

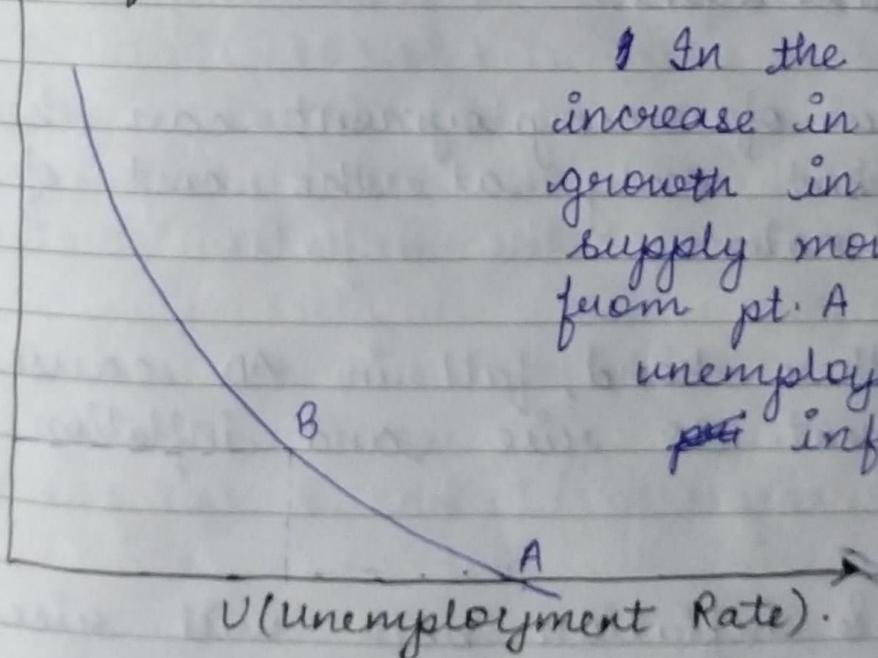
- ∵ If the inflation is expected to rise in the future, then it will also rise in the current period due to fall in ideal balance in the current period as people will buy more goods in the current period.
- ∵ Both demand & supply for money have to be changed in order to maintain price stability.

THE PHILLIPS CURVE

- The Phillips curve presents an inverse relationship between the unemployment rate (U) and the inflation rate (P).
- It ~~also~~ presents a trade-off between unemployment and inflation. Lower is the ~~more~~ unemployment, higher is the inflation.
- The policy makers use monetary and fiscal policies to enhance Aggregate Demand (AD). This leads to shift in the AD curve rightward on the short-run supply ~~curve~~ (AS) curve leading to increase in Y and P .
- In short-run, supply curve is upward sloped, ∵ when demand will rise, AD curve will shift towards right which will lead to increase in both output and price level.

- Higher output (Y) \rightarrow low unemployment as firms need more labour to produce more.
- For increasing output, firms will need more labour, ~~unemployment~~ unemployment of labour will fall as more labours will be hired.
- Whenever there is expansionary monetary or fiscal policy, aggregate demand rises given aggregate supply, output rises & rising output causes unemployment to fall.
- On one side, there will be fall in ~~in~~ unemployment rate and on the other side, there is rise in price.

$\uparrow P$ (Inflation rate)



In the short run, an increase in the rate of growth in the money supply moves the economy from pt. A to pt. B \rightarrow unemployment declines & ~~pt~~ inflation rises.

$$\text{If } \text{Inflation} \propto \frac{1}{\text{unemployment rate}}$$

- When output increases, price rises.
- If unemployment has to be kept low, inflation rate ~~must~~ must be high. Whereas, if inflation rate is to be kept low, unemployment will be high. i.e. both cannot be low simultaneously.
- We can contain inflation only if we let the unemployment rate to rise.
- Higher P given the previous period's P leads to higher inflation.
- Hence, when the economy moves on the SR AS curve, unemployment decreases and inflation increases.
- Lower rates of unemployment can be achieved, but only at the cost of higher inflation rates.
- On the other hand, fall in AD causes unemployment to rise and inflation to fall.
- Output & inflation, both will rise simultaneously.
- This is short run phenomena, which is observed when AD curve shifts towards

right causing the output to rise.

- When demand falls, causing AD curve to shift towards left, output falls, causing unemployment to rise and inflation rate to fall.

