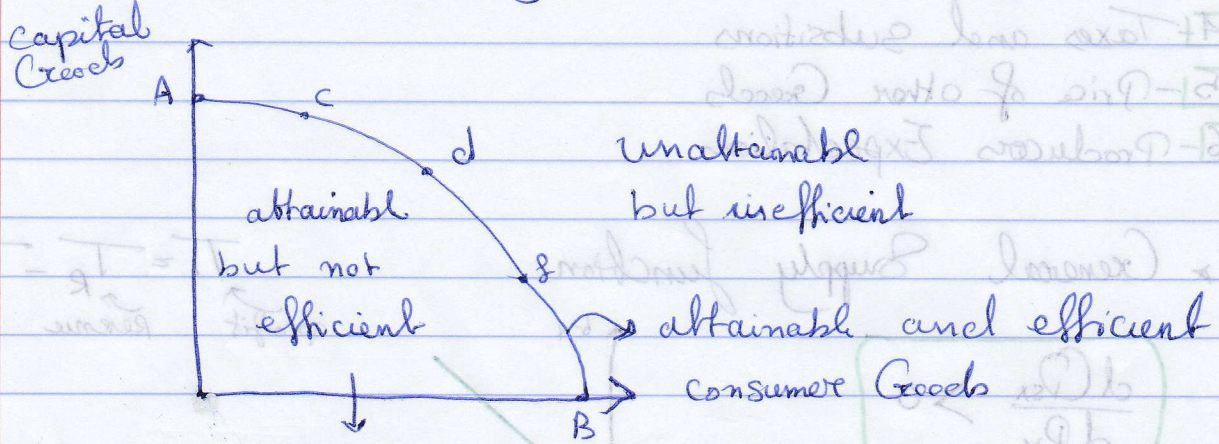
Part ①

Engineering Economy :-

- Factors of Production :-
  1- land
  2- labor
  3- Capital
  4- Entrepreneurs

- Production possibility Frontier :-



- Moving (There is no opportunity Cost) inside

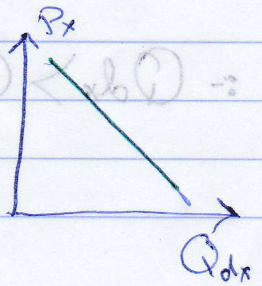
* Demand :-

↳ Determinants :-

1- Prices (P_x)
2- Consumer Taste (T)
3- " income (I)
4- number of consumers N_c
5- Price of related Goods (P_r) → substitute goods, → Complement goods
6- Expectations (E)

↳ General Demand function :-

$$\frac{d(Q_{dx})}{dP_x} < 0$$



Same for Supply

- If We Change Price Only → Movement on the Curve
- If " " other factors → Shifting of the Curve

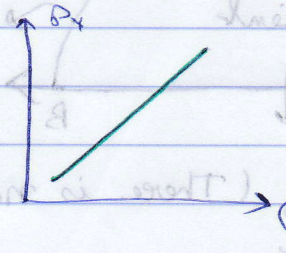
* Supply :-

↳ Determinants :-

1. Price
2. Number of firms
3. Tech
4. Taxes and Subsitions
5. Price of other Goods
6. Producers Expectations

↳ General Supply function

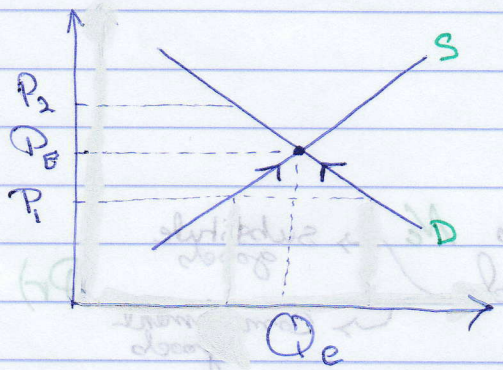
$$\frac{dQ_{sx}}{dP_x} > 0$$



$\Pi = T_R - T_C$

Profit — Revenue — Cost

Equilibrium Point :-



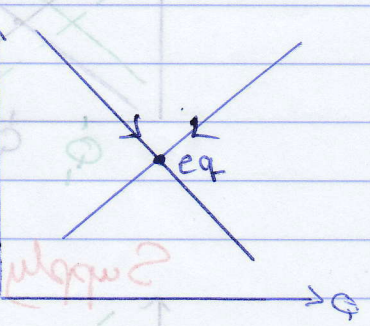
$$Q_{dx} = Q_{sx}$$

If Theres is Taxes . substracte it from P in Q_s

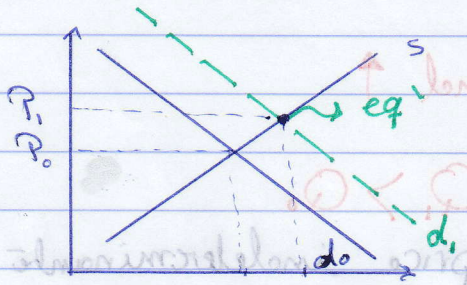
ah P_1 :- $Q_{dx} > Q_{sx}$ → demand is More than Supply so Shortage. So Price increases

at P_2 :- $Q_{sx} > Q_{dx}$ → demand is less than Supply so Surplus of Goods The Price Goes Down

- Cases for Shifting Curves:-

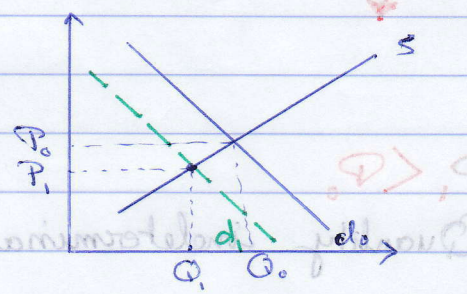


→ Change in demand :-



$P_1 > P_0$
$Q_1 > Q_0$

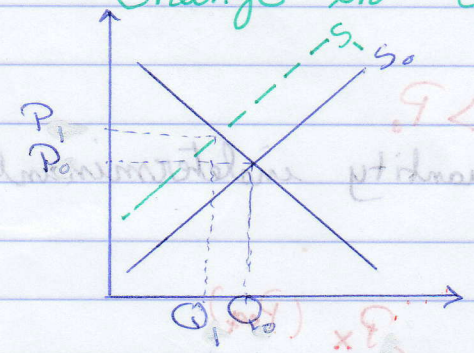
- Any factor shifting D.C to the right will rise the Price.



