firm i's profit :

$$\pi_i = [a - (q_i + q_j) - c]\, q_i$$

objective of firm → maximize profit.

it must choose a strategy s.t.

$U_i(s_i^*, s_j^*) > U_i(s_i, s_j^*)$ → for i^{th} player (Condition for Nash eq^m)

↓

what I'm playing is best strategy for me given the other player is also playing his best strategy.

Obj : Max $U_i(s_i, s_j^*)$ Strategies → quantity but his payoff is the profit obtained

Payoff : Profit

⇒ max. $[a - (q_i + q_j^*) - c]\, q_i = \pi_i$

i believes j is playing optimal strategy ⇒ $q_j = q_j^*$

To find q_i^*,

$$\frac{\partial \pi_i}{\partial q_i} = 0 \Rightarrow (a - (q_i + q_j^* - c) - q_i = 0$$

$$\Rightarrow \boxed{q_i^* = \frac{a - c - q_j^*}{2}} \quad \text{— (1)}$$

similarly, $\frac{\partial \pi_j}{\partial q_j} = 0$

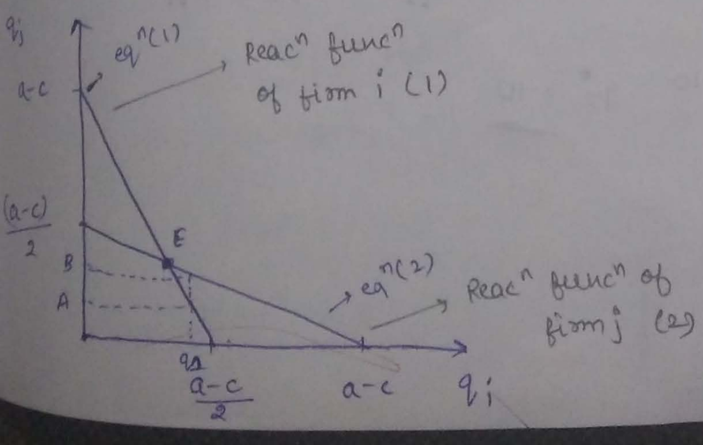
$$\boxed{q_j^* = \frac{a - c - q_i^*}{2}} \quad \text{— (2)}$$

(1), (2) → Reaction func^ns

From eq^n (1) & (2),

$\frac{dq_i}{dq_j} < 0$ ⇒ If i^{th} firm ↑ o/p, j^{th} firm ↓ o/p → strategic dependence

Reaction func^ns :



Through this model, we get to know :

if i^{th} firm ↑es its o/p by some value, ~~how~~ by how much scale I (j^{th} firm) should change its o/p.

Firm 1 believes if 1 ~~both~~ produces q_1 → 2 will produce A

but Firm 2 --- ---- → --- B } → mismatch of Perception

Market will clear when perception of both is same → point E.

⇓

no deviation

E → best strategy by both i & j

$$2q_i = a - c - q_j \quad , \quad 2q_j = a - c - q_i$$

$$2q_i = 2a - 2c - 4q_j$$

$$0 = -a + c + 3q_j$$

$$\boxed{q_j^* = \frac{a-c}{3} = q_i^*}$$

→ both i & j have equal share in market

Point E → Nash eqm point.

Q. $P = 30 - Q$, No cost of prodn

Find q_1^*, q_2^*

$$\pi_1 = (30 - (q_1 + q_2^*))\, q_1$$

$$= 30q_1 - q_1^2 - q_2^* q_1$$

$$\frac{\partial \pi_1}{\partial q_1} = 30 - 2q_1 - q_2^* = 0 \quad \Rightarrow \quad 2q_1 = 30 - q_2^*$$

$$2q_2 = 30 - q_1^*$$

$$2q_2 = 60 - 4q_1$$

$$q_1^* = \frac{30}{3} = 10 \; , \; q_2^* = 10$$

06-11-19 (1 class Missing)

Last class : 2. Bertard Model of Prices

→ What will happen if firms are engaged in Price competition ?

