

**Economics 101**  
**Fall 2011**  
**Homework #3**  
**Due 10/11/11**

**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 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.** Good luck!

**Please realize that you are essentially creating “your brand” when you submit this homework. Do you want your homework to convey that you are competent, careful, professional? Or, do you want to convey the image that you are careless, sloppy, and less than professional. For the rest of your life you will be creating your brand: please think about what you are saying about yourself when you do any work for someone else!**

### **1. Shifting Supply and Demand**

Each of the following questions describes a change in one or more markets and asks how these changes affect other markets. Your response should include which curves (supply, demand, or both) shift, in what direction, and what the result is for equilibrium price and quantity. Please include at least one graph for each part.

- (a) We want to study the interactions in the market for Paper, Pens, and Pencils. Pens and Pencils are substitutes for each other, and Paper is a complementary good for both Pens and Pencils. Assume all three goods have upward sloping supply curves and downward sloping demand curves. Assume that each of the described changes is the only change that occurs (e.g., the change described in (i) is not continued into (ii)).
- i. The price of Paper rises. What happens in the markets for Pens and Pencils?  
**Demand falls for Pens and for Pencils. The demand curve in each market shifts left, with equilibrium prices and quantities decreasing.**
  - ii. The price of Pens falls. What happens in the markets for Paper and Pencils?  
**Demand for Paper increases, while demand for Pencils decreases. Demand curve for paper shifts right, price and quantity rise. Demand curve for Pencils shifts left, price and quantity fall.**
  - iii. The price of Pens falls, while the price of Pencils rises. What happens to the market for Paper?  
**The falling price of Pens increases demand for Paper, but the rising price of Pencils decreases demand for Paper. This means there are two demand shifts for Paper, one to**

the left and one to the right. The net effect is unknown, so we cannot make any predictions about price or quantity.

(b) If multiple curves are shifting, you may not be able to always determine what's happening to equilibrium price or quantity. In addition to the information requested above, draw at least two graphs for each of the following cases to demonstrate why one part of the equilibrium is undetermined.

i. A recent report claimed that apple juice contains high levels of arsenic (a chemical dangerous to human health). News agencies also recently reported that fire blight (a bacterial disease only harmful to apple trees) has struck apples trees in Australia. What can you predict about the market for apples in Australia?

Demand will shift left since fewer people will want to buy apple juice. Supply will shift left since producers will produce less apple juice. Equilibrium quantity will drop. Equilibrium price cannot be determined without more information about the size of these two shifts.

ii. Amazon.com recently announced that it's selling the Kindle Fire, a device designed to lure customers away from buying the Apple iPad. Rumors are also circulating that Apple has found a way to produce the iPad with less materials (and therefore more cheaply). What do you expect will happen to the market for iPads?

Demand will shift left since at least some people will prefer the Kindle. Supply will shift right because Apple can produce more iPads at the same price now that materials cost less. Equilibrium price will decrease. Equilibrium quantity cannot be determined without more information about the size of these two shifts.

## 2. Market Supply

Consider the (simplified) market for peanut butter. There are only two producers: Jif and Skippy. They each make identical peanut butter and have unique supply schedules:

