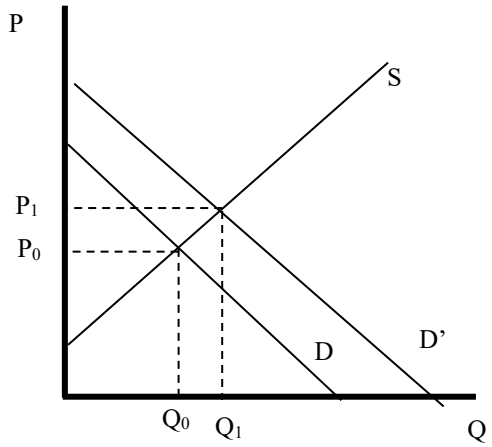
PAI 723 **Professor David Popp**
Solutions to Problem Set #1 **Fall 2023**

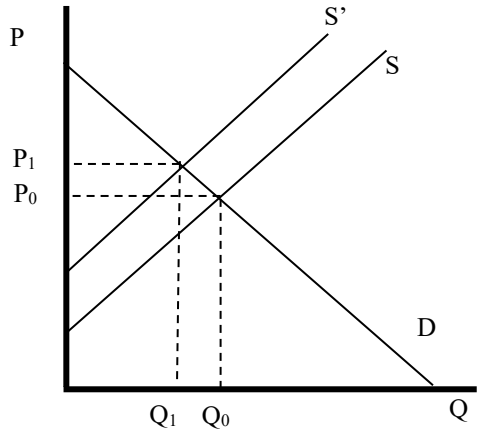
1. The purpose of this problem is to get you thinking about how demand and supply curves are affected by outside influences, and to help you distinguish between shifts of a curve versus a movement along a curve.

a)



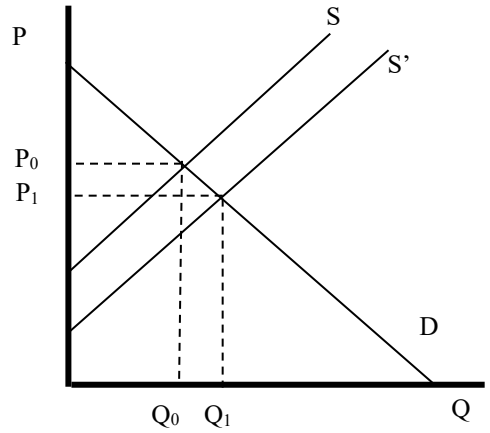
The health benefits of apples will increase the demand for apples. The demand curve shifts up and to the right. The equilibrium price and quantity both rise.

b)



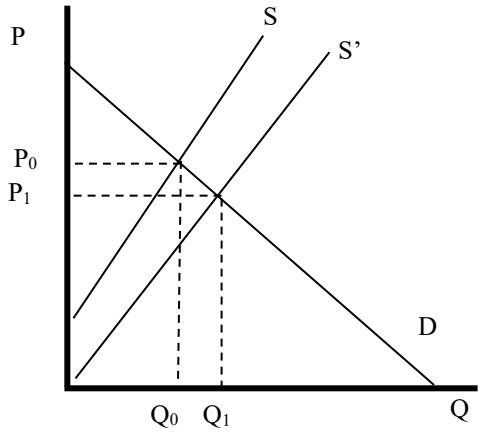
A decrease in the apple crop lowers the supply curve – fewer apples are available for sale. The supply curve shifts up and to the left. Equilibrium price rises, but equilibrium quantity falls.

c)

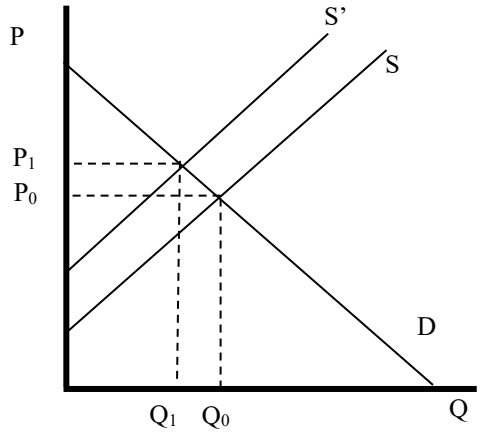


By increasing the number of apple pickers available, the new immigration laws decrease the costs of producing apples, as wages for apple pickers will fall. Thus, supply increases, shifting down and to the right. Equilibrium quantity rises, and equilibrium price falls.