(earlier → discussed " " Quantity)

→ 2 firms (i, j) → Differentiated Products

Case-I $q_i = a - p_i + b p_j$

Here, $\frac{\partial q_i}{\partial p_i} < 0$, $\frac{\partial q_i}{\partial p_j} > 0$, $b > 0$

↑ Law of demand

In this setup,

$\pi_i = TR - TC$

$= p_i q_i - \underbrace{c q_i}_{\text{assumption}}$

$= [a - p_i + b p_j] p_i - c q_i$

The strategies are prices (variable)

$\pi_i (p_i, p_j^*) = [a - p_i + b p_j^*] [p_i - c]$

↓

Firm i believes that firm j is playing best strategy

$\frac{\partial \pi_i}{\partial p_i} = 0 \Rightarrow a - p_i + b p_j^* - p_i + c = 0$

$\Rightarrow p_i^* = \frac{a + b p_j^* + c}{2}$ —— (1)

Similarly, $\frac{\partial \pi_j}{\partial p_j} = 0 \Rightarrow p_j^* = \frac{a + b p_i^* + c}{2}$ —— (2)

Solving both eq^ns simultaneously, we get :

$b 2 p_i^* = ba + b^2 p_j^* + bc$

$2 b p_i^* = -2a + 4 p_j^* - 2c$

$0 = a(2+b) + b(b-2) p_j^* + (b+2) c$

$b(2-b) p_j^* = (2+b)(a+c) \Rightarrow \boxed{p_j^* = \frac{(a+c)}{b(2-b)} = p_i^*}$

(1 class Missing)

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$\pi_i (p_i, p_j^*) = [a - p_i + b p_j^*][p_i - c]$

↓

Firm i believes that firm j is playing best strategy

$\frac{\partial \pi_i}{\partial p_i} = 0 \Rightarrow a - p_i + b p_j^* - p_i + c = 0$

$\Rightarrow p_i^* = \frac{a + b p_j^* + c}{2}$ — ①

similarly, $\frac{\partial \pi_j}{\partial p_j} = 0 \Rightarrow p_j^* = \frac{a + b p_i^* + c}{2}$ — ②

Solving both eqns simultaneously, we get:

$b 2 p_i^* = ba + b^2 p_j^* + bc$

$- \; 2 b p_i^* = -2a + 4 b p_j^* - 2c$

$0 = a(2+b) + b(b-2) p_j^* + (b+2) c$

$b(2-b) p_j^* = (2+b)(a+c) \Rightarrow \boxed{p_j^* = \frac{(a+c)}{b(2-b)} = p_i^*}$

For p_i^* & p_j^* to be positive,

$\boxed{b < 2}$

Always, $p_i^* \neq 0$ & $p_j^* \neq 0$

p_i^* & p_j^* depends on degree of subsitute b.

$b = 0.1$ → As b↑, prices are more differents
$b = 1.5$

(more differentiated goods are, more difference in price)

Case II : 2 firms i and j are producing identical goods q_i & q_j and charge p_i & p_j.

$q_i = f(p_i, p_j)$

if $p_i = p_j$, $\frac{1}{2} D(p_i)$ → demand faced by i^{th} firm will be half.

if $p_i > p_j$, 0 → selling at higher price, demand = 0

if $p_i < p_j$, $D(p_i)$ → " " lower " , full demand

Firm will try to supply goods as much as possible.
The situation will be like a Price War.

Price War :

if $\underset{10}{p_i^*} > \underset{5}{p_j^*} > c$

i^{th} firm won't face any demand in this case.

so, it will try to make its price

$p_i^* = p_j^* - \epsilon_0 > c$

↓

4.99

1	2
10	5
4.9	4.8
4.7	4.6

Based on this, P_j (j^{th} firm) will also ↓ price :

$p_j^* = p_i^* - \epsilon_1$

How long will they go ?
They will go on till price per unit = cost per unit

$\boxed{p_i^* = p_j^* = c}$ → Bertrand Paradox (In oligopoly, behaving like perfect competition)

Collusion v/s Cheating

- If firms form a cartel, they get ↑ π.
- But we don't see much cartels happening?
- What is obstructing them?

