Department of Agricultural and Resource Economics
University of California at Berkeley

INTRODUCTION TO ENVIRONMENTAL ECONOMICS AND POLICY

Problem Set No. 2

(Solutions by Joyce Luh)

Fixed Supply ⇒ or "Perfectly Inelastic" Supply

Problem 1

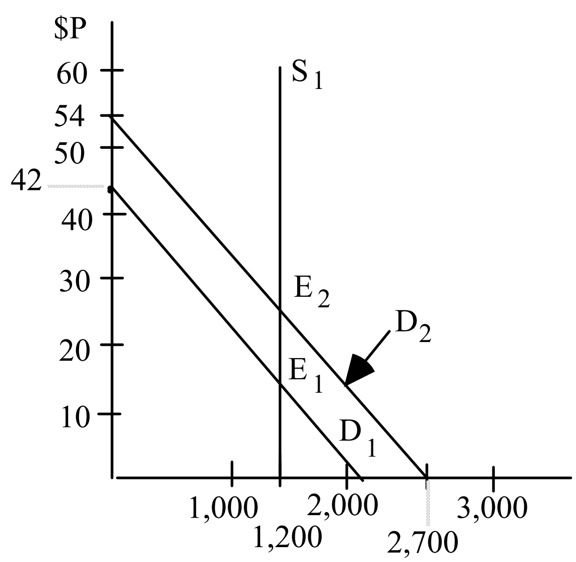
Demand function: q = 2,100 - 50 p.

Demand - price function (or inverse - demand function).

$$\frac{q - 2{,}100}{-50} = \frac{-50\ p}{-50}$$

$$P = 42 - \frac{1}{50}\ q.$$

Problems 2 and 3



$$\left.\begin{array}{l} D_1: \; q = 2{,}100 - 50\,p \\ S_1: \; q = 1{,}200 \end{array}\right\} \text{Equilibrium price and quantity:}$$

$$2{,}100 - 50\,p = 1{,}200$$

$$P = \frac{900}{50} = 18$$

$$q = 1{,}200,$$

which match the graph approximately.

Problem 4

$$D_2: \; q = 2{,}700 - 50\,p.$$

Demand-price function:

$$p = \frac{2{,}700}{50} - \frac{1}{50}\,q$$

$$p = 54 - \frac{1}{50}\,q.$$

Problem 5

At new equilibrium, E_2,

$$2{,}700 - 50\,p = 1{,}200$$

$$50\,p = 1{,}500$$

$$p = 30.$$

Problem 6

The price under the old demand (@ E_1) was \$18. What would be the quantity demanded at the old price (\$18) at the *new* demand (D_2)?

$$D_2: \; q = 2{,}700 - 50\,p$$

$$@\; p = 18$$

$$q_D = 2{,}700 - 50(18) = 2{,}700 - 900 = 1{,}800$$

$$q_D = 1{,}800,$$

but quantity supplied, at all demands, is just

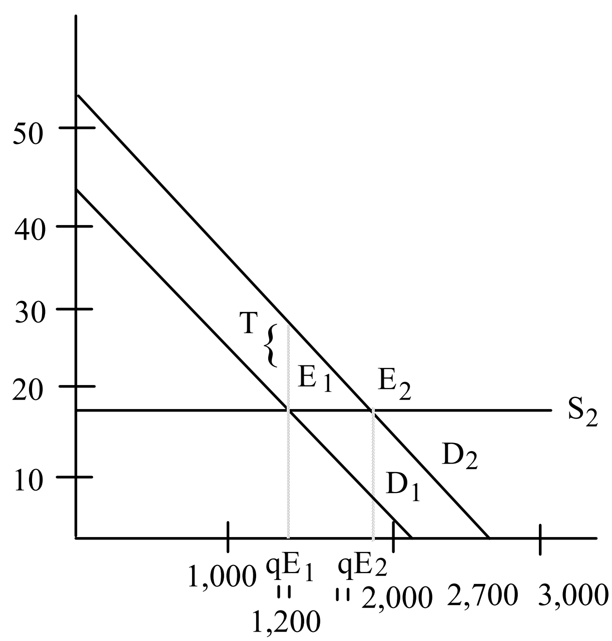
$$q_S = 1{,}200.$$

Thus, with a price ceiling of $18 under the new demand, there is an excess demand of 600 units.

Constant Cost Supply

$p^S = 18$ (*Note*: One graph for all is fine, but I am using multiple graphs to keep everything clearly distinguished.)

Problem 8



Supply schedule given by horizontal line p = $18.

This means that producers are willing to supply any amount at $18 per unit.

The eqm quantity is determined by the demand for the good at p = $18.

$$Q_d = D_1(p).$$

$$Q_d = D_1(18) = 2{,}100 - 50.18 = 1{,}200.$$

Problem 9

The eqm quantity from the new demand curve is:

$$Q_d = D_2(p) = 2{,}700 - 50.18 = 1{,}800.$$

Problem 10

Demand has increased, but government wants to keep the equilibrium quantity by charging a per-unit fee for a license or permit for each unit produced. Note that this is just like a tax.

In the new equilibrium, q = 1,200 (because that is what the government wants!). Also, $p^D - p^S = T$, where T is the per-unit cost of the permit.