$P_1 < P_0$
$Q < Q_0$

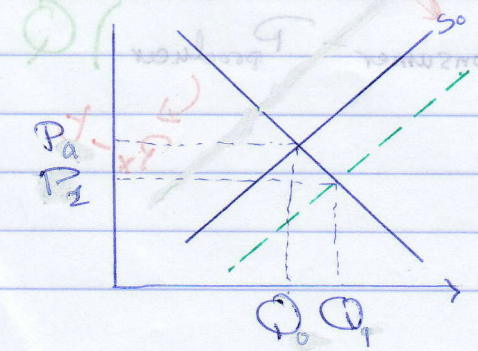
- Any factor shifting D.C to the left will lower the Price.

→ Change in Supply :-



$P_1 > P_0$
$Q_1 < Q_0$

- Any factor shifting S.C to the left will rise the Price

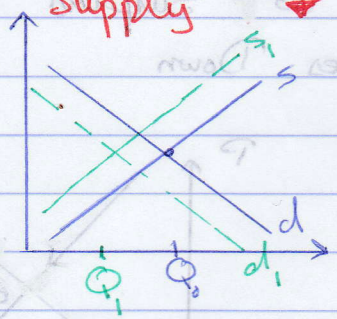


$P_1 < P_0$
$Q_1 > Q_0$

- Any factor shifting S.C to the right will lower the Price

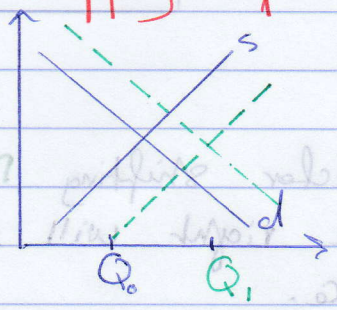
→ Change in Both Sides :-

Supply ↓ Demand ↓



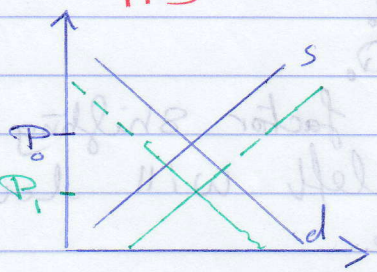
- $Q_1 < Q_0$
- price indeterminate

Supply ↑ Demand ↑



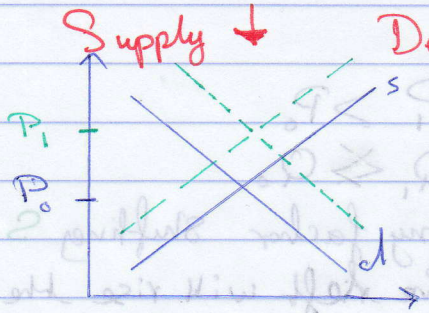
- $Q_1 > Q_0$
- price indeterminate

Supply ↑ Demand ↓



- $P_1 < P_0$
- Quantity indeterminate

Supply ↓ Demand ↑



- $P_1 > P_0$
- Quantity indeterminate

- Gorerement Revenue = $(P_{consumer} - P_{producer})Q$ (P_x (P_{eq}); $P_x - t$)
- Total Revenue = PQ

Engineering Economy:

Three Basic Concepts:-

[1] Resources → Free: Zero-price
→ Economic: Non-Zero price

limited / can be put in different Production activities

• What we call:-
Factors of Production:-
1- labour → Payments (wages and salaries).
2- land → Rent.
3- Capital → Int.
4- Enterprenear → Profit.

[2] Alternative Uses:-
Mutually exclusive: Meaning you Choose one of the Alternatives only.

→ opportunity Cost: • التكلفة الضائعة أو البديلة

The value of the next Best alternative that is Given up.

You should choose the best Alternative.

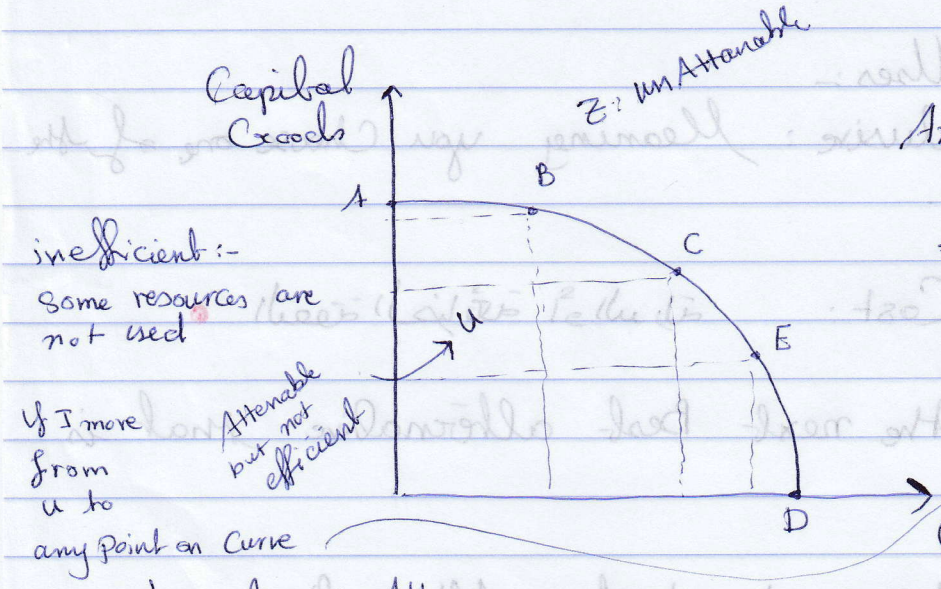
[3] Human Needs (wants)

Properties :-

a) They vary among individuals.
b) " " over time for the same individual.
c) They are unlimited

Def: Production Possibility Curve : P.P.C or P.P.F

Combinations	Consumers Goods	Capital Goods
A	0	15
B	2	14
C	4	12
⋮	⋮	⋮
D	12	0



Any Point inside the Curve is called :-

* Attenable but not efficient.

opportunity cost = 0 at u

1. A : All resources are used to produce Capital Goods
2. D All resources are used to produce Consumer Goods

Any Point on the Curve is called :

* Attenable and efficient

• Engineering Economy :- lec(2

* Production possibility frontiers.