* The origin of the Phillips Curve

- The Phillips curve derives its name from the New Zealand economist A.W.H. Phillips, who found a trade-off between unemployment and wage inflation in the British economy (1861-1957).
- According to his study, the rate of change in the wage rate is a negative funcⁿ of the rate of unemployment, i.e. when wage rate increases, rate of unemployment falls and vice-versa. Higher the rate of unemployment, lower is the wage rate.
- In other words, the rate of change in nominal wage rate (w) is a linear funcⁿ of the inverse of the rate of unemployment.
- On the USA economy (1950-1966), the Phillips curve was estimated to be

$$w = -1.43 + \frac{8.27}{u} \quad R^2 = 0.38$$

Slope coefficient = 8.27

→ Change in wage rate by one unit change in unemployment.

R^2 → Coefficient of determination
Explanatory power of the independent variable in the determination of the dependent variable.

- ∵ There is a trade-off between unemployment rate and the nominal wage rate.

- Natural rate of unemployment:

There is always some amount of unemployment in an economy for natural reasons. Unemployment cannot be zero. This is the natural rate of unemployment [Non-accelerating inflation rate of unemployment (NAIRU)]

It is that amount of ~~inflation rate~~ ~~that~~ ~~doesn't accelerate the~~ unemployment that doesn't accelerate the inflation rate.

u^* = Natural rate of unemployment (NAIRU).

- Natural unemployment has 2 components:
 - i) frictional
 - ii) structural

- Frictional unemployment: It arises when there is a search-effort going on in the economy. When people are given jobs, but

they leave the job in search of a better job. There are frictions created in an economy that cause some minimum amount of unemployment.

- Structural unemployment - It can arise because of change in the structure of an economy or change in structure of a sector. Certain structural transformations are brought in which can cause some unemployment temporarily.
- Frictional and structural unemployment can coexist with full-employment in an economy.
- There is always some minimum amount of structural and frictional unemployment. It can never be 0.

$$u = \text{Actual unemployment}$$

$$u - u^n = \text{Cyclical unemployment.}$$

- In an economy, with change in output, there is a change in actual unemployment which is a deviation from the natural unemployment.
- If $u > u^n \Rightarrow +ve$ cyclical unemployment
 $u < u^n \Rightarrow -ve$ cyclical unemployment

w = Rate of change in the nominal wage rate.

- On the introduction of the natural rate of unemployment by Friedman, the formulation of the Phillips curve changed to

$$w = -\beta(u - u^*)$$

where $\beta > 0$.

- Cyclical unemployment adversely affects nominal wage rate.
- Paul Samuelson and Robert Solow (1960) popularized the Phillips ~~law~~ curve in the USA and extended it to the rate of inflation.
- To them, the price inflation is merely a mark up over the nominal wage inflation.
- Rise in nominal wage implies wage inflation. When wage paid to the labours rise, price of the goods rise. Because price of the goods is always cost inclusive, and wages paid to the labours comes under the cost of production.
- ∴ Wage inflation implies that there is price inflation

- Accordingly, they transformed the Phillips curve in terms of inflation and unemployment rate.

$$\mu = -\beta(u - u^n)$$

where μ is the inflation rate.

This eqⁿ shows the famous trade-off as Phillips curve proposes.

- If the policy makers like to reduce unemployment, they must accept a higher inflation rate.
- The credibility of the Phillips Curve was challenged in late 1960s.
- This led to the introduction of inflation expectations by Friedman and Phelps.
- The Phillips curve tells the bidirectional causality between the variables taken on both sides. ∵ There is a trade-off b/w inflation & unemployment rate.
- i.e. If inflation rate is controlled, unemployment rises and vice-versa.
- In employment analysis, we take employment or unemployment as the dependent variable & inflation rate as the independent variable.
- In inflation analysis, we take inflation as the dependent variable & employment or

unemployment as the independent variable.

- Unemployment & inflation are bidirectionally related.
- The inflation augmented Phillips curve is expressed as

$$u = u^e - \beta(u - u^*)$$

where u^e is the expected inflation rate.
Higher the expected inflation, higher is the current inflation.

Current inflation also depends upon the inflation caused by cyclical unemployment.

