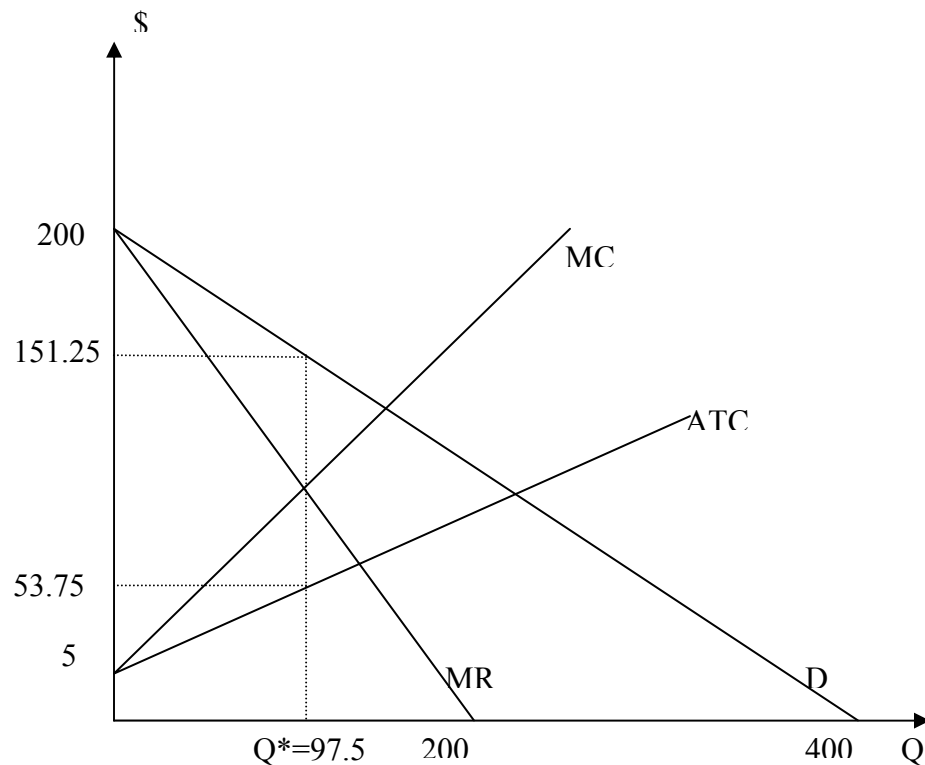


Homework Assignment 8 solution.

1. (5 points) Consider a monopolist who has a total cost curve of $C=5Q+0.5Q^2$ (the corresponding marginal cost function is given by $MC=5+Q$, and the average cost function is given by $ATC=5+0.5Q$). The market demand is given by $P=200-0.5Q$ (the corresponding marginal revenue function is given by $MR=200-Q$).
 - a. What is the optimal production level for this monopolist, what is the price charged, and what is the level of profits?



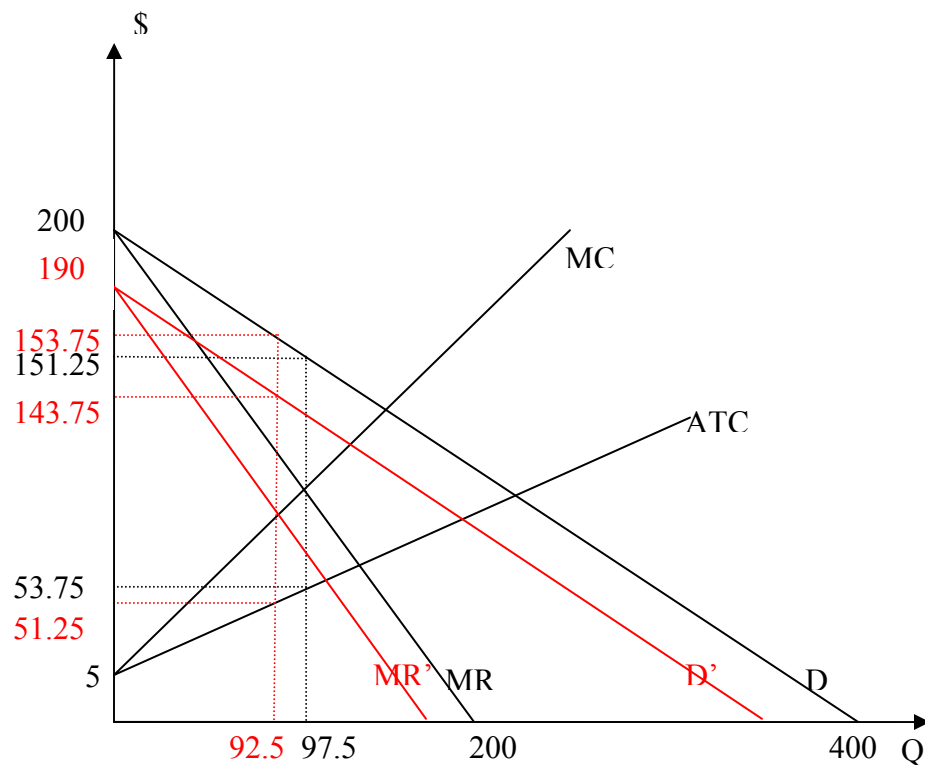
- Refer to the graph above. There are three basic steps that we'll need to follow to answer all the questions in this and later parts of the problem:
- (1) Determine the optimal (profit maximizing production level) by setting $MR=MC=200-Q=5+Q$, which gives us $Q^*=195/2=97.5$.
 - (2) Determine the price charged by monopolist and its average total costs at the optimal production level. We do this by plugging the Q^* that we just obtained in demand and ATC functions respectively. Given that monopolist produces Q^* the monopolist can charge $P=200-$