2. Note that both explanations would lower demand for coal. But only one is consistent with what has happened in electricity markets, where prices have fallen. The first explanation – that technological advances lowered costs of natural gas – results in such an outcome. Lower natural gas costs lower the cost of generating electricity. Lower costs increase supply, which shifts down and to the right. The equilibrium price falls, but equilibrium quantity rises. This outcome is consistent with what has happened in electricity markets.



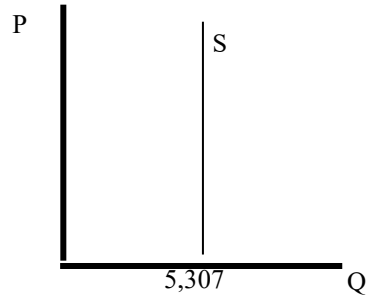
While increased regulation in scenario (b) would reduce demand for coal, for (b) to be true, the price of electricity should rise. The requirement to install new pollution control devices raises the cost of generating electricity. The supply curve shifts up and to the left. Equilibrium price rises, but equilibrium quantity falls.



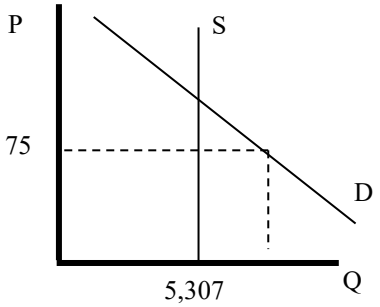
One point that this question helps illustrate is why economists use models. Both explanations offered are consistent with one of the facts – that less coal is used. However, only the first explanation is consistent with electricity prices falling. Applying the supply and demand model helps us to reach our conclusion.

Note as well that it is certainly possible that both effects *could* be occurring at the same time. At a minimum, the above analysis tells us that, if that is the case, the effect of natural gas lowering prices dominates.

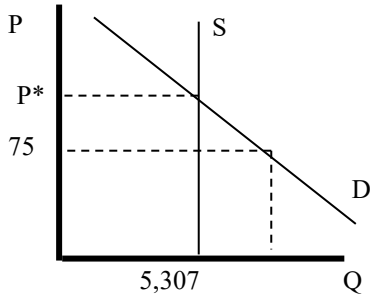
3. a) In the short run, the supply of parking spaces is fixed at 5,307. Thus, supply is given by a vertical line:



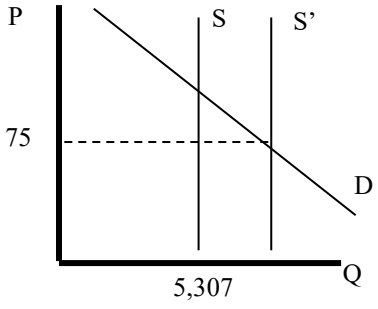
b) Since the quantity sold at the current sticker price is greater than the number of spaces available, there is excess demand in the market. As a result, the price of stickers must be too low:

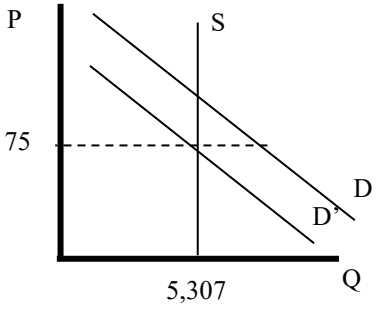


c) In the short run, the number of parking spaces is fixed. To bring the market into equilibrium, the price needs to be raised to where demand equals supply (shows as P* on the graph). Note that simply saying sell fewer permits is not enough. Even if permit sales were restricted to 5,307, the market would still not be in equilibrium at a price of $75. Other problems, such as long lines for the limited number of stickers or a potential black market for stickers, may develop.



In the long run, other solutions are possible. More parking spaces could be built. This would cause the supply curve to shift outward (shown on the left). Another possibility is decreasing demand. This could be done, for example, by improving bus service, so that more students choose to take the bus, rather than drive (shown on right).





