Chapter 9. Applying the Competitive Model

We know that a change in supply curve or demand curve will change the price and quantity. But how does this affect consumers and producers? How much do they lose or gain? And what about the society?

First, to what extent is consumer affected? We need some measure for that. Utility can measure the pleasure gain from consuming one good. But utility measure is not good because of the following reason: 1. It is hard to obtain individual’s utility function. 2. Different people have different utility even for same amount of good and this makes it hard to compare. So, we measure consumer welfare in terms of dollars.

I. Consumer welfare

Consumer welfare from a good is the benefit a consumer gets from consuming that good minus what the consumer paid to buy that good.

How much a good is worth to you? A good way is to ask you for how much money do you want to buy it. This is called “willingness to pay” – a money measure of satisfaction or welfare. We are asking a consumer to evaluate a “fair exchange” between a good and money. Thus, the money amount is of the same value as the good.

1. The price on the demand curve shows consumers’ “willingness to pay” (Figure 9.1).

![Figure 9.1](image)
If you buy 3 magazines in the market, can we know your willingness to pay for them together and for each unit? – The information is in the demand curve. Why?
Demand curve shows, how much you buy at a price. You stop buying when the value (satisfaction) of the last unit is equal to the price. Suppose the market price is $5 and you buy the first unit, that unit must have value $5 to you, otherwise you would have bought it at a price > $5, or you will not buy it at $5. At price $4, you buy two units. The second unit must have value $4 to you. Otherwise you would have bought it at a price > $4, or would not buy it at $4.

2. The surplus
Take Figure 9.1 (a), the transaction is 3 units at $3.
The surplus is the $ amount you get exceeding the $ you pay. So, for the first unit, you are willing to pay $5, buy only paid $3, so the surplus is $2, and $1 for the second unit and $0 for the third unit.

What is the total value a consumer gets from this transaction:
Total willingness to pay = Area under demand curve
And,
Payment = rectangle under price
We define the welfare measure as
Consumers surplus = the total value (willingness to pay) – payment
⇒ Consumer surplus (CS) = Area between D curve and price (F 9.1 (b)).

[2] How does consumer surplus change with price (Figure 9.2)?
As P goes up, quantity decreases, the triangle area (CS) reduced to A from A+B+C. P up $\Rightarrow$ CS down

How does elasticity affect $\Delta$CS (Problem 9.1)?

Problem 9.1:
Suppose that two linear demand curves go through the initial equilibrium $e_1$. One demand curve is less elastic than the other at $e_1$. For which demand curve will a price increase cause the larger consumer surplus loss?

Answer: 1) less elastic, steeper demand curve
2) If the price increases, CS falls by only $-C$, while $-C-D$ for less inelastic demand curve.
2. **Producer welfare**

[1] Producers receive revenue from the market and pay the cost to produce the goods. The surplus is the $ amount you get exceeding what you pay.

Producer surplus = Revenue – Total variable cost

We do not count fixed cost because it is sunk cost (cannot be avoided), already spent. Firms’ welfare will not be affected by it.

And total cost is $ACq$ and also the area under the MC curve. So we will use MC since it is exactly the $S$ curve.

Total cost = sum the cost of each units = area under MC (Figure 9.3, left panel)
Figure 9.3(a)

\[ \text{Producer surplus (PS)} = \text{Area between price and S curve (F. 9.3 right panel)} \]

(b) A Market’s Producer Surplus

Figure 9.3(b)
Note that PS is not profit, the difference is the fixed cost.

[2] How does PS change with price (Problem 9.2)?

As price decreases, PS reduces to F from D+E+F.

\[ P \text{ down } \rightarrow \text{ PS down} \]

3. **Competition maximizes welfare**

[1] Social welfare in a market is the sum of surplus of both.

\[ W = CS + PS \]

But later on, we will face different government policies. And when government is involved, then there is a issue of government revenue/expenditure. And we should add this government revenue/expenditure into social welfare.

Each priced and quantities imply values of PS and CS. What is the best arrangement in the society? If we want to maximize social welfare, what is the best arrangement?

A good should be produced if someone values it more than the cost to produce it.

D: consumers’ valuation of an extra unit of good.
S: producers’ cost in producing extra unit.

We can see that when
D is higher than S, the good should be produced
D is lower than S, it should not

The best is to stop at D and S cross \( \rightarrow \) equilibrium quantity.
The social welfare is maximized at the market equilibrium in a competitive market.

If the production is not at the equilibrium quantity, there is a **deadweight loss** (DWL): the net reduction in welfare from a loss of surplus by one group that is offset by a gain to another group from an action that alters a market equilibrium.

