ECON 1B03: Exam Study Guide/Notes

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Question Distribution

Chapter 2/3 – 5 Questions

Chapter 5 – 3 Questions

Chapter 6 – 2 Questions

Chapter 8 – 3 Questions

Chapter 9 – 3 Questions

Chapter 11 – 1 Question

Chapter 13 – 3 Questions

Chapter 14 – 8 Questions

Chapter 15 – 7 Questions

Chapter 16 – 2 Questions

Chapter 17 – 5 Questions

Chapter 18 – 2 Questions

Chapter 21 – 6 Questions

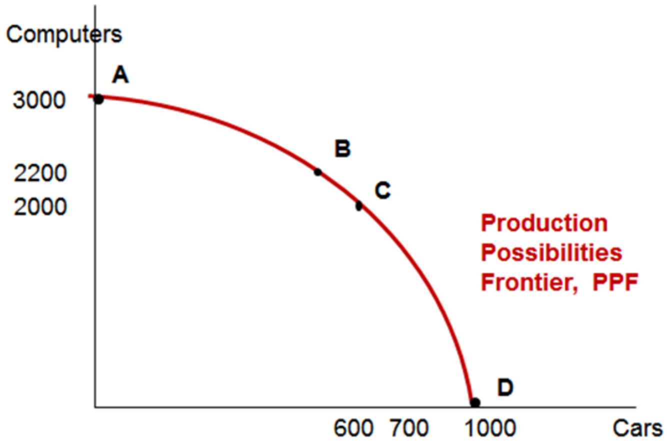
Unlisted however needed:

Chapter 4/7 to Answer Chapter 14-17

Chapter 2 - PPF

Consider the chart:

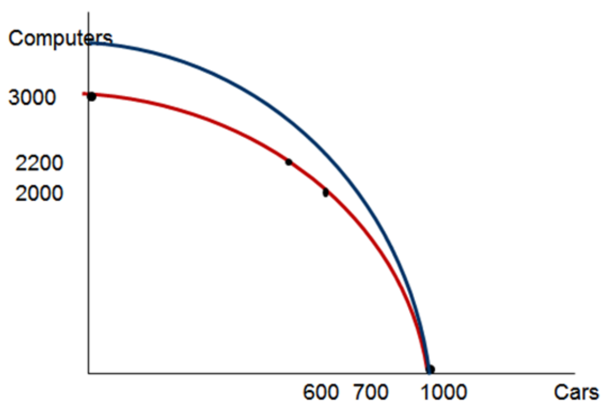
	Computers	Cars
A	3000	0
B	2200	600
C	2000	700
D	0	1000



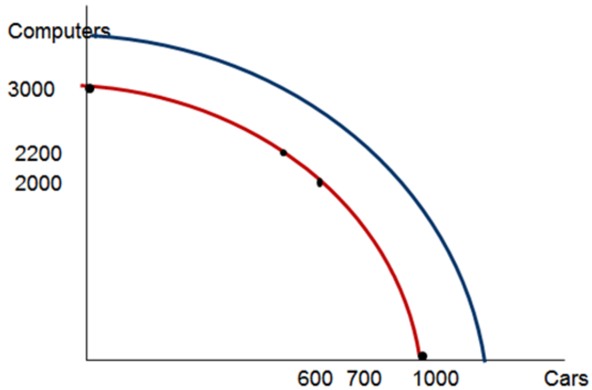
Note: Everything above the PPF line is unattainable with current technology. Everything below is attainable but doesn't use all resources. Everything on the red line uses all resources.

Opportunity Cost:
To get 600 cars, you must give up 800 computers. To get 1 car, you give up 800/600 = 1.33 computers.
Opportunity cost of a car = 1.33 computers.
Opportunity cost of a computer = 1/1.33 = 0.75 cars.

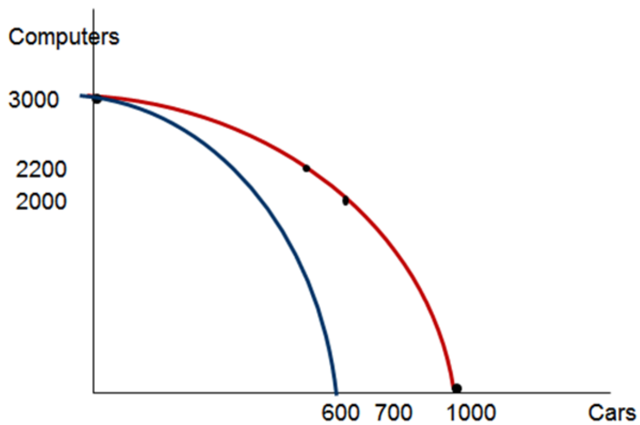
Computer production is better?



Both productions are better?



Shortage in car production?



Chapter 3 – Gains from Trade

	Meat	Potatoes
Company A	8 oz	32 oz
Company B	24 oz	48 oz

Company A:
To get one potato, you give up 1/4 meat.
Opportunity cost of potato = 1/4 meat.
Opportunity cost of meat = 4 potatoes.

Company B:
To get one potato, you give up 1/2 meat.
Opportunity cost of potato = 1/2 meat.
Opportunity cost of meat = 2 potatoes.

	Opp. Cost of Potato	Opp. Cost of Meat
Company A	¼ meat	4 potatoes
Company B	½ potato	2 potatoes

Company A produces potatoes at a lower opportunity cost than Company B.
Company A has **comparative advantage** in potatoes.
Company A should specialize in potatoes.

Company B produces meat at a lower opportunity cost than Company B.
Company B has **comparative advantage** in meat.
Company B should specialize in meat.

<u>How much should they trade?</u>

1 Meat = 4 Potatoes for Company A
1 Meat = 2 Potatoes for Company B

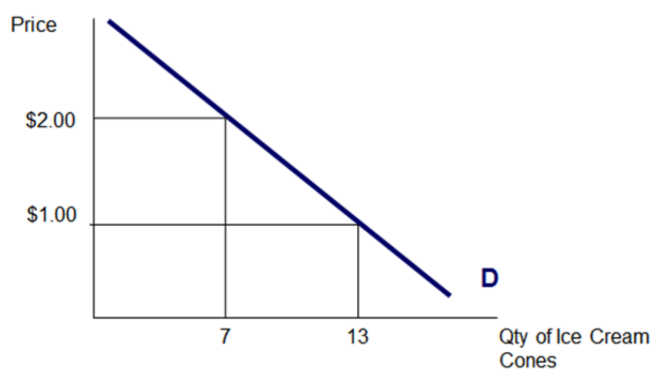
Therefore 1 meat should be traded for every 3 potatoes.
Which is totaled at 5 meat from Company A for 15 potatoes from Company B.

Company B produces more potatoes than Company A.
Company B also produces more potatoes than Company A.
Therefore, Company B has an **absolute advantage** in both potatoes and meat.

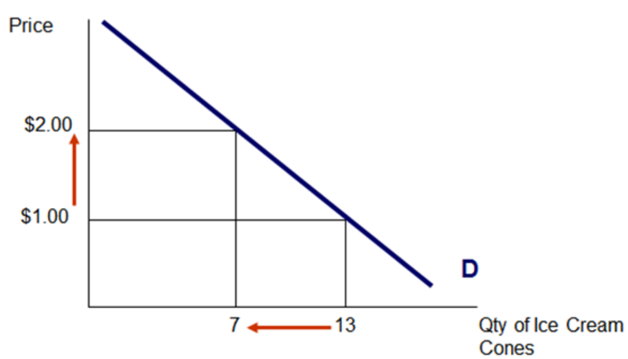
Chapter 4 – Market Forces of Supply and Demand

Price	Kylie's Qd	Jack's Qd	Market D
$0.00	12	7	19
$0.50	10	6	16
$1.00	8	5	13
$1.50	6	4	10
$2.00	4	3	7
$2.50	2	1	3

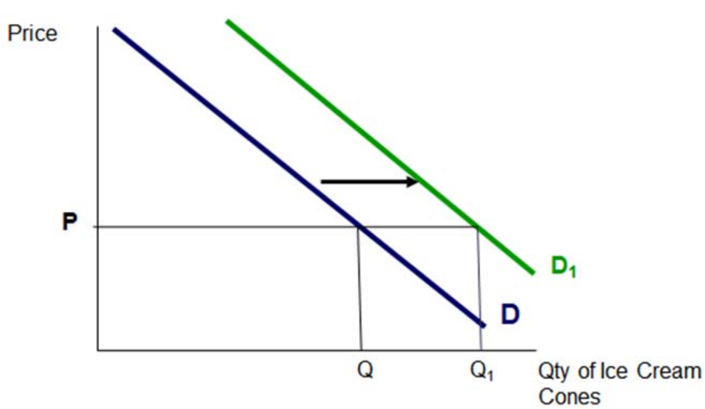
Note: **Qd** is Quantity Demanded and **D** is Demand
Market Demand is TOTAL Quantity Demanded



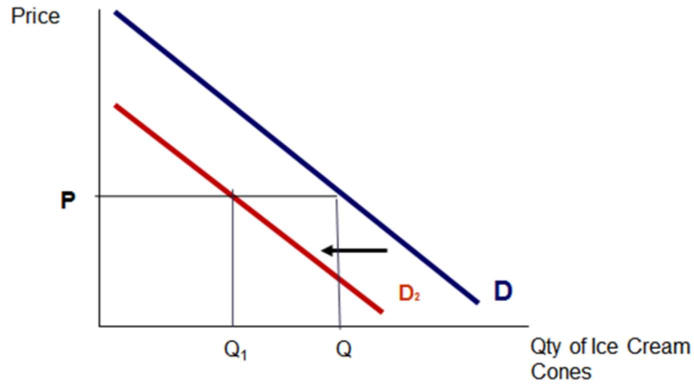
A change in price shifts along the curve, it does not move the curve.



Increase in Demand:

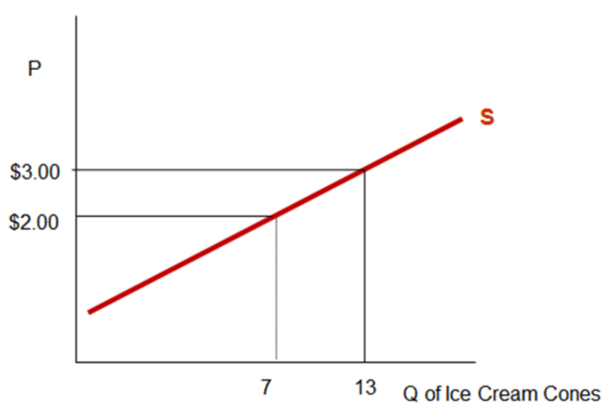


Decrease in demand:

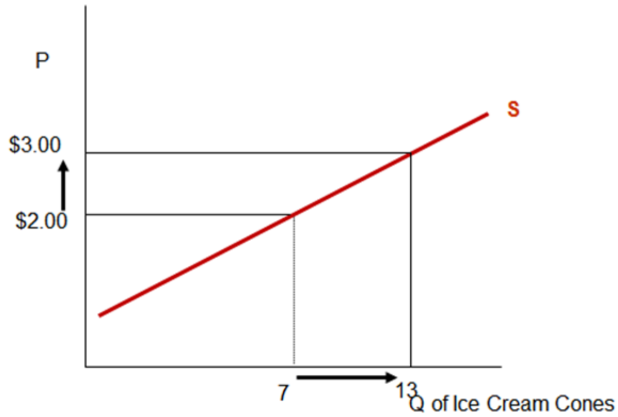


Price	Kylie's Qs	Jack's Qs	Market S
$0.00	0	0	0
$0.50	0	0	0
$1.00	1	0	1
$1.50	2	2	4
$2.00	3	4	7
$2.50	4	6	10
$3.00	5	8	13

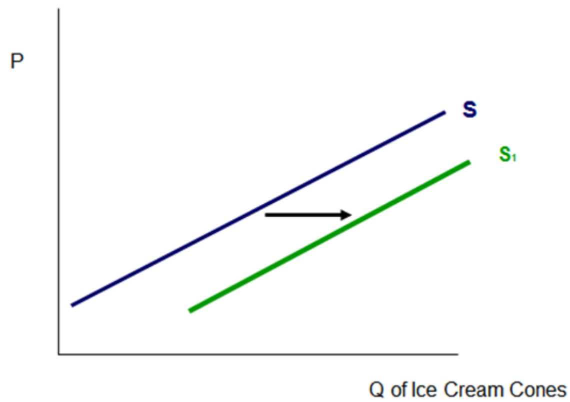
Note: **Qs** is Quantity Supplied and **S** is Supply
Market Supply is TOTAL Quantity Supplied



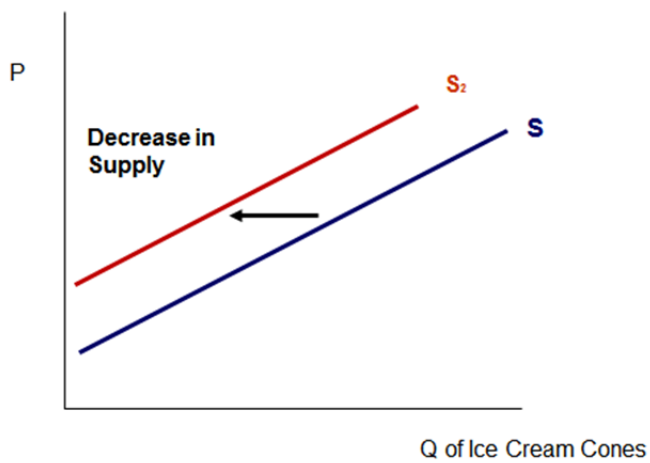
A change in price moves along the curve, it does not move the curve.