Market demand $P = 8 - Q$; $Q = q_1 + q_2$

cost of i^{th} firm $C_i = 4q_i$

If 2 firms are colluding : Profit will be distributed equally.

$$\pi = (8 - Q)Q - 4Q$$

$$\frac{\partial \pi}{\partial Q} = 0 \Rightarrow 8 - Q - Q - 4 = 0$$

$$\Rightarrow Q = 2$$

$$P = 6$$

$$\pi = 12 - 8 = 4$$

	π	Q	P
Firm 1	2	1	6
Firm 2	2	1	6

→ will share this way

1 firm thinks it'll cheat.
It will sell at $P = 5$.

Firm 1 thinks to charge $P = 5$
Demand of firm 2 $= 0$ (Firm 2 will sell 0 o/p)

$$\Rightarrow 5 = 8 - Q$$

$$\Rightarrow Q = 3$$

$$\pi = 3 \times 5 - 4 \times 3 = \underline{3}$$

↳ getting a higher profit when he is cheating

similarly, Firm 2 can also cheat
If transformed into game

1 \ 2	cheat	Not cheat
Not Agree / Cheat	(1.5, 1.5) ~~(2, 2)~~	(3, 0)
Agree / Not cheat	(0, 3)	(2, 2)

Gary Baker
↓
economics in marriages

When both cheat:

$S = 8 - Q$ $\quad 1.5 \times 3 -$

$Q = 3$

$q_1 = q_2 = 1.5$

OP $\pi = 5 \times \cancel{3} - 12 = 3$

~~$\pi_i = (1.5) \times 3 - 4(3)$~~

$\pi_i = 1.5$

cheating & cheating → is the Nash eq^m. Lack of trust makes us go to inferior sol^n

(1.5, 1.5)

↓

same as Prisoner

→ If this game continues:

Q. Suppose, if after sometime both firms decide to collute again? why can't they do it? (after knowing they are getting $\pi \downarrow$)

If the game is played for finite period (n = 10, 20, ---) still, they don't collute because each year, they'll think like this

1, 2 . — — — — , 10 ↳ in 10th year, both firms know that they won't be in business from next year, they'll try to cheat.

similary, in (n-1)th year also, they'll ~~try to~~ think in the same way. So, they'll again cheat & so on...

- Since firms will cheat in last round regardless of what went before, they'll consider (n-1) round(s) again independently & cheat

Q. What can be done to make them agree?

- If players don't know how ~~match~~ many years they are doing business, they can collute.

⟶

Today's class:

3. Follower Leader Model (Stackelberg)

Ashok Leyland Trucks are followers of Tata?

or Xiomi iPhone?

There is a topper & rest follows

↳ 1st entering the market.

↳ model was given by Stackelberg

↳ suppose there are 2 firms 1 and 2 in the market and firm 1 gets to choose quantity first in the market (leader)

↳ The leader enjoys a first-mover advantage.

↳ Firm 2 is follower

↳ There is a strategic dependence b/w both the firms

↳ Firm 1 will try to cover whole market.

↳ This kind of games are solved through - Backward Induction

Backward Induction:

Firm 2 : $\pi_2 = [a - q_1 - q_2] q_2 - cq_2$; $P = a - Q$, $Q = q_1 + q_2$

$$\frac{\partial \pi_2}{\partial q_2} = 0 \Rightarrow a - 2q_2 - q_1 - c = 0$$

$$\Rightarrow q_2 = \frac{a - q_1 - c}{2} \quad \text{--- (1)} \quad \Rightarrow \frac{\partial q_2}{\partial q_1} < 0$$

↓

This is how firm 2 will react given firm 1 is the leader.

→ Firm 1 knows this fact how firm 2 will move as he has more experience in market. It'll use this fact to maximize its profit

→ Since firm 1 is an early entrant in the market, it knows how firm 2 is going to react.