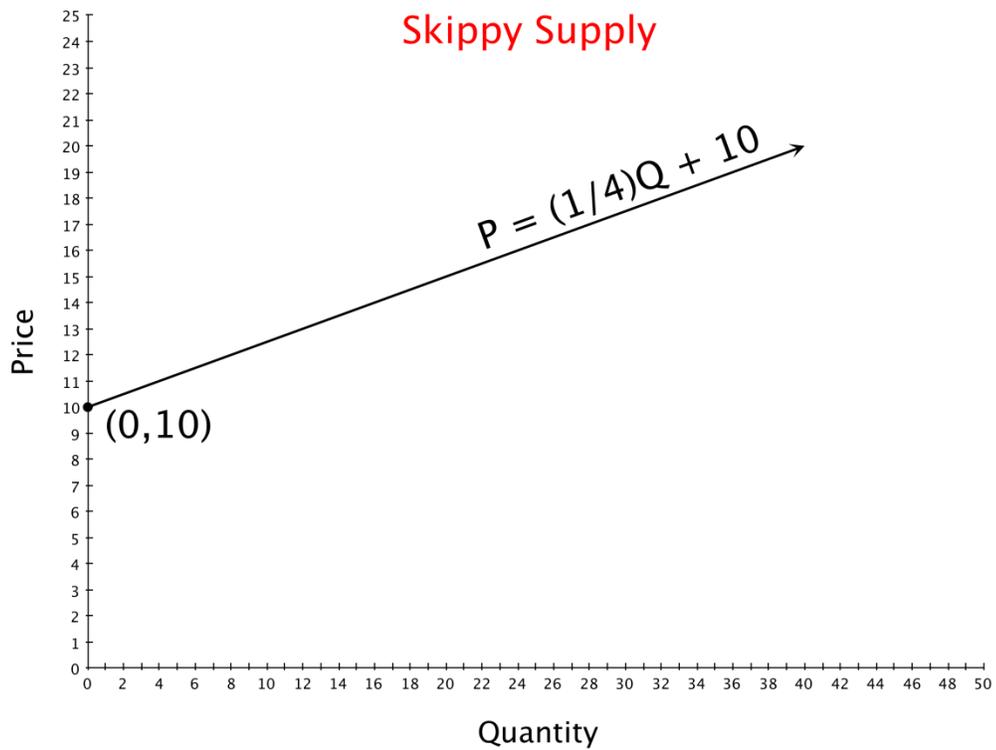
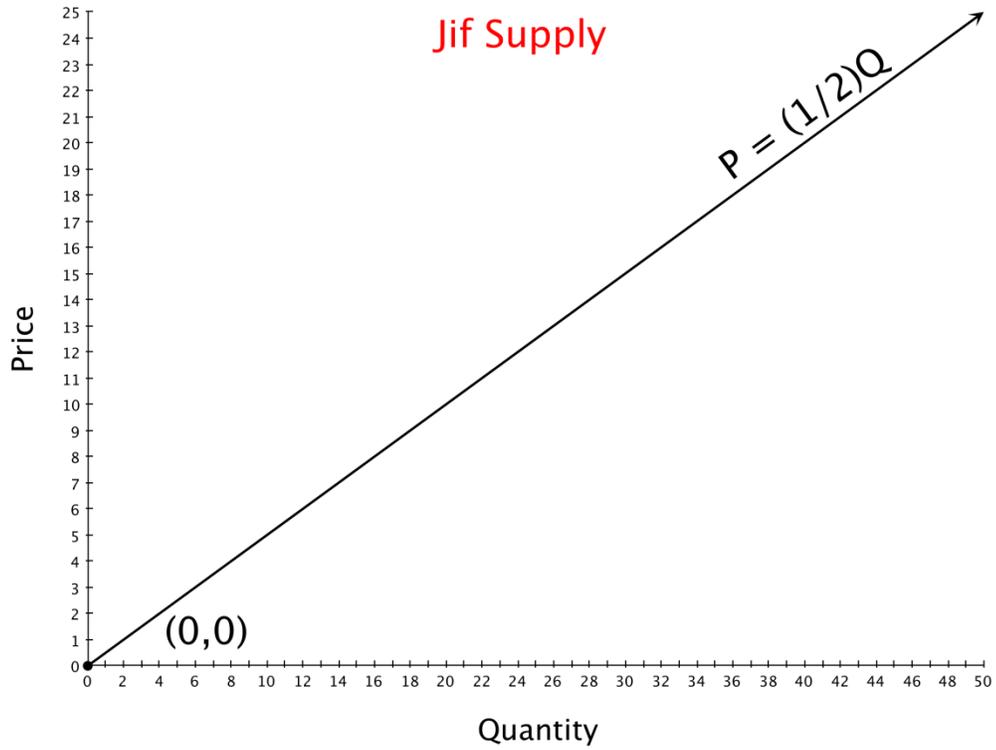
- Jif's Supply Schedule:  $Q_s = 2P$
- Skippy's Supply Schedule:  $Q_s = 4P - 40$

(a) Graph each brand's individual supply curve.

Jif's Supply can be rewritten as  $P = 1/2Q_s$

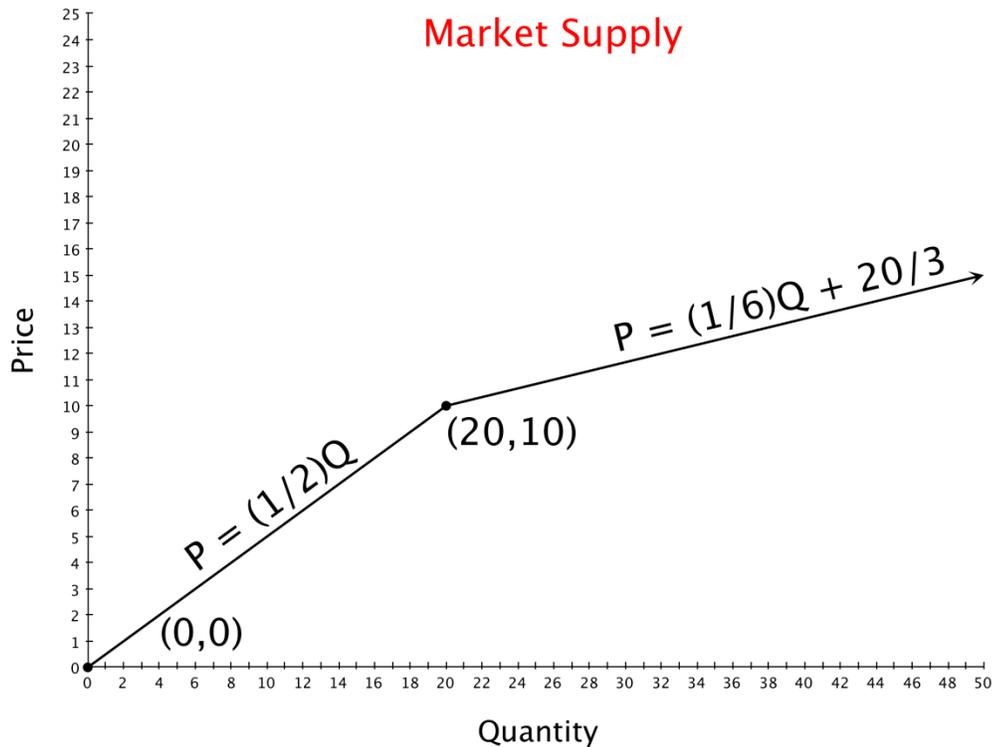
Skippy's Supply can be rewritten as  $P = 1/4Q_s + 10$

Graph each of these equations on its own graph, with P on the y-axis



(b) Graph the market supply curve for peanut butter.