• Def: Check different combinations of goods and services producers can produce efficiently by reallocating the available Resources and technologies

→ Shifting happens in our Curve if we change Resources or Technology or both.

Economic Theory

MicroEconomic Theory
- individual Behaviour
- Employment.
- we are intreseted in it.

MacroEconomic Theory
- We deal with inputs as a whole → GDP
  يقيس كل ما تم إنتاجه.
- CPI: Consumer Price index
  ينظر إلى سلة المستهلك التي تحتوي على السلع المشتراة وتقوم بحساب ال Average change في سعر السلع
- labour force

MicroEconomics :-
- Demand and Supply
- Product Market → Products (Goods) tangable
  → Services غير ملموس

Demand side — supply side

→ Def: Shows different various Quantities of a product. Consumers are willing and able to buy at different Alternative Prices during a Specific Period of time holdeing other factors constract.

- Main determinants of Quantity of a product:-
  ↑ various Quantit ---- prices

⚠ Note: Prices of the Goods is a Main determinant but it's not the Only One.

Q_{dx} → Quantity Demand of goods x

1- Price of Goods P_x

2- Price of Related Goods P_r → Substitute Goods
→ Complement Goods

3- Number of Consumeres N_c

4- Consumer Taste T

5- Consumer income I

6- Consumer Expectation E

- General Demand function:-

$$Q_{dx} = f(P_x, \bar{P}_r, \bar{N}_c, \bar{T}, \bar{I}, \bar{E}, \dots)$$

- Simple Demand function:-

$$Q_{dx} = f(P_x) \quad \text{Given other factors}$$

* Now,

$P_x \uparrow \rightarrow Q_{dx} \downarrow$ $\quad \frac{d Q_{dx}}{d P_x} < 0$

$P \rightarrow Q_{dx}$ (Substitude)

$\frac{\Delta Q_{d\,peps}}{\Delta P_{Cole}} > 0$

(عكسية) علاقة

Engineering ~~Functio~~ Economic

lec 3

General Demand function:-

$$Q_{dx} = f(P_x, I, T, P_r, N_c, E, \dots)$$

لتبسيط الدراسة

simple Demand function

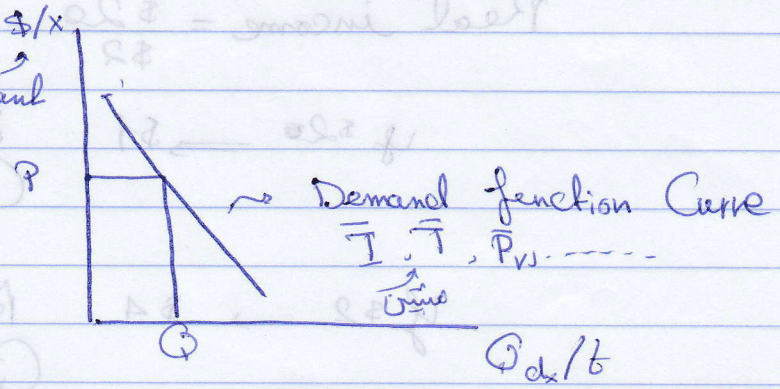
$$Q_{dx} = f(P_x) \quad \text{Given other factors}$$

$$Q_{dx} = \alpha - bP_x$$

$$Q_{dx} = 10 - P_x \quad \text{equation}$$

Price	Q_{dx}	t ← time
1	9	
3	7	
9	6	

كلما ارتفع السعر قلة الكمية المطلوبة .



Two effects

- law of demand : The higher the Price the lower the Quantity $P_x \uparrow \quad Q_{dx} \downarrow$ $P_x \downarrow \quad Q_{dx} \uparrow$

(1) Income effect

(2) Substitution effect : استبدال سلعة بدل الأخرى

$Q_{d_{cola}} \rightarrow P_x \mid \bar{P}_{y\,pepsi}$ ← كلما زاد سعر البيبسي مع ثبات سعر الكولا

(2) Substitution effect → ΔQ_{dx} → Changes in the Relative prices → $\frac{P_x}{P_y}$ → Given $\bar{P}_y$

Ex : $\frac{P_{x_0}}{P_{y_0}} = \frac{\$10}{\$10} \Rightarrow Q_{d_x} = 100$ (Cola)

$\Delta P_x \Rightarrow \frac{P_{x_1}}{P_{y_0}} = \frac{\$8}{\$10} \Rightarrow Q_{d_x}$ ↑ ← ↵

$\Delta P_x \Rightarrow \frac{P_{x_2}}{P_{y_0}} = \frac{\$12}{\$10} \Rightarrow Q_{d_x}$ ↓ ← ↵

① Income effect → in case of Normal Goods $\propto Q_{d_x}$ Real income = Nominal income / P_x

Ex : $20 for coffee / week
$P_{coffee} = \$2$

Real income = $\frac{\$20}{\$2} = 10$ units $= Q_{d_{x_0}}$

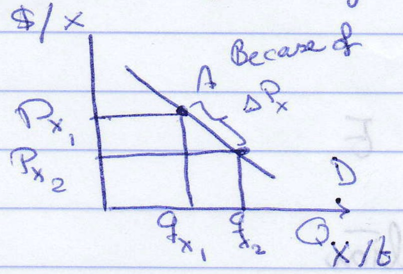
If \$2 → \$1 Real income ↑
$Q_{d_{x_1}} = 20$ units

If \$2 → \$4 Real income ↓
$Q_{d_{x_2}} = 5$ units

* The two effects are negative and the describe the Demand Curve.

Distinguesh Between :- Changes in Q_{d_x} (Quantity demanding) or Movement along Demand Curve and Shift in Demand or Changes in Demand.

