Microeconomics and mathematics (with answers)

2 Changes in demand and supply; taxes and price controls

Remarks:

- The quantity demanded depends on the price of the good (for example: $Q_d = 1000 - 5P$). Other factors, like income, prices of other goods, tastes are unchanged (so-called ceteris paribus-condition). If we take notice of these factors, the demand function could be:
  $Q_d = 100 - 5P + 0.1Y + 0.5P_o$ (Y = Income, P_o = Price of other goods)
  $Q_d = 100 - 5P + 0.1*8500 + 0.5*100$ (if for example Y = 8500 and $P_o = 100$)
  $Q_d = 1000 - 5P$
  If we want to graph the demand (Quantity on the x-axis, price on the y-axis), we transform the equation as follows:
  $Q_d = 1000 - 5P$
  $5P = 1000 - Q_d$
  $P = 200 - 0.2Q_d$
  A change in income or in the price of other goods would change the intercept and shift the demand curve. The new demand curve would be parallel to the old one. A change in taste could change the intercept or the slope.

- Similarly, the quantity supplied does not only depend on the price. Other factors are the cost of production, the technology or the regulations by the government.

2.1 Changes in demand

2.11 Graph the demand function: $P = 200 - 0.2Q_d$

2.12 Due to an increase in income, the intercept rises to 250. Complete the graph.

2.13 After 2.12: Due to a change in tastes, the slope rises to 0.25. Complete the graph.

2.2 Changes in demand and in supply

Demand: $P = 150 - 5Q_d$
Supply: $P = 60 + 4Q_s$

The following developments are observed:
- Income increases, hence $P = 200 - 5Q_d$
- Production costs decrease, hence $P = 20 + 4Q_s$

2.21 Graph the old and the new situation in the same diagram.

2.22 Calculate the old and the new market equilibrium.

2.23 Discuss the changes in P and in Q.

2.3 Effects of a per unit tax

2.31 Situation on a 'no tax'-market:
Demand: $P = 32 - 8Q_d$
Supply: $P = 12 + 2Q_s$
Calculate the market equilibrium.

2.32 Now a tax is introduced. The seller has to pay a tax of 2 out of the price received.
New supply: $(P^* - 2) = 12 + 2Q_s$ [P* = Gross receipt (new price)]
Calculate the market equilibrium with tax.

2.33 Who bears how much of the new tax (tax incidence)?

2.34 Calculate total tax receipt.

2.35 Graph the market without tax and with tax in the same diagram.

2.4 Effects of a proportional tax

'No tax'-situation (as in 2.31):
Demand: $P = 32 - 8Q_d$
Supply: $P = 12 + 2Q_s$

Now a 10%-tax is introduced. It has to be paid by the seller out of the gross receipt P* (= 100 %).

2.41 Formulate the new supply function (P* = ...).

2.42 Calculate the market equilibrium with tax.

2.43 Who bears how much of the new tax (tax incidence)?

2.44 Calculate total tax receipt.

2.5 Maximum price

2.51 Graph this market and calculate the market equilibrium:
Demand: $Q_d = 5 - \frac{1}{4}P$
Supply: $Q_s = \frac{P}{3} - \frac{4}{3}$
(Hint: Before graphing, transform these functions (P = ...)

To protect consumers, the government sets a maximum price (ceiling) of 9.

2.52 Add the maximum price to the graph 2.51.

2.53 Calculate the excess demand.

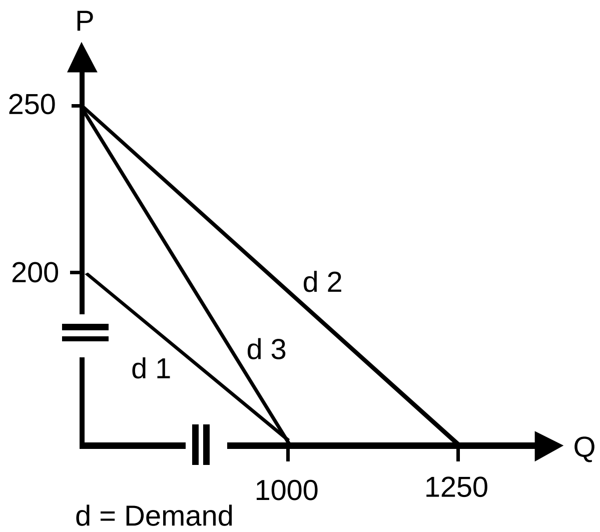
2.6	**Minimum price** Situation on a market: Demand: $P = 208 - 10Q_d$ Supply: $P = 80 + 6Q_s$ To favour producers, the government sets a minimum price (floor) of 150. 2.61 Calculate the excess supply. 2.62 The government buys the excess supply at the minimum price. How much does the government spend?

→ Answers. Click here!