→ Firm 1's objective : Maximize π_1

$$\pi_1 = [a - (q_1 + q_2)] q_1 - cq_1$$

But it'll also consider Firm 2's reaction. & incorporate it in its own strategy.

$$\Rightarrow \pi_1 = \left[a - q_1 - \frac{a - q_1 - c}{2}\right] q_1 - cq_1$$

$$\frac{d\pi_1}{dq_1} = 0 \Rightarrow a - 2q_1 - \frac{a}{2} + \frac{c}{2} + q_1 - c = 0$$

$$\boxed{q_1^* = \frac{a - c}{2}} \quad \text{--- (2)}$$

First leader will operate, then follower will sell for rest of demand.

Applying ② in ① :

$$q_2^* = \frac{a - c - \frac{a-c}{2}}{2}$$

$$\Rightarrow \boxed{q_2^* = \frac{a-c}{4}}$$

$\Rightarrow q_2^* < q_1^*$ → O/P of follower < O/P of leader

$$P = a - (q_1 + q_2)$$

$$= a - \left[\frac{3a - 3c}{4}\right]$$

$$P = \frac{a+3c}{4}$$

$$\pi_1 = \left(\frac{a+3c}{4}\right)\left(\frac{a-c}{2}\right) - c\left(\frac{a-c}{2}\right)$$

$$= \frac{1}{8}\left[a^2 - ac + 3ac - 3c^2\right] - \frac{1}{2}\left[ac - c^2\right]$$

$$= \frac{1}{8}(a^2 + 2ac - 3c^2) - \frac{1}{8}(4ac - 4c^2)$$

$$= \frac{1}{8}(a^2 - 2ac + c^2) = \frac{(a-c)^2}{8}$$

$$\pi_2 = \cancel{\frac{1}{8}(a^2+2ac-3c^2) - \frac{1}{4}(ac-c^2)} \left(\frac{a+3c}{4}\right)\left(\frac{a-c}{4}\right) - c\left(\frac{a-c}{4}\right)$$

$$= \cancel{\frac{1}{8}(a^2+2ac-3c^2) - \frac{2ac+2c^2}{8} - \frac{1}{8}(a^2+c^2)} = \frac{1}{2}(\pi_1)$$

$$\boxed{\pi_1 = \frac{(a-c)^2}{8} \qquad \pi_2 = \frac{(a-c)^2}{16}}$$

International Market

↳ Subsequently, many outside products are being ~~available~~ manufactured (mfg) in India

How?

Before 1991 → economy was closed

After 1991 → Liberization, Privatization and Globalization)

↓

eventually opened economy in India

Can a domestic grown firm compete with foreign firms? No, they've more superior tech.

To protect its own goods from imported one, govt imposed a ~~tari~~ tariff on imported goods.

↓

selling Price will ↑

But it also obstructs ~~to~~ outside firms to come to India.

So, tariff rates had been brought down by govt.

1990 → 85% → tariff rate

2018 → 9.23% → on ~~a~~ advice of World Trade Organization

↓

India got membership in 1995

Q. But what about domestic firms?

WTO would have to give some incentive to India to join it (↓ tariff rates)

↓

Contingent Protection Measures

Anti dumping (89%)

Ex. Product X:

in US → sold at ₹P.

exported to India → ₹Q

if Q<P: Product is called dumped

[People producing X in India ~~cons~~ are affected due to this, govt. can ask for this measure)

↓

Due to this, tariff will ↑ on X good.

Countervailing (5%)

ex X is exporting at ₹5. to India

But his cost of prodⁿ ~~on~~ is 12. US govt. tells to export at 5 & it'll compensate to prevail in India market. (Export subsidy).

Indian govt. can apply this measure

Safeguard (6%)

Ex. Diwali lights: most used ~~manufacturers~~ are Chinese. Due to this, domestic people are not getting chance. So, govt. can request to ↑ tariff on these products

Currently, India is largest filer of Anti-dumping

↳ India ~~too~~ is very strategically filling these to compensate the traditional tariff

Q. US knows it'll face anti-dumping if it solds product at P↓ But why does it still do it? What are the loopholes in this measure?

