the supply depends on the weather for the year.

In bad-weather years, supply is  $P = 6Q^s + 2$

In good-weather years, supply is  $P = 6Q^s - 58$

The demand for pumpkins is  $Q^d = 25 - \frac{1}{2}P$ .

Suppose that the government institutes a price support program to stabilize pumpkin prices at \$32. The government promises farmers to buy or sell all that consumers desire or producers want to sell, at the price of \$32. Assume the government has enough storage capacity to buy all that farmers grow and enough in storage to supply all that consumers demand. Assume storage costs \$1 per pumpkin.

a) How many pumpkins do consumers consume in good-weather years?

$Q = 9$  - Quantity demanded at the intersection of  $P = 32$  and  $Q = 25 - \frac{1}{2}P$  is characterized by  $Q = 25 - (\frac{1}{2})32 = 25 - 16 = 9$ . After 9 units, suppliers sell to the government instead of the consumers.

b) How many pumpkins do consumers consume in bad-weather years?

$Q = 9$  - same as part (a)

c) How much does the government spend in good-weather years?

\$198 - Good-weather year, consumers will buy up to  $Q = 9$ , after which there is no more consumer surplus to be had from the purchase of additional pumpkins. However, with the price support, producers will be willing to sell up to 15 pumpkins. Government must buy what is left, amounting to

$(15-9) \times 32 = 6 \times 32 = \$192$ . Storage costs will be \$1 per pumpkin, at a total of 6 pumpkins, so storage cost is \$6. Total government expenditure is therefore \$198.

d) How much does the government earn in bad-weather years?

\$128 - Bad-weather year, suppliers will only supply the first 5 units if the price is \$32. After which, additional consumer demand will be met by the government's supply in storage. Government therefore earns  $(9-5) \times 32 = \$128$ .

Now suppose that instead of a price support program, the government begins subsidizing pumpkins.

e) In bad-weather years, the government spends a total of \$128 on the subsidy to pumpkin growers. What is the per-unit subsidy? What was the target price?

The per-unit subsidy is \$16 and the target price must have been \$50.

- With no subsidy and no price support, the equilibrium quantity is 6 units. To increase this by one unit, the government must set a per-unit subsidy of the sum of the absolute value of the slope for the demand and supply curves (think about why this is true). The slopes are 6 and -2, so every \$8 in subsidy shifts quantity up one unit. Letting  $s$  be the subsidy we are left to solve:

$$(6 + s/8) \times s = 6s + s^2/8 = 128$$

$$s^2 + 48s - 1024 = 0$$

$$(s - 16)(s + 64) = 0$$

So  $s$  is either \$16 or -\$64. The negative subsidy value has no economic meaning, so we conclude the subsidy must be \$16 (and can verify this to make sense graphically). Given a quantity supplied with the subsidy to be 8 units, we can determine the target price by solving for price necessary to induce a supply of 8 units. In bad weather years,  $P = 6Q + 2 = 6(8) + 2 = 48 + 2 = 50$ , so the target price is \$50.

7. Suppose Latvia is a small, open economy that has a competitive steel market. The market supply curve is:

$$\text{Domestic supply: } Q^s = P/2$$

and the market demand in Latvia is:

$$\text{Domestic demand: } Q^d = 120 - P$$

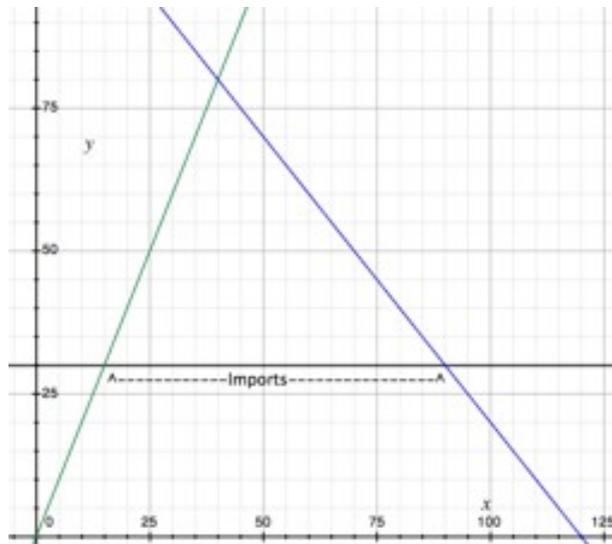
On the world market, steel sells for \$30 a unit. Please note that graphs will be helpful in answering the following questions.