Increase in Supply

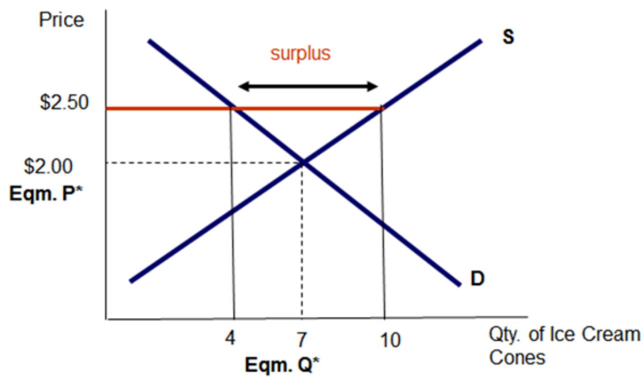


Decrease in Supply

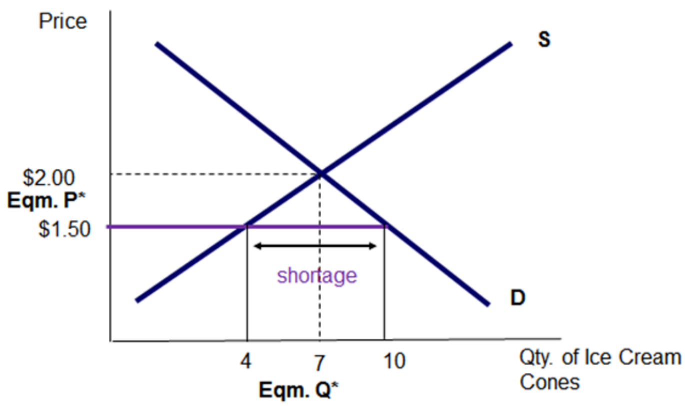


Equilibrium price occurs when the Qd = Qs.
In this market, at $2.00 the Qd = Qs = 7.
So the equilibrium price is $2.00.

Note: If the price chosen is above equilibrium, there will be a surplus.



If the price chosen is below equilibrium, there will be a shortage.



If given equations, such as:
Qd = 1600 – 300P
Qs = 800 + 700P

Equilibrium is when Qd = Qs.
1600 – 300P = 800 + 700P
P = 0.80

If price chosen causes a shortage/surplus:
Excess Demand (Shortage) = Qd – Qs
Excess Supply (Surplus) = Qs – Qd
Plug in the price chosen to find out the amount of surplus or shortage.

Chapter 5 – Elasticity

Ep is Price Elasticity

$$Ep = \frac{\text{percentage change in Qd}}{\text{percentage change in P}} = \frac{\%\ \triangle \text{ in Qd}}{\%\triangle\ \text{ in P}}$$

If Ep < 1, you have inelastic demand.
If Ep > 1, you have elastic demand.

Perfectly Inelastic Demand is when Ep = 0.
Perfectly Elastic Demand is when Ep = infinity.
When Ep = 1, it is called Unit Elastic.

Example: The price of milk increases by 2% and Qd decreases by 0.5%.
Ep = -0.5/2 = -0.25

Midpoint Formula:

$$Ep = \frac{(Q_2 - Q_1) / ([Q_2 + Q_1] / 2)}{(P_2 - P_1) / ([P_2 + P_1] / 2)}$$

Point Elasticity Formula:

$$Ep = dQ/dP * P/Q$$

Example:
Demand is Qd = 200 – 3P
What is point elasticity at $15?

Slope = –3
At P = 15, Qd = 155 (plugged in P)
Ep = (-3)(15/155) = -0.29

<u>Total Revenue</u>

$$TR = P * Q$$

TR will increase if demand is inelastic.
TR will decrease if demand is elastic.
TR will be at a maximum when Ep = 1.

Income Elasticity

$$E_I = \frac{\%\triangle \text{ in Qd}}{\%\triangle \text{ in I}}$$

Midpoint Formula:

$$E_I = \frac{(Q_2 - Q_1) / ([Q_2 + Q_1] / 2)}{(I_2 - I_1) / ([I_2 + I_1] / 2)}$$

If $E_I > 0$, the good is a normal good.
If $E_I < 0$, the good is an inferior good.

If $-1 < E_i < 1$, then the good is income inelastic.
If $E_I > 1$ or $E_i < -1$, the good is income elastic.

Cross-Price Elasticity

$$E_{ab} = \frac{\%\triangle \text{ in Qd of good ``a''}}{\%\triangle \text{ in P of good ``b''}}$$

Midpoint Formula:

$$E_{ab} = \frac{(Q_{2a} - Q_{1a}) / (Q_{2a} + Q_{1a}) / 2}{(P_{2b} - P_{1b}) / (P_{2b} + P_{1b}) / 2}$$

If $E_{ab} < 0$, the goods are substitutes.
If $E_{ab} > 0$, the goods are complements.

Supply

$$Es = \frac{\%\triangle \text{ in Qs}}{\%\triangle \text{ in P}}$$

Midpoint Formula:

$$Es = \frac{(Q_2 - Q_1) / ([Q_2 + Q_1] / 2)}{(P_2 - P_1) / ([P_2 + P_1] / 2)}$$

Point Elasticity Formula:

$$Es = dQ/dP * P/Q$$

Perfectly Inelastic Supply: Es = 0
Inelastic Supply: 0 < Es < 1
Elastic Supply: Es > 1
Perfectly Elastic Supply: Es = infinity
Unit Elastic Supply: Es = 1

Chapter 6 – Price Control and Taxes

Price Ceiling Example:
Equations for an apartment are as follows:

Qd = 1700 – 2P
Qs = 2P – 900

In Equilibrium, Qd = Qs.
1700 – 2P = 2P – 900
P = 650

Qd = 1700 – 2(650)
Qd = 400 = Qs

What if the province imposes a rent ceiling of $500?

Qd = 1700 – 2(500) = 700
Qs = 2(500) – 900 = 100

Shortage = Qd – Qs = 600

Price Floor Example:
Equations for the labour market are as follows:
W is wage (price of labour) measured in 1000's of hours.

Qd = 22 – 2W
Qs = 3W – 18

In Equilibrium, Qd = Qs.
22 – 2W = 3W – 18
W = 8

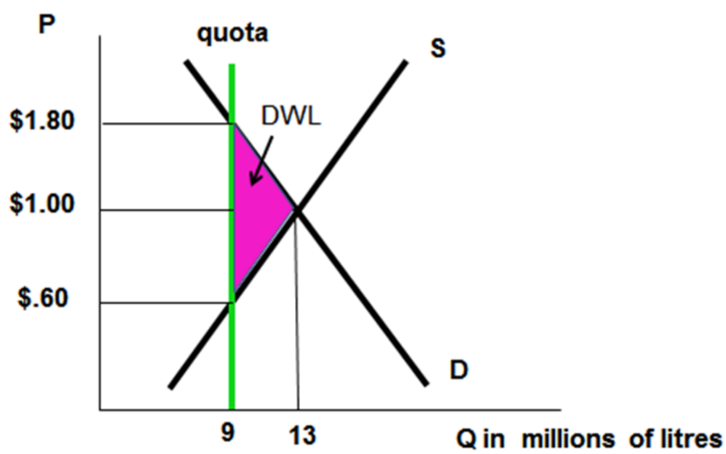
Qd = 22 – 2(8)
Qd = 6 = Qs (6000 hours)

What if the province imposes a minimum wage of $10 per hour?

Qd = 22 – 2(10) = 2 (2000 hours)
Qs = 3(10) – 18 = 12 (12000 hours)

Surplus = Qs – Qd = 10 (10000 hours)

<u>Quota Example:</u>
Equilibrium price = $1 and Q = 13 million litres of milk per week.
A quota is set at 9 million litres per week.
At Q = 9, consumers are willing to pay $1.80. But normally, at that Q, producers would be happy to receive $0.60 per litre.



DWL is Dead Weight Loss.

Therefore the **value** of the quota is $1.20 per litre per week.

<u>Tax on Consumers Example:</u>
In equilibrium, P = $3.00 and Q = $100
Suppose the government imposes a tax of $0.50 on the **consumers**.
The new equilibrium is at P = $2.80 and Q = 90.

New price for consumers is Pc = $3.30
New revenue for producers is Pf = $2.80.
The government makes:
$0.50 * 90 = $45.00

After the tax…
Consumers pay $0.30 more per bottle.
Sellers receive $0.20 less per bottle.
Therefore, consumers have the higher burden.

<u>Tax on Suppliers Example:</u>
In equilibrium, P = $3.00 and Q = $100
Suppose the government imposes a tax of $0.50 on the **producers**.
The new equilibrium is at P = $3.30 and Q = 90.

New price for consumers is Pc = $3.30.
New revenue for producers is Pf = $2.80. (They receive $3.30 and pay $0.50 to government.)

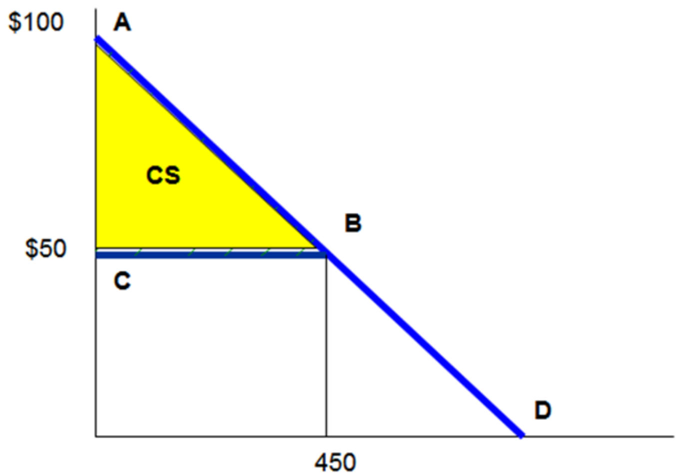
The government makes:
$0.50 * 90 = $45.00

Consumers pay $0.30 more.
Sellers receive $0.20 less.
Therefore, consumers STILL have the higher burden.

Note: Tax on Consumers or Suppliers has the same effect in the end!

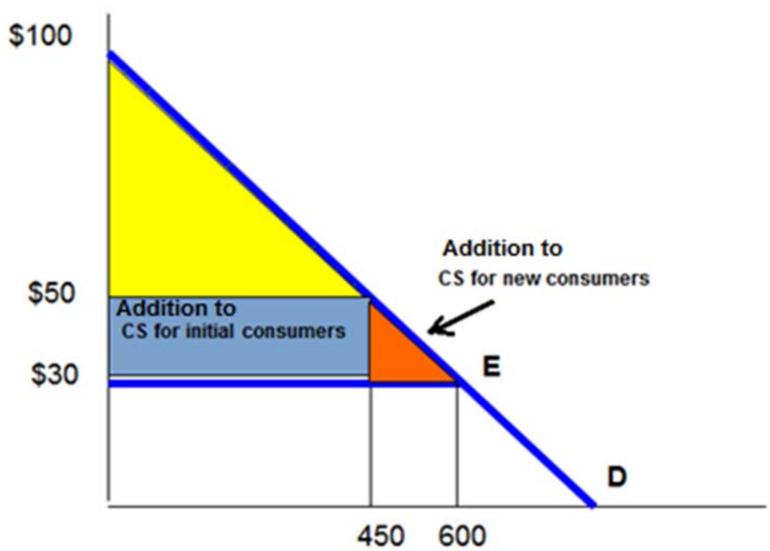
Chapter 7 – Consumer/Producer Surplus

Consumer Surplus:

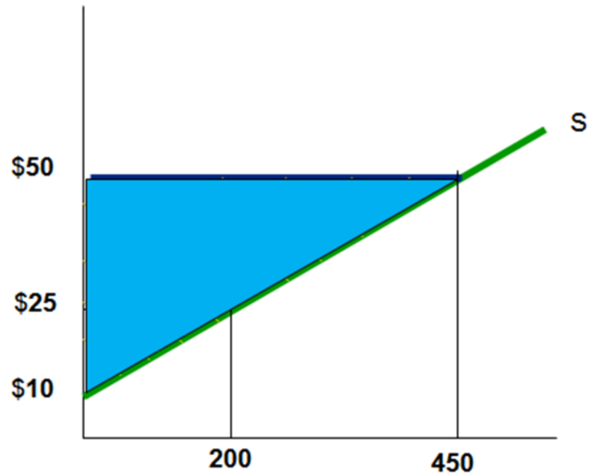


Consumer Surplus = ½*(bh)
CS = ½*450*50
CS = $11,250

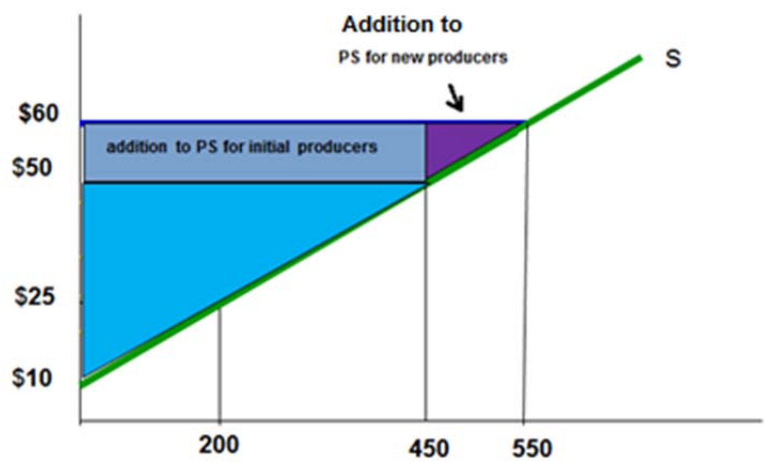
After the price changes…



Producer Surplus:

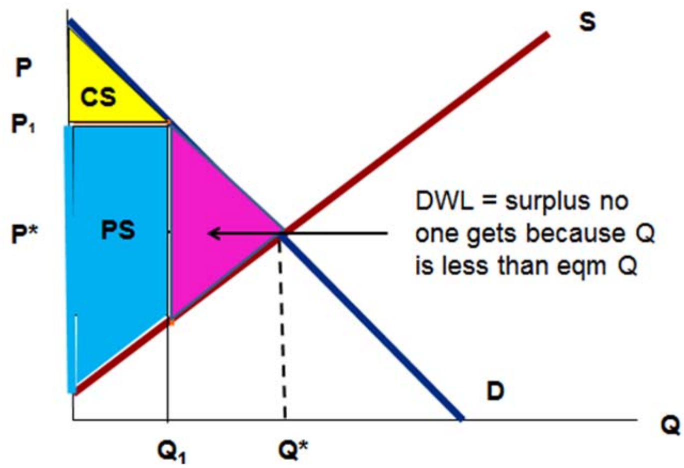


Producer Surplus = ½*(bh)
PS = ½*(450)*(40)
PS = $9000



Total Surplus = CS + PS

Deadweight Loss:



Chapter 8 – Deadweight Loss from Taxes

Example:
This is the market for pizzas:
Qd = 20 – 2P
Qs = P – 1

In Equilibrium, Qd = Qs.
20 – 2P = P – 1
P = $7
Q = 6 (Plug P into Qd *or* Qs)

Now suppose there is a $3 per pizza tax.
The new supply curve is:
Qs = P – 4 (Qs = P – 1 – 3)

New equilibrium:
Qs = Qd
P – 4 = 20 – 2P
Pc = $8
Q = 4 (Plug P into new Qs *or* Qd)

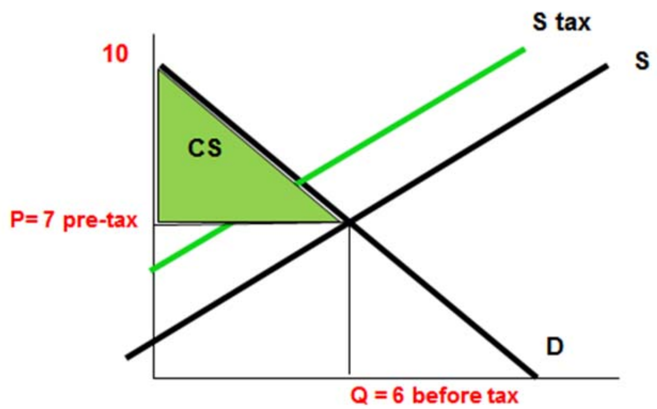
Now substitute Q = 4 into the ***old*** Qs.
Qs = P – 1
4 = P – 1
Pf = $5

Therefore, consumers pay $8 and firms receive $5.
The government makes:
$3 * 4 = $12

Consumer Surplus/Deadweight Loss
Continuation from last example:

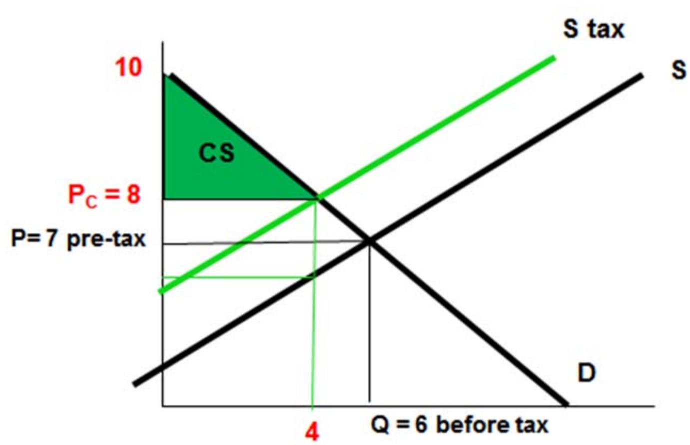
Set Qd = 0 to find the P-intercept. (Intercept along the Y-axis).
0 = 20 – 2P
P = 10

Consumer Surplus **Before Taxes**:



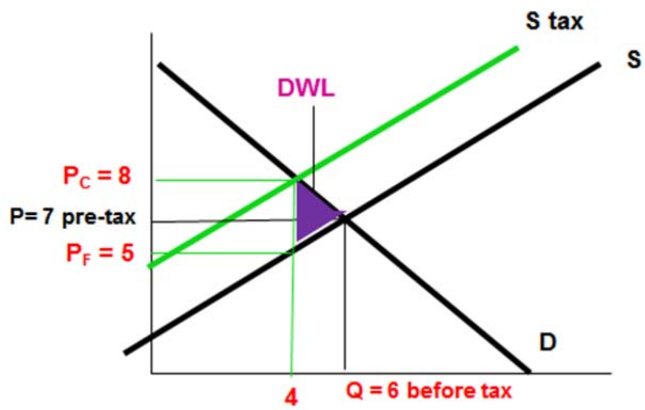
CS = ½ (3)(6)
CS = $9 before taxes

Consumer Surplus **After Taxes**:



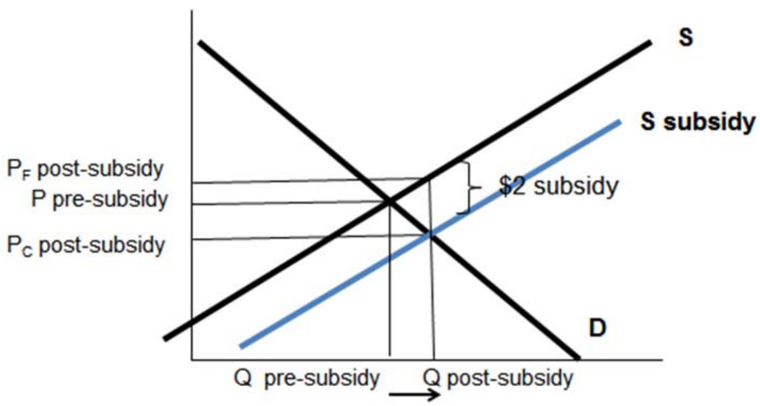
CS = ½ (2)(4)
CS = $4 after taxes

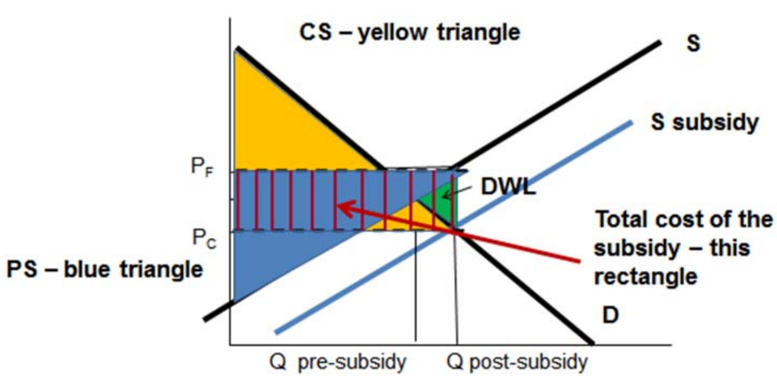
Deadweight Loss:



DWL = ½ (3)(2)
DWL = $3

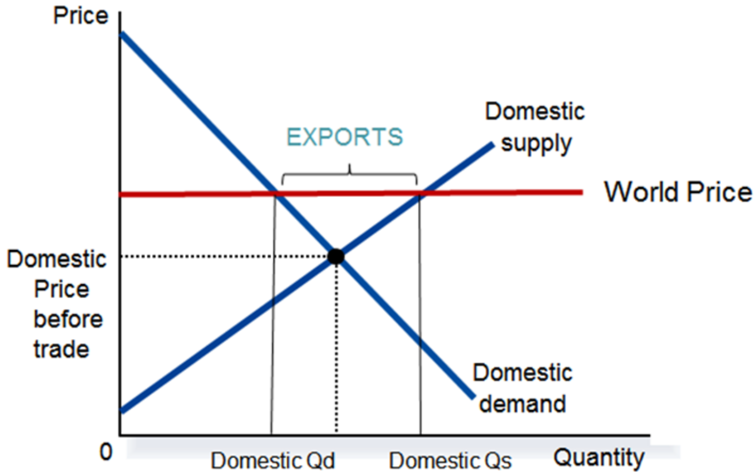
Subsidies:
Subsidies are the same as taxes, but in reverse.