- As both the workers and firms are interested in real wage rate rather than nominal wage rate, money wage contracts are negotiated based on expected inflation rate.
- The expectation of inflation rate that is going to prevail in the economy affects the money wage that the workers will negotiate ~~today~~ today.
- If the inflation is expected to increase, labour ask for higher money wage so that real wage remains high.
- Hence, u^e affects the nominal wage rate and it

turn, inflation rate.

- Expected inflation will directly affect the current inflation whereas cyclical unemployment will inversely affect the current inflation rate.
- * Derivation of the Phillips Curve from the AS curve.
- The inflation rate depends on:
 1. Expected inflation
 2. The deviation of the unemployment from the natural rate (cyclical unemployment)
 3. Supply shocks.

Thus,

$$\pi = \pi^e + \beta(u - u^n) + \epsilon$$

- The above equation is derived from the AS eqⁿ

$$Y = Y^n + \alpha(P - P^e) \quad \alpha > 0$$

$Y^n \rightarrow$ natural rate of output

$P \rightarrow$ current price

$P^e \rightarrow$ expected price.

$P - P^e \rightarrow$ Deviation of current price from expected price. and it is a factor to determine the AS curve.

- Higher the value of $(P - P_e)$, higher is the output and vice-versa.
Higher is the price, higher is the quantity supplied.
- The output that we get considering the natural rate of unemployment is the natural output. i.e. if output of an economy when frictional & structural unemployment may be present.

$$P = P^e + \left(\frac{1}{\alpha}\right)(Y - Y_n)$$

- $Y - Y_n \rightarrow$ Actual income deviated from the natural output. (Cyclical output)
 \rightarrow Output that changes with cyclical unemployment.
- Price depends upon the expected price, deviation of Y from natural Y & supply shock.

\therefore We add supply shock v to the RHS

$$P = P^e + \left(\frac{1}{\alpha}\right)(Y - Y_n) + v.$$

where v ~~event~~ represents ~~a~~ exogenous event that alter the price level and shift the AS curve.

- Second, to go from price level to inflation rate, we subtract last year's price level P_{-1} from both sides of the equation & then we get.

$$P - P_{-1} = (P^e - P_{-1}) + \left(\frac{1}{\alpha}\right)(Y - Y^n) + v.$$

- Inflation is actually a% change in price level.

Interpreting P as logarithm of the price level, the changes in P can be roughly considered as inflation rate.

- Thus, we can rewrite the eqn. as

$$\pi = \pi^e + \left(\frac{1}{\alpha}\right)(Y - Y^n) + v.$$

- Third, to go from the output to employment, we need to apply the Okun's law.
- Okun's law: It states that the deviation of output from its natural rate is inversely proportional to the deviation of unemployment from its natural rate. When the actual output > natural rate of output, actual unemployment < natural rate of unemployment.

$$Y > Y^n, u < u^n$$

- So, we get.

$$\left(\frac{1}{\alpha}\right)(Y - Y^*) = -\beta(U - U^*).$$

- Now, if we substitute $-\beta(U - U^*)$ into the eqⁿ, we get:

$$\boxed{\pi = \pi^e - \beta(U - U^*) + v}$$

Phillips curve equation

- In essence, Phillips curve and short-run AS equations give the same ideas,
- 1. According to SR AS eqⁿ, output is related to ~~to~~ unexpected movements in price level

$$Y = \alpha * Y^* + \alpha(P - P^e), \alpha > 0$$

$\therefore Y$ is related to unexpected movements in price level i.e. $P - P^e$
- 2. according to Phillips curve equation, unemployment is related to ~~to~~ unexpected movements in the inflation rate.

- The above 2 are same ideas, as output and unemployment are closely related. When output is high, unemployment is low and vice-versa.

* What determines Expected Inflation?