- a) How much steel does Latvia import?

75 units of steel - First, compute the amount Latvia will demand. This is calculated by solving for  $Q^d$  given a price of \$30.

$$Q^d = 120 - 30 = 90$$

We can figure out how much is supplied domestically by setting  $Q^s = (30)/2$ . Domestic producers supply 15 of the 90 units of steel. This implies that Latvia is importing 75 units of steel.



Above graph shows: World price, Domestic supply, Domestic demand

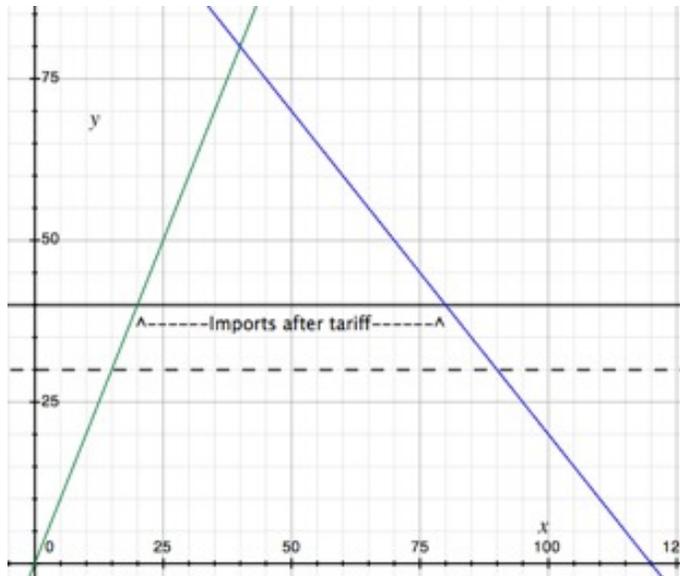
- b) How much revenue will be raised by a tariff of \$10 per unit of steel?

\$600 - Compute new amount of steel imported and multiply by \$10 (tariff amount) to calculate the government revenue.

$$\text{Domestic supply given new world price of } \$40: Q^s = (40)/2 = 20$$

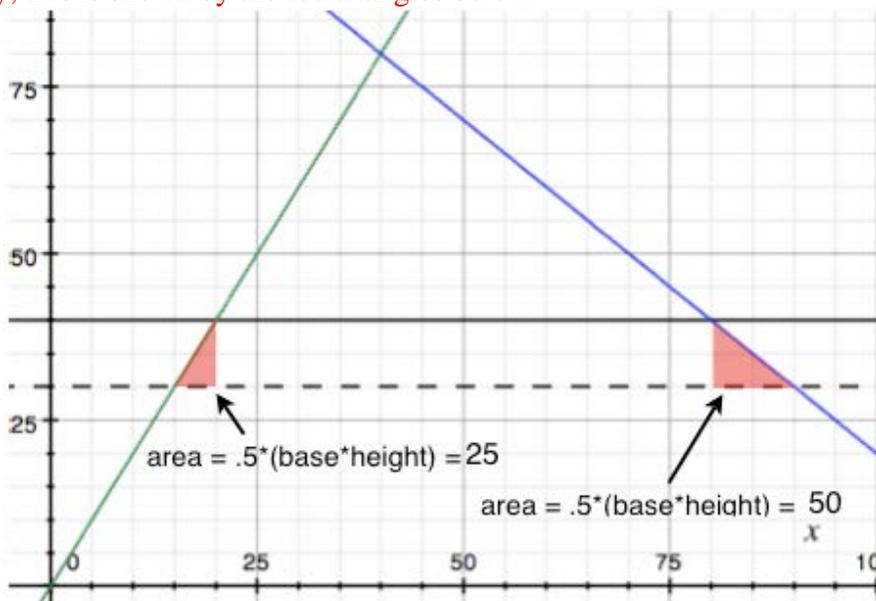
$$\text{Domestic demand given new world price of } \$40: Q^d = 120 - (40) = 80$$