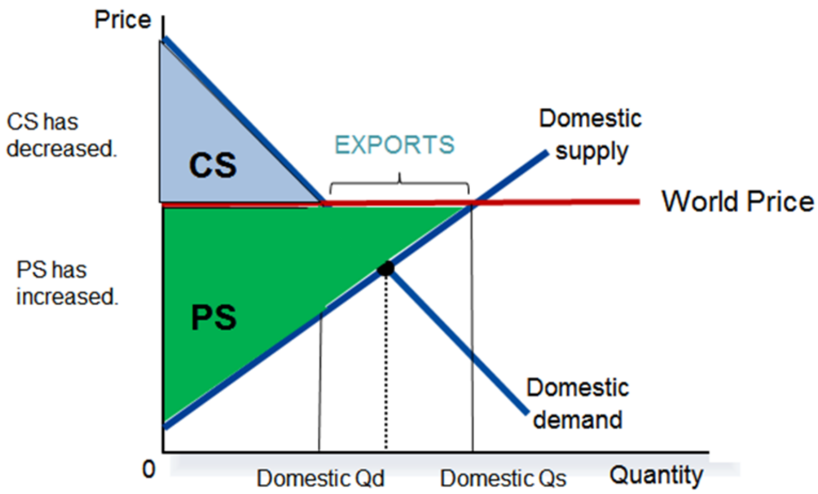




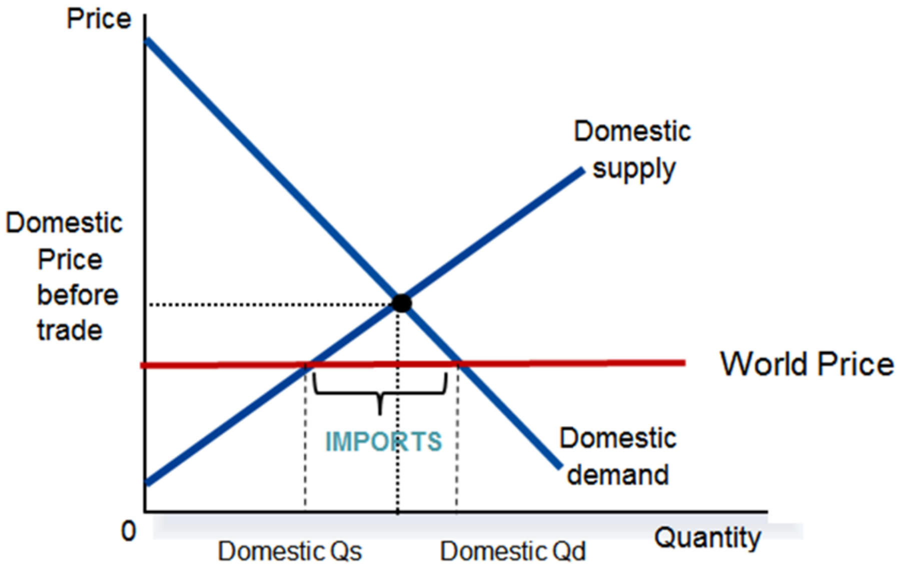
Chapter 9 – International Trade

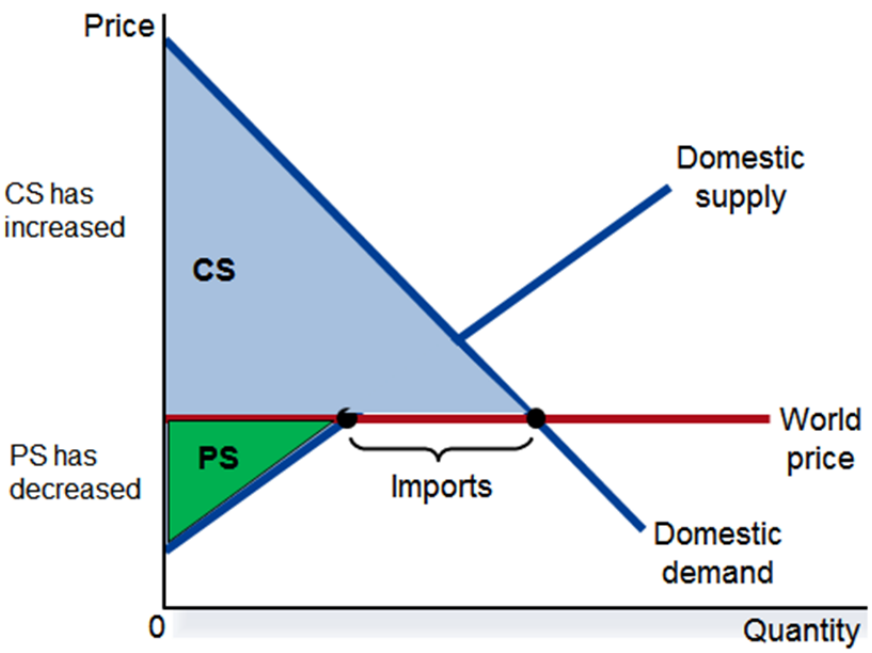
Exporting:



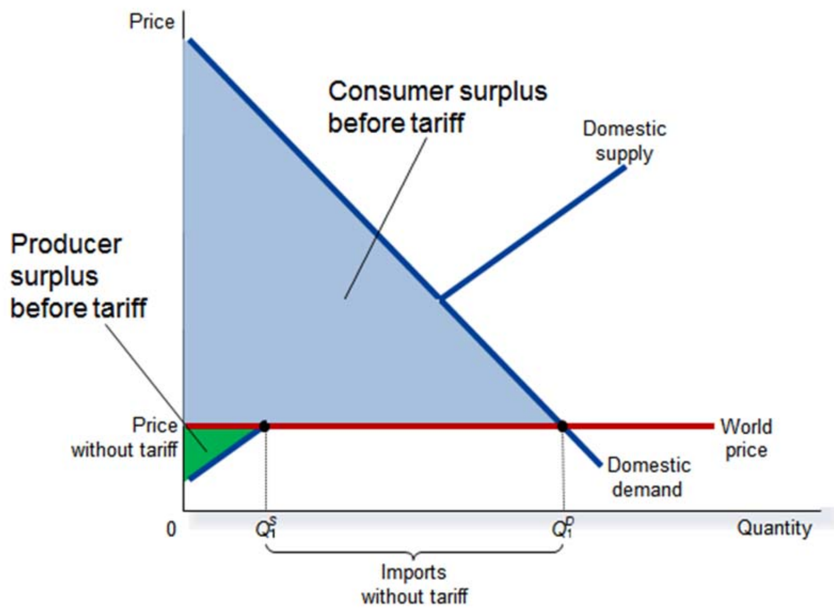


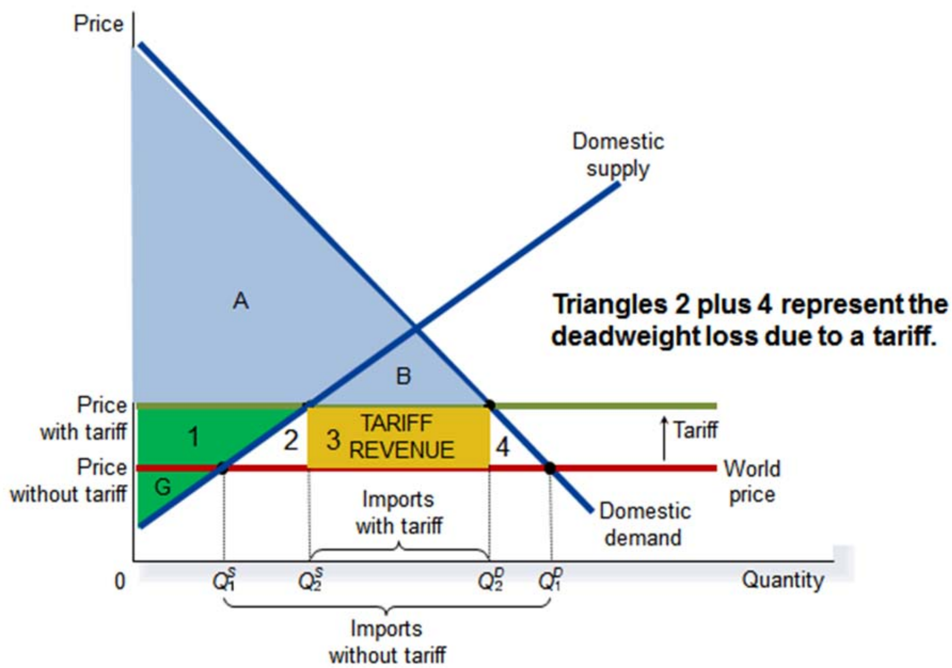
Importing:


Price
Domestic supply
Domestic Price before trade
World Price
IMPORTS
Domestic demand
0
Domestic Qs
Domestic Qd
Quantity

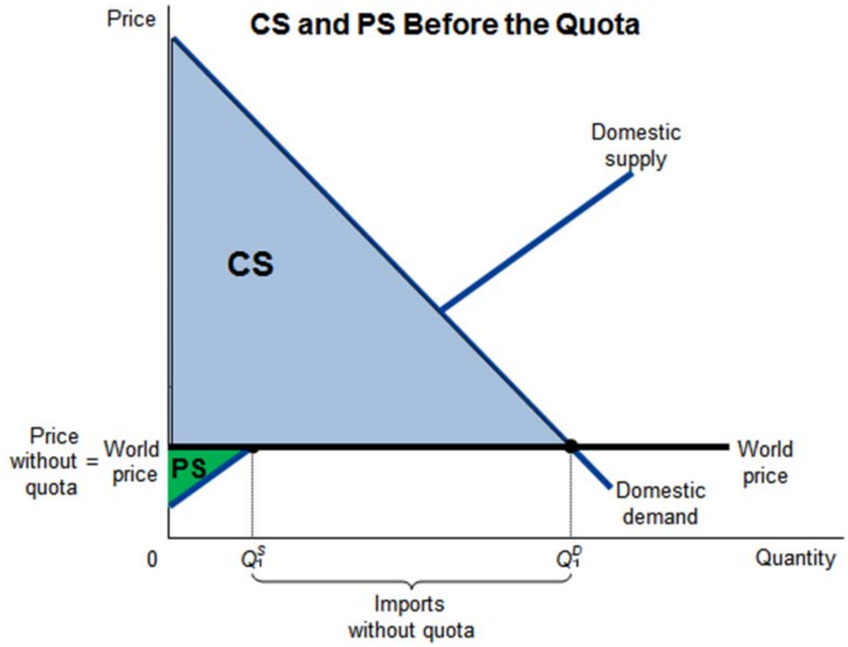

Price
Domestic supply
CS has increased
CS
World price
PS has decreased
PS
Imports
Domestic demand
0
Quantity

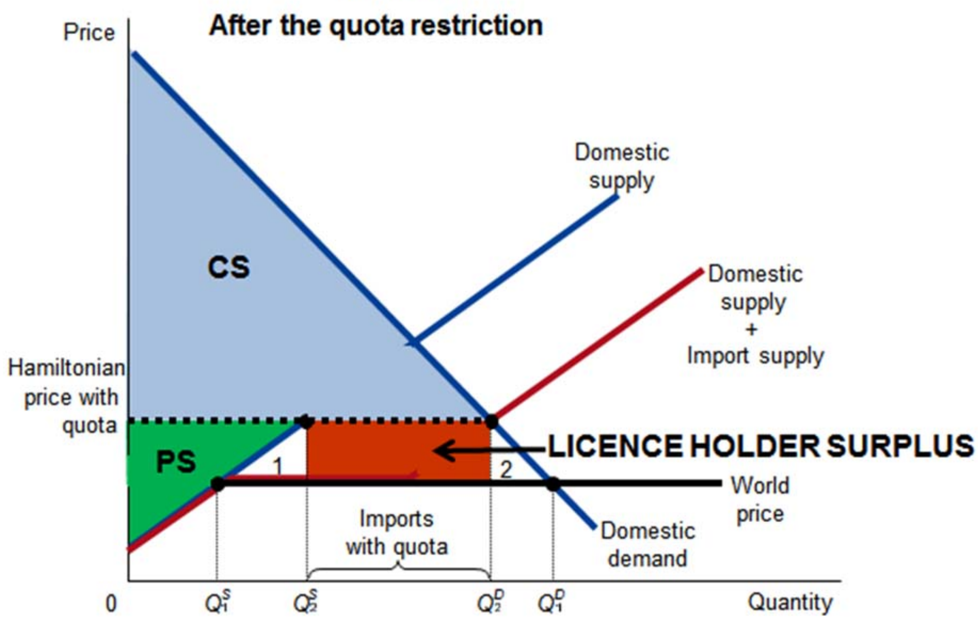
<u>Tariffs:</u> (Taxes on Imports)





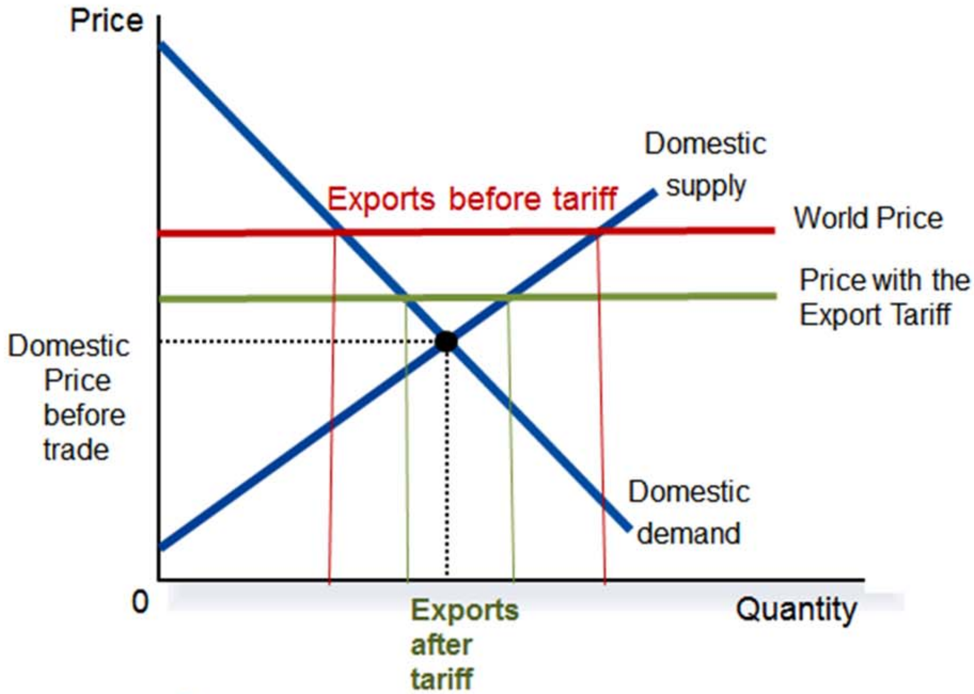
Import Quotas:

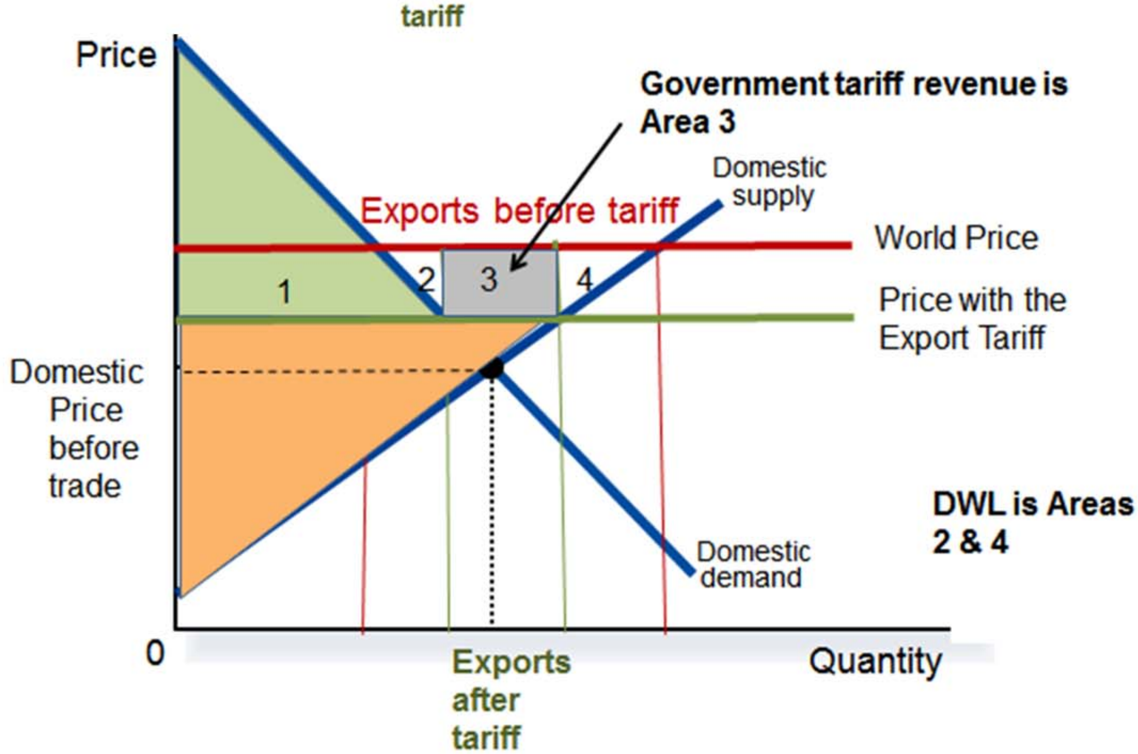




Triangle 1 and 2 represent deadweight loss.