11/11/19

Game representation:

1.) Players : Exporting Firm
Importing Firm

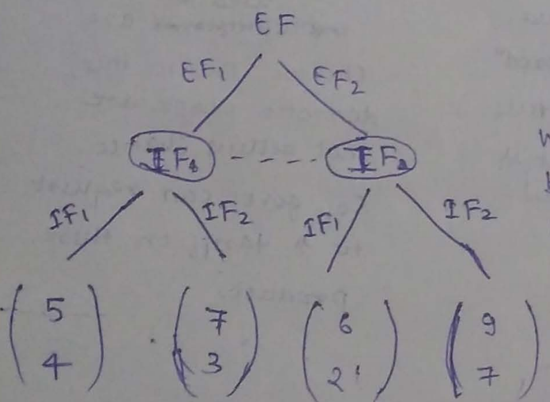
2.) Payoff : Market share/
Profit

3.) strategies : Exporting firm
- EF1 Predatory Pricing → setting a price below cost. (In dumping, firm exports less than price charged in its home country)
- EF2 Normal Pricing

Importing firm
- IF2 compete (engage in Price War)
- IF1 May file an anti-dumping case with the govt.

Players are playing strategies

→ This will be a sequential game → EF will make 1st move.



We know P at which good is sold in India ~~but~~ we ~~does~~ mostly think it is ~~less~~ less but it has to be prove by court of law
So, IF doesn't know which strategy is EF using ⇒ singleton set

India files case will get compensation

Local market can never compete with EF

filing a false case. Diff will be larger than in 1st case

g will be slightly greater than h. $\begin{pmatrix} g \\ h \end{pmatrix}$
[Had g not been exporting, h would have a complete market share]

China has exported goods in January.
In Aug. → I file case
In Dec. → I win
I get compensation from Aug.
What about Jan-Aug?
⇓
China has taken revenue in this term so Payoff (EF) ≃ Payoff (IF)

Predatory pricing :

Initially when launched : Predatory price is charged.
consumer surplus is ↑

once you get habitual of product : Normal pricing is charged.

Nash eqm :

	IF_1	IF_2
EF_1	(5, 4)	(7, 3)
EF_2	(6, 2)	(9, 7)

→ EF_2 & IF_2 : Nash eqm

Q. If IF_2 & EF_2 is Nash eqm, why still India files so many anti-dumping cases? Why in realistic world still there are so many " " ?

Ans. Because to come to point (9, 7), govt has to find

optimal Anti-dumping duty

⇓

It may be possible if this duty is not optimal → E.F. can still conquer the market : Not fair

If govt gives a ~~credible~~ ~~treat~~ credible threat ⇒ EF will do Normal Pricing & Nash eqm can be achieved.

In real world, the threat is not that Robust / credible.

Macroeconomics

1. Aggregate DD →

2. Aggregate supply (SS)

I	II	---	XX			
2	7		1	=	2 + 7 + --- + 1 →	This is Market DD.

→ ~~Both~~ Everyone has some no. of transactions
↳ buying sweet, watching movie

T → no. of transactions in any economy

P → price of transaction

PT → total price of transaction

$$PT = VM^s$$

V → Velocity of money

M^s ↳ total money supplied (money circulated in economy

~~Not all money supplied is used in transaction~~

- What I'm giving to a person, he can use it in another transaction
↳ so V part added

T : total no. of transactions in an economy

P : Price of a typical transaction

M^s : quantity of money supplied

V : velocity of money [Rate at which money circulates in an economy]
↓
Rate at which a note exchanges hands

If in an economy, if price level ↑ ⇒ More price is paid in each transacⁿ, exchanged ~~money~~ more rapidly

velocity ↑.

100 loafs of bread are sold in ~~a~~ a given year at Rs. 20 / loaf.

