Monmouth COLLEGE

- Name: _____
- Date: _____
- Section: _____

ECON 300: Intermediate Price Theory

Problem Set #6 - Part #1: Suggested Solutions

Fall 2024

Problem 1. Basic Equilibria

Suppose that the output market for good x is in perfect competition, and that the demand (Q_x^D) and supply (Q_x^S) functions are given as:

$$\begin{cases} Q_x^D = 500 - P_x \\ Q_x^S = 200 + 2P_x \end{cases}$$

1.A. State the five assumptions that define a perfectly competitive market.

1. Infinitely many buyers and sellers.
2. Homogeneous products.
3. Perfect information.
4. Free entry and exit.
5. No transaction costs.

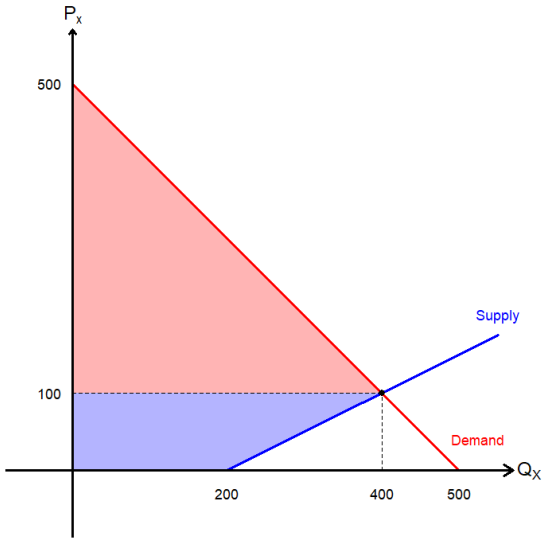
1.B. Find the equilibrium price (P_x^*) and quantity (Q_x^*).

The market equlibrium price is the price that equalizes market demand and supply:

$$Q_x^D = Q_x^S \quad \Rightarrow \quad 500 - P_x = 200 + 2P_x \quad \Rightarrow \quad 300 = 3P_x \quad \Rightarrow \quad \boxed{P_x^* = 100}$$

$$\Rightarrow \quad \boxed{Q_x^* = 400}$$

1.C. Plot the demand and supply curves in the empty chart. You must plot and label all elements clearly:



- The demand curve.
- The supply curve.
- The equilibrium price and quantity.
- ALL intercepts.

Problem 1. Basic Equilibria (continued)

Suppose that the output market for good x is in perfect competition, and that the demand (Q_x^D) and supply (Q_x^S) functions are given as:

$$\begin{cases} Q_x^D = 500 - P_x \\ Q_x^S = 200 + 2P_x \end{cases}$$

1.D What is the value of consumer surplus and producer surplus in this market?

Consumer surplus (CS) is the red triangle in the solution for 1.C, and producer surplus (PS) is the blue trapezoid in the solution for 1.C:

$$CS = 400 \cdot 400 \cdot \frac{1}{2} = 80,000$$

$$PS = (400 + 200) \cdot 100 \cdot \frac{1}{2} = 30,000$$

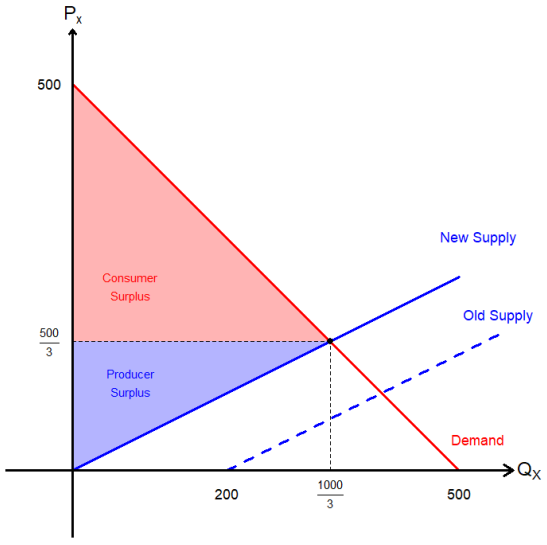
1.E Find the equilibrium price and quantity when the supply shifts to $Q_x^S = 2P_x$.

The market equlibrium price is the price that equalizes market demand and supply:

$$Q_x^D = Q_x^S \quad \Rightarrow \quad 500 - P_x = 2P_x \quad \Rightarrow \quad 500 = 3P_x \quad \Rightarrow \quad \boxed{P_x^* = \frac{500}{3}}$$

$$\Rightarrow \quad \boxed{Q_x^* = \frac{1000}{3}}$$

1.F Plot the elements listed below in the empty chart. You must plot and label all elements clearly:



- The original demand curve.
- The new supply curve from `1.E`.
- The equilibrium price and quantity.
- ALL intercepts.
- Consumer surplus.
- Producer surplus.