Export Tariff:





Chapter 11 – Public Goods

Excludability: People can be prevented from using the good or service.
Example: You can't attend a NFL game without a ticket.
Rivalry: One person's use of a good takes away that use from another person.
Example: If you park in a free spot, you take up space that someone else could want.

There are 4 types of goods:

- Private Goods – Both excludable and rival.
    - i.e. Chocolate Bar
- Public Goods – Neither excludable and nor rival.
    - i.e. Viewing Fireworks
- Common Resources – Rival but not excludable.
    - i.e. Fish in the Ocean
- Natural Monopoly Goods – Excludable but not rival.
    - i.e. Cable TV

Chapter 13 – Costs of Production

Profit = Total Revenue – Total Cost

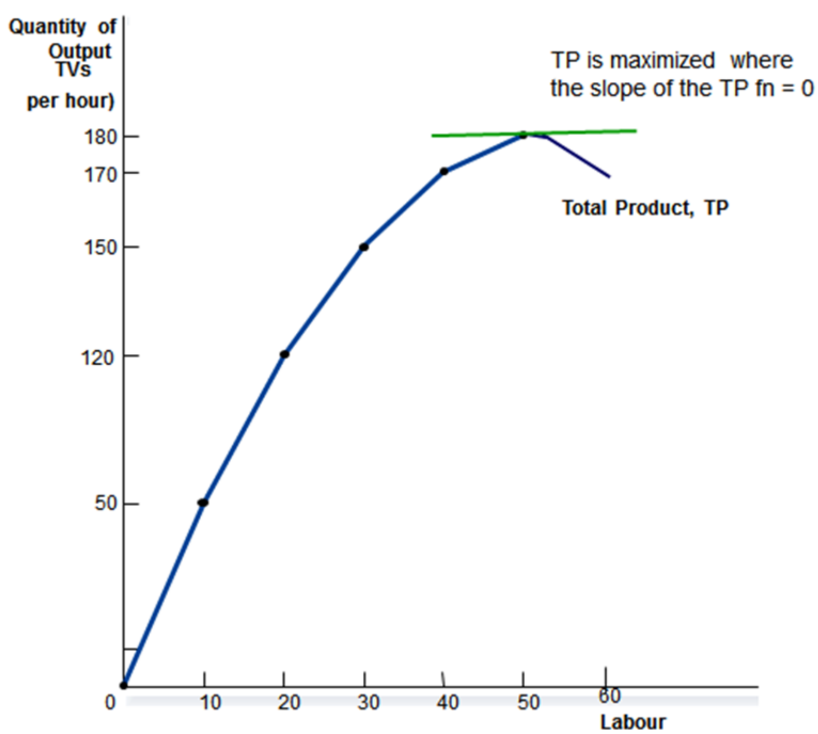
Costs of Production – all opportunity costs of making its output of goods and services.
Explicit Costs - costs that require a direct outlay of money by the firm.
Implicit Costs - costs that do not require an outlay of money by the firm.

Economic Profit - total revenue minus total cost, including both explicit and implicit costs.
Accounting Profit - total revenue minus only the firm's explicit costs.

The Production Function
The production function shows the relationship between quantity of inputs used to make a good and the quantity of output of that good.

Marginal Product - of any input in the production process is the increase in output that arises from an additional unit of that input.

$$MP = \frac{\text{change in total output}}{\text{change in \# of inputs}} = \frac{\Delta Q}{\Delta L}$$



Average Product - the quantity of output per input.

$$\text{Average Product, AP} = \frac{Q}{\#\text{ of inputs}}$$

Fixed Costs - costs that <u>do not</u> vary with the quantity of output produced.
Variable Costs - costs that <u>do vary</u> with the quantity of output produced.

Short Run, SR: the period of time in which at least one input into production is fixed.
Long Run, LR: the period of time in which all inputs into production can vary.

Total Cost = Total Fixed Cost + Total Variable Cost

$$TC = TFC + TVC$$

Marginal Cost - the increase in total cost that arises from an extra unit of production.

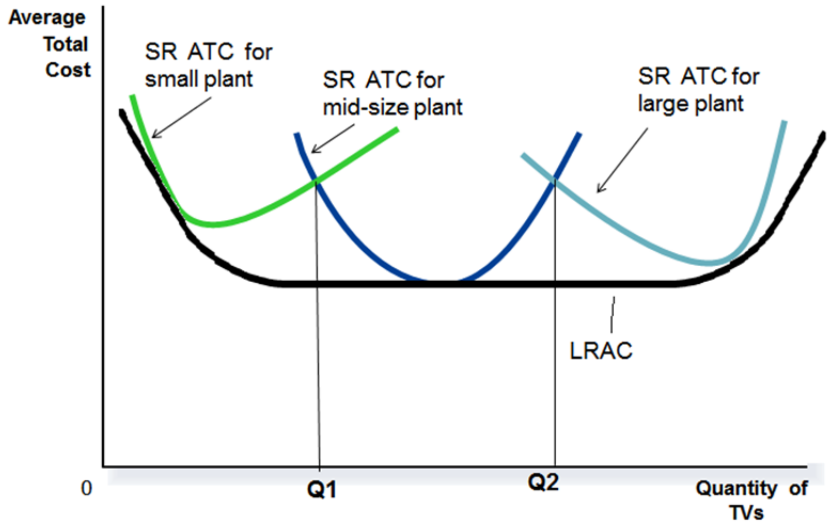
$$MC = \frac{\text{change in total cost}}{\text{change in total output}} = \frac{\triangle TC}{\triangle Q}$$

Example of Graph:
Note, certain columns would be empty.

Q	TFC	TVC	TC	MC	AFC	AVC	ATC
0	$200	$0	$200				
50	200	5000	5200	$100	$4	$100	$104
120	200	10000	10200	71	1.7	83	85
150	200	15000	15200	167	1.3	100	101
170	200	20000	20200	250	1.2	118	119
180	200	25000	25200	500	1.1	139	140

<u>Costs in Long Run and Short Run</u>

Because many costs are fixed in the short run but variable in the long run, a firm's long-run cost curves differ from its short-run cost curves.



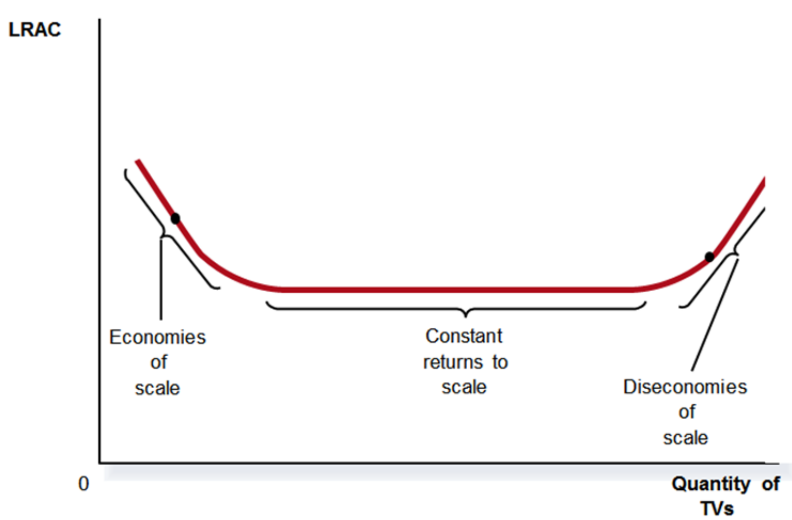
Economies of scale, EOS: long-run average total cost falls as Q h.

- Also called increasing returns to scale (IRS) or scale economies

Diseconomies of scale, DOS: long-run average total cost rises as Q h.

- Also called decreasing returns to scale (DRS)

Constant returns to scale, CRS: long-run average total cost stays the same as Q h.



Different Explanation:

- IRS: if you increase inputs by some factor X, you get more than an X increase in output.
- CRS: if you increase inputs by some factor X, you get exactly an X increase in output.
- DRS: if you increase inputs by some factor X, you get less than an X increase in output.

Recap of Terms:

Term	Definition	Mathematical Description
Explicit costs	Costs that require an outlay of money by the firm	—
Implicit costs	Costs that do not require an outlay of money by the firm	—
Fixed costs	Costs that do not vary with the quantity of output produced	FC
Variable costs	Costs that do vary with the quantity of output produced	VC
Total cost	The market value of all the inputs that a firm uses in production	$TC = FC + VC$
Average fixed cost	Fixed costs divided by the quantity of output	$AFC = FC/Q$
Average variable cost	Variable costs divided by the quantity of output	$AVC = VC/Q$
Average total cost	Total cost divided by the quantity of output	$ATC = TC/Q$
Marginal cost	The increase in total cost that arises from an extra unit of production	$MC = \Delta TC/\Delta Q$

Chapter 14 – Perfect Competition

- There are many buyers and sellers in the market.
- The goods offered by the various sellers are homogeneous (identical).
- Firms can freely enter or exit the market.
- There are no barriers to entry such as patents, exclusive rights to a key input to production, etc.
- No one firm has any market power – no firm is big and powerful enough to control price.

Total Revenue: TR = P * Q

Average revenue (AR) - how much revenue a firm receives for the typical unit sold.

$$AR = \frac{TR}{Q} = \frac{PQ}{Q} = P$$

Marginal revenue (AR) - the change in total revenue from an additional unit sold.

$$MR = \Delta TR / \Delta Q$$

Golden Rule for a profit-maximizing firm:
For profit to be MAX, produce the quantity when…

$$MR = MC$$

Quantity (Q)	Total Revenue (TR)	Total Cost (TC)	Profit (TR – TC)	Marginal Revenue (MR = ΔTR/ΔQ)	Marginal Cost (MC = ΔTC/ΔQ)
0 gallons	$ 0	$ 3	−$3		
				$6	$2
1	6	5	1		
				6	3
2	12	8	4		
				6	4
3	18	12	6		
				6	5
4	24	17	7		
				6	6
5	30	23	7		
				6	7
6	36	30	6		
				6	8
7	42	38	4		
				6	9
8	48	47	1		

A firm will shut down in the short run if P < AVC.

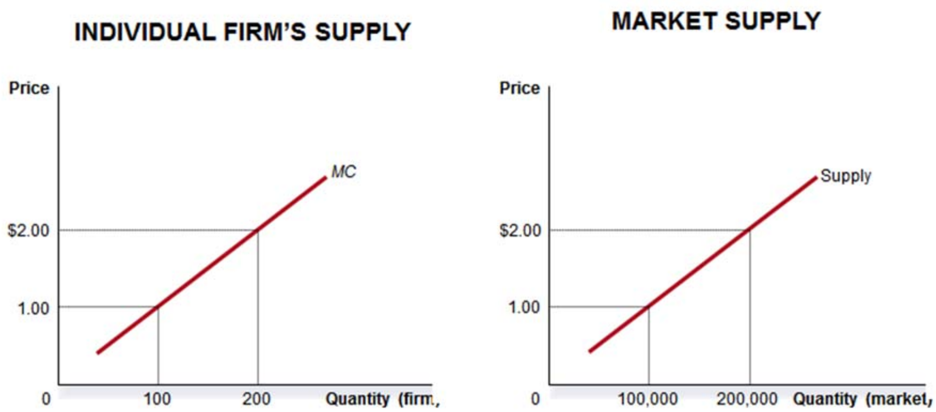
<u>Short Run Profit for a Firm</u>

$$\textbf{Profit } (\Pi) = (P - ATC)Q$$

- When P > ATC, a firm makes positive economic profit.
- When P < ATC, a firm makes negative economic profit, a loss.
- When P = ATC, a firm makes zero economic profit.

