Practice Problem Set 5

180.102 Elements of Microeconomics - TA Section 03

Pinda Wang, 27 September 2024

Part I. Consumer and producer surplus

1. Suppose the supply and demand curves in the market for oranges are "well-behaved", that is to say, the supply curve is upward sloping and the demand curve is downward sloping.
   (a) In a diagram, identify the consumer surplus and the producer surplus in equilibrium.
   (b) Suppose a drought devastated this year's orange harvest. How does the consumer surplus change? Explain the reason for that change, and indicate it using the diagram.
2. Suppose the demand curve of a good is $P = 70-Q$, and the supply curve is $P = 10+2Q$.
   (a) With a price floor of \$60, identify the consumer surplus and producer surplus in a graph, and calculate them.
   (b) With a tax of \$30 per unit on the seller, identify the consumer surplus and producer surplus in a graph, and calculate them.

Part II. Proportional taxation

The demand curve for computers is given by $P = 2000 - 25Q$, and the supply curve is $P = 600 + 15Q$.

1. Draw the supply and demand curves in a diagram, and calculate the equilibrium price and quantity.
2. Suppose the government levies a 25% sales tax on the seller (i.e. the seller has to pay 25% of the listed price to the government in taxes). On top of the diagram in question (1), draw the new supply and/or demand curves, and calculate the new equilibrium price and quantity.
3. Suppose the government levies a 25% sales tax on the buyer (i.e. the buyer has to pay the full listed price to seller, as well as an additional 25% to the government in taxes). On top of the diagram in question (1), draw the new supply and/or demand curves, and calculate the new equilibrium price and quantity.

4. Is there still equivalence between taxes on sellers and taxes on buyers if the tax rates on them are the same? If not, can you think of a condition for the two tax rates under which there is equivalence?

Solutions to Practice Problem Set 4

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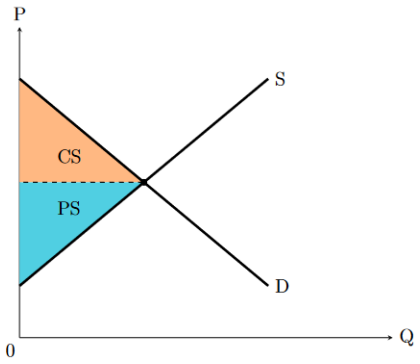
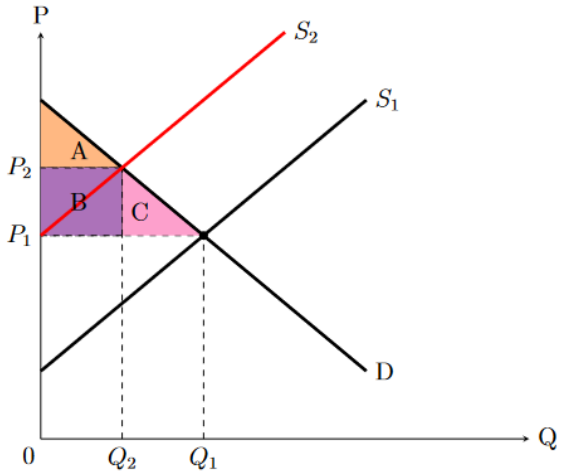
Part I. Consumer and producer surplus

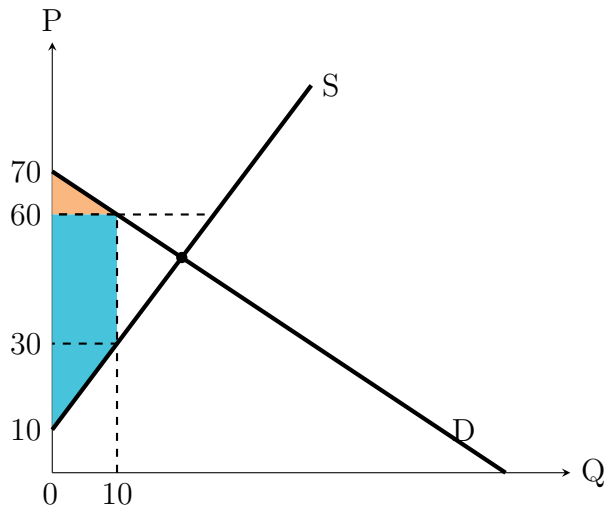
1. (a) See the diagram below, where CS stands for consumer surplus, and PS stands for producer surplus.