$PT = 20 \times 100$ $\quad M^S = 1000$

$= 2000$

$PT = V M^S$

$\boxed{V = 2}$ ⇒ ~~Rates of circulation~~ Re 1 is circulated 2 times

⇓

For Rs. 2000 of transactions per year, with money supplied = Rs. 1000, each Rupee has to exchange hands <u>2 times a year</u>

, since T is very difficult to measure; T is substituted with <u>total o/p</u> of an economy.

→ no. of goods & services produced in an economy

$$PY = V M^S$$

$T \cong Y \Rightarrow T = f(Y)$: if more no. of transacⁿ : O/p will be more.

so, T can be replaced by Y.

⇓

Quantity theory of Money.

$$\Rightarrow \frac{\overline{M^S}}{P} = \frac{1}{\overline{V}} Y$$

P : aggregate price level.

In any year, M^S by RBI is fixed.

so, I can find relation b/w P & Y.

suppose V is also const.

so, $P(\uparrow) \Rightarrow Y(\downarrow)$

Q. If 1000 items are sold, why not sum it up.? why $P \propto \frac{1}{Y}$ is proved?

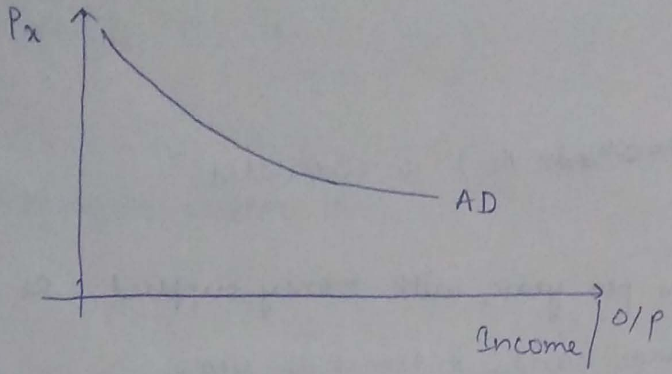
why to discuss this all?

Ans. micro → Individual level

macro → A group of diff. classes

To talk about macro ⇒ we did all this.

Aggregate DD Curve :



Aggregate Supply

2 situations :