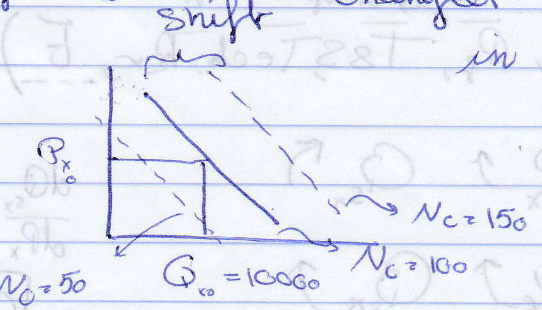
- If P_x only Changed :- There will be a Change in Quantity demanding meaning: A Movement on the Demand Curve.

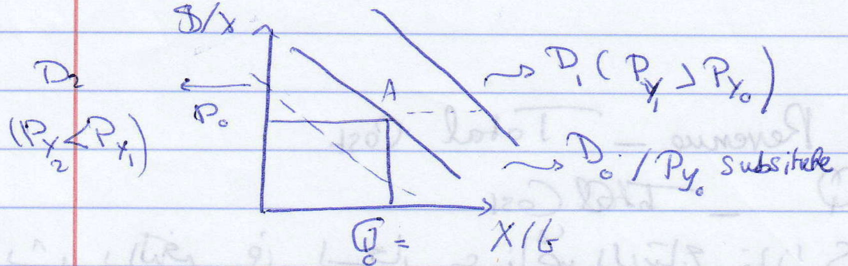


(Remember ⚠ : Other factors Are Constant)

or any other factor

- If The Demand Changed then there will be a Shift in the Demand Curve.





- Supply Curve shows the various Quantity of a Product Producers (firms) are willing and able to produce / Sell at different alternative Prices during a Specific period of time holding other Factors Constant.

→ Supply α P_x is a main Determinante to the Quantity supplied.
other Factors Given / holding them Constant
↳ ① Number of firms (producers) N_f
② Price of factors of Production P_f

③ Taxes and Subsidies T&S
④ Technology Tech
⑤ P_r
⑥ Expectations of producers. E

General Supply function

Q_{S_x} : Quantity Supplied of Good x

$Q_{S_x} = f(P_x, \overline{N_f}, \overline{P_s}, \overline{T\&S}, \overline{Tech}, \overline{P_r}, \overline{E}, \dots)$ ← simple supply fun.

$P_x \rightarrow Q_{Sx} \Rightarrow P_x \uparrow \; Q_{S_x} \uparrow$

$N_f \rightarrow Q_{Sx} \Rightarrow N_f \uparrow \; Q_{Sx} \uparrow$

$\frac{dQ_{Sx}}{dP_x} > 0$

so $\boxed{Q_{Sx} = \alpha + \beta P_x}$

P_f :-

π = Total Revenue − Total Cost
profit = $P \cdot Q$ − Total Cost

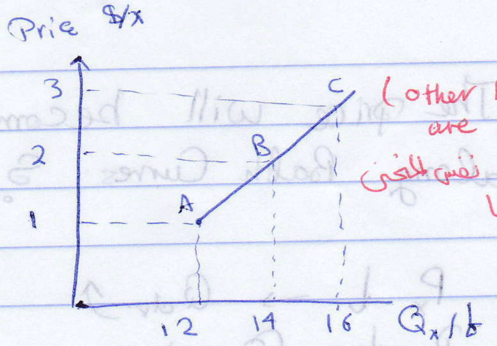
يتأثر بالتغير في اسعار عناصر الانتاج فاذا كان T.F ثابت
تقل ال π اذا زادة سعر هذه العناصر والعكس صحيح

Taxes :- negative
Subsidies :- positive

Technology: Positive (if improvement)
Expectation :- (Prices ↑ → Q ↑
Prices ↓ → Q ↓)

Simple S. F
$Q_x = f(P_x)$ Given other Factors

Price $/x$	Q_{sx}/t
1	12
2	14
3	16
4	18



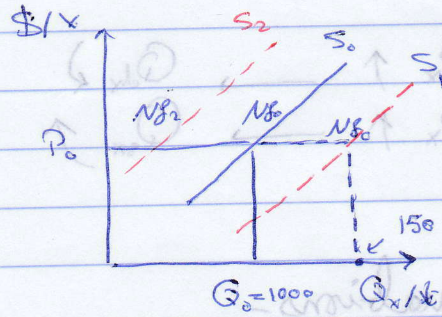
(other Factors are constant)
الرسم هنا تحمل نفس المعنى هنا

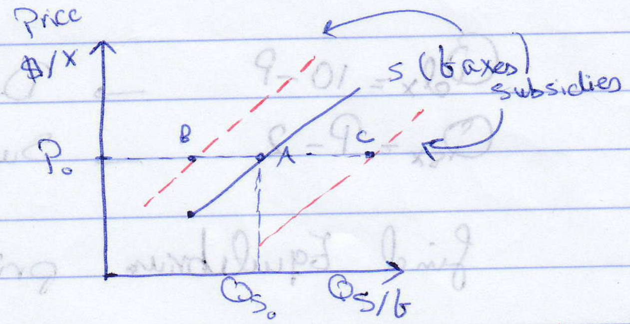
(تغيّر سعر السلعة فقط (لا تغيير ال Factors الأخرى)

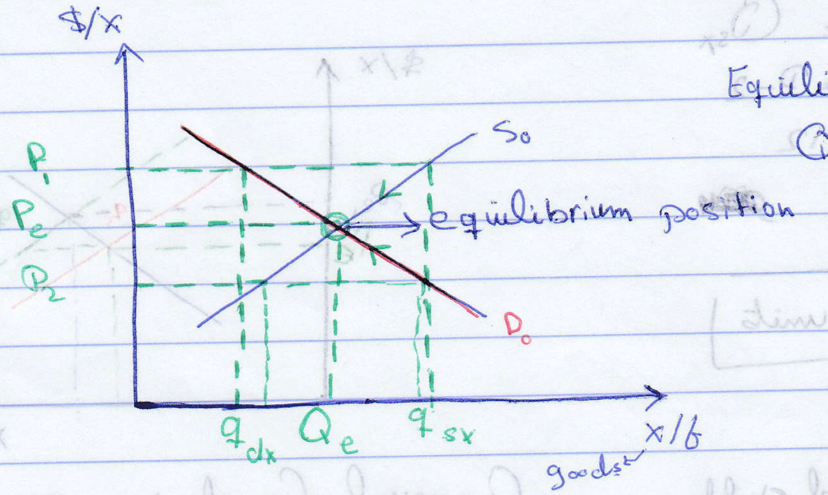
- Movement along Supply Curve or ≡ changes in Quantities supplied and Shift of Supply Curve or ≡ changes in Supply Curve