Problem 2. Price Controls

Suppose that the output market is in perfect competition with the same parameters as **Problem 1**. The demand (Q_x^D) and supply (Q_x^S) functions are given as:

$$\begin{cases} Q_x^D = 500 - P_x \\ Q_x^S = 200 + 2P_x \end{cases}$$

2.A The government sets a price ceiling of $\bar{P}_x = 80$. Is this price ceiling "binding?" Why?

A price ceiling is *binding* when the ceiling is set below the current market price. We found that the equilibrium price of the market described above is $P_x^* = 100$ in **Problem 1**, so a price ceiling of $\bar{P}_x = 80$ is *binding*.

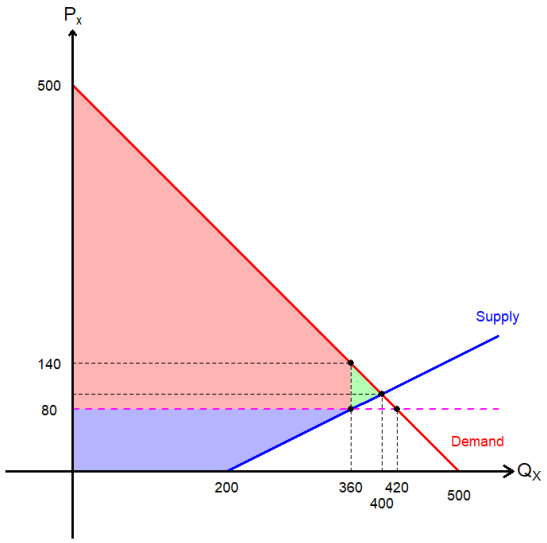
2.B Find the market price and quantity traded in the market following the price control.

The market price will be set at the ceiling, $\bar{P}_x = 80$. At this market price, the quantity demanded and supplied in the market will follow the demand and supply functions:

$$Q_x^D = 500 - \bar{P}_x = 500 - 80 = 420 Q_x^S = 200 + 2\bar{P}_x = 200 + 2 \cdot 80 = 360$$

The quantity traded in the market will be the lesser of the two, so it will be $Q_x^T = 360$.

2.C Plot the effect of the price ceiling in the empty chart below. You must plot and label all elements clearly:



- The demand curve.
- The supply curve.
- The market price.
- The quantity traded in the market.
- ALL intercepts.

Problem 2. Price Controls (continued)

Suppose that the output market is in perfect competition with the same parameters as **Problem 1**. The demand (Q_x^D) and supply (Q_x^S) functions are given as:

$$\begin{cases} Q_x^D = 500 - P_x \\ Q_x^S = 200 + 2P_x \end{cases}$$

2.D What is the value of consumer surplus and producer surplus in this market?

Consumer surplus (CS) is the red trapezoid in the solution for 2.C, and producer surplus (PS) is the blue trapezoid in the solution for 2.C:

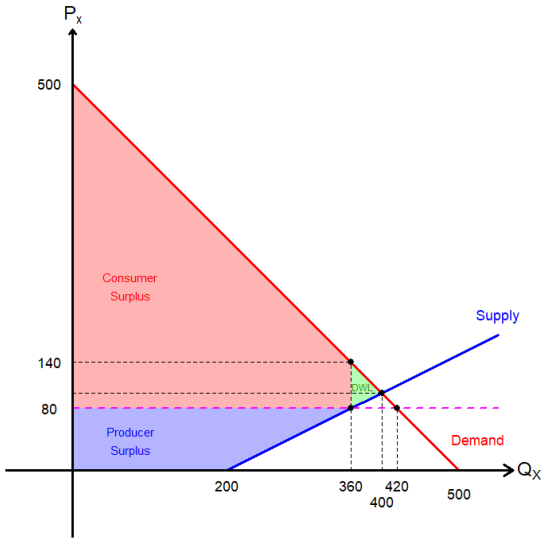
$$CS = (420 + 60) \cdot 360 \cdot \frac{1}{2} = 86,400$$
$$PS = (360 + 200) \cdot 80 \cdot \frac{1}{2} = 22,400$$

2.E What is the value of deadweight loss in this market with price controls?