- Long Run
- Short Run

① Long - Run

$\bar{Y} = f(\bar{K}, \bar{L})$ → Production func^n

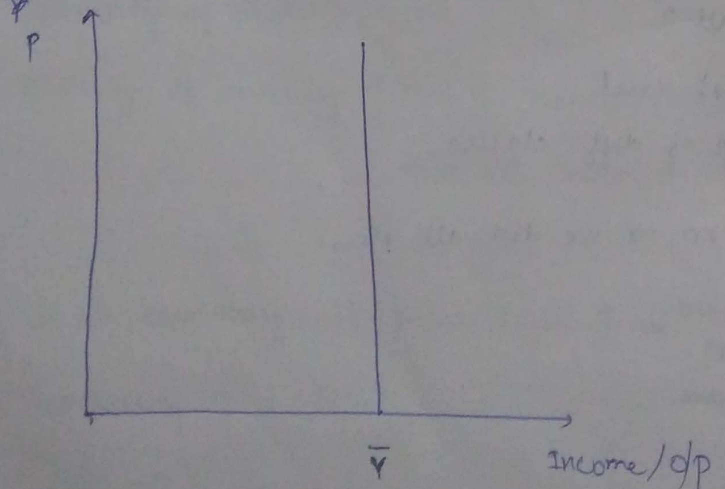
↓

In Macro : in long Run, capital & labor are fixed & total o/p is fixed

| Reason

- entire resources are exhausted
- you are at your maximum point

⇒ its o/p is not going to change

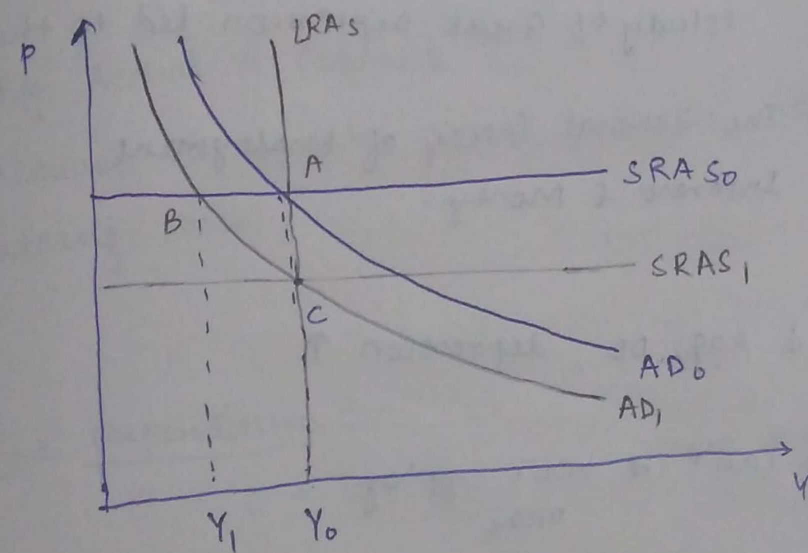


Prices are flexible here

② Short-Run

Prices are sticky
↓
Ex. High inflation is occurring. You go to a restaurant today and after some days. Menu card won't have change in prices immediately. It'll change after lot of time
→ Prices are adjusted at slow rate (slow to adjust)

Q. How to move from Short-Run to Long-Run?



Aggregate DD : $\frac{\overline{M_s}}{P} = \left(\frac{1}{\overline{V}}\right) Y$

Short-Run : P not changed (sticky)
If $M_s \downarrow$: Aggregate DD will ↓ : At same P, Y has ↓

⇒ Peoply won't buy goods → $P_x \downarrow$

o/p has ↓ ⇒ Employment ↓

Economy will move from A to B

In Long Run → shift from B to C.
(They know permanent change, so, they will change Price)

SRAS1 → new short run price.

12-11-19

2009 → Recession

World's GDP ↓ by 1%.

1929 → The Great Depression

World's GDP ↓ by 15%

Keynesian Economics

Macro

↳ Keyensian Economics (study of Great Depression led to this)

⟶ Book : The General Theory of Employment, Interest & Money.

↓

Idea : Whenever there is ↓ Agg. DD, depression ↑

Once low Income ⇒ Firm can't sell ⇒ won't employ more

Income / o/p / GDP = C + I + G + (X − M)

C → Total consumption expenditure

I → Investments

↳ Prt.

↳ Public

G → Total expenditure by govt.

X − M → Exports − Imports

Data analysed has shown that : [uniform across all countries]

C → 60 %.

→ India : economy has ↓ $\xrightarrow{\text{Reason}}$ C has dropped down for the first time.

→ We'll study tools of Keynesian Economics:
1. Goods Market (How Y is affected)
2. Goods & Money Market (Y + Money from bank (stock)

Simple Keynesian Model

2 kinds of things an economy has:
→ Actual expenditure
→ Planned "

to this)

Q. Why Actual ≠ Planned?

Ans. Because Firms sales don't meet the expectations & they end up adding stock.

Planned Expenditure:

$$E = C + I + G$$

(Not adding Trade part to avoid complications)

