Intermediate Microeconomics. Lecture 2

Applications of Supply and Demand

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Summer 2021

Contents

Contents

Consumer Surplus

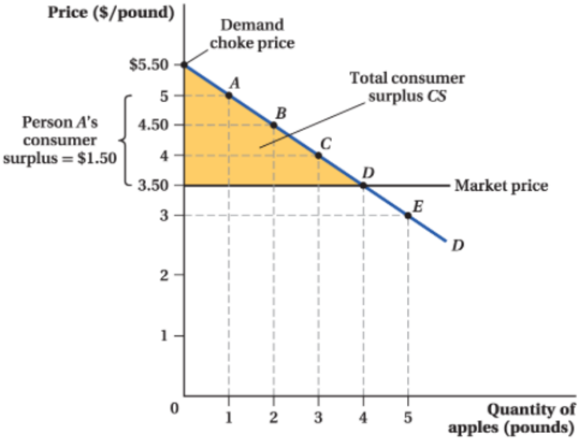

Figure: Consumer Surplus

Producer Surplus

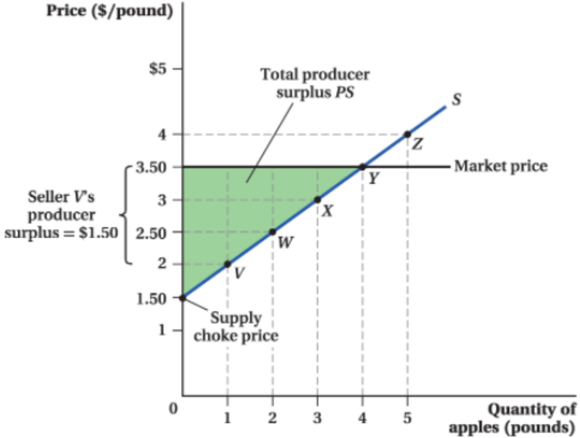

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Figure: Producer Surplus

An example

First, find the equilibrium price and quantity in the following market

$$Q^D = 152 - 20 * P$$

$$Q^S = 188 * P - 4$$

We know that at market equilibrium, quantity demanded equals quantity supplied:

$$Q^D = Q^S$$

An example

$$Q^D = Q^S$$

$$152 - 20 * P = 188 * P - 4$$

$$208 * P = 156$$

$$P = 0.75$$

To find the equilibrium quantity, we need to plug the equilibrium price into either the demand or supply curve:

$$Q = 137$$

An example

Now, calculate the consumer and producer surplus at the equilibrium price

- To calculate consumer and producer surplus, it is easiest to use a graph
- First, we need to plot the demand and supply curves
- For each curve, we can identify two points
    - Equilibrium
    - Choke price

An example

The choke prices for demand and supply can be determined by setting Q^D and Q^S equal to zero and solving for P

$$Q^D = 152 - 20 * P$$

$$0 = 152 - 20 * P$$

$$152 = 20 * P$$

$$P = 7.6$$

$$Q^S = 188 * P - 4$$

$$P \approx 0.02$$

Graphical representation

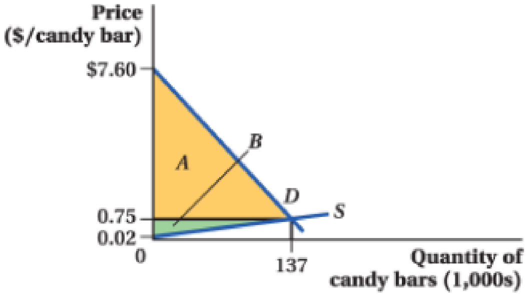

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Figure: Consumer and Producer Surplus

Mathematical representation

$$CS = area(A) = (\frac{1}{2}) * (base) * (height)$$

$$CS = (\frac{1}{2}) * (137) * (6.85) = 469.225$$

$$PS = area(B) = (\frac{1}{2}) * (base) * (height)$$

$$PS = (\frac{1}{2}) * (137) * (0.73) = 50.005$$

Contents

Price Ceilings

A price ceiling establishes the highest price that can be paid legally for a good or service.