Horizontally sum the two graphs from part (a). There should be a kink in the line at  $P = 10$ .



(c) What is the equation for the market supply curve for peanut butter?

We want to add the two quantities supplied together:

$$Q_s^{\text{Total}} = Q_s^{\text{Jif}} + Q_s^{\text{Skippy}}$$

$$Q_s^{\text{Total}} = 2P + 4P - 40 = 6P - 40$$

$$P = 1/6 Q_s^{\text{Total}} + 20/3$$

Note that this is equation for when  $P >$  or equal to 10. For  $P <$  or equal to 10, the market supply curve is equal to Jif's supply curve, because Skippy will not enter the market.

### 3. Quota and Deadweight Loss

Consider the market for haircuts in the small town of Harrison, Wisconsin, during a typical day. In this market, hair stylists are producers and any resident of Harrison with hair is a consumer. There is only one type of haircut in Harrison. The demand curve and supply curves for the market for haircuts are given by

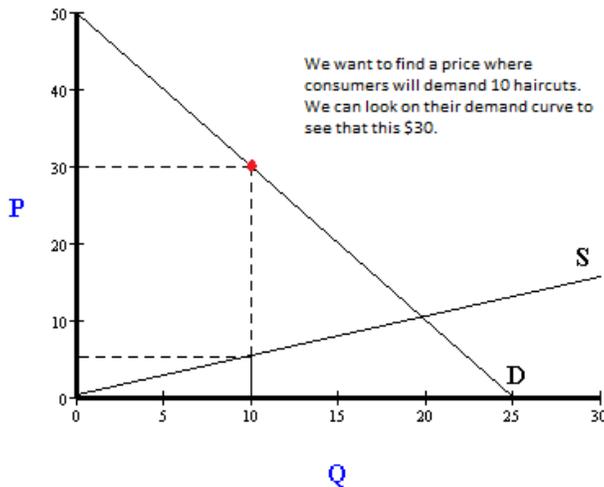
Demand:  $Q_d = 25 - \frac{1}{2}P$

Supply:  $Q_s = 2P$

- (a) Find the equilibrium price and quantity in this market for haircuts.  
Set supply and demand equal:  $25 - 1/2P = 2P \rightarrow P = \$10$   
Plug this price into supply or demand:  $Q = 2P = 2 * 10 = 20$
- (b) Calculate the consumer's surplus and producer's surplus in the market for haircuts. Sum consumer and producer surplus to get the total surplus in the market for haircuts.  
For consumer surplus, find the area beneath the demand curve and above the price line. In this case, this is a triangle with height 40 and base 20. The area equals  $\frac{1}{2} b * h = \frac{1}{2} * 40 * 20 = \$400$ .  
For producer surplus, find the area above the supply curve and below the price line. In this case, it's a triangle with height 10 and base 20.  $\frac{1}{2} b * h = \frac{1}{2} * 10 * 20 = \$100$ .  
Total surplus =  $\$400 + \$100 = \$500$ .

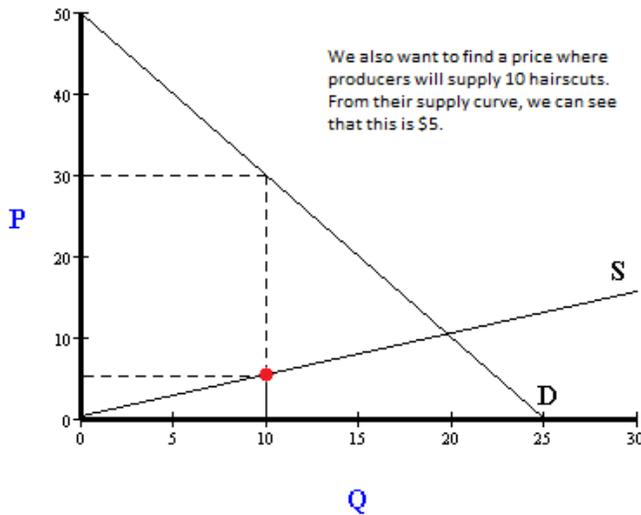
Assume now that the government of Harrison imposes a quota of 10 haircuts per day. That is, the government of Harrison is going to limit the number of haircuts per day to a total of 10 haircuts irrespective of the demand for haircuts. To implement this quota, the government requires that hair stylists purchase an operating license that allows them to cut hair.

- (c) For parts (c), (d) and (e) of this question you will find it helpful to draw a graph and then use that graph as a roadmap for the calculations you will be making. At what price will consumers demand exactly 10 haircuts?