تغيّر في أي من ال Factors الأخرى

$Nf_0 = 100$ firms
$Nf_1 = 150$ "
$Nf_2 = 50$







Equilibrium Condition
$Q_{dx} = Q_{sx}$ is at Equilibrium position
⇓
Equilibrium price Pe
Quantity Qe

- At $P_1 \rightarrow Q_{sx} > Q_{dx}$ Surplus / excess Supply

- The price will become less so There's a movement along Both Curves S and D.

$P_x \downarrow \rightarrow Q_{dx} \uparrow$
$P_x \downarrow \rightarrow Q_{sx} \downarrow$

- At $P_2 \rightarrow Q_{dx} > Q_{sx}$ excessive demand or shortage

- The Price will rise so There is a

$P_x \uparrow \longrightarrow Q_{dx} \downarrow$
$P_x \uparrow \longrightarrow Q_{sx} \uparrow$

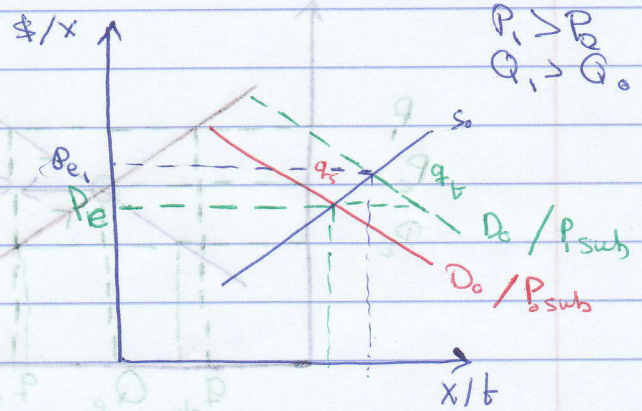
Equations -

$Q_{dx} = 10 - P$ → Demand eq
$Q_{sx} = P - 2$ → Supply eq

find Equilibrium price and Quantity

$Q_{dx} = Q_{sx}$
$10 - P_e = P - 2$
$-2P_e = -12$
$\boxed{P_e = 6}$

$\boxed{Q_e = 4 \text{ units}}$

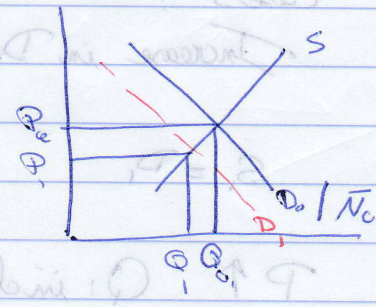


- any factor would shift Demand to the right make price increase

General Conclusion, Shortage or excess of demand always makes Prices increase

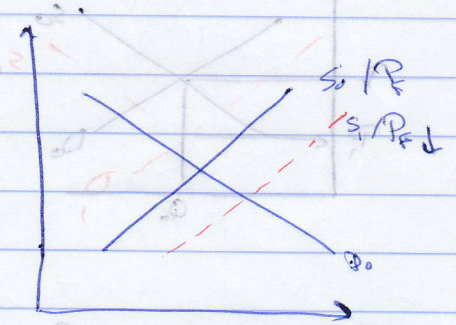
- of supply decrease

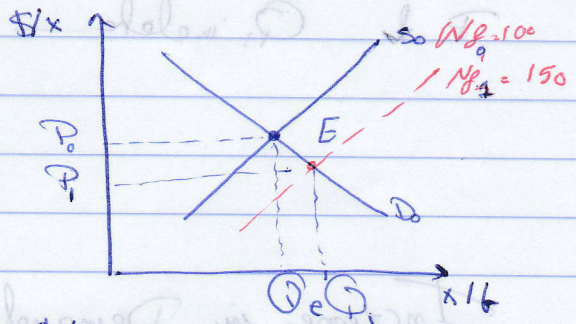
* $D_1 = S_0$ is the new equilibrium Case



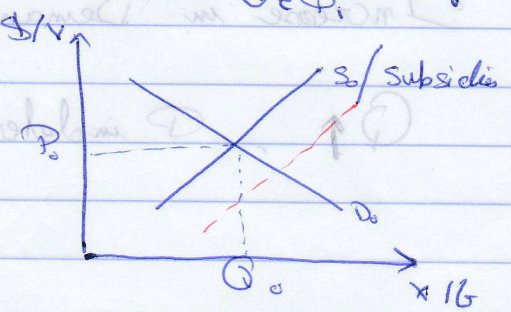
Negative changing → P and Q ↓

- Conclusion 2: Any Factor shifts the dem to the left and does not affect the Supply will lower the eq price and Quantity

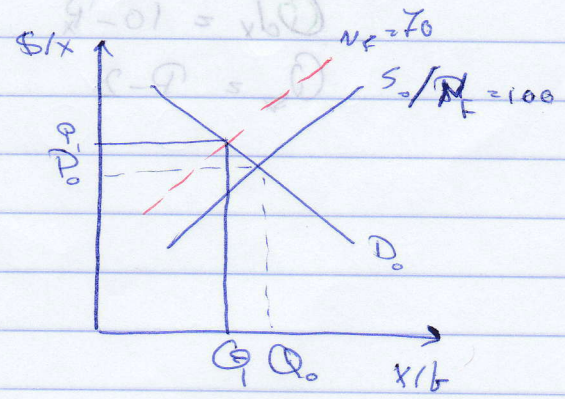




- Conclusion: Any ... Supply Curve to the right (Dem. constant) ↘ ↘ ↘ ↘ ↘ and increase eq Quantity.