- Expected inflation is primarily based on recently observed inflation. (adaptive expectations)
- If people expect prices to rise at the same rate as last year's, then

$$\pi^e = \pi_{-1}$$
- Thus, we can write the Phillips curve equation as,

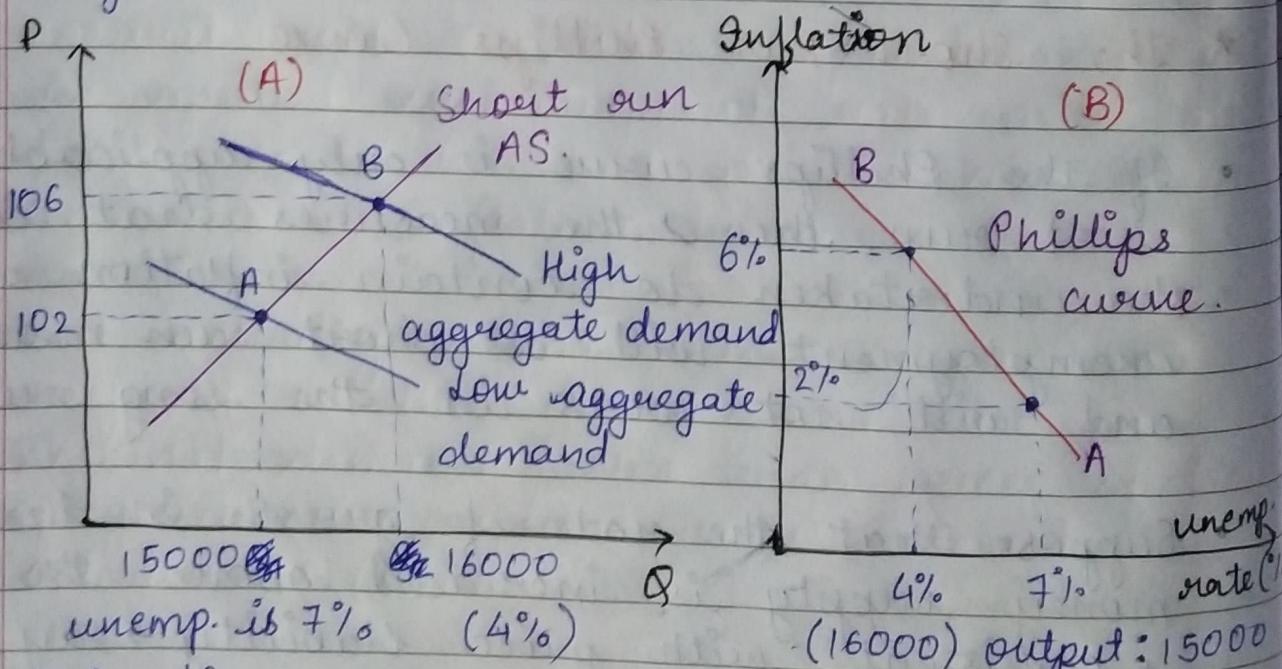
$$\pi = \pi_{-1} - \beta(u - u^*) + \nu.$$

π_{-1} implies we have inflation inertia i.e. expected inflation is the same as last year's.

* The Short Run Phillips Curve

- If the Phillips curve is only applicable for short run, then the measures that can be undertaken to contain inflation or unemployment will be short run measures and will not work in the long run.
- Suppose that the rate of growth in the money supply is increased above the rate consistent with price stability \rightarrow say, rate of growth of money supply increases from 3% to 5%.

- This will stimulate the aggregate demand and, the nominal income
- Much of the rise in income will take the form of an increase in output and employment rather than in prices.
- People have been expecting prices to be stable, and prices and wages have been set for some time in the future.
- Producers will tend to react to the initial expansion in aggregate demand by increasing output, employees by working longer hours and unemployment by taking jobs now offered at former nominal wages.