To the social welfare at Q1 is (Figure 9.4.)

\[
\text{CS: } A+B+C \text{ and PS: } D+E.
\]

![Figure 9.4](image)

If we regulate producers to produce at Q2 and regulating price to be \( P_2 > P_1 \), the welfare is

\[
\text{CS: } A \text{ and PS: } B+D.
\]

\[
\Delta CS = -B-C \text{ and } \Delta PS = B-E
\]

The triangle \( \Delta W = -(C+E) \) is missing.

Note that consumers lose \( B+C \), but producers gain \( B \) and lose \( E \). The part \( B \) simply “changes hands”.

The consequence of producing over the equilibrium is also DWL (Figure 9.5).
If we regulate the firms to produce at $Q_2 > Q_1$ and price to be $P_2 < P_1$ so that consumers will buy, the units above $Q_1$ have values lower than their cost. The social welfare is reduced.

Produce at $Q_1$

\[\text{CS: A and PS: C+F}\]

Produce at $Q_2$

\[\text{CS: A+C+D+E and PS: F+G+H-B-D-E-G-H=F-B-D-E}\]

\[\Delta\text{CS} = C+D+E\]

\[\Delta\text{PS} = -B-C-D-E\]

The new triangle $\Delta W = -B$ is a negative amount.

Note that $C+D+E$ changes hands; this is the part of producers’ loss that is gained by consumers.

It is very helpful if you want to study the effect of policies. When a policy changes the market equilibrium, it changes consumers’ and producers’ welfare. In the next section, we will analyze a few policies.

4. Policies and welfare
The reason that we learn welfare analysis is that we want to predict the impact of government policy. By using welfare analysis, we can predict which policy is good or bad and we can vote to influence it.

[1] Policies that shift supply curve
Two common types: limits on the number of firms in a market
Limits on the amount of output that firm can produce

Three ways to limit the number of firm: Restrict the number of firms
   Bar some member of society
   Raise the entry cost or exit cost (only applied new firms, not to the one remains).

Let’s consider the first way—Restricting the number of firms.
A limitation on number of firms will cause a shift of the supply curve to the left, which raises the equilibrium price and reduces the equilibrium quantity. Consumers are now harmed: they have to pay more to get fewer units of good. Firms that are in the market when the restriction is imposed benefit from higher profit.

Application: Regulation of taxicab
Compare the welfare of competitive equilibrium with the one when the restriction is imposed.

(a) Cab: Firm

(b) Market

1) The welfare of competitive equilibrium
When there is no restriction on number of firms, in the long-run, firm will produce at the minimum of average cost, and supply curve is horizontal line $S^1$. The market equilibrium is at point $E_1$, and equilibrium price is $p_1$, equilibrium quantity is $Q_1$. There are $n_1$ firms in the market.

We know in the long-run, producers have a zero profit, therefore, $PS=0$. And $CS$ is the area between Demand curve and $p_1$ up to $Q_1$: $A+B+C$.

2) If the restriction is imposed (let’s say $n_2$ firms in the market and $n_2 < n_1$).
Then each firm is producing $q_i$ at price $p_i$. So, when price is equal to $p_i$, the market supply equals to $n_2q_1$. If the market needs more production (more cab firms), price has to rise, i.e., follow the MC. When $Q > n_2q_2$, the supply curve is the sum of all $n_2$ firms’ supply curve.

The new supply curve is $S^2$. And the new equilibrium is at point $E_2$. New market price is $p_2$, quantity is $Q_2$.

(3) Compare:
(1): $CS = A+B+C$; \hspace{1cm} PS=0; \hspace{1cm} W=A+B+C.
(2): $CS = A$; \hspace{1cm} PS=B; \hspace{1cm} W=A+B
\hspace{1cm} \hspace{1cm} \hspace{1cm} \hspace{1cm} CS=-B-C; PS=B \hspace{1cm} W=-C=DWL

Interpretation: By preventing other cab firms from entering the market, economic profit is created, the area $\pi$. So the firms that are in the market benefit from the restriction; but consumers lose because of higher price.

In most cities, permits can be rented or sold. So the owners of permits can charge this $\pi$, and we call this “Rent”. The rent for the permit causes the cab driver’s average cost to rise to $AC^2$. Then, for new firms, they don’t have positive profits anymore, because market price is equal to the minimum of AC. Producer surplus B go to original owner rather than to the current owner.

[2] Policies that create a wedge between Supply and Demand
Most common policies are sale taxes (or subsidy) and price controls. These policies create a wedge between MC and price, and either too little or too much is produced.