Suppose the city council of a college town passes a pizza price control regulation. With the intent of helping out the college's financially strapped students, the city council says no pizzeria can charge more than $8 for a pizza.

$$Q^D = 20,000 - 1,000 * P$$

$$Q^S = 2,000 * P - 10,000$$

Price Ceilings

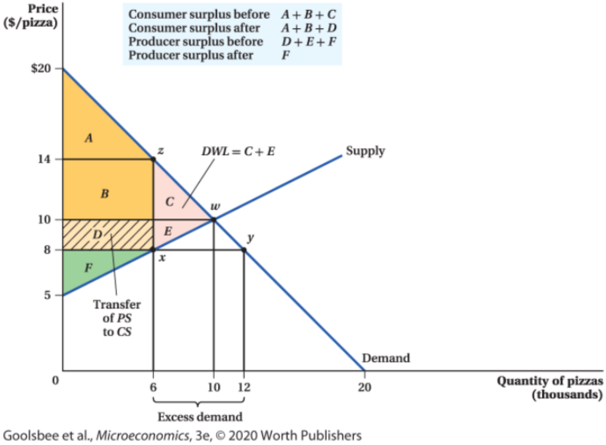

Figure: The Effects of a Price Ceiling

Math E Math PC

Mathematical representation. Market equilibrium

We would like to compare the free and regulated markets for pizzas using the supply and demand equations. To determine the free-market equilibrium using the equations, we set quantity supplied equal to quantity demanded and solve for the market clearing price P.

$$Q^D = Q^S$$

$$20,000 - 1,000 * P = 2,000 * P - 10,000$$

$$3,000 * P = 30,000$$

$$P = 10$$

Mathematical representation. Market equilibrium

Plugging that price back into either the supply or demand equation gives the equilibrium quantity

$$Q = 20,000 - 1,000 * P$$

$$Q = 20,000 - 1,000 * (10)$$

$$Q = 20,000 - 10,000$$

$$Q = 10,000$$

Mathematical representation. Consumer and Producer Surplus

The consumer surplus in the free market is the triangle $A + B + C$. The area of that triangle is

$$CS = (\frac{1}{2}) * (base) * (height)$$

$$CS = (\frac{1}{2}) * (10,000) * (10) = 50,000$$

The producer surplus is the triangle $D + E + F$ in the graph. The area of that triangle is

$$PS = (\frac{1}{2}) * (base) * (height)$$

$$PS = (\frac{1}{2}) * (10,000) * (5) = 25,000$$

Graph

Mathematical representation. Price Ceiling

Now consider the impact of the price ceiling. The price of a pizza cannot rise to \$10 as it did in the free market. The highest it can go is \$8. This policy leads to excess demand, the difference between the quantity demanded and the quantity supplied at the price ceiling, P_c

$$Q^D = 20,000 - 1,000 * P$$

$$Q^D = 20,000 - 1,000 * (8) = 20,000 - 8,000 = 12,000$$

$$Q^S = 2,000 * P - 10,000$$

$$Q^S = 2,000 * (8) - 10,000 = 16,000 - 10,000 = 6,000$$

Mathematical representation. Price Ceiling

Next, we compute the consumer and producer surpluses after the price control is imposed. Producer surplus is area F

$$PS_c = (\frac{1}{2}) * (6,000) * (3) = 9,000$$

The consumer surplus is now areas $A + B$

$$Area(A) = (\frac{1}{2}) * (6,000) * (6) = 18,000$$

$$Area(B) = (6,000) * (4) = 24,000$$

$$CS_c = Area(A) + Area(B) = 18,000 + 24,000 = 42,000$$

Graph

Mathematical representation. Deadweight Loss

The DWL is the area of triangle $C + E$ in the figure

$$DWL = (\frac{1}{2}) * (6,000) * (4) = 12,000$$

Importance of Price Elasticities

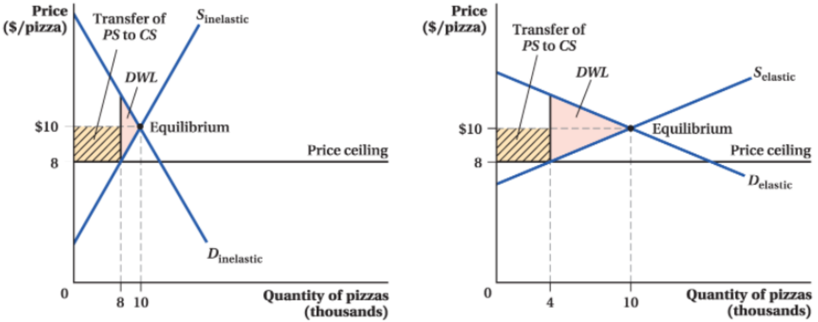

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Figure: Deadweight Loss and Elasticities

Price Floors

- A price floor sets the lowest price that can be paid legally for a good or service.
- In the United States, the federal government began setting price supports for agricultural goods such as milk, corn, wheat, tobacco, and peanuts in the 1930s. The goal was to guarantee farmers a minimum price for their crops to protect them from fluctuating prices. Many of these price supports remain today.
- Let's look at the market for peanuts.