$$C = c(Y-T)$$

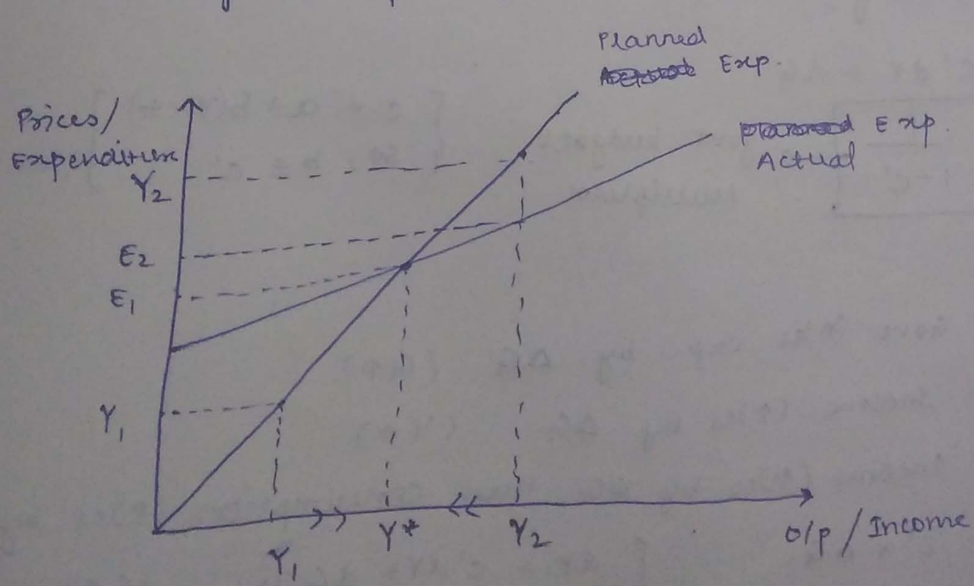
$$= a + b(Y-T)$$

Y: Income
T: Taxes
Y−T: Personal Disposable Income

↳ slope: how much consumption change by changing Y−T
→ intercept: even if Y is 0, I'll consume something

$0 < b \leq 1$

b: Marginal Propensity to Consume (MPC)



Keynesian Cross

Monetary Policy : undertaken by RBI

suppose,

Economy is producing at Y_2 level:

Actual < Planned : stocks will accumulate → employ less → economy goes from Y_2 to Y^*

Y_1 : Actual > Planned Firms can't meet expectation → employ more → go from Y_1 to Y^*

→ govt. makes many policies based on this premise.

Q. How govt. expenditure depends on this ?

Ans. If the govt. decides that it is launching a scheme, invest in any kind of $\underbrace{\text{Fiscal Policy}}_{\text{undertaken by govt.}}$, then

$$Y = C + I + G$$

$$Y = c(Y - T) + I + G$$

As $G\uparrow$, Y also $\uparrow$

Taking T & I const. (since we've to find relation b/w Y & G)

$$Y = c(Y - \bar{T}) + \bar{I} + G$$

On differentiating,

$$dY = c'\,dY + dG$$

$$\boxed{\frac{dY}{dG} = \frac{1}{1-c'}} \rightarrow \text{govt budget Multiplier}$$

$$\left[\begin{array}{l} c = a + b(Y - t) \\ \text{so, } b \equiv c' \end{array}\right]$$

Initial Round : Govt. ($\uparrow$)es exp. by ΔG ($G\uparrow$)

First Round : Income ($\uparrow$)es by ΔG ($Y\uparrow$)

second Round : Income ($\uparrow$)es by ΔG, then consumption ($\uparrow$)es by $c' \times \Delta G$ $\left[dY = \underbrace{c'dY}_{\text{consumption part}} + dG\right]$ ($C\uparrow$)

Third Round : C ↑ → Expenditure ↑
→ Firms will produce more → employment ↑ → Income ↑ → Consumption will ↑ by $c' \times (c' \times \Delta G)$

Ex: → Govt. Investment of ₹ 100 Crores in 2013

$Y_0 = C(Y - T) + \bar{I} + G$

→ so, Y_0 (↑) es by 100 Crores (Y_1) in 2013

If Y (↑es) from Y_0 to Y_1, then consumption will also (↑)

→ consump^n (↑)es by MPC (c') in 2013

New consump^n = $c' \times \Delta G$

→ Income (↑) es from Y_1 to Y_2 by $c' \times \Delta G$ in 2014

→ when income has (↑)ed to Y_2, in 2014 consumption (↑)es by $c' \times (c' \times \Delta G)$

so, (↑) in Y is :

$$dY = dG + c'dG + (c')^2 dG + (c')^3 dG + \dots$$

$$= dG\,(1 + c' + (c')^2 + \dots\dots)$$

$$dY = dG \left[\frac{1}{1-c}\right]$$ → govt. budget multiplier