(1) Welfare effects of a sale tax (Figure 9.7)
If we assume that government will impose this tax on producers, supply curve will shift to left and price will increase.
Figure 9.7

Original equilibrium is at point $e_1$, while the new equilibrium is at point $e_2$. Price that producer charges is 32 cents, but producers can only receive 32-11=21 cents. Price that consumers paid is 32 cents. And only 1.16 billion roses are sold in the market.

No tax: $CS = A + B + C$;  
$PS = D + E + F$;  
$W = A + B + C + D + E + F$;

With tax: $CS = A$;  
$PS = F$;  
Tax revenue = $B + D$;  
$W = A + B + D + F$;

$\Delta CS = -B - C$;  
$\Delta PS = -D + E$;  
$\Delta W = -C - E$.

Even when we include tax revenue in our welfare measure, some welfare still get lost (area C+E: DWL).

The extra 2 cents per stem that buyers pay causes consumer surplus to fall by $B + C = $24.1. And due to 9 cents drop in the price that firms receive, they lose PS of $D + E = $108.45. The government gains tax revenue of $B + D = $127.6.

The combined loss of CS and PS is only partially offset by government gain in tax revenue, so welfare drops because of under production.

(2) Welfare effects of a subsidy:

Subsidy = tax. So instead of taking something away, gov’t will subsidize consumers/producers in buying/selling goods.

A per-unit subsidy to consumers will cause the demand curve to shift right, and creates a wedge between the supply and demand. Let $p^e =$ price consumer pays, $p^f =$ price producers receives, then $p^e = p^f - \tau$. 
No subsidy: \( CS = A + B; \) \( PS = D + G; \) \( W = A + B + D + G; \)

With subsidy: \( CS = A + B + D + E; \) \( PS = B + C + D + G; \)
\[ \text{Gov't expenditure} = -(B + C + D + E + F) \]
\( W = A + B + D + G - F; \)

So, \( \Delta CS = D + E, \Delta PS = B + C, \Delta W = -F \) (DWL)

Interpretation: Consumers gain because they can pay less, and get more goods. Producers receive a higher price and sell more output. But the gains for consumers and producers are less than the government expenditure, so the society experiences a DWL from two much production, where production cost is higher than the value.

(3) Welfare of a price floor

In some market, gov’t sets a price floor, which is the lowest price a consumer can pay legally for the good. In chapter 3, we learned that an effective price floor must be set above the equilibrium price. Let’s see how this policy affects the welfare.

Application: Soybean market (Figure 9.9).
Government pledges to buy as much output as farmers want to sell.
Since the equilibrium price is higher now, consumers will demand less amounts of goods. So consumers will only purchase $Q_d$. However, when price is higher, farmers will produce more and wants to sell $Q_s$ amount of soybeans in the market. Because of the price support policy, farmers will sell $Q_d$ to consumers and sell $Q_s - Q_d$ units of soybeans to government at price $5$ per unit.

No price floor:
$CS = A + B + C; \ PS = E + F; \ W = A + B + C + E + F$;

Price floor:
$CS = A; \ PS = B + C + D + E + F; \text{gov’t expenditure} = -(C + D + F + G); \ W = A + B + E - G$;

$\Delta CS = -B - C; \ \Delta PS = B + C + D; \ \Delta W = -C - F - G$ (DWL).

Interpretation:
Price floor (price support) incurs a distortion in the market.
Excess production: more output is produced than is consumed. So extra output is stored or destroyed.
Inefficiency in consumption: At $Q_d$, consumers are willing to pay $5$ for the last good, which is more than the marginal cost, $3.60$ of producing this last one.

(4) Welfare effects of a price ceiling
A price ceiling: the highest price that a firm can charge. Normally the price is set below the price equilibrium.

If the price ceiling is set below $p^*$, consumers demand more than the equilibrium quantity and firms supply less. Producer surplus will fall, because producers receive a lower price and sell fewer units.

Consumers can buy the goods at a lower price but cannot buy as much as they would like ⇒ deadweight loss.

Figure 9.10

No restriction: $\text{CS}=A+B+C; \text{PS}=D+E+F; \text{W}=A+B+C+D+E+F$.
Price ceiling: $\text{CS}=A+B+D; \text{PS}=F; \text{W}=A+B+D+F$

$\Delta \text{CS} = D - C; \Delta \text{PS} = -D - E; \Delta \text{W} = -C - E$

Interpretation:
Consumers gain because of a lower price, ⇒ gain area D; but they cannot buy more output because suppliers now produce less ⇒ lose area C.
Producers lose D+E because they sell less and receive a lower price.
Deadweight loss occurs because of underproduction.