Deadweight loss is the green triangle in the solution for 2.C:

$$DWL = (140 - 80) \cdot (400 - 360) \cdot \frac{1}{2} = 1,200$$

2.F Plot the elements listed below in the empty chart. You must plot and label all elements clearly:



- The demand curve.
- The supply curve.
- The market price.
- The quantity traded in the market.
- ALL intercepts.
- Consumer surplus.
- Producer surplus.
- Deadweight loss.

Problem 3. Taxation

Suppose that the output market is in perfect competition with the same parameters as **Problem 1**. The demand (Q_x^D) and supply (Q_x^S) functions are given as:

$$\begin{cases} Q_x^D = 500 - P_x \\ Q_x^S = 200 + 2P_x \end{cases}$$

3.A What is the equilibrium price and quantity if the government imposes a \$5 per unit tax?

The price that the consumer pays and the price that the producer receives is not the same:

$$\text{Consumer's Price} = \text{Producer's Price} + \text{Tax} \quad \Rightarrow \quad P_x^D = P_x^S + 5$$

Then, set up the condition $Q_x^D = Q_x^S$:

$$500 - P_x^D = 200 + 2P_x^S \;\Rightarrow\; 500 - (P_x^S + 5) = 200 + 2P_x^S \;\Rightarrow\; \boxed{P_x^S = \frac{295}{3}}$$

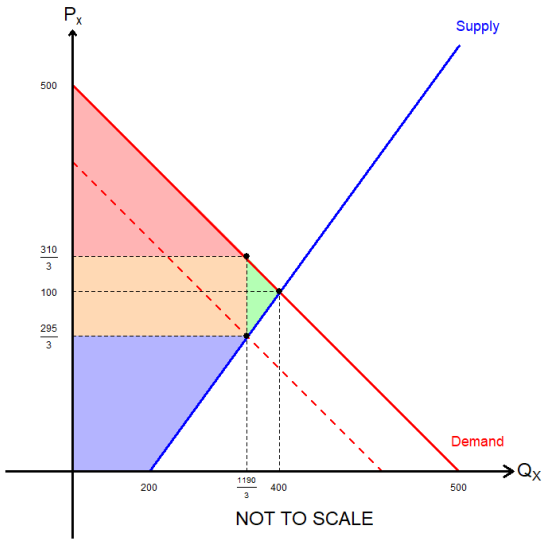
$$\Rightarrow \boxed{P_x^D = \frac{295}{3} + 5 = \frac{310}{3}}$$

$$\Rightarrow \boxed{Q_x^* = 500 - P_x^D = \frac{1190}{3}}$$

3.B What information do you need to determine whether the consumer or the producers bear a greater burden from taxation?

The own price elasticities of demand and supply. The side that has the lower price elasticity will bear a greater burden.

3.C Plot the effect of taxation in the empty chart below. You must plot and label all elements clearly:



- The demand curve.
- The supply curve.
- The market price.
- The quantity traded in the market.
- ALL intercepts.

Problem 3. Taxation (continued)

Suppose that the output market is in perfect competition with the same parameters as **Problem 1**. The demand (Q_x^D) and supply (Q_x^S) functions are given as:

$$\begin{cases} Q_x^D = 500 - P_x \\ Q_x^S = 200 + 2P_x \end{cases}$$

3.D What is the value of consumer surplus in this market with taxation?

Consumer surplus is the red triangle in the solution to 3.C:

$$CS = \left(500 - \frac{310}{3}\right) \cdot \frac{1190}{3} \cdot \frac{1}{2} = \frac{708050}{9} \simeq 78,672.22$$

3.E What is the value of producer surplus in this market with taxation?

Producer surplus is the blue trapezoid in the solution to 3.C:

$$PS = \left(200 + \frac{1190}{3}\right) \cdot \frac{295}{3} \cdot \frac{1}{2} = \frac{264025}{9} \simeq 29,336.11$$

3.F What is the value of deadweight loss in this market with taxation?

Deadweight loss is the green triangle in the solution to 3.C:

$$DWL = \left(\frac{310}{3} - \frac{295}{3}\right) \cdot \left(400 - \frac{1190}{3}\right) \cdot \frac{1}{2} = \frac{25}{3} \simeq 8.3$$

3.G What is the value of government revenue in this market with taxation?

Government revenue is the orange rectangle in the solution to 3.C:

$$GR = \left(\frac{310}{3} - \frac{295}{3}\right) \cdot \frac{1190}{3} = \frac{5950}{3} \simeq 1983.33$$

- Score: _____
- Extra Credit: _____