- Conclusion: ... to the left and (Dem. Cons) ↘ ↘ ↘ eq price ↑ and lower eq Quantity

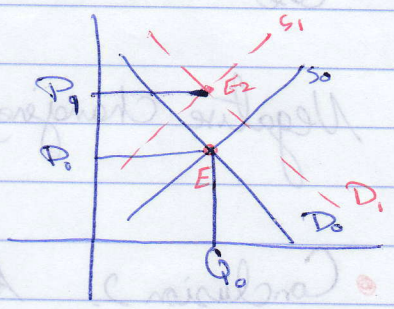


Case 3 :

Increase in Dem , Decrease in Supply

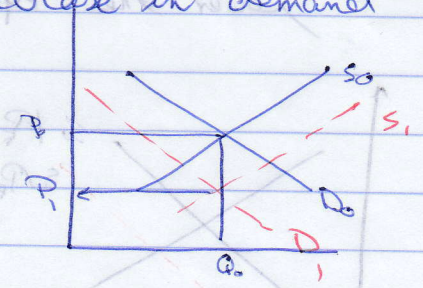
$S_1 = D_1$

P ↑ Q: indeterminate



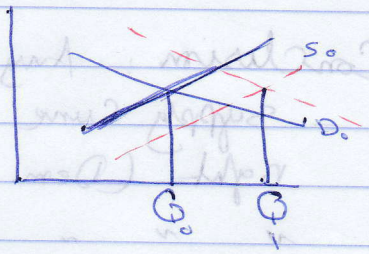
Increase in Supply decrease in demand

P ↓ Q: indeter



Increase in Demand , Increase in Supply

Q ↑ . P indeterminate

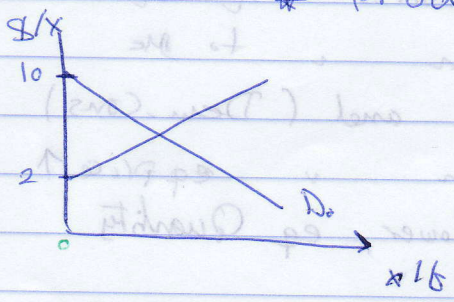


decrease in

$Q_{dx} = 10 - P_x$

$Q_{sx} = P - 2$

* Consumer Surplus
* Producer Surplus



P > avg → Q

P < avg → Q

• Elasticity of Demand and Supply :-

1- Price elasticity of demand
   - Point elasticity
   - midPoint elasticity
2- Cross-Price elasticity of demand
3- Income elasticity of demand

① $E_p = \frac{\% \text{ Change in the dependant } (Q_{dx})}{\% \text{ Change in the independant } (P_x)}$

$\% \text{ Change in } Q = Q_{d_1} - Q_{do} \,/\, Q_{do}$

$\% \text{ Change in } P_x = P_{x_1} - P_{x_0} \,/\, P_{x_0}$

So $\boxed{E_p = \frac{\Delta Q_{dx}}{\Delta P_x} \cdot \frac{P_{x_0}}{Q_{do}}}$ ⇝ Point (ignore the Sign)

$E_{p\,mid} = \frac{\Delta Q_{dx}}{\Delta P_x} \cdot \frac{(P_{x_1} + P_{x_0})/2}{(Q_{x_1} + Q_{x_0})/2}$

→ E_p has Three possibilities :-

$E_p > 1$	elastic	$\% Q > \% P$	more Sens
$E_p < 1$	inelastic	$\% Q < \% P$	less Sens
$E_p = 1$	Unitary	$\% Q = \% P$	

$E_p = \frac{\text{Marginal function}}{\text{Average function}} = \frac{M.f}{A.f} \rightsquigarrow Q_a / P_a$

Determinants of Price elasticity of demand:-

1- The availability of Substitutes Goods:-
Make it More elastic

2- Propotion of income
اذا سعر السلعة جزء بسيط ← inelastic لا نشعر بتغير السعر
elastic ← كبير " " " " " "

SPLAT

3- Type of products

luxuries	Vs	Necessities
كماليات		اساسيات
Elastic		Inelastic

4- Time:-
Short period : inelastic . Time that takes people to notic the Change
long period : elastic . people needs time to find Substitutes

5- habits (Addictivness) : inelastic / مثل التدخين
لأنه الناس مدمنين عليه

② Cross Elasticity of Demand:- Measures sensitivity of Q_{dx} due to change in the price of other Goods (y)

$$E_{cross} = \frac{\% \Delta Q_{dx} \rightarrow \text{Good } x}{\% \Delta P_y \rightarrow \text{other Goods}}$$

$E_c > 0$:- $P_y \uparrow$ $Q_x \uparrow$ Two Goods are Substitutes
$P_y \downarrow$ $Q_x \downarrow$

$E_c < 0$:- $P_y \uparrow$ $Q_x \downarrow$ Two Goods are Complement
$P_y \downarrow$ $Q_x \uparrow$

$E_c = 0$: No Relation between Goods

③ Income Elasticity :- لتغير الـ income الـ مرونة Q_{dx}

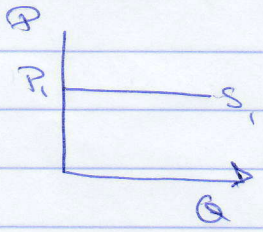
$$E_{inc} = \frac{\% \Delta Q_{dx}}{\% \Delta I}$$

→ $E_I > 0$ $\quad I \uparrow \longrightarrow Q_{dx} \uparrow$ Normal Goods / Superior
$\quad I \downarrow \longrightarrow Q_{dx} \downarrow$

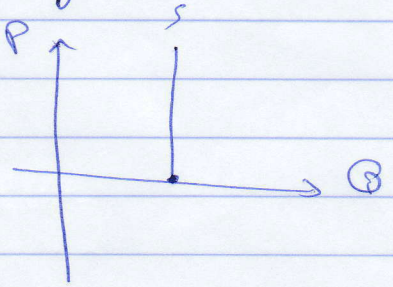
→ $E_I < 0$ $\quad I \uparrow \longrightarrow Q_{dx} \downarrow$ Inferior Goods
$\quad I \downarrow \longrightarrow Q_{dx} \uparrow$ سلع ردئية