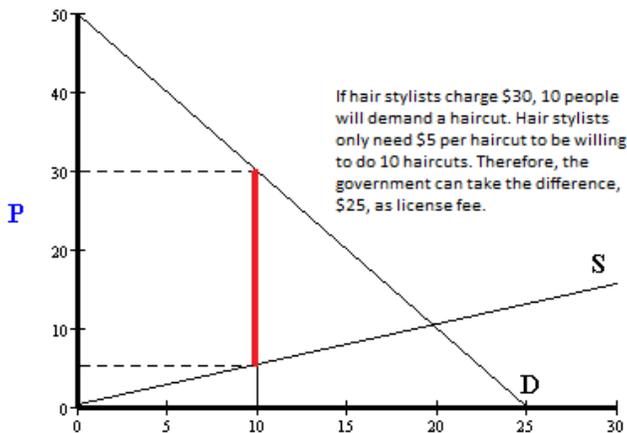
Plug in 10 for  $Q_d$  and solve for  $P$ . This gives  $P = \$30$ .

- (d) What price must producers receive in order to be willing to sell exactly 10 haircuts?  
 Plug in 10 for  $Q_s$  and solve for  $P$ . This give  $P = \$5$ .



- (e) The hair stylists will be forced to pass on the cost of the operating license to their customers in order to stay in business. Based on (c) and (d), how much should the government charge hair stylists (per haircut) for the operating license in order to impose the quota of 10 haircuts per day?

If the government licenses at \$25 per haircut, the stylists can get \$5 per haircut (and therefore produce 10) and the customers will pay \$30 per haircut and therefore demand 10. Any more than \$25 per haircut, and fewer than 10 haircuts would be sold. Any less than \$25 per haircut, and more than 10 haircuts would be sold.



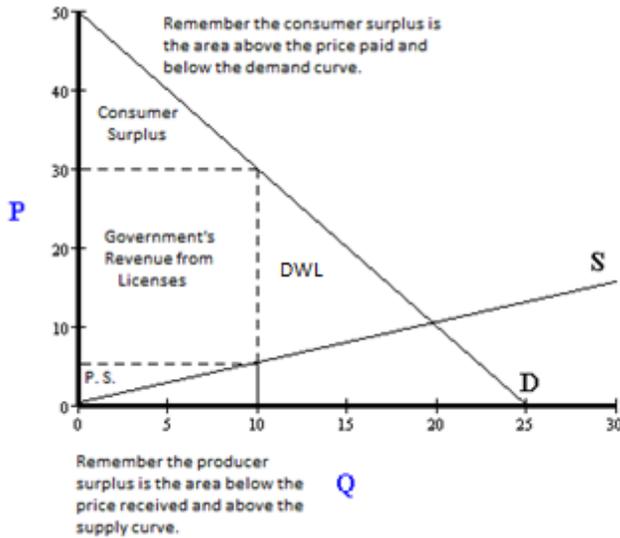
- (f) Calculate the consumer surplus, producer surplus, and the total amount of money collected by the town from selling licenses. Add these three numbers to find the total surplus with the quota. You will find it helpful in making these calculations to draw a graph where you label these areas.

Now CS is a triangle with height 20 and base 10. Area =  $\frac{1}{2} * 20 * 10 = \$100$ .

Now PS is a triangle with height 5 and base 10. Area =  $\frac{1}{2} * 5 * 10 = \$25$ .

If the government is charging \$25 per haircut for licenses and there are 10 haircuts sold, the government must earn  $\$25 * 10 = \$250$ .

Total surplus =  $\$100 + \$25 + \$250 = \$325$ .



- (g) Subtract the new total surplus from the total surplus of the market you obtained in (b) to find the deadweight loss.

$DWL = \$500 - \$325 = \$125$ . This is also the area of the triangle to the right of the quota quantity (10) which has base  $20 - 10 = 10$  and height  $\$30 - \$5 = \$25$ .  $\frac{1}{2} * 10 * \$25 = \$125$ .

- (h) Based on your calculations, do you think the quota policy is a good idea? Why or why not?  
Based on the calculations above, the policy seems to be negative since it causes the total surplus in the market for haircuts to drop by \$250.

#### 4. Agricultural Intervention

Use the following information to answer parts (a) through (d).

Consider the market for coconuts in a small island nation. The domestic demand curve (in Dollars) is  $P = 140 - 4Q_D$  and the domestic supply curve is  $P = 20 + 2Q_S$ .

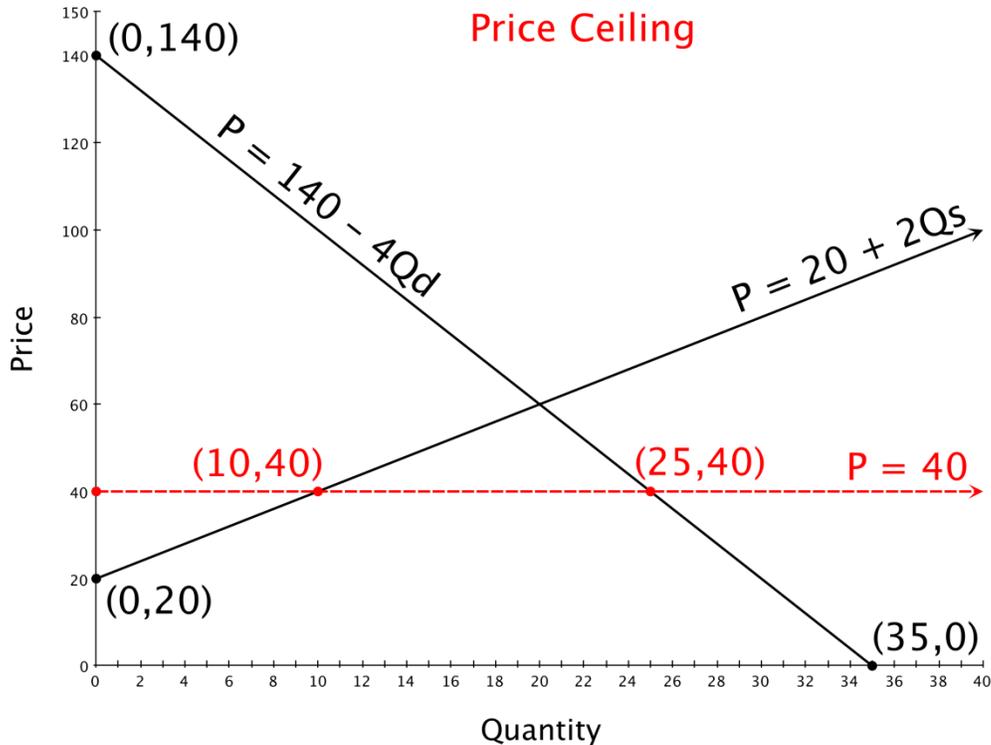
- (a) What is the market equilibrium price and quantity?