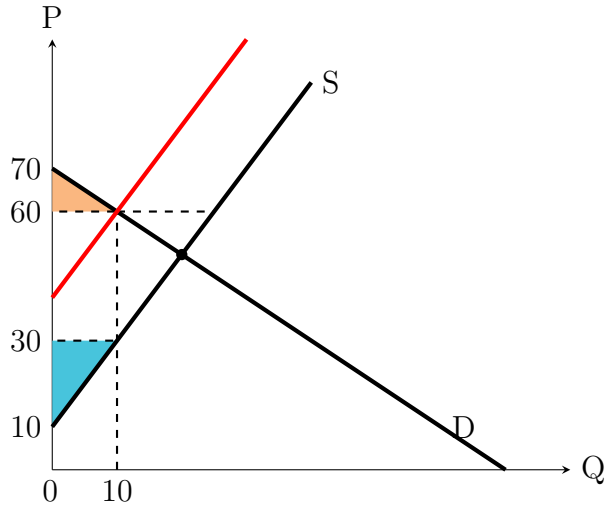
(b) See the diagram below. Consumer surplus declines from the region $A + B + C$ to just the region A. The drought decreases supply of oranges, shifting supply curve to the left. The region B is lost from the consumer surplus because the price rises for consumers that are still buying oranges. Region C is lost because there are some consumers whose willingness to pay is below the new price, and therefore exits the market.



2. (a) See the diagram below. The orange triangle is the consumer surplus, and the blue shape is the producer surplus. The amount of consumer surplus is 50, and the amount of producer surplus is 400.

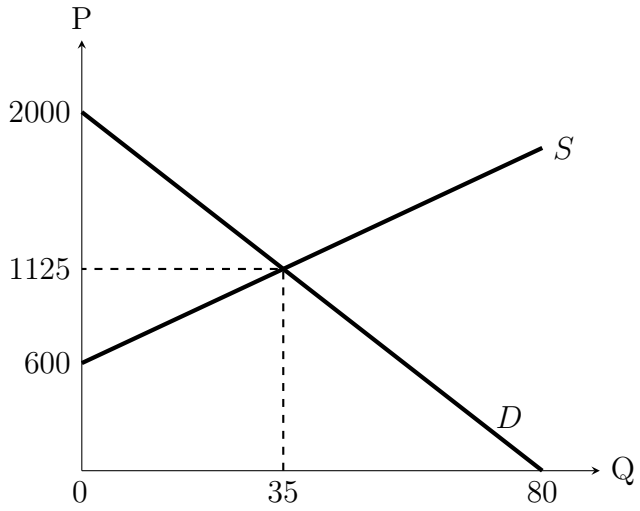


(b) See the diagram below. The orange triangle is the consumer surplus, and the blue triangle is the producer surplus. (The rectangle in between is the government's tax revenue.) The amount of consumer surplus is 50, and the amount of producer surplus is 100.