On the graph, this is just the vertical distance between the supply curve, S_1 (p = 18), and the demand curve, D_2, at the quantity, q = 1,200. It appears to be about 30 -18 = $12 on the graph. Checking mathematically:

$$D_1, q = 1{,}200 \text{ and } p = 18 \text{ (trivially)}$$
$$\Downarrow$$
$$= p^S = p^D = p^E.$$

Now:

$$p^D - p^S = T$$
$$p^D = T + p^S$$

$$@D_2: \; p^S = 18$$
$$p^D = 54 - \frac{1}{50} q$$
$$p^S = 18$$
$$p^D = T + 18,$$

so

$$T + 18 = 54 - \frac{1}{50} q.$$

But we fix q = 1,200 because the government wants *old* equilibrium quantity. Therefore,

$$T = 54 - 18 - \frac{1}{50}(1{,}200)$$

$$T = 54 - 18 - 24 = 12$$

$$T = 12 \Rightarrow \text{good, same as the graph.}$$

Case of Increasing Cost Supply (the "Usual" Story)

Problem 11

$$S_3: \; q = -600 + 100\,p \qquad \text{for } p \geq 6$$

$$\Downarrow$$

(This is to rule out negative quantities supplied.)

$$\text{Inverse supply: } \; p = \frac{600}{100} + \frac{1}{100}\,q$$

$$\Downarrow$$

$$p = 6 + \frac{1}{100}\,q.$$

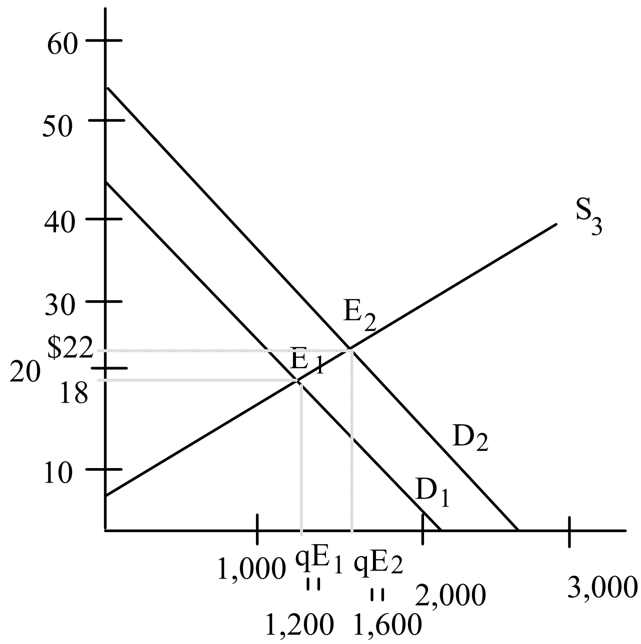
Problem 12

$$D_1: \; q = 2{,}100 - 50\,p$$

$$p = 42 - \frac{1}{50}\,q.$$

$$S_3: \; q = -600 + 100\,p$$

$$p = 6 + \frac{1}{100}\,q.$$



At eqm, $Q_S = Q_d$

$$-600 + 100\,p = 2{,}100 - 50\,p.$$

Solve for p; $p^* = 18$.

$$Q_S(p^*) = Q_S(18) = 1{,}200.$$

Problem 13

$$D_2: \; q = 2{,}700 - 50\,p$$

$$p = 54 - \frac{1}{50}\,q.$$

$$S_3: \; q = 600 + 100\,p$$

$$p = 6\,\frac{1}{100}\,q.$$

At eqm, $Q_S = Q_d$

$$-600 + 100\,p = 2{,}700 - 50\,p.$$

Solve for p*; $p^* = 22$.

Plug p* into supply or demand to get eqm Q.

$$Q^* = 2{,}700 - 50.22 = 1{,}600.$$

Taxes

Problem 15

There is a new equilibrium condition when a tax is imposed. *Before*, equilibrium was $p^S = p^d$. Now, equilibrium is $p^d - p^S = t$.

Constant cost supply (horizontal supply curve). The eqm q comes from demand curve.

Producers are willing to supply any amount as long as they get \$18 per unit.

In order for them to get \$18 per unit, consumers must pay \$18 + t = 24.

$$\text{eqm } Q = D(24) = 2{,}100 - 50\,(24) = 900.$$

(We have examined the problem from buyers' perspectives by shifting the supply curve *up* by t units.)

Problem 16

Usual upward-sloping supply curve. The eqm comes from $Q_S = Q_d$.

$$S(p_S):\ Q_S = -600 + 100\,p_S$$
$$D(p_d):\ Q_d = 2{,}100 - 50\,p_d$$
$$Q_S = Q_d \text{ (market-clearing condition).}$$

$$-600 + 100\,p_S = 2{,}100 - 50\,p_d$$
$$\text{substitute } p_d = p_S + t$$
$$-600 + 100\,p_S = 2{,}100 - 50(p_S + t)$$
$$p_S = 16;\ p_d = 22.$$

Problem 17

Vertical or perfectly inelastic supply.

$$S:\ Q_S = 1,200$$
$$D:\ Q_d = 2,100 - 50\ p_d.$$

$$\text{eqm condition}:\ Q_S = Q_d$$
$$1,200 = 2,100 - 50\ p_d$$
$$p_d = 18.$$

$$p_S = p_d - t = 18 - 6 = 12.$$

$$Q = 1,200.$$

$$p_S = 12; p_d = 18; Q = 1,200; T = 6 \cdot 1,200 = \$7,200$$

change in $p_d = 0$.