Set prices equal:  $140 - 4Q = 20 + 2Q \rightarrow Q = 20$

Then plug in to solve for P:  $P = 20 + 2(20) = \$60$

#### PRICE CEILINGS AND FLOORS

- (b) If the government, hoping to help poor consumers, imposes a price ceiling of \$40, what will be the shortage of coconuts in the market? Graph your response.



Draw your graph with the supply and demand curves, and mark where on each curve the line  $P = 40$  intercepts. If you plug the value  $P = 40$  into each curve, you will get  $Q_s = 10$ ,  $Q_d = 25$ . Shortage =  $Q_d - Q_s = 15$ .

- (c) What price floor would yield a surplus of 9 coconuts?

We want to calculate the price at which  $Q_s - Q_d = 9$ .

If we solve for our demand and supply curves in terms of  $P$ :

$$Q_d = -1/4P + 35$$

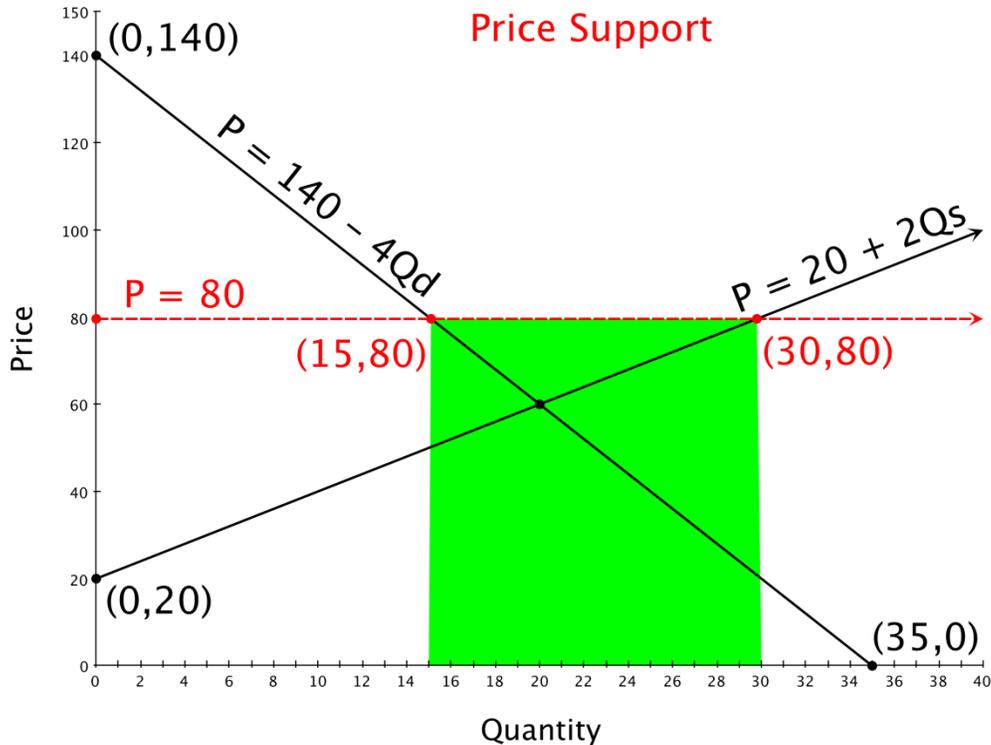
$$Q_s = 1/2P - 10$$

Then plug these into  $Q_s - Q_d = 9$ :

$$1/2P - 10 + 1/4P - 35 = 9 \rightarrow P = \$72$$

### PRICE SUPPORT PROGRAMS

- (d) Suppose the government price target is \$80, which they plan to accomplish by use of a price support program. How many coconuts will the government have to buy with this program, and how much will the program cost the government? Graph your results, and shade the region corresponding to total government cost.



Draw your graph with the supply and demand curves, and mark where a price of \$80 intersects each of these two curves. We can plug the value  $P = 80$  into each curve, and get  $Q_s = 30$ ,  $Q_d = 15$ . So in order to support a price of 80, suppliers must be able to sell 30 coconuts. But consumers only want to buy 15 at that price, meaning that the government must buy an additional 15. The government's cost is  $15 \times \$80 = \$1200$ . This is the rectangle on the graph from  $Q = 15$  to  $Q = 30$ , and  $P = 0$  to  $P = 80$ .