$0.5Q^*=151.25$ and it will incur the average cost of $ATC=5+0.5Q^*=53.75$.

(3) The profits are equal to $\text{profits} = \text{total revenue} - \text{total cost} = Q^*(\text{average revenue} - \text{average total cost}) = Q(P-ATC) = 97.5(151.25-53.75) = 9506.25$.

- b. Suppose that a \$10 unit tax is levied on buyers in this market. What is the new level of production, prices buyers pay and monopolist receives as well as monopolist's profits? Also what is the tax revenue in this case?

The demand and MR curves will shift down in parallel fashion by exactly \$10 (exactly the same logic as we applied when we analyzed the tax on buyers in competitive markets) to become $P'=200-0.5Q-10=190-0.5Q$ and $MR'=200-Q-10=190-Q$. The tax schedules remain unchanged (monopolist does not pay this tax).



We follow the same steps as in (a):

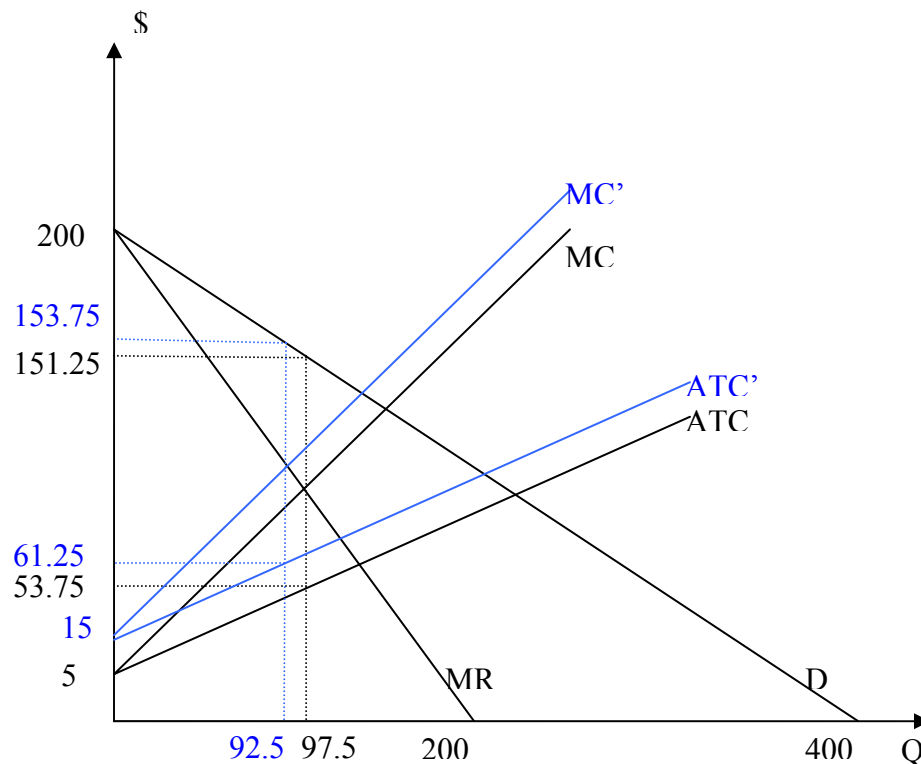
- (1) Determine the optimal (profit maximizing production level) by setting $MR'=MC=190-Q=5+Q$, which gives us $Q^*=185/2=92.5$.
- (2) Determine the price charged by monopolist and its average total costs at the optimal production level. We do this by plugging the Q^* that we just obtained in demand and ATC functions respectively. Given that

monopolist produces Q^* the monopolist can charge $P=190-0.5Q^*=143.75$ and it will incur the average cost of $ATC=5+0.5Q^*=51.25$. In addition to these numbers we have to note that buyers will pay \$10 more per unit, so price to buyers is $143.75+10=153.75$.

