

# LECTURE NOTES ON MICROECONOMICS

## ANALYZING MARKETS WITH BASIC CALCULUS

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### Part 3: Firms and competition

#### Chapter 12: Welfare analysis

##### Problems

(12.1) [Pareto improvement, economic efficiency] Suppose Amy has an art poster that Bob likes. The poster is worth \$5 to Amy, but it is worth \$10 to Bob. State whether each of the following changes is (i) a Pareto improvement, and (ii) an increase in economic efficiency (also called a potential Pareto improvement). Explain your reasoning.

- a. Amy gives Bob the poster.
- b. Amy gives Bob the poster and Bob pays Amy \$3.
- c. Amy gives Bob the poster and Bob pays Amy \$7.
- d. Amy gives Bob the poster and Bob pays Amy \$12.

(12.2) [Consumer and producer surplus] True or false? Explain your answer in detail.

- a. “If demand is perfectly elastic, then consumer surplus is zero.”
- b. “If supply is perfectly elastic, then producer surplus equals the entire revenue to producers.”

(12.3) [Effects of tax] True or false? Explain your answer in detail.

- a. “If demand is perfectly inelastic, then a tax has no effect on the price received by producers, and consumers bear the entire burden of the tax.”
- b. “If supply is perfectly elastic, then a tax has no effect on the price received by producers, and consumers bear the entire burden of the tax.”

(12.4) [Effects of international trade] True or false? Explain your answer in detail.

- a. “A country only enjoys an increase in social welfare from international trade if the world price is greater than the initial domestic price.”
- b. “For two countries to both benefit from international trade with each other, there must be a 'level playing field' in the sense that each country must have the same initial domestic price.”

(12.5) [Price controls] Suppose a competitive market is defined by the following demand and supply equations:  $Q_D = 2000 - 200P$  and  $Q_S = 100P - 100$ . First, consider the unregulated competitive equilibrium. [Hint: Sketch the demand and supply curves before proceeding.]

- a. Compute the equilibrium price and quantity. [Hint:  $Q_D = Q_S$ .]
- b. Compute consumer surplus.
- c. Compute producer surplus.

Now suppose the government imposes a *price ceiling*, or legal maximum price. This good may not be sold for a price higher than \$5.

- d. Compute the quantity now traded.
- e. Is there excess demand or excess supply? How much?
- f. Compute the change in producer surplus caused by the price controls. Do producers gain or lose?
- g. Compute the value to consumers of the last unit actually sold, assuming that those consumers who are willing to pay the most for the good are first in line to get it. This value is sometimes called the “shadow price.” [Hint: This is the height of the demand curve at the quantity now traded.]
- h. Compute the change in consumer surplus caused by the price controls. Do consumers as a group gain or lose from price controls?
- i. Compute the change in social welfare caused by the price ceiling. Does society as a whole gain or lose from the price ceiling?

(12.6) [Price controls] Suppose a competitive market is defined by the following demand and supply equations:  $Q_D = 2000 - 200P$  and  $Q_S = 100P - 100$ . First, consider the unregulated competitive equilibrium. [Hint: Sketch the demand and supply curves before proceeding.]

- a. Compute the equilibrium price and quantity. [Hint:  $Q_D = Q_S$ .]
- b. Compute consumer surplus.
- c. Compute producer surplus.

Now suppose the government imposes a *price floor*, or legal minimum price. This good may not be sold for a price lower than \$8.

- d. Compute the quantity now traded.
- e. Is there excess demand or excess supply? How much?
- f. Compute the marginal cost of the last unit actually sold, assuming that those producers with the lowest marginal cost are first in line to sell the product. [Hint: This is the height of the supply curve at the quantity now traded.]
- g. Compute the change in producer surplus caused by the price controls. Do producers gain or lose?
- h. Compute the change in consumer surplus caused by the price controls. Do consumers as a group gain or lose from the price floor?
- i. Compute the change in social welfare caused by the price controls. Does society as a whole gain or lose from the price floor?

(12.7) [Tax] Suppose a competitive market is defined by the following demand and supply equations:  $P_D = 20 - (Q/100)$  and  $P_S = 2 + (Q/200)$ . First, consider the unregulated competitive equilibrium. [Hint: Sketch the demand and supply curves before proceeding.]

- a. Compute the equilibrium price and quantity. [Hint:  $P_D = P_S$ .]
- b. Compute producer and consumer surplus.

Second, suppose the government imposes a tax of \$6 per unit. [Hint: Now  $P_D = P_S + 6$ .]

- c. Compute equilibrium quantity.
- d. Compute the net price received by suppliers excluding the tax ( $P_S$ ).
- e. Does producer surplus increase or decrease as a result of the tax? By how much?
- f. Compute the total price paid by demanders including the tax ( $P_D$ ).
- g. Does consumer surplus increase or decrease as a result of the tax? By how much?
- h. Compute tax revenue received by the government.
- i. Compute the social deadweight loss (also called the “excess burden”) caused by the tax.

(12.8) [Tax] Suppose a competitive market is defined by the following demand and supply equations:  $P_D = 20 - (Q/100)$  and  $P_S = 2 + (Q/200)$ . First, consider the unregulated competitive equilibrium. [Hint: Sketch the demand and supply curves before proceeding.]

- a. Compute the equilibrium price and quantity. [Hint:  $P_D = P_S$ .]
- b. Compute producer and consumer surplus.