## 5. International Trade

Let's say the U.S. has the following supply and demand curves for oil where quantity is measured in millions of barrels of oil and price is measured as price per barrel of oil:

Supply:  $Q_s = (1/5)P$

Demand:  $Q_d = 30 - (1/10)P$

In your answers please make sure you provide accurate units of measurement!!

- (a) Assuming the U.S. does not export or import any oil, find the equilibrium price and quantity for U.S. oil.

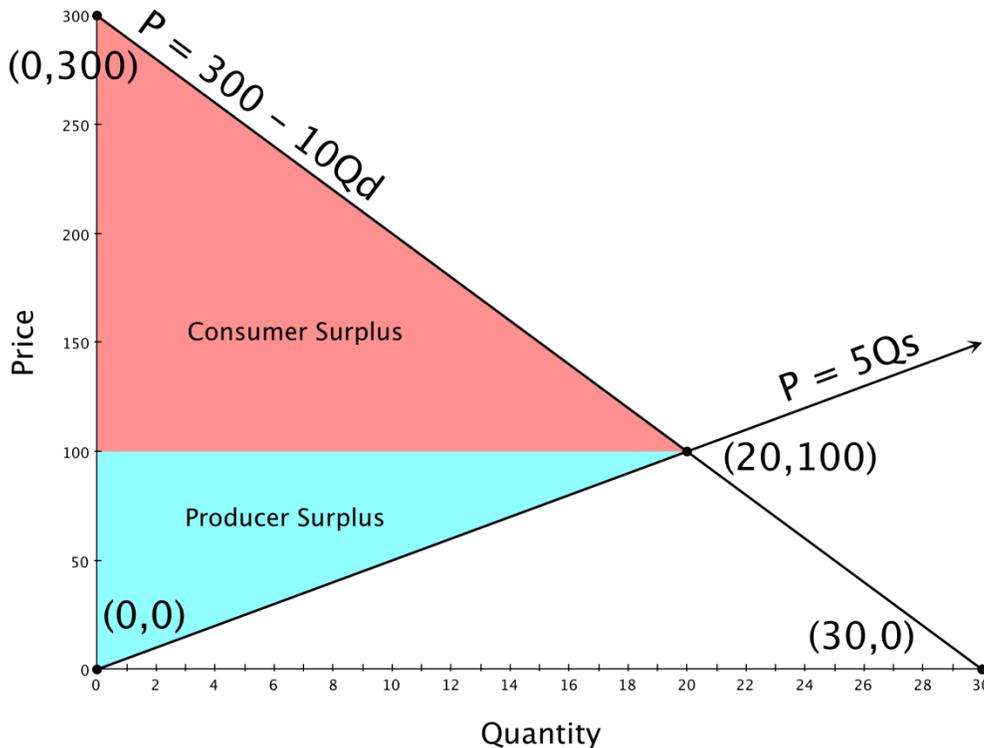
We want to set supply and demand equal:  $(1/5)P = 30 - (1/10)P$ . Now solve for  $P$ :  $P = \$100$  per barrel of oil. And we can plug that into either supply or demand to find  $Q = 20$  million barrels.

(b) Calculate consumer surplus, producer surplus, and total surplus.

Consumer surplus is a triangle with height \$200/barrel of oil and base 20 million barrels of oil. So  $CS = \frac{1}{2} * 200 * 20 = \$2$  billion.

Producer surplus is a triangle with height \$100/barrel and base 20 million barrels of oil. So  $PS = \frac{1}{2} * 100 * 20 = \$1$  billion.

Total surplus =  $CS + PS = \$2$  billion +  $\$1$  billion =  $\$3$  billion.



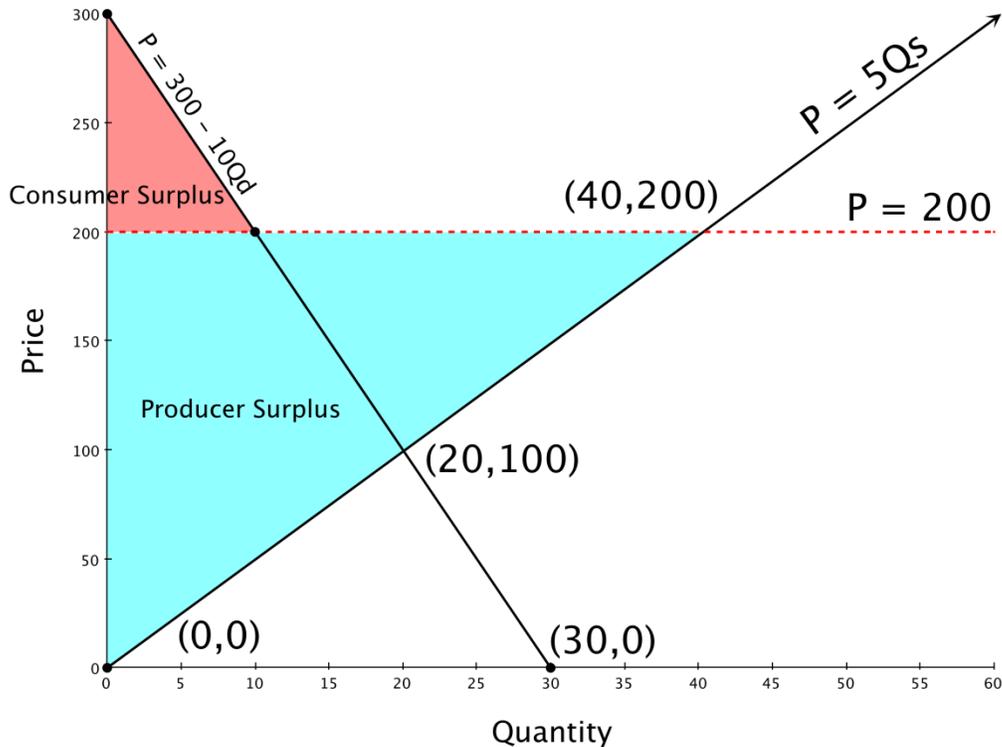
(c) Now suppose the U.S. allows oil to be imported and exported. If the world price is \$200 per barrel of oil, what are the new consumer surplus, producer surplus, and total surplus when this market opens to trade? Is the U.S. importing or exporting oil?