Price Floor

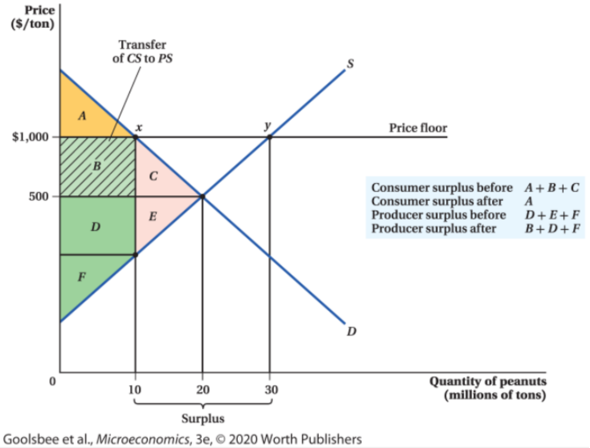

Figure: The Effects of a Price Floor

Contents

Taxes. Graphical representation

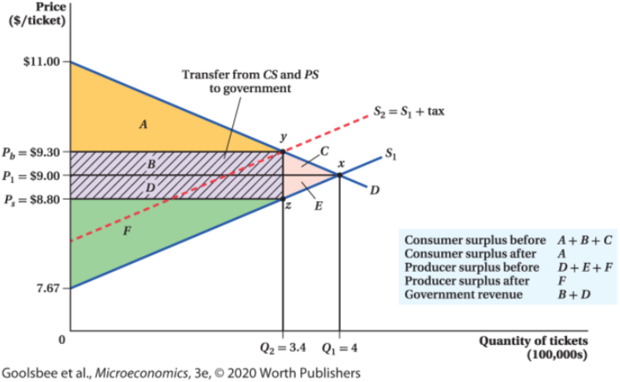

Figure: Effect of a Tax on Boston Movie Tickets

Math tax

Taxes. Mathematical representation

$$Q^D = 22 - 2 * P$$

$$Q^S = 3 * P - 23$$

The no-tax market equilibrium equates quantity demanded and quantity supplied

$$Q^D = Q^S$$

$$22 - 2 * P = 3 * P - 23$$

$$5 * P = 45$$

$$P = 9$$

Taxes. Mathematical representation

$$Q = 22 - 2 * P$$

$$Q = 22 - 2 * (9) = 22 - 18 = 4$$

The pre-tax consumer surplus is the triangle above the price and below the demand curve

$$CS = (\frac{1}{2}) * (400,000) * (2) = 400,000$$

The producer surplus is the triangle above the supply curve and below the price

$$PS = (\frac{1}{2}) * (400,000) * (1.333) = 266,666$$

Taxes. Mathematical representation

What happens to consumer and producer surplus under the 50-cent tax? Theaters must pay the state for each ticket they sell.

The prices that result for both the buyer and the seller are summed up in the equation $P_b = P_s + \tau$, where $\tau = 0.5$

To solve for the post-tax quantity and prices, we substitute this expression, which links the two supply prices in our supply and demand equations

Taxes. Mathematical representation

$$Q^D = Q^S$$

$$22 - 2 * P_b = 3 * P_s - 23$$

$$22 - 2 * (P_s + 0.5) = 3 * P_s - 23$$

$$22 - 2 * P_s - 1 = 3 * P_s - 23$$

$$5 * P_s = 44$$

$$P_s = 44/5 = 8.8$$

Taxes. Mathematical representation

Therefore, the buyers face the following price

$$P_b = 8.8 + 0.5 = 9.3$$

Now if we plug the buyers' price into the demand curve equation and the sellers' price into the supply curve equation, they will both give the same after-tax market quantity

$$Q_2^D = 22 - 2 * (9.3) = 3.4$$

$$Q_2^S = 3 * (8.8) - 23 = 3.4$$

Taxes. Mathematical representation

The consumer surplus after a tax is the area below the demand curve but above the price that the buyers pay

$$CS = (\frac{1}{2}) * (340,000) * (1.7) = 289,000$$

The producer surplus is the area above the supply curve and below the price that the suppliers receive

$$PS = (\frac{1}{2}) * (340,000) * (1.133) = 192,666$$

Graph tax

Taxes. Mathematical representation

Tax revenue is

$$TR = \tau * Q_2 = 0.5 * 340,000 = 170,000$$

DWL is

$$DWL = (\frac{1}{2}) * (Q_1 - Q_2) * (\tau) = (\frac{1}{2}) * (60,000) * (0.5) = 15,000$$