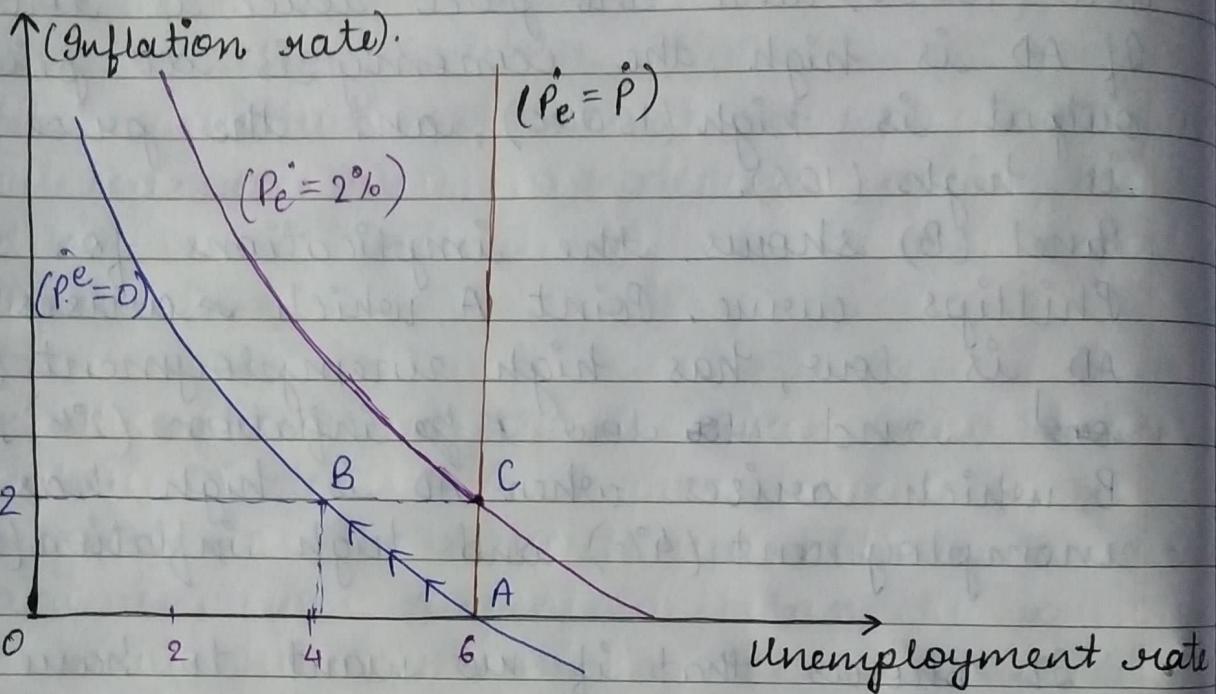
- This figure assumes a price level of 100 for the year 2019 and charts possible outcomes for the year 2020. Panel

- (A) shows the model of AD and AS. If AD is low, the economy is at point A; output is low (15000) and the price level is low (102). If AD is high, the economy is at point B; output is high (16000), and the price level is high (106).

Panel (B) shows the implications for the Phillips curve. Point A, which arises when AD is low, has high unemployment (7%) and ~~and~~ and ~~too~~ low inflation (2%). Point B, which arises when AD is high, has low unemployment (4%) and high inflation (6%).

- It shows that if we want to have low unemployment rate then we must be prepared for high inflation rate and vice-versa.
- Phillips curve in short run is downward sloping, i.e. higher is the inflation rate, lower is the unemployment and vice-versa.
- As AS curve is positively sloped, ∴ we get a negatively sloped Phillips curve which implies that there is a trade-off b/w inflation rate and unemployment.
- In the short run, it was assumed to have stable prices ($\dot{P} = 0$), and the unemployment rate to be natural rate. The expansionary AD policy lowers the unemployment rate below

the natural rate. These are the initial effects.



- In this case, we start with 0 inflation rate, unemployment rate will ~~not~~ be the natural rate, 6%. When expansionary policy is applied, unemployment rate will fall from 6% to 4% but it will also result in rise of inflation from 0% to 2%.
- But actually, selling prices of products respond to the unanticipated rise in nominal demand faster than prices of factors of production \rightarrow real wages received deteriorates (w/p).
- Wages are determined by contracts on the basis of ~~not~~ expected inflation, \therefore already a wage remains fixed, \therefore when price will rise,

real wage will fall.

- The simultaneous fall ex post in real wages to employers and rise ex ante to employees is what enables the employment to increase in the short run, which is temporary.
- It will take time for the employees ~~to~~ to realize that real wage is lost, ~~and~~ and during that time, ~~the~~ employment will rise.
- Workers eventually observe the higher price level and demand higher money wages.
- Hence, real wages will tend to rise towards the initial level.
- There are 2 situations which affect the Phillips curve such that trade-off between inflation and unemployment rate will not exist.