At a price of \$200 per barrel of oil, the U.S. will demand 10 million barrels of oil and produce 40 million barrels of oil. Therefore the U.S. will export oil.

Consumer surplus is now a triangle with height \$100 per barrel of oil and base 10 million barrels of oil.  $CS = \frac{1}{2} * 100 * 10 = \$500$  million.

Producer surplus is now a triangle with height \$200 per barrel of oil and base 40 million barrels of oil.  $PS = \frac{1}{2} * 200 * 40 = \$4$  billion.

Total surplus =  $PS + CS = \$500$  million +  $\$4$  billion =  $\$4.5$  billion.



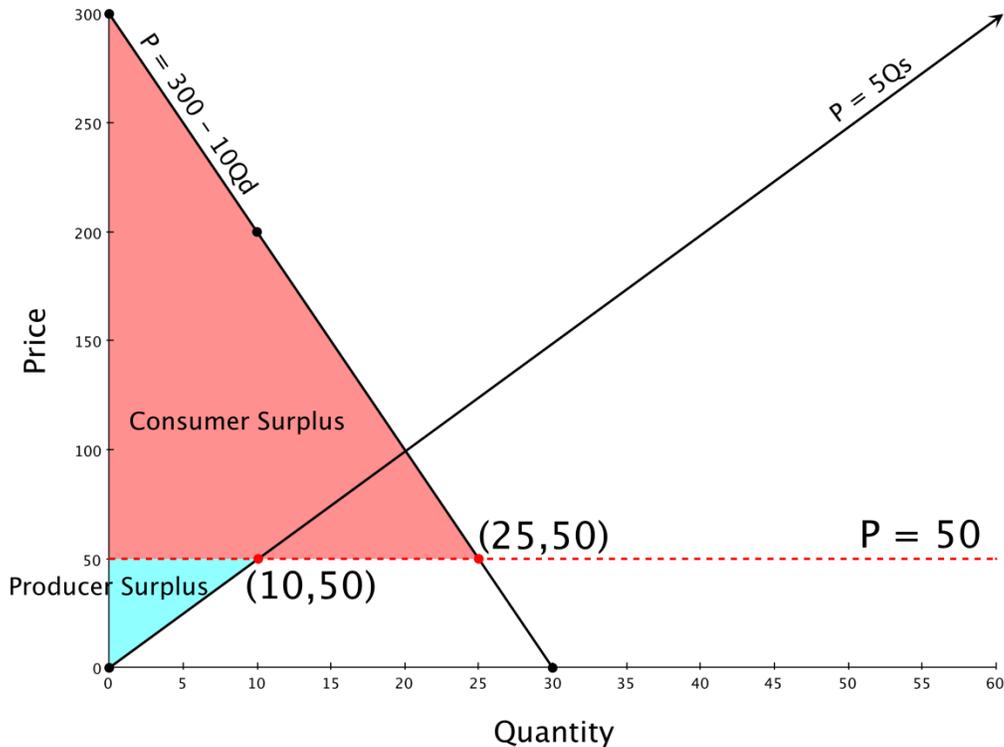
(d) Recalculate the consumer surplus, producer surplus, and total surplus if the world price is \$50 per barrel of oil. Is the U.S. importing or exporting oil?

At a price of \$50 per barrel of oil, the U.S. will demand 25 million barrels of oil and produce 10 million barrels of oil. Therefore, the U.S. will import oil.

Consumer surplus is now a triangle with height \$250 per barrel of oil and base 25 million barrels of oil.  $CS = \frac{1}{2} * 250 * 25 = \$3.125$  billion.

Producer surplus is now a triangle with height \$50 per barrel of oil and base 10 million barrels of oil.  $PS = \frac{1}{2} * 50 * 10 = \$250$  million.

Total surplus =  $CS + PS = \$3.125$  billion + \$250 million = \$3.375 billion.



- (e) With the world price at \$50, the U.S. decides it wants to reduce its dependence on foreign oil so it places a tariff on imported oil of \$10 per barrel of oil. Find consumer surplus, producer surplus, government revenue (from the tariff), and deadweight loss.