4. a) The equilibrium occurs where supply equals demand:

$$10 - 2Q = 1 + 0.5Q$$
$$2.5Q = 9$$
$$Q = 9/2.5$$
$$\mathbf{Q = 3.6 \text{ million gallons}}$$

To find the price, we substitute the equilibrium quantity into either the demand or supply equation:

Either:

$$P = 1 + 0.5(3.6) = \mathbf{\$2.80}$$

Or:

$$P = 10 - 2(3.6) = \mathbf{\$2.80}$$

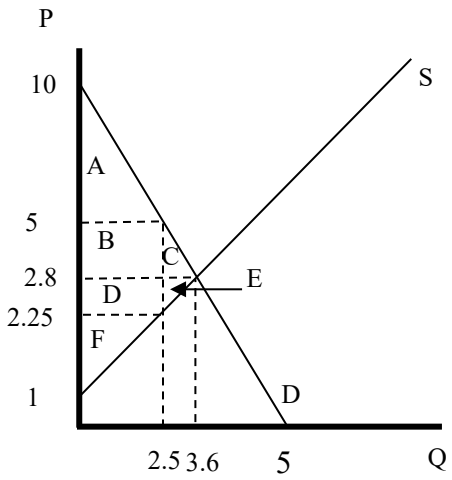
b) The price ceiling is below the equilibrium price of gasoline. Thus, there will be excess demand for gasoline. Consumers will want to purchase more gasoline than suppliers will make available at the price of $2.25 per gallon. Thus, we need to find out how much supply is available. We do this by plugging in $2.25 in the supply curve and solving for Q:

$$2.25 = 1 + 0.5Q$$
$$1.25 = 0.5Q$$
$$\mathbf{Q = 2.5}$$
2.5 million gallons of gasoline are sold

To draw the graph, we begin by drawing the supply and demand curves. Note that the equations are already solved for P. Thus, we know that the y-intercept (on the price axis) for demand is $10. Similarly, by setting P = 0, we find that Q = 5 when P = 0 (because 10 – 2(5) = 0).

For supply, we know the y-intercept is at $1, and intersects demand at a quantity of 3.6 and a price of $2.80. Note also that the line for a price of $2.25 is below equilibrium, so that we get the new quantity of 32.5om the supply curve.

Finally, the graph below also includes labeled areas for consumer and producer surplus. We will use this to answer the questions on the following page.



Note from the graph that it is supply, rather than demand, that determines what the new quantity will be. Because the price ceiling is lower than the equilibrium price, the quantity is constrained by how much suppliers are willing to make available at $2.25. There will be excess demand.

c) Consumer surplus is the area under the demand curve and above the price. In the initial equilibrium, this includes areas A, B, & C. This is a triangle with a height of 7.2 (= 10-2.8) and a base of 3.6. Its area is 0.5(7.2)(3.6) = **$12.96**.

Producer surplus is the area above the supply curve and below the price producers receive. It is areas D, E, & F. This is a triangle with a height of 1.8 (= 2.8 - 1) and a base of 3.6. Its area is 0.5(1.8)(3.6) = **$3.24.**

d) Again, consumer surplus is everything above the new price ($2.25) and below the demand curve. This is areas A, B, & D. To find the area of A, we need to know the value at the bottom of the triangle. This is the amount that consumers are willing to pay for 2.5 million gallons of gasoline. We find this by plugging 2.5 into demand:

$$P = 10 – 2(2.5) = \$5.$$

Thus, triangle A has a height of 5 (= 10 – 5) and a base of 2.5. Its area equals 0.5(5)(2.5) = $6.25. The area of the rectangle comprised of B & D has a height of 2.75 (= 5- 2.25) and a length of 2.5. Its area equals (2.75)(2.5) = $6.875. Thus, the total consumer surplus is **$13.125**.

Producer surplus is just area F. This is a triangle with a height of 1.25 (= 2.25 – 1) and a base of 2.5. Its area is 0.5(1.25)(2.5) = **$1.5625**.

e) The total consumer and producer surplus in part (c) is $16.20.
The total consumer and producer surplus in part (d) is $14.6875.

The difference between these two is **$1.5125**. This difference is the **deadweight loss**. Deadweight loss is the lost welfare resulting from potentially beneficial transactions that took place before but do not occur after rent control is in place. Note that we can check our work by referring back to the graph. The deadweight loss is the triangle comprised of areas C & E. It has a base of 1.1 (= 3.6 – 2.5) and a height of 2.75 (= 5 – 2.25). The area is thus 0.5(1.1)(2.75) = **$1.5125**.