Note

- Elastic and inelastic supply Curve
  - Elastic: Supply is Constant (fixed)



No change in Price



- Total Revenue Test

$TR = P \times Q$

① demand is elastic $E_p > 1$ $\quad E_d = \infty$

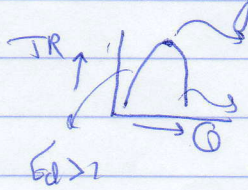
$P \downarrow \quad Q \uparrow \quad TR \uparrow$
$P \uparrow \quad Q \downarrow \quad TR \downarrow$

② demand is inelastic $E_p < 1$ $\quad E_d = 0$

$P \uparrow \quad TR \uparrow$ It doesn't have effect in Quantity
$P \downarrow \quad TR \downarrow$

③ $E_p = 1$

No change in TR



• Price elasticity of Supply = $E_s = \frac{\% \Delta Q_s}{\% \Delta P} = \frac{\frac{Q_2 - Q_1}{(Q_2+Q_1)/2}}{\frac{P_2 - P_1}{(P_2+P_1)/2}}$

$= \frac{2(Q_2 - Q_1)}{Q_2+Q_1} \div \frac{2(P_2-P_1)}{(P_2+P_1)}$

$P \uparrow \quad Q_s \uparrow \quad (+) \quad E_s > 0$

$P \downarrow \quad Q_s \downarrow$

$E_{P_s} < 1$ • ~~Short period perfectly~~ inelastic ← ↑ time is the Main

$E_{P_s} > 1$ • long period ; more elastic ← ↓ Determinant

$E_{P_s} = 0$ • The Good is fixed in Supply (perfectly inelastic) (short period)

$E_{P_s} = 1$:. unit elastic

$\frac{2(Q_2 - Q_1)(P_2+P_1)}{(Q_2+Q_1)(P_2-P_1)}$

• Production function :-

→ Types, ① Simple prod. function
② Production function with f variables

→ $Q = f(V_1, V_2, V_3 - , V_n)$ ← inputs

Fixed ← inputs → Variable

Capital (K) — Labor (L)

So $Q = f(L, K)$ (No waste of input)

No substitution between factors of inputs

$L\uparrow$ $K\downarrow$

$L\downarrow$ $K\uparrow$

Firm Optimization

Q Given → Cost Min

Cost Given → Q Max

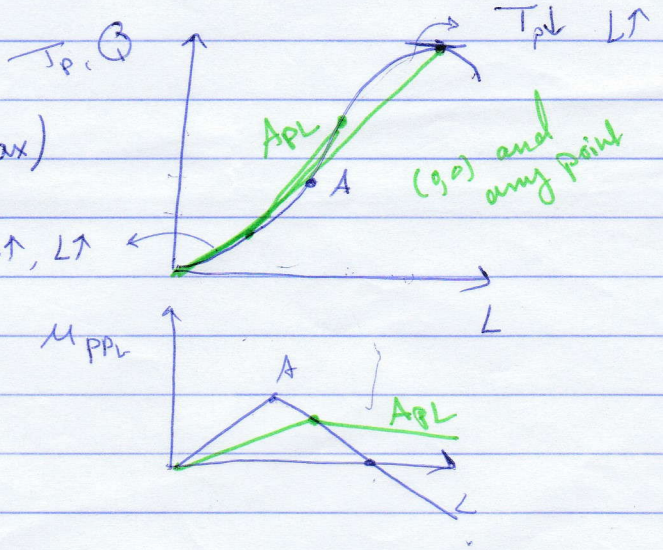
$\Pi = T_R - T_C$

$= P \times Q - T_C$

① S.P.F :- (Single variable input)

- T. P. ⓒ
- MPP$_L$: Marginal (physical) Products
- AP$_L$: Average Productivity of Labor
- Relation between :- A_P, M_{PP_L}, T_P
- Marginal Revenue of Product ← Total product

- A is when slope begins to come down (M_{PP_L} is Max)
- M_{PP_L} = Slope $(T_P \text{ vs } L) = \frac{\Delta Q}{\Delta L}$
- $A_{P_L} = \frac{Q}{L}$



• The Relationship Between: AP_L and MPP_L

$MPP_L > AP_L$ when AP_L is increasing
$MPP_L = AP_L$ when AP_L is Max
$MPP_L < AP_L$ " AP_L is decreasing

② 2. V. P. F

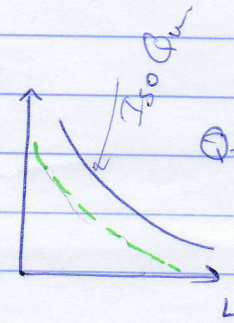
L, K are substitutional

a - Iso Quant Curve = Production indeferent Curve

slope - MRTS : Marginal Rate of Technical Substitution

- Budgent line (Constrain) = Iso Cost line
- least Costly inputs Combination
- law of Returns to scale

a-



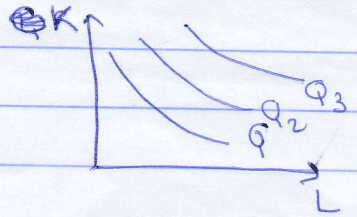
Q = constant

• Deffrent values of L, K Gives us same value of Q

→ • shifting (In Case of Technical improvement) same output but less inputs $Q = 10\sqrt{LK}$ $Q = 20\sqrt{LK}$ (↓ →↓)

$\text{slope} = \frac{\Delta K}{\Delta L}\Big|_Q$: negative = $MRTS$

→ Iso-Quant Map:



• if the Curve is in L shape = L, K are Complement (fixed proportions production) slope = 0