* Shift in the Phillips Curve: Role of Expectations

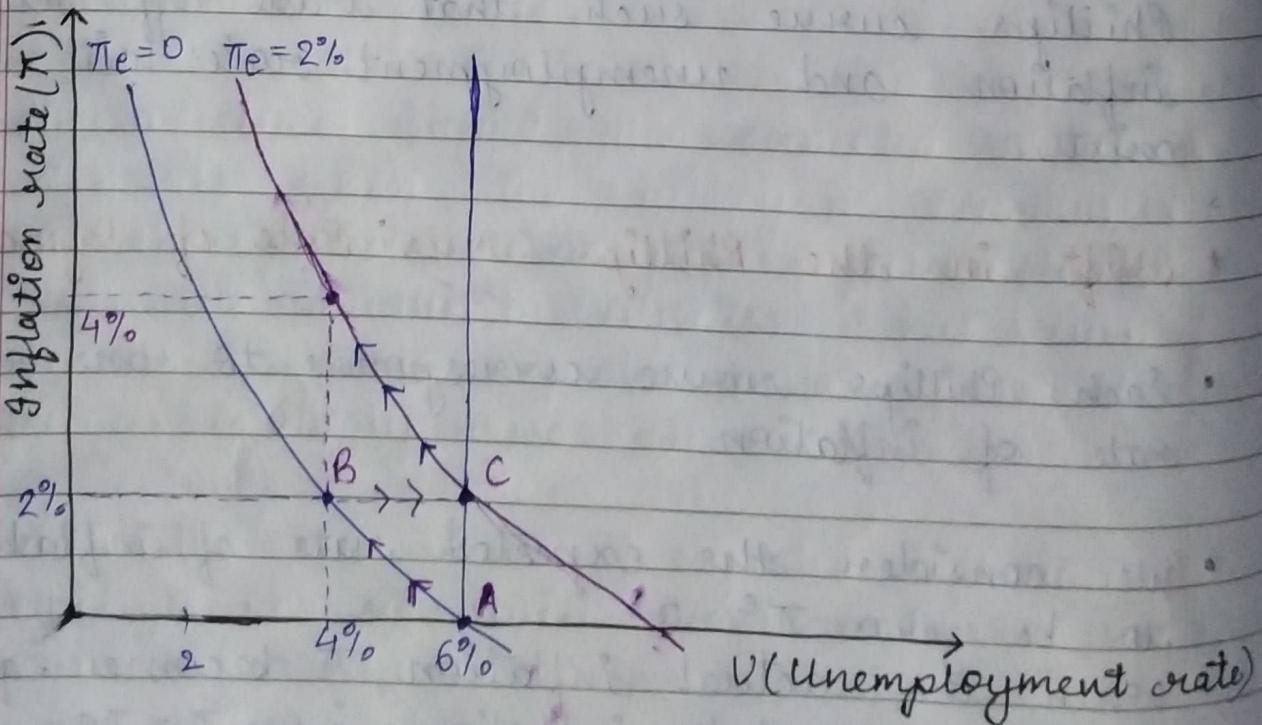
- Each Phillips curve corresponds to one expected rate of inflation.
- We consider the expected rate of inflation to be zero, $\pi^e = 0$. When the actual inflation, π becomes equal to the expected inflation i.e. $\pi = \pi^e$,

employment becomes equal to the natural rate of unemployment.

$$u = u^* - \alpha(\pi - \pi^e)$$

- The deviation of actual unemployment from natural unemployment depends upon the deviation of actual inflation from expected inflation.
- In the short-run, π^e is given and hence, higher π leads to ~~higher~~ lower u .
 i.e. in the short-run, both employer and employee expect inflation to prevail in near future. For a short period of time, inflation will remain same as the expected inflation.

If $\pi > \pi^e$, u will be lower.



- We have the initial Phillips curve with $\pi^e = 0$, but it will shift when expected inflation changes to $\pi^e = 2\%$

- π^e has a role to play in the trade-off.

$$\pi = \pi^e - \beta(u - u^n) + v.$$

- π^e (expected inflation) & v (supply shock) determine the position of the Phillips curve. Higher the π^e or v , higher would be the position of the Phillips curve.

- If π^e falls, Phillips curve will shift towards left. Similarly, if v falls, Phillips curve will shift towards left.

$\pi^e + v$ determines the position of the Phillips.

- Slope coefficient, β determines the slope of the Phillips curve. And as β is -ve, Phillips curve is -vely sloped.

- When expansionary policies are executed to reduce the unemployment from 6% to 4%, inflation rises from 0% to 2% i.e. actual inflation becomes greater than the expected inflation.

- As long as, actual inflation $<$ expected inflation, unemployment rate $>$ natural unemployment.