Therefore, given the tariff, imports are 60 units of steel. Government revenue will be \$600.



c) What is the deadweight loss associated with the tariff?

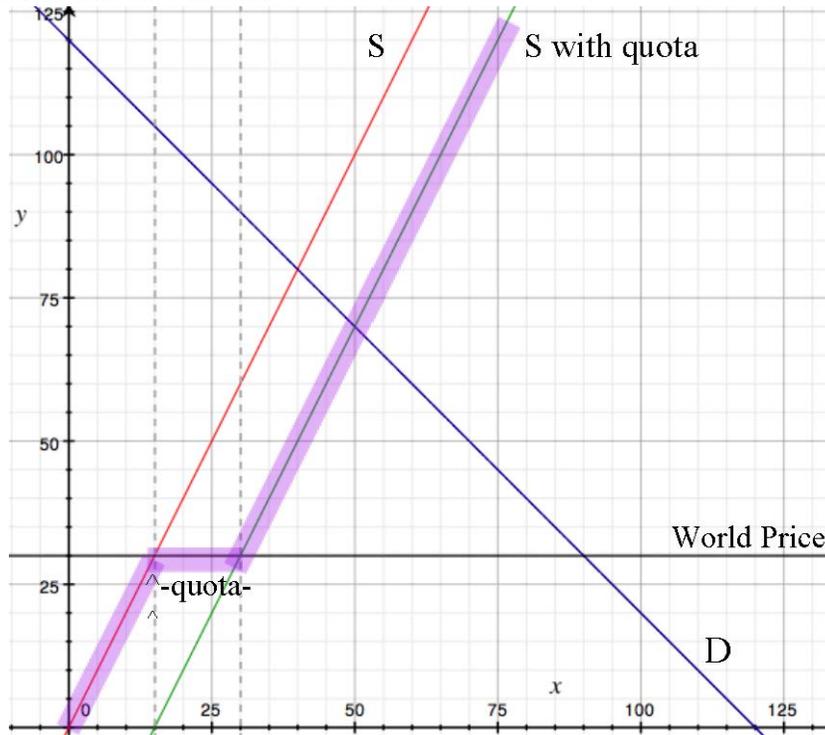
DWL = \$75 - Deadweight loss is found by calculating the lost gains from trade given the tariff and the wasteful expenditure by domestic suppliers relative to the world price. Graphically, this is shown by the red triangles below.



The left triangle represents the wasteful costs associated with the additional 5 units supplied domestically given the tariff. For these 5 units, domestic manufacturers are producing at above the world price. The area of this triangle gives the portion of DWL coming from this effect of the tariff, \$25.

The right triangle represents the lost gains from trade. Without the tariff, 90 units steel were sold, adding to the surplus. Raising the world price to \$40 eliminates the gains to trade from those last 10 units. The area of this triangle quantifies this loss at \$50. DWL is the sum of these two triangle areas, \$75.

- d) Suppose that instead of a tariff, Latvia creates a quota limiting the number of imports to only 15 units. How much steel will be consumed in Latvia? Try to draw the supply curve that consumers in Latvia will face.