The U.S. can now purchase oil from the rest of the world at  $\$50 + \$10 = \$60$  per barrel of oil. At that price, the U.S. will demand 24 million barrels of oil and produce 12 million barrels of oil. So the U.S. will import  $24 - 12 = 12$  million barrels of oil. (No U.S. producers will want to sell to the world at \$50 per barrel of oil when they could sell for \$60 per barrel of oil domestically.)

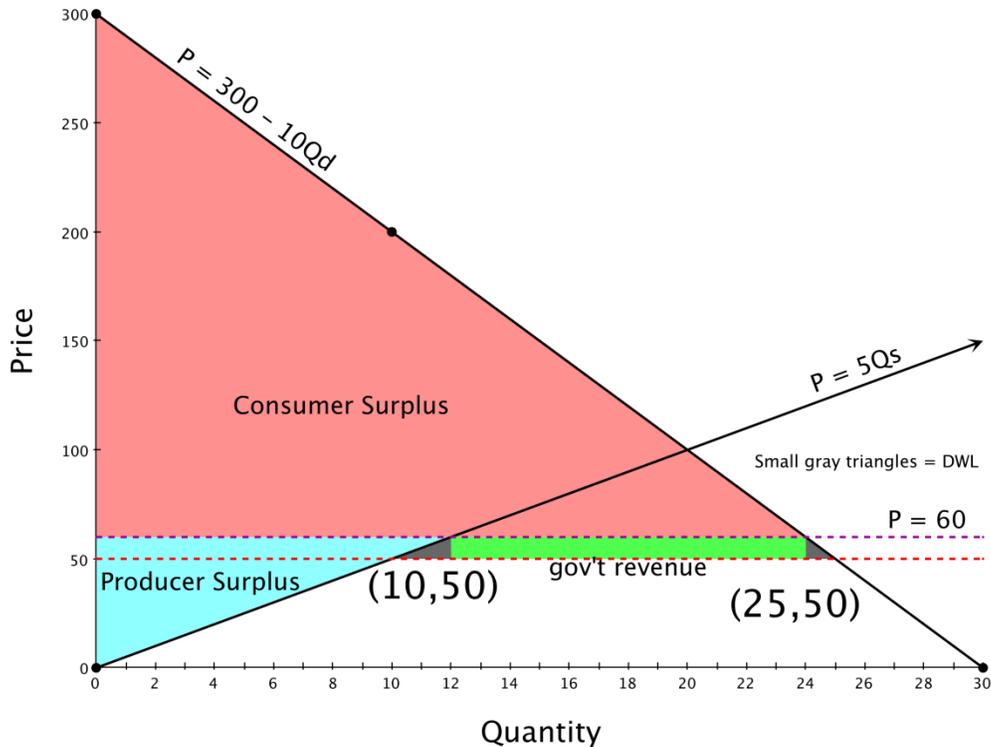
Consumer surplus is now a triangle with height \$240 per barrel of oil and base 24 million barrels of oil.  $CS = \frac{1}{2} * 240 * 24 = \$2.88$  billion.

Producer surplus is now the triangle with height \$60 per barrel of oil and base 10 million barrels of oil.  $PS = \frac{1}{2} * 60 * 12 = \$360$  million.

Since the U.S. must import 12 million barrels of oil and the government is charging 10 per barrel of oil, government earn revenue of  $12 * 10 = \$120$  million.

Total surplus =  $CS + PS + \text{Government Revenue} = \$2.88 \text{ billion} + \$360 \text{ million} + \$120 \text{ million} = \$3.36$  billion.

$DWL = \$3.375 \text{ billion} - \$3.36 \text{ billion} = \$15$  million.



- (f) If the world price is still \$50 per barrel of oil and the U.S. instead institutes a quota (a limit on the quantity imported) of barrels of 9 million barrels, what are the new consumer surplus, producer surplus, license holder revenue and deadweight loss?

From part (d), we found that at a price of \$50 per barrel of oil, the U.S. will demand 25 million barrels of oil and produce 10 million barrels of oil. Therefore, the U.S. will want to import 15 million barrels but will only be allowed to import 9 million. The price must rise so that U.S. producers supply more oil. We know the difference between the quantity demanded and quantity supplied should be 9 million barrels (since that's how much is allowed to be imported). This occurs at a price of \$70. At that price, the U.S. will demand 23 million barrels of oil and produce 14 million barrels of oil.

Consumer surplus is now a triangle with height \$230 per barrel of oil and base 23 million barrels of oil.  $CS = \frac{1}{2} * 230 * 23 = \$2.645$  billion.

Producer surplus is now a triangle with height \$70 per barrel of oil and base 14 million barrels of oil.  $PS = \frac{1}{2} * 70 * 14 = \$490$  million.

License holder revenue = \$20 per barrel of oil \* 9 million barrels of oil = \$180 million.

Total surplus = CS + PS + License Holder Revenue = \$2.645 billion + \$490 million + 180 million = \$3.315 billion.

$DWL = \frac{1}{2} * 20 * 4 + \frac{1}{2} * 20 * 2 = \$60$  million.

Note that the sum of CS + PS + License Holder Revenue + DWL should equal the value of total surplus when this market is open to trade and there is no government intervention in the market. Let's check that this is true:  $CS + PS + License Holder Revenue + DWL = \$2.645$  billion + \$.49 billion + \$.18 billion + \$.06 billion = \$3.375 billion.