Answers *Microeconomics* and mathematics

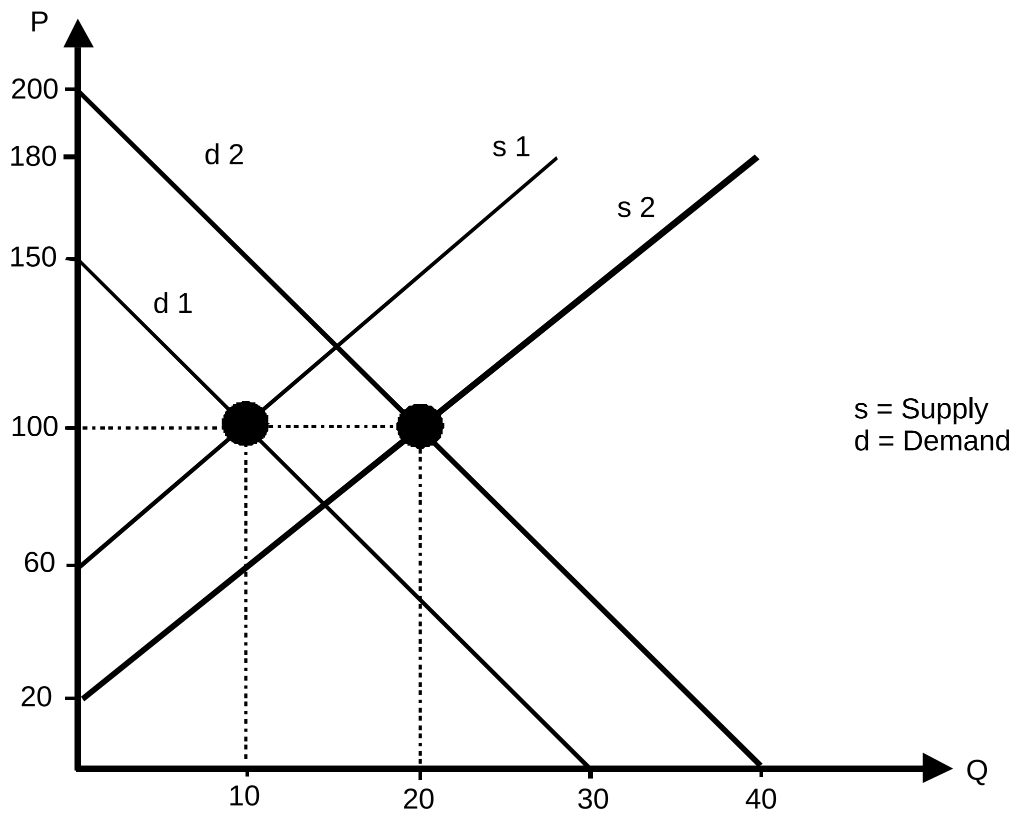
2 Changes in demand and supply; taxes and price controls