50 units of steel - Supply will follow the purple trajectory in the above graph. At quantity below 15 units, the market supply will come completely from domestic producers. After this point, the world price is below the supply curve for domestic steel producers in Latvia. However, imports are limited to 15, so the world price is only effect for the 15 units between total quantity of 15 and 30. After this point, all remaining demand must be met by domestic producers. We must shift the supply curve to the right by the size of the quota (15 units). The original supply was  $P = 2Q$ , and the supply with a quota will be  $P = 2(Q - 15)$ . We then solve for the intersection of this new supply curve and the unchanged demand curve.

$$P = 2(Q - 15) = 2Q - 30 = 120 - Q$$

$$3Q = 150$$

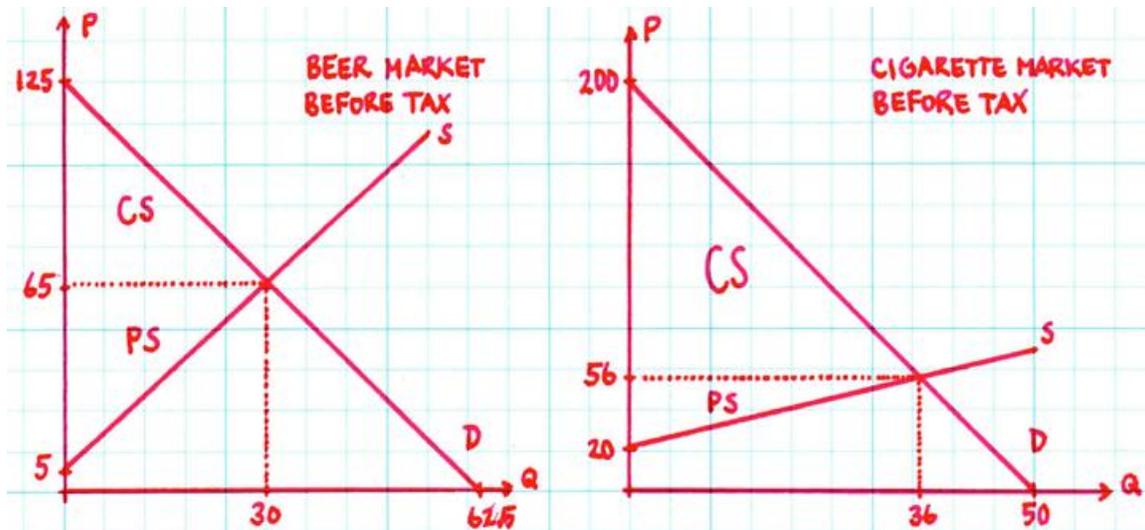
$$Q = 50 \text{ units of steel.}$$

8. This question walks you through the problem as a consultant for the taxation authority in Neverneverland. You study the following information for the demand and supply functions for two goods – Beer and Cigarettes:

Beer      Demand:       $P = 125 - 2Q^d$       Unit of quantity: Thousands of Cans  
                  Supply:       $P = 5 + 2Q^s$       Unit of price: \$/Can

Cigarette      Demand:       $P = 200 - 4Q^d$       Unit of quantity: Thousands of Packs  
                  Supply:       $P = 20 + Q^s$       Unit of price: \$/Pack

- a) Plot the demand and supply curves in both markets. Denote the area of consumer surpluses and producer surpluses.