Second, suppose the government imposes a tax of \$3 per unit. [Hint: Now  $P_D = P_S + 3$ .]

- c. Compute equilibrium quantity.
- d. Compute the net price received by suppliers excluding the tax ( $P_S$ ).
- e. Does producer surplus increase or decrease as a result of the tax? By how much?
- f. Compute the total price paid by demanders including the tax ( $P_D$ ).
- g. Does consumer surplus increase or decrease as a result of the tax? By how much?
- h. Compute tax revenue received by the government.
- i. Compute the social deadweight loss (also called the “excess burden”) caused by the tax.

(12.9) [Subsidy] Suppose a competitive market is defined by the following demand and supply equations:  $P_D = 18 - (Q/1000)$  and  $P_S = 3 + (Q/2000)$ . First, consider the unregulated competitive equilibrium. [Hint: Sketch the demand and supply curves before proceeding.]

- a. Compute the equilibrium price and quantity. [Hint:  $P_D = P_S$ .]
- b. Compute consumer surplus.
- c. Compute producer surplus.

Second, suppose the government pays a subsidy of \$6 per unit. [Hint: Now  $P_D + 6 = P_S$ .]

- d. Compute equilibrium quantity.
- e. Compute the net price paid by demanders excluding the subsidy ( $P_D$ ).
- f. Compute the total price received by suppliers including the subsidy ( $P_S$ ).
- g. Does consumer surplus increase or decrease as a result of the subsidy? By how much?
- h. Does producer surplus increase or decrease as a result of the subsidy? By how much?
- i. Compute the direct cost of the subsidy program to the government. In other words, how much should the government budget for subsidy payments?
- j. Compute the social deadweight loss (also called the “excess burden”) caused by the subsidy.

(12.10) [Ad valorem tax with demand elasticity] Suppose a competitive market has perfectly elastic supply, and a demand curve with constant price elasticity = -0.5. Total revenue without a tax is \$10 million. Then suppose an *ad valorem* tax of 6% is imposed on this industry. [Hint: Make a very rough sketch of the demand and supply curves before proceeding.]

- a. Will the total price paid by demanders including the tax ( $P_D$ ) increase or decrease? By about how much, in percentage terms?
- b. Will the net price received by suppliers excluding the tax ( $P_S$ ) increase or decrease? By about how much, in percentage terms?
- c. Will the quantity traded increase or decrease? By about how much, in percentage terms?
- d. Will total spending by demanders, including the tax, increase or decrease? By about how much, in percentage terms?
- e. Will net revenue received by suppliers, excluding the tax, increase or decrease? By about how much, in percentage terms?
- f. How much tax revenue will be collected?
- g. Compute the approximate social deadweight loss (also called the “excess burden”) caused by the tax. [Hint: In this case, the demand curve is not a straight line. But assume it is approximately straight to answer this question.]

(12.11) [International trade] Domestic demand and supply for a particular good are given by the following demand and supply equations:  $Q_D = 1100 - 100P$  and  $Q_S = 200P - 400$ . [Hint: Sketch the demand and supply curves before proceeding.]

- a. Compute the equilibrium price and quantity in the absence of international trade. [Hint:  $Q_D = Q_S$ .]

Now suppose this market is opened to free international trade and the world price of the good turns out to be \$3.

- b. Now how many units of the good will be produced domestically?
- c. Will the good be imported or exported? How many units?
- d. Will producer surplus increase or decrease as a result of international trade? By how much?
- e. Will consumer surplus increase or decrease as a result of international trade? By how much?
- f. Will total social welfare in this country increase or decrease as a result of international trade? By how much?

(12.12) [International trade] Domestic demand and supply for a particular good are given by the following demand and supply equations:  $Q_D = 1100 - 100P$  and  $Q_S = 200P - 400$ . [Hint: Sketch the demand and supply curves before proceeding.]

- a. Compute the equilibrium price and quantity in the absence of international trade. [Hint:  $Q_D = Q_S$ .]

Now suppose this market is opened to free international trade and the world price of the good turns out to be \$10.

- b. Now how many units of the good will be produced domestically?
- c. Will the good be imported or exported? How many units?
- d. Will producer surplus increase or decrease as a result of international trade? By how much?
- e. Will consumer surplus increase or decrease as a result of international trade? By how much?
- f. Will total social welfare in this country increase or decrease as a result of international trade? By how much?

(12.13) [Tariff on international trade] Domestic demand and supply for a particular good are given by the following demand and supply equations:  $Q_D = 3000 - 200P$  and  $Q_S = 400P - 600$ . Suppose free international trade is permitted and the world price of the good turns out to be \$3. [Hint: Sketch the demand and supply curves before proceeding.]

- a. How many units of the good will be produced domestically?
- b. How many units will be imported?

Suppose a tariff of \$2 is imposed on imports of the good. Compare the outcome under the tariff with the outcome under free trade.

- c. What will be the new domestic price?
- d. How many units of the good will now be produced domestically?
- e. How many units will be imported?
- f. Will producer surplus increase or decrease as a result of the tariff? By how much?
- g. Will consumer surplus increase or decrease as a result of the tariff? By how much?
- h. How much tariff revenue will the government collect?
- i. Will total social welfare in this country increase or decrease as a result of the tariff? By how much?

[end of problem set]