<u>Long Run Exit And Entry</u>

A firm will exit an industry if P < Min ATC.
A firm will enter an industry if P> Min ATC.



One firm supplies 200 at a price of $2.00

1000 firms supply 200 000 at a price of $2.00

Chapter 15 - Monopoly

A monopoly has 3 characteristics:

- Only seller of a certain product.
- Product does not have close substitutes.
- Not free for entry.
- The firm is a **price setter**.

Total Revenue:

$$P*Q = TR$$

Average Revenue:

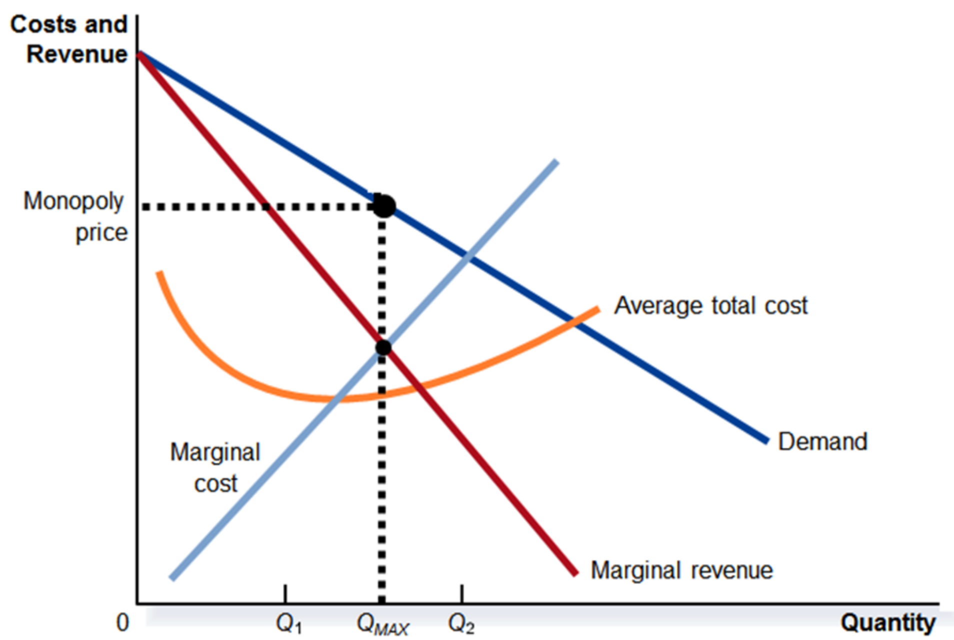
$$TR/Q = AR = P$$

Marginal Revenue:

$$\Delta TR / \Delta Q = MR$$

A monopoly would always choose to produce a Q such that:

$$MR = MC < P$$

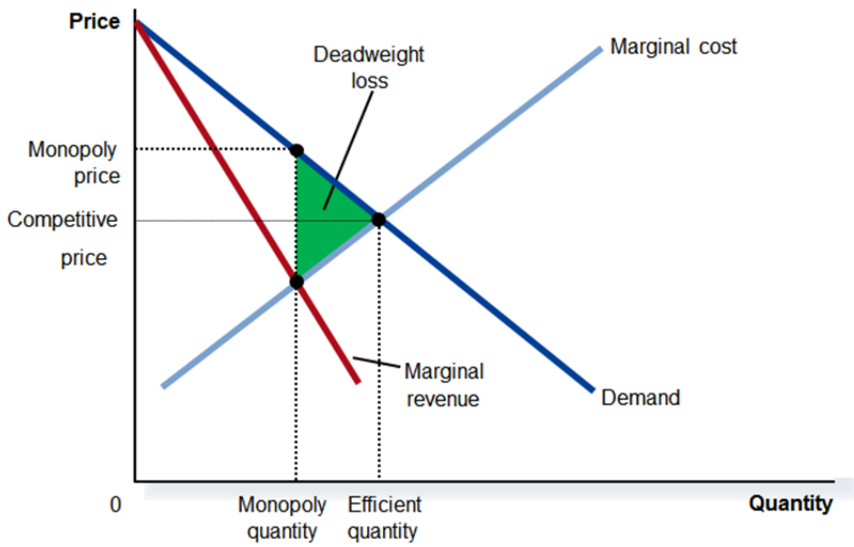


$$\Pi = TR - TC \quad \text{so}$$

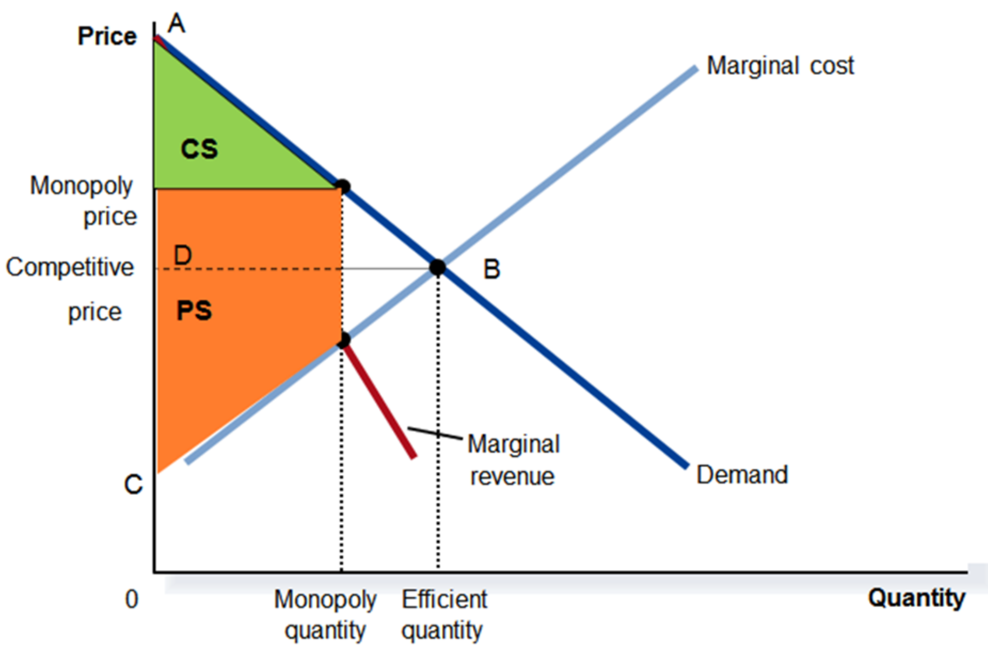
$$\Pi = (P - ATC)*Q$$

Monopolies have lower quantities than perfect competitions.
But monopolies have higher prices than perfect competitions.

Deadweight Loss in Monopoly



Consumer/Producer Surplus in Monopoly



Notice that in a competitive market, PS and CS are switched!!

<u>Monopoly Example:</u>
Here is information about a monopoly:

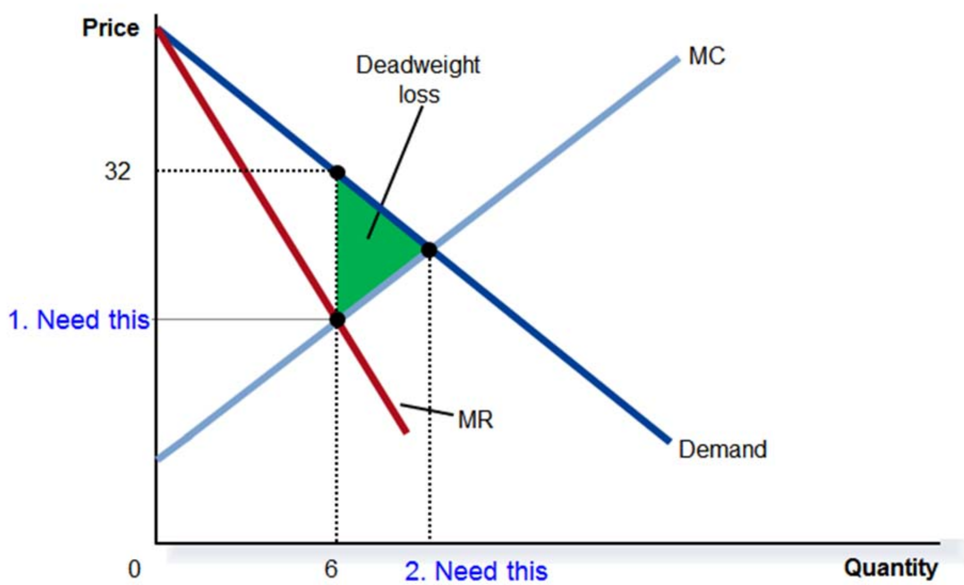
Demand = P = 50 – 3Q
MR = 50 – 6Q
MC = 8 + Q
ATC = 20

What are the monopoly's profits (π)?
MR = MC
50 – 6Q = 8 + Q
Q = 6

P = 50 – 3(6) (Sub Q=6 into Demand Equation.)
P = 32

π = (P – ATC)Q
π = (32 – 20)(6)
π = $72

What is the deadweight loss?



For #1.	For #2.
At Q = 6 MC = 8+6 = 14	Set MC = D 8 + Q = 50 – 3Q Q = 10.5

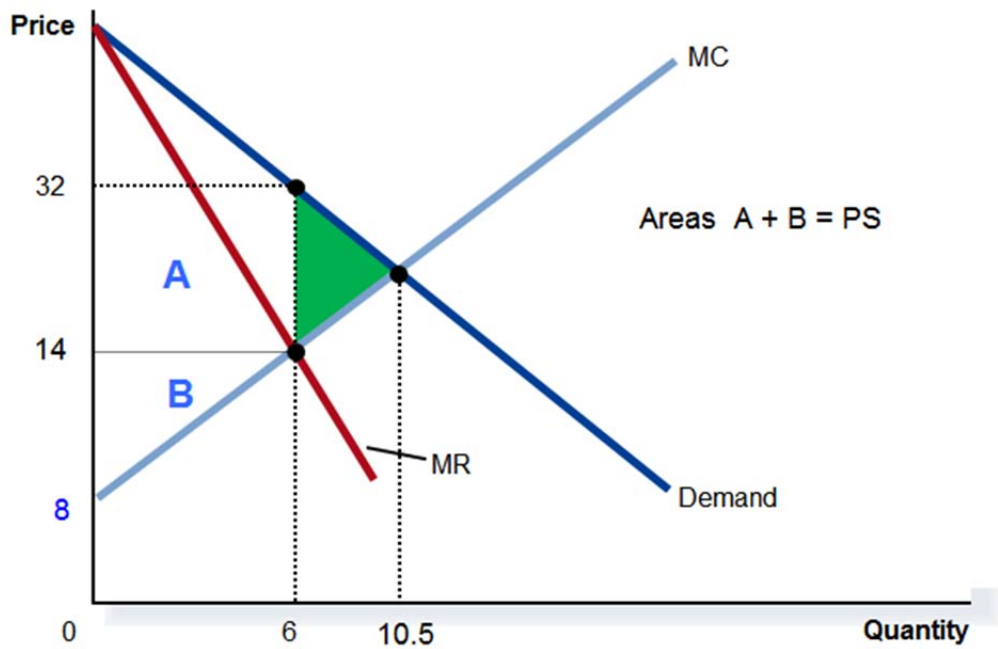
DWL = ½(4.5)(18)
DWL = $40.50

If this was a competitive market, what would the price be?
Find P at MC = D. We already have Q = 10.5.
Sub Q = 10.5 into D or MC.

MC = 8 + 10.5
MC = 18.5 = P in competition

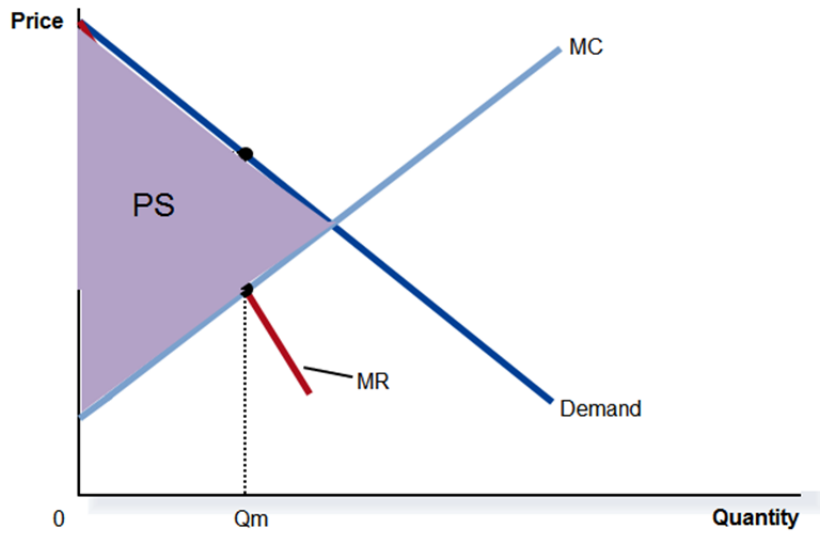
What is the Producer Surplus?