(3) The profits are equal to $\text{profits} = \text{total revenue} - \text{total cost} = Q^*(\text{average revenue} - \text{average total cost}) = Q(P-ATC) = 92.5(143.75-51.25) = 8556.25$.

c. Now assume that instead of buyers, a \$10 tax is levied on the monopolist (hint: this tax will change the cost schedule of the monopolist – new marginal cost and average cost functions will be $MC'=10+5+Q=15+Q$, $ATC'=10+5+0.5Q=15+0.5Q$). What is the new level of production, prices buyers pay and monopolist receives as well as monopolist's profits? Also what is the tax revenue in this case?

This time the cost curves will shift up by \$10 (because it costs +\$10 to produce each and every unit of this good no matter how many units are produced) to become $MC'=15+Q$, $ATC'=15+0.5Q$.



We follow the same steps as in (a):

- (1) Determine the optimal (profit maximizing production level) by setting $MR=MC'=200-Q=15+Q$, which gives us $Q^*=185/2=92.5$.
- (2) Determine the price charged by monopolist and its average total costs at the optimal production level. We do this by plugging the Q^* that we just obtained in demand and ATC functions respectively. Given that monopolist produces Q^* the monopolist can charge $P=200-0.5Q^*=153.75$ and it will incur the average cost of $ATC=15+0.5Q^*=61.25$. The fact that the monopolist pays the tax doesn't affect the price collected, it affects the costs. Alternatively we could think of this tax as decreasing the price collected by monopolist by \$10 (keeping costs constant).
- (3) The profits are equal to $\text{profits}=\text{total revenue} - \text{total cost}=Q^*(\text{average revenue} - \text{average total cost})=Q(P-ATC)=92.5(153.75-61.25)=8556.25$.

d. Comment on tax incidence depending on which side of the market the tax is imposed comparing your answers in (b) and (c)?

The two alternative ways to impose a \$10 unit tax are equivalent in terms of its incidence. Consumers end up paying exactly the same after-tax amount and monopolist gets exactly the same after-tax profit.

2. (1 point) Suppose that government imposes a tax on air travel. Suppose that there are two types of travelers – business and vacation. Assume also that the elasticity of the demand for air tickets is -0.5 for business travelers, and -4 for vacation travelers. Which type will bear relatively more burden of this tax?

We know that the burden is inversely related to the elasticity. The more elastic the demand is the less is the burden on this type of consumers. Therefore, vacation travelers will bear relatively lower burden compared to business travelers. Intuitively, vacation travelers are more likely to switch to some other mode of transportation (like traveling by car or train) as a result of a tax (meaning that the demand is elastic) or cancel/postpone vacation, whereas business travelers are a lot less flexible in terms of time and mode of travel. It means that business travelers cannot escape the tax and will bear the burden.

3. (1 point, problem 2 on page 302) According to estimates by Goolsbee [1998], purchases on the Internet are highly sensitive to tax rates, and applying existing sales taxes to such purchases would substantially reduce the number of online buyers and the amount of online spending. What are the implications for the incidence of a tax levied on Internet sales?

The fact that internet sales are highly sensitive to the tax rates (sensitive to prices) means that the demand for goods on the internet is very elastic (flat). We know that if the demand is elastic the consumers bear little burden of a tax on internet sales. Intuitively, internet shoppers can escape the tax by buying the goods in bricks-and-mortar stores instead.

4. (3 points) Consider a general equilibrium economy with two goods – cigarettes and all-other-goods produced by competitive firms using two inputs (labor and capital). Assume that cigarette production is capital intensive and production of all-other-goods and labor intensive.
- a. What are the effects of a cigarette tax in this economy?

The direct effect is that the price (to consumers) of cigarettes will go up and production will decrease. In addition, the price of the input intensively used in the production of cigarettes (capital) will decrease. Intuitively, the reduction in the production of cigarettes will free some resources, which would need to be accommodated in the other sector. There will be relatively more capital (because cigarette sector is capital-intensive) freed, so its relative (to labor) price will have to go down to accommodate it in the other sector.

- b. What are the effects of a tax on labor used in the production of cigarettes?

There are two effects:

- (1) Substitution effect – the relative price (to owners) of labor will go down because cigarette manufacturers will substitute away from labor (because it is more expensive to acquire for producers);**
- (2) Output effect – tax on labor in cigarette production will increase the price of cigarettes and decrease the level of cigarette production in general. In part (a) we found out that this leads to higher relative price of labor (lower relative price of capital).**

The overall effect is ambiguous because the two effects outlined above act in the opposite directions.