2.1 Changes in demand

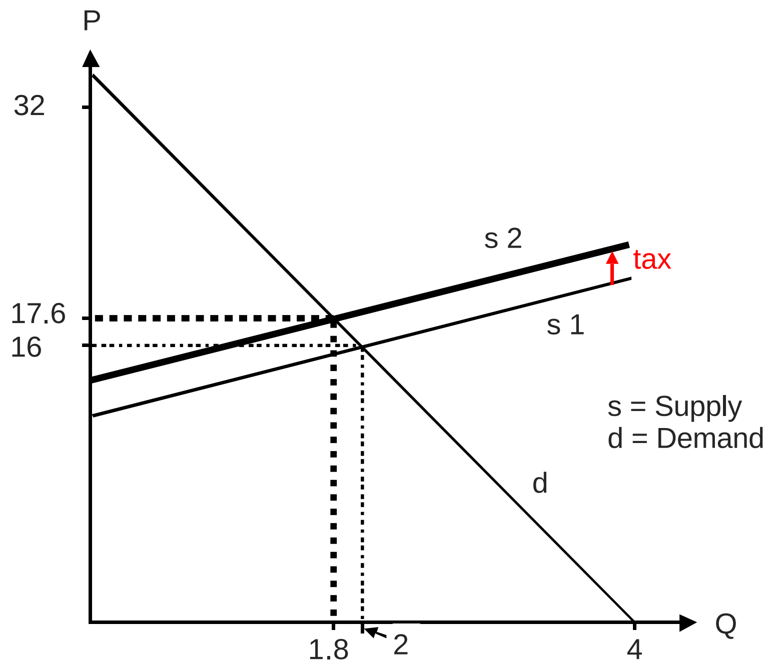


2.2 Changes in demand and in supply

2.21 Old and new situation



2.2 cont.	2.22 **Old** market equilibrium ($Q_S = Q_d = Q$): 150 - 5Q = 60 + 4Q **Q = 10** **P = 100** **New** market equilibrium ($Q_S = Q_d = Q$): 200 - 5Q = 20 + 4Q **Q = 20** **P = 100** 2.23 **Quantity** increases in any case, because both developments raise quantity. **Price** can increase or decrease or (as in our case) remain the same. These possibilites are due to the fact that both developments have opposite effects (Increase in income ----> Increase in price; Decrease in cost ----> Decrease in price). The result is the summation of the two effects.
2.3	**Effects of a per unit tax** 2.31 Market equilibrium on a 'no tax'-market: 32 - 8Q = 12 + 2Q ---> - 10Q = - 20 **Q = 2** **P =** 32 - 8Q = 32 - 16 = **16** 2.32 Demand: $P = 32 - 8Q_d$ Supply: $(P^* - 2) = 12 + 2Q_S$ ----> $P^* = 14 + 2Q_S$ Market equilibrium with tax: 14 + 2Q = 32 - 8Q ---> 10Q = 18 **Q = 1.8** **P** = 32 - 8Q = 32 - 14.4 = **17.6** 2.33 **Buyer bears 1.6** (old price 16, new price 17.6), **seller bears 0.4** (old receipt = 16, new net receipt = 15.6). Q is reduced for both. 2.34 Total tax receipt = 1.8 * 2 = **3.6** 2.35 Diagram



2.4 Effects of a proportional tax

2.41 Supply: $(P^* - 0.1P^*) = 12 + 2Q_S$

$0.9P^* = 12 + 2Q_S$

$\mathbf{P^*} = \frac{12}{0.9} + \frac{2Q_S}{0.9} = \mathbf{13\frac{1}{3} + 2\frac{2}{9}Q_S}$

2.42 Market equilibrium with tax ($Q_S = Q_d = Q$ / $P^* = P$):

Demand: $P = 32 - 8Q$

Supply: $P = 13\frac{1}{3} + 2\frac{2}{9}Q$

Market equilibrium:

$32 - 8Q = 13\frac{1}{3} + 2\frac{2}{9}Q$

$-10\frac{2}{9}Q = -18\frac{2}{3}$

$\mathbf{Q = 1\frac{19}{23} = 1.83}$ $\mathbf{P} = 32 - 8*1\frac{19}{23} = \mathbf{17\frac{9}{23} = 17.39}$

2.43 Market equilibrium (no tax) → as in 2.31

Q = 2 P = 16

Market equilibrium (with tax)

Q = 1.83 P = 17.39

Buyer bears **1.39** (17.39 - 16), **seller 0.35** (16 - [0.9*17.39]).

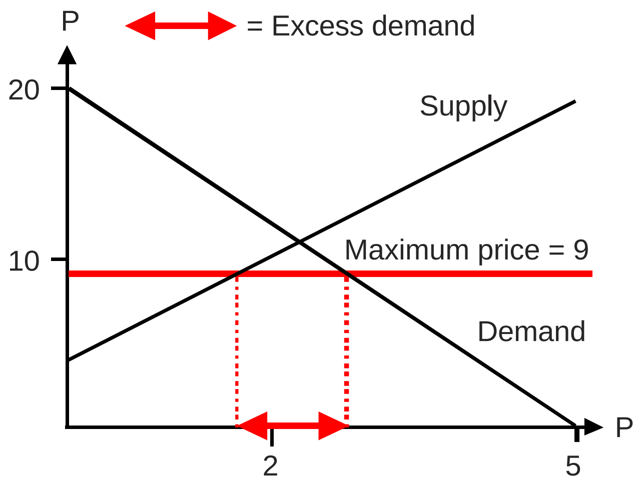
2.44 Total tax receipt: Q*0.1*P = 1.83*0.1*17.39 = **3.18**

2.5 Maximum price

2.51 Demand: $Q_d = 5 - \frac{1}{4}P \rightarrow P = 20 - 4Q_d$

Supply: $Q_S = \frac{P}{3} - \frac{4}{3} \rightarrow P = 4 + 3Q_S$

2.51+2.52 Graph



2.5 cont.	2.53 Excess demand: Maximum price = 9 Demand: $9 = 20 - 4Q_d$ $4Q_d = 11$ $Q_d = 2\frac{3}{4}$ Supply: $9 = 4 + 3Q_s$ $3Q_s = 5$ $Q_s = 1\frac{2}{3}$ Excess demand = $2\frac{3}{4} - 1\frac{2}{3} = \mathbf{1\frac{1}{12}}$
2.6	**Minimum price** 2.61 Excess supply: Minimum price = 150 Demand: $150 = 208 - 10Q_d$ $10Q_d = 58$ $Q_d = 5\frac{4}{5}$ Supply: $150 = 80 + 6Q_s$ $6Q_s = 70$ $Q_s = 11\frac{2}{3}$ Excess supply = $11\frac{2}{3} - 5\frac{4}{5} = \mathbf{5\frac{13}{15}}$ 2.62 Spending by the government: $5\frac{13}{15} * 150 =$ **880**

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