Set Qd = 0 to find the P-intercept. (Intercept along the Y-axis).
MC = 8 + 0
MC = 8



PS = A + B
PS = 18(6) + ½(6)(6)
PS = $126

<u>With Perfect Price Discrimination:</u>



Extra Note: The monopolist does not have a supply curve!

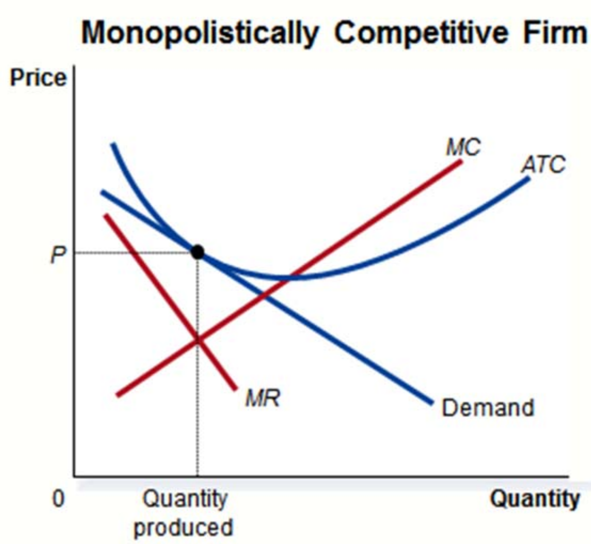
Chapter 16 – Monopolistic Competition

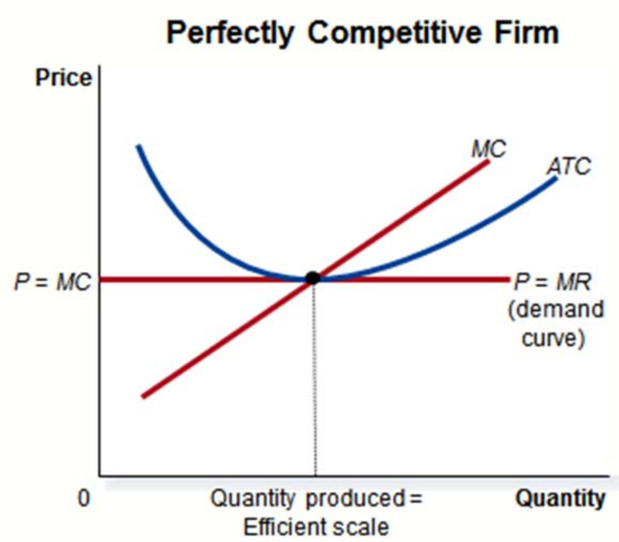
Characteristics of a monopolistic competition:

- Many sellers.
- Each firm's product is slightly different than other firms.
- Free entry/exit.
- Somewhat price setters.

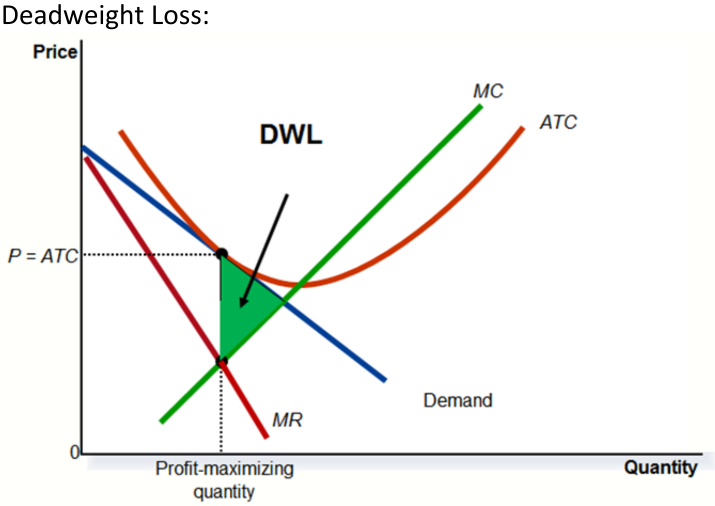
A monopolistically competitive firm will produce where MC = MR and charge a price based on demand.
A monopolistically competitive firm is just like a monopoly in the short run.

Firms make zero economic profits when P = ATC.
Like a monopoly, P > MC.
Like a competitive market, P = ATC in the long run.
Unlike competitive markets, firms produce at a level of Q where ATC is above the minimum ATC.





Deadweight Loss:



	Market Structure		
	Perfect Competition	Monopolistic Competition	Monopoly
Features that all three market structures share			
Goal of firms	Maximize profits	Maximize profits	Maximize profits
Rule for maximizing	$MR = MC$	$MR = MC$	$MR = MC$
Can earn economic profits in the short run?	Yes	Yes	Yes
Features that monopoly and monopolistic competition share			
Price taker?	Yes	No	No
Price	$P = MC$	$P > MC$	$P > MC$
Produces welfare-maximizing level of output?	Yes	No	No
Features that perfect competition and monopolistic competition share			
Number of firms	Many	Many	One
Entry in long run?	Yes	Yes	No
Can earn economic profits in long run?	No	No	Yes

Chapter 17 - Oligopoly

Characteristics of an oligopoly:
- Few sellers, usually big firms.
- Nearly identical products.
- Interdependent firms, one firm's decisions affects another firm's profits.

A **duopoly** is an oligopoly with only two members.

Duopoly Example:
Robin and Wills are the only two producers of clean drinking water in Thorold. Every Saturday they pump water at no cost to them and sell it to meet this schedule:

Quantity (in barrels)	Price	Total Revenue (and total profit since costs = 0)
0	$120	$ 0
10	110	1,100
20	100	2,000
30	90	2,700
40	80	3,200
50	70	3,500
60	60	3,600
70	50	3,500
80	40	3,200
90	30	2,700
100	20	2,000
110	10	1,100
120	0	0

The price and quantity in a **monopoly** market would be where total profit is maximized.
P = $60
Q = 60 Barrels
π = $3600

If Robin and Wills were cooperative, they would both settle on the monopoly outcome and split production at 30 barrels each and make a maximum profit of $1800.

If Robin cheats and produces 40 barrels, there will be a total of 70 barrels being produced at a market price of $50. Robin would make $2000.

However, Wills sees his profit decrease and starts cheating too by producing 40 barrels. There are now 80 barrels on sale for $40 each.

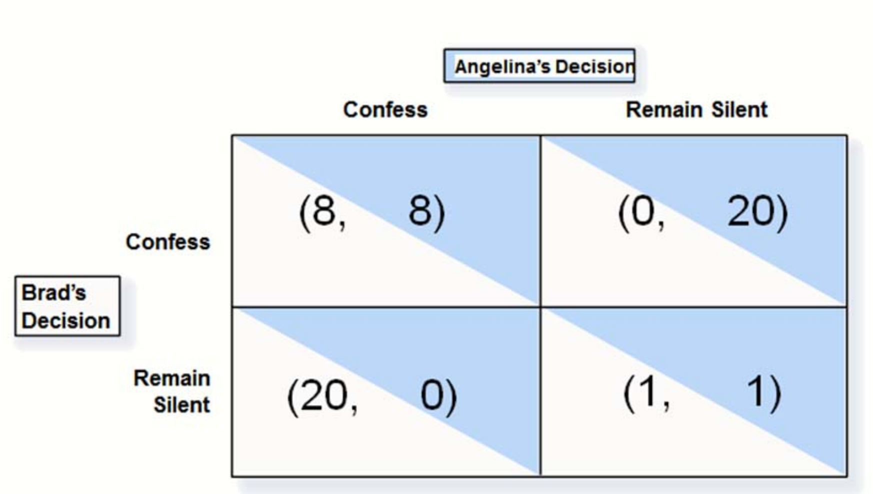
In the end, they both make a profit of $1600. If they stuck to the original plan, they would still be at $1800.

Comparing Monopoly (M), Oligopoly (O) and Perfect Competition (C):
$P_M > P_O > P_C$
$Q_C > Q_O > Q_M$

<u>Prisoner's Dilemma Example #1:</u>
Brad and Angelina have been caught on a weapons' charge – the sentence is one year.
They are also suspects in a bank robbery but there is not enough proof.
They are separated and given this option:

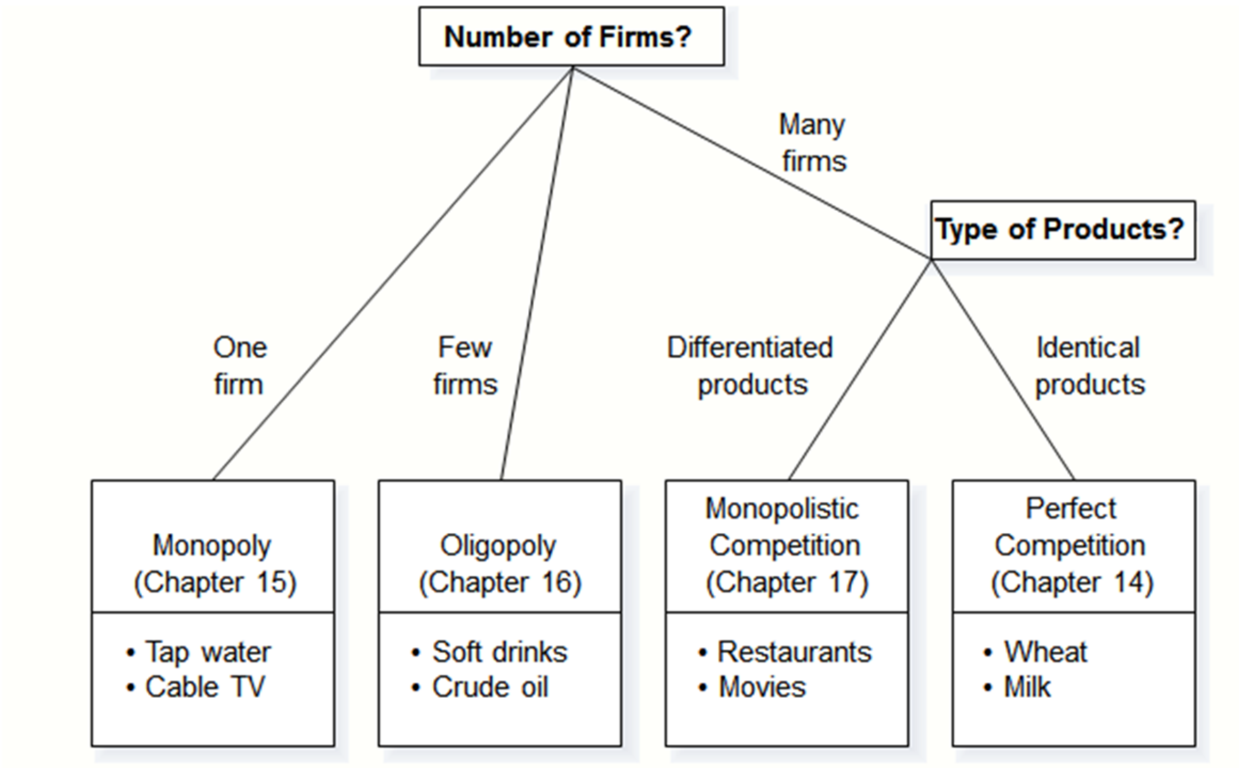
If you confess to the bank robbery and your partner doesn't, you are free and your partner gets 20 years.
If you both confess, you both get 8 years.
If neither of you say anything, you both get 1 year for the weapons' charge.

Payoff Matrix:



If Brad or Angelina want to have less years on their own, they should confess no matter what the other says. (8 instead of 20 or 0 instead of 1).
If they work as a team and do not confess, they would both get 1 for sure. It can be tough for people and firms to cooperate because of self-interest.

Four Types of Market Structures: A Summary



Chapter 18 – Factor Markets

Demand for Labour

A worker's contribution is the MP times selling price.

$$VMPL = P*MP_L$$

Example:
If a worker adds 5 pens to total output which sell for $2 each, she adds $10 to TR. Her VMPL is $10.

To maximize profits, a firm hires workers till

W = VMPL = $P*MP_L$

Example:
Brady's bottles sells plastic bottles in a competitive market at $0.50 per bottle. The firm hires labour at an hourly wage of $20.