- b) Look graphically at the demand curves for both markets. Which market has the lower price elasticity of demand, i.e., in which market are the consumers less sensitive to price change? Looking at the slope of the demand curve, clearly the demand curve for cigarette market is steeper. Since a dollar increase in price of cigarettes results in the decrease in quantity demanded of 0.25 thousand of packs, while a dollar increase in price of beer results in the decrease in quantity demanded of 0.5 thousand of cans. Hence, consumers are less sensitive to price change in the cigarette market.
- c) Find the equilibrium price and quantity in both markets.
- Beer                      Equate the demand and supply, so  $125 - 2Q = 5 + 2Q$ , so:  $Q = 30, P = 65$
- Cigarette                Equate the demand and supply, so  $200 - 4Q = 20 + Q$ , so:  $Q = 36, P = 56$
- d) Find the value of consumer surpluses and producer surpluses in both markets.
- Use the answers from part a) and c) to find the area of consumer and producer surpluses triangles. Consumer surplus is the area under the demand curve above the equilibrium price. Producer surplus is the area above the supply curve below the equilibrium price.
- Beer                      Consumer surplus:  $\frac{1}{2} \times (125 - 65) \times 30 = 900$  thousands of dollars
- Producer surplus:  $\frac{1}{2} \times (65 - 5) \times 30 = 900$  thousands of dollars
- Cigarette                Consumer surplus:  $\frac{1}{2} \times (200 - 56) \times 36 = 2592$  thousands of dollars
- Producer surplus:  $\frac{1}{2} \times (56 - 20) \times 36 = 648$  thousands of dollars

Suppose you can choose only ONE of the two goods to apply an excise tax on the producer side of the particular market.

Option 1    Apply the excise tax of \$10/Can to beer

Option 2    Apply the excise tax of \$10/Pack to cigarette

In analyzing the taxation on each good and choosing the appropriate option in each case, you as a consultant must know the equilibrium traded price and quantity after taxation, the price that producers receive at the new equilibrium, tax revenue, consumer's tax incidence, producer's tax incidence and deadweight loss for both options.

- e) Give the equations for the supply curves in both markets after the excise tax has been imposed.

With the excise tax on producers, the supply curves must shift **UP** by the dollar amount of tax imposed. Hence, the supply curves after tax in each market are given by:

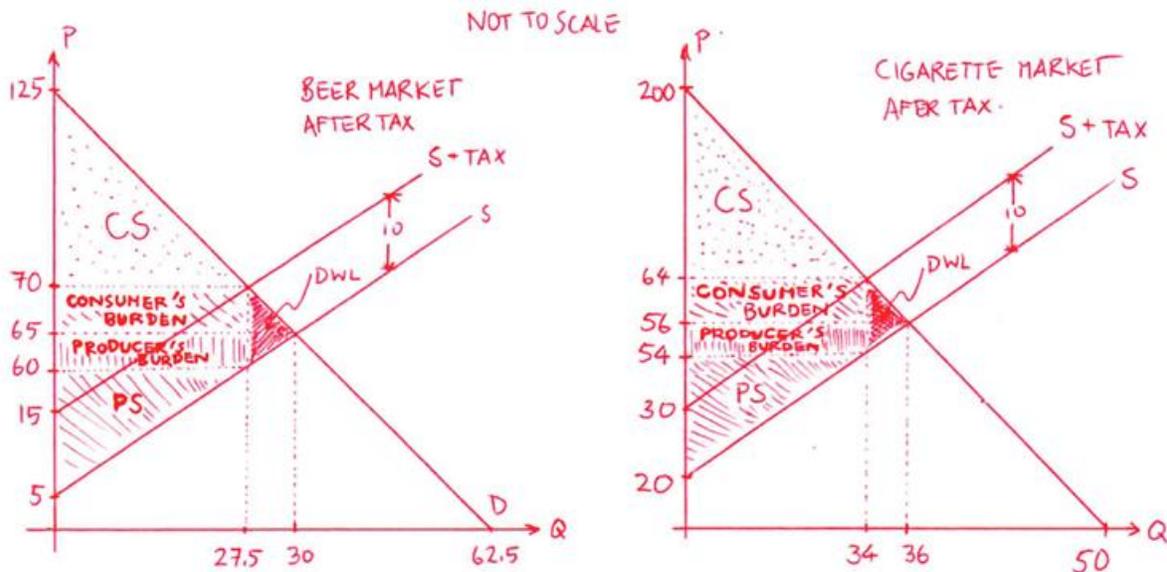
Beer                       $P = (5 + 10) + 2Q^s = 15 + 2Q^s$