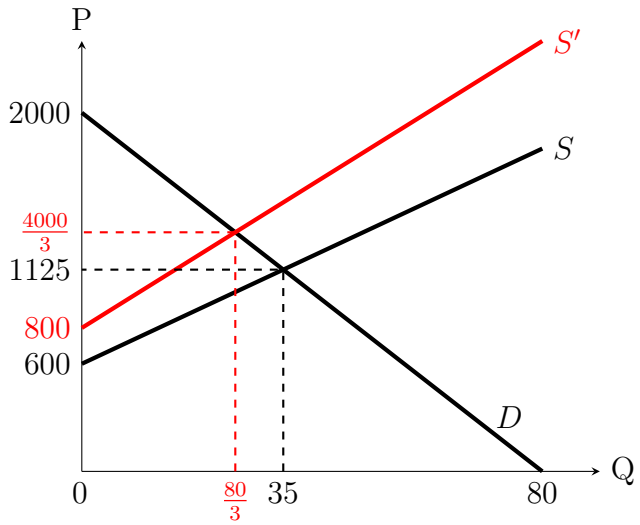
Part II. Proportional taxation

1. Solving the supply and demand equations, we get $P^* = 1125, Q^* = 35$. The diagram is given below.



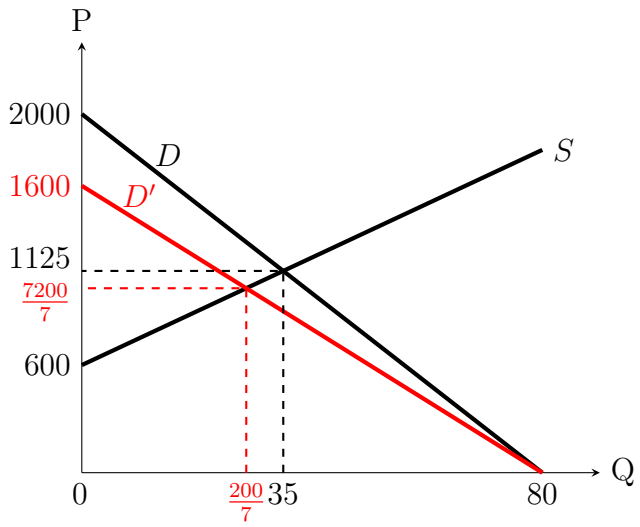
2. With a 25% sales tax on the seller, what the seller can keep in his pocket is 25% lower than the price he charges to the buyer: it is only with a price of P that the seller is willing to supply the same quantity as with a price of $0.75P$ before the introduction of the tax.

   Then, the new supply curve is given by $(1-0.25)P = (600+15Q) = 800+20Q$, and the demand equation is unchanged. Solving these two equation gives $P^* = \frac{4000}{3}, Q^* = \frac{80}{3}$. The diagram is given below.



3. With a 25% sales tax on the buyer, the total amount that the buyer is paying is 25% higher than the price he sees from the seller: it is only with a price of P that the buyer is willing to demand the same quantity as with a price of $1.25P$ before the introduction of the tax.

   Then, the new demand curve is $(1 + 0.25)P = 2000 - 25Q$. Rearranging, we have $P = 1600 - 20Q$. The supply equation is unchanged. Solving the two equations gives $P^* = \frac{7200}{7}, Q^* = \frac{200}{7}$. The diagram is given below.



4. With proportional taxes, if the tax rate is the same on sellers and buyers, the equivalence between taxes on sellers and taxes on buyers no longer holds. However, a tax rate of t on the seller would be equivalent to a tax rate of $\frac{t}{1-t}$ on the buyer. To see this, notice from question (2) that the new supply curve with a proportional tax rate of t on the seller is given by:

$$(1 - t)P = 600 + 15Q \tag{1}$$

   The demand equation is unchanged:

$$P = 2000 - 20Q \tag{2}$$

   Putting these two together, we have:

$$P = \frac{600 + 15Q}{1 - t} = 2000 - 20Q \tag{3}$$

   Notice from question (3) that the new demand curve with a proportional tax rate of $\frac{t}{1-t}$ on the buyer is given by:

$$(1 + \frac{t}{1 - t})P = \frac{1}{1 - t}P = 2000 - 20Q \tag{4}$$

   The supply equation is unchanged:

$$P = 600 + 15Q \tag{5}$$

Putting these two together, we have:

$$P = 600 + 15Q = (1 - t)(2000 - 20Q) \tag{6}$$

But equations (3) and (6) are exactly the same with regard to Q! Therefore, a proportional tax rate of t on the seller is equivalent to a proportional tax rate of $\frac{t}{1-t}$ on the buyer.