• " " " line L, K are substitutional slope is constant

• Cost Function

Short Run Costs:-

1- TFC 4- AFC 7 Marginal Cost = T_C تكلفة الوحدة الأخيرة

2- TVC 5- AVC

3- TC 6- ATC

↳ = ATFC + ATVC

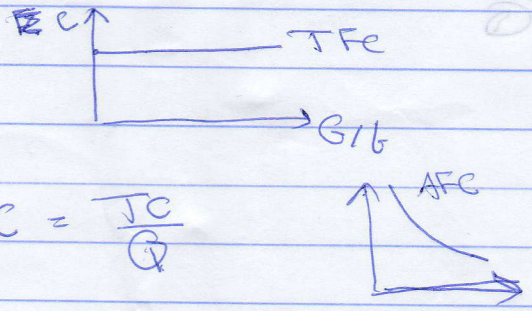
$MC = \frac{dTVC}{dQ} = \frac{W}{MP_{PL}}$ $\left(\frac{dTFC}{dQ} = 0 \text{ constant}\right)$

① Cost of fixed inputs / can't be Returned

④ - They don't vary

- F.C > 0 even if output = 0

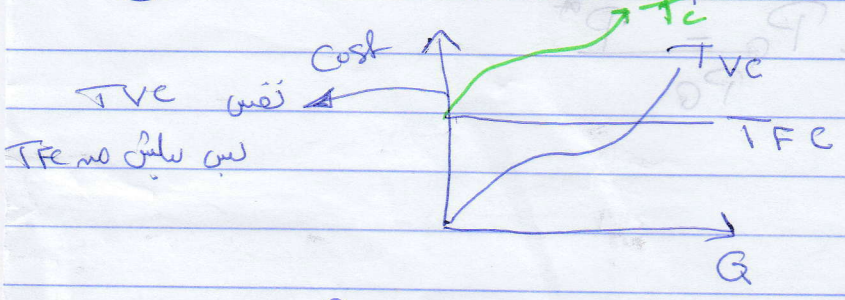
= investement Cost = Capital Cost



$AFC = \frac{TC}{Q}$

② TVC- Total opport. Cost = ~~ΔTC/ΔQ~~ $T_C - TFC = W \cdot L =$ (wages)

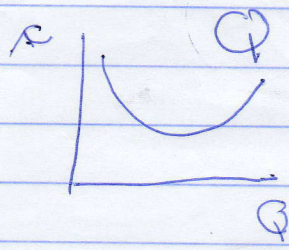
⑤ Annual expenditure / annual disperement Cost



TVC تبدأ من

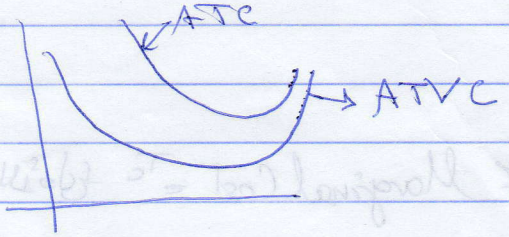
TFC مش بتبدأ من

$AVC = \frac{TVC}{Q} = \frac{W}{AP_L}$



if Q = 0 ⇒ TVC = 0

③ TC = TVC + TFC



$Q^* = \frac{TFC}{TR - TVC}$ = i.e. productive Capacity

$Q^* \Rightarrow \frac{TFC}{P - V}$

$\frac{TR}{Q}$ $\quad$ $\frac{TVC}{Q}$

$P^* \Rightarrow TR = TC$

$P^* = \frac{TFC + TVC}{Q}$

Price safety margin $= \frac{P_Q - P^*}{P_Q}$

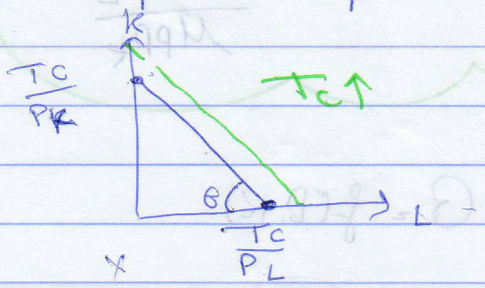
Iso Cost line/curve

$TC = P_L \times L + P_K \times K$ (firm's expenditure equation)

Price

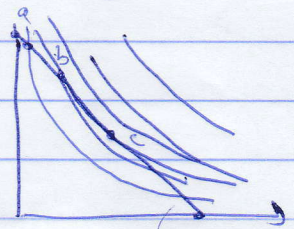
↳ $TC \rightarrow$ on K : OA on curve

↳ $TC \rightarrow$ on L : OB on curve



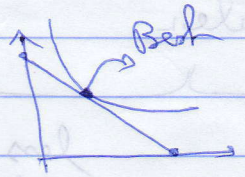
$$\text{Slope} = \tan\theta = \frac{OA}{OB} = \frac{\frac{TC}{P_K}}{\frac{TC}{P_L}} = \frac{P_L}{P_K} = MRTS$$

→ Firm optimization: Iso line + Iso-Quant Map



a, b, c are mutually exclusive
You can choose one / c is the best

$$MRTS = \frac{P_L}{P_K}$$



Meaning

$$\frac{P_L}{P_K} = \frac{\Delta K}{\Delta L}$$ firm optimization

- Prove That

$$MRTS = \frac{-MPP_L}{MPP_K}$$

→ $Q = f(L, K)$

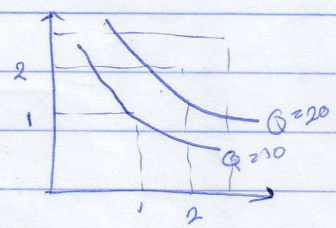
constant $dQ = \left(\frac{dQ}{dK}\right) dK + \frac{dQ}{dL} dL$

$$0 = MPP_K \, \Delta K + MPP_L \, \Delta L$$

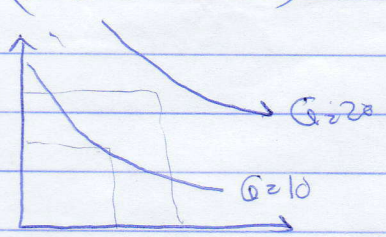
$$\text{so } -\frac{MPP_L}{MPP_K} = \left.\frac{\Delta K}{\Delta L}\right|_{Q} = MRTS$$

- Returns to Scale:-

Increasing Return
Input double
outputs more than double
(Economies)



less than double (Decreasing)
Inputs double
ouputs less than double
(diseconomies)



exactly in double (constant
Inputs double
outputs double