Cigarette                 $P = (20 + 10) + Q^s = 30 + Q^s$

- f) Compute the consumer tax incidence (CTI), the producer tax incidence (PTI), the tax revenue, and the deadweight loss (DWL) for each of option. Draw the appropriate demand and supply curves in both markets after the tax has been imposed, clearly denote the various areas (CTI, PTI, tax revenue, and DWL).

i. **Demand and supply curves after tax imposed**

It is better to draw the graphs before you proceed with the questions. In the graphs, consumer's burden is the consumer tax incidence, producer's burden is the producer tax incidence, and the sum of consumer's burden and producer's burden is equal to tax revenue.



ii. **New equilibrium traded price and quantity**

Equate the demand curve and the new supply curve after taxes, so:

Beer  $125 - 2Q = 15 + 2Q$ , so:  $Q = 27.5$ ,  $P = 125 - 2(27.5) = 70$

Cigarette  $200 - 4Q = 30 + Q$ , so:  $Q = 34$ ,  $P = 200 - 4(34) = 64$

iii. **Price that producers receive at new equilibrium**

Producers will receive the equilibrium traded price minus taxes, so:

Beer Producers receive  $70 - 10 = 60$  dollars per can

Cigarette Producers receive  $64 - 10 = 54$  dollars per pack

iv. **Tax revenue**

Government receives the tax revenue equals to the amount traded multiplied by taxes:

Beer Government revenue  $27.5 \times 10 = 275$  thousands of dollars

Cigarette Government revenue  $34 \times 10 = 340$  thousands of dollars

v. **Consumer's burden**

Consumer's tax incidence can be found from the rectangular area between the traded price and the original equilibrium price, below the new equilibrium quantity, so:

Beer Consumer's tax incidence  $(70 - 65) \times 27.5 = 137.5$  thousands of dollars

Cigarette Consumer's tax incidence  $(64 - 56) \times 34 = 272$  thousands of dollars

vi. **Producer's burden**

Producer's tax incidence can be found from the rectangular area between the original equilibrium and the price producers are receiving after tax paid, below the new equilibrium quantity, so:

Beer            Producer's tax incidence  $(65 - 60) \times 27.5 = 137.5$  thousands of dollars

Cigarette      Producer's tax incidence  $(56 - 54) \times 34 = 68$  thousands of dollars

*Note: The sum of consumer's and producer's burden must equal tax revenue.*

vii. **Deadweight loss**

Deadweight loss can be found from the triangle area between the sandwich of original demand and supply curves and the difference between quantity traded, so:

Beer            Deadweight loss  $\frac{1}{2} \times (70 - 60) \times (30 - 27.5) = 12.5$  thousands of dollars

Cigarette      Deadweight loss  $\frac{1}{2} \times (64 - 54) \times (36 - 34) = 10$  thousands of dollars

- g) Motivated from the results in part f), is it true that producers can push the entire burden, namely, tax incidence, onto consumers?

**No. Clearly both producers and consumers must share the economic burden of these excise taxes.**

- h) Which option should the taxation authority choose if she wishes to maximize her tax revenue? **Option 2**

- i) Which option should the taxation authority choose if she wishes to minimize the consumer's burden? **Option 1**

- j) Which option should the taxation authority choose if she wishes to minimize the producer's burden? **Option 2**

- k) Which option should the taxation authority choose if she wishes to minimize the deadweight loss? **Option 2**

- l) Would the results you have analyzed in part e) - k) hold if the excise tax is imposed on the consumer's side? (You are not required to re-compute all questions above; a simple set of graphs that can convince yourself is sufficed.)

**Yes, all exactly hold. Instead of shifting supply curve upward, one may try to shift the demand curve **downward** by the amount of excise tax. The equilibrium traded price is projected upward back to the original demand curve. The rest of the analyses and results are identical.**