L	Q	MP_L	VMPL	W
0	0			$20
1	90	90	$45	20
2	170	80	40	20
3	240	70	35	20
4	300	60	30	20
5	350	50	25	20
6	390	40	20	20
7	420	30	15	20

Therefore, Brady will only hire 6 workers.

Land and Capital
A firm will hire capital where:

$$r = P*MP_K$$

r = rental price of capital
K = amount of capital
P = price of selling good
This is the same for land and the MP of land.

<u>Worth of Money over Time</u>

Present Value is the amount of money needed to produce a given amount of money at a specific future date, according to the prevailing interest rate.

$$PV = \frac{X}{(1 + i)^{t}}$$

X = Amount you want to receive in period t
i = Prevailing Interest Rate

If you want an annual payment in addition to the money you receive in the future, you use coupon payments (C).

$$PV = \frac{C}{(1 + i)} + \frac{C}{(1 + i)^2} + \dots + \frac{C+X}{(1 + i)^t}$$

Note: Firms always will choose an investment that has the highest present value.

<u>Example:</u>
You want to have $100 in 5 years. The interest rate is 4%. (i = 0.04)

PV = 100 / $(1+0.04)^5$
PV = $82.24

If you invest $84.24 today, you'll have $100 in 5 years.

What if you wanted an additional payment of $10 per year?

$$PV = \frac{10}{(1 + .04)} + \frac{10}{(1 + .04)^2} + \frac{10}{(1 + .04)^3} + \frac{10}{(1 + .04)^4} + \frac{(10 + 100)}{(1 + .04)^5}$$

PV = $126.71

<u>Example 2:</u>
You need to pick between two technologies that cost $50,000.
Interest rate is 9% for the next 10 years.

Technology A has a 10-year lifetime and an expected VMPK of $8000 per year.
Technology B has a 9-year lifetime and an expected VMPK of $9000 per year.
Which technology do you buy?

For Technology A:

$$PV = \frac{8000}{(1+.09)} + \frac{8000}{(1+.09)^2} + \frac{8000}{(1+.09)^3} + \ldots + \frac{8000}{(1+.09)^{10}}$$

PV = $50,423.92

For Technology B:

$$PV = \frac{9000}{(1+.09)} + \frac{9000}{(1+.09)^2} + \frac{9000}{(1+.09)^3} + \ldots + \frac{9000}{(1+.09)^{9}}$$

PV = $53,957.23

You should choose technology B.

Note: If PV was less than $50,000, you would not buy the technology at all.

Chapter 21 – Consumer Theory

When consumers are satisfied from consumption, it is called **utility**.
As people use a certain product more and more, the utility for that product goes down.

Marginal Utility (MU)

$$MU = \Delta TU / \Delta Q$$

(TU = Total Utility)

Budget Constraint (BC)
The BC formula for 2 goods (X and Y) and N income is:

$$Px*X + Py*Y = N$$

The slope is $\frac{-Px}{Py}$.

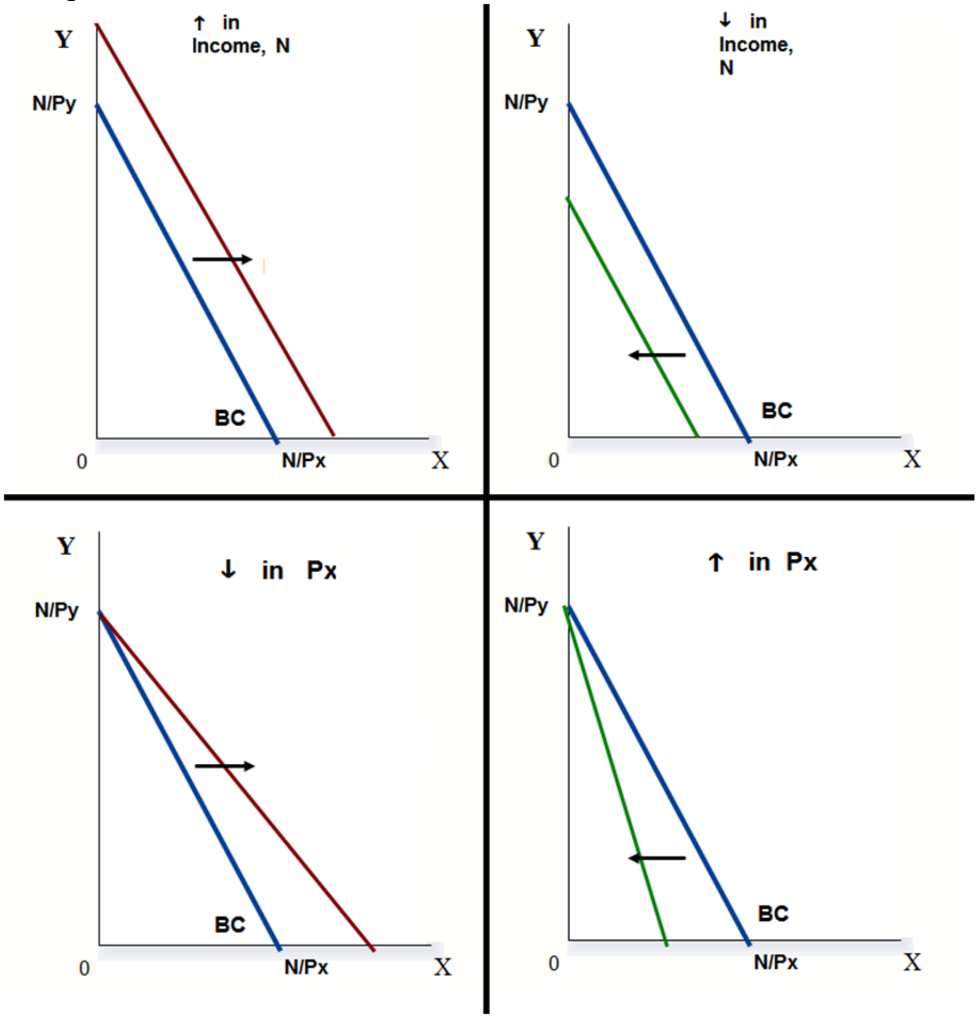
The x-intercept is N / Px.
The y-intercept is N / Py.

Example:
Ryan has an income of $50 which he can spend on pizza or wings.
P_{Pizza} = $10 per pizza
P_{wings} = $5 per lb.

Qp = Quantity of Pizza, Qw = Quantity of Wings
Therefore the BC is:
10Qp + 5Qw = 50

Px / Py is the **relative price** of two goods.

Changes to the BC



TU is maximized when $\frac{MUx}{Px} = \frac{MUy}{Py}$

Example:
Consider Good X and Good Y.
How much of each good should be consumed in order to maximize utility?

Good X P=4

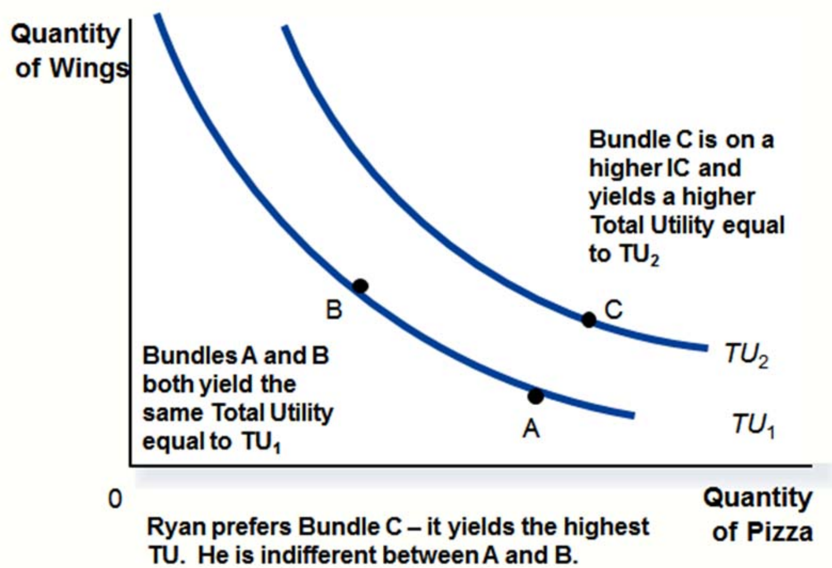
Q	MU	MUx/Px
		5
2	20	
3	14	(3.5)
4	9	2.25

Good Y P=5

Q	MU	MUy/Py
		4
4	20	
5	17.5	(3.5)
6	15	3

To maximize total utility, the consumer should buy 3X and 5Y.

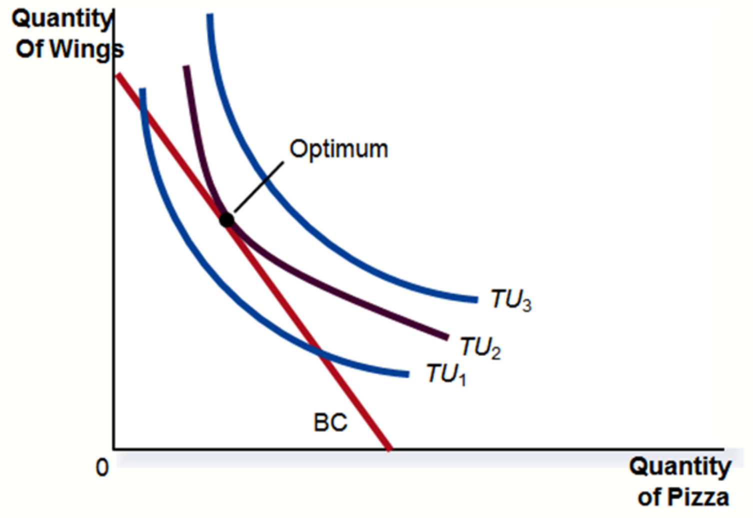
Consumers often prefer different bundles over others, shown as indifference curves (IC).



The slope of an Indifference Curve is called the Marginal Rate of Substitution (MRS).

$$MRS = \frac{MUx}{MUy}$$

When the BC curve is shown, anything over the BC curve is unaffordable.



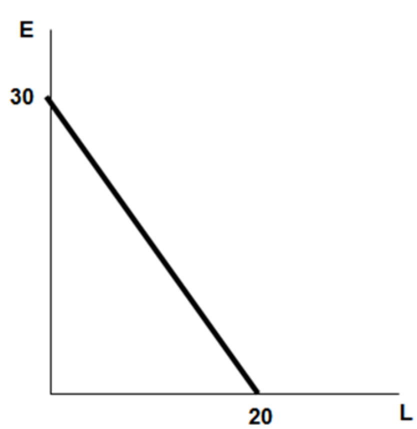
The optimal consumption occurs at:

$$\frac{MUx}{MUy} = \frac{Px}{Py}$$

Example:
Julie has an income of $120 that she can spend on various combinations of lipstick and eyeshadow.
Lipstick sells at P_L = $6
Eyeshadow sells at P_E = $4

What is the equation of Julie's BC?
Pl*L + Pe*E = N
6L + 4E = 120

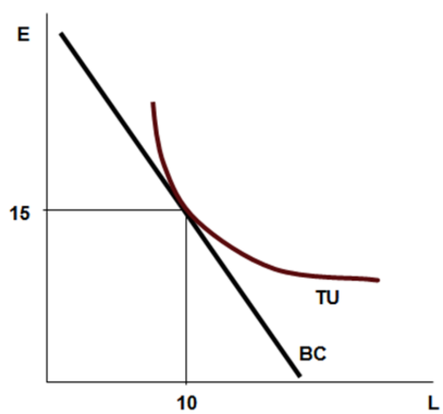
Draw her BC.
If she spends all her money on lipstick, she can buy 120/6 = 20 lipsticks.
If she spends all her money on eyeshadow, she can buy 120/4 = 30 eyeshadows.



If Julie buys 10 lipstick and 10 eyeshadow, could this be her optimal consumption bundle?
6 * 10 + 4 * 10 = 100, less than her income
Therefore, no.

If Julie was maximizing her TU at 10 lipstick, how many eyeshadows would she be buying?
6*10 + 4E = 120
4E = 120
E = 15

Draw an IC that illustrates the above result.



What is the slope of her IC at this bundle?
|slope of IC| = MRS = P_L / P_E = 1.5

Suppose, at tangency, Julie's MU of lipstick is 2. What must her MU of her eyeshadow be?

$$\frac{MU_L}{MU_E} = \frac{P_L}{P_E}$$

2/MU_E = 1.5
2/1.5 = MU_E
MU_E = 1.33

Forgetting about Julie being at a tangency, if she was consuming such that her MU of lipstick was 6 and her MU of eyeshadow was 5, should she change her consumption?

For lipstick:	For eyeshadow:
MU / P	MU / P
= 6 / 6	= 5 / 4
= 1	= 1.25

She should consume more eyeshadow and less lipstick until MU per dollar spent are the same for each good.

A price change has two effects on consumption:

- Income Effect – price change moves the consumer to a higher or lower indifference curve
- Substitution Effect – price change moves the consumer along an indifferent curve to a point with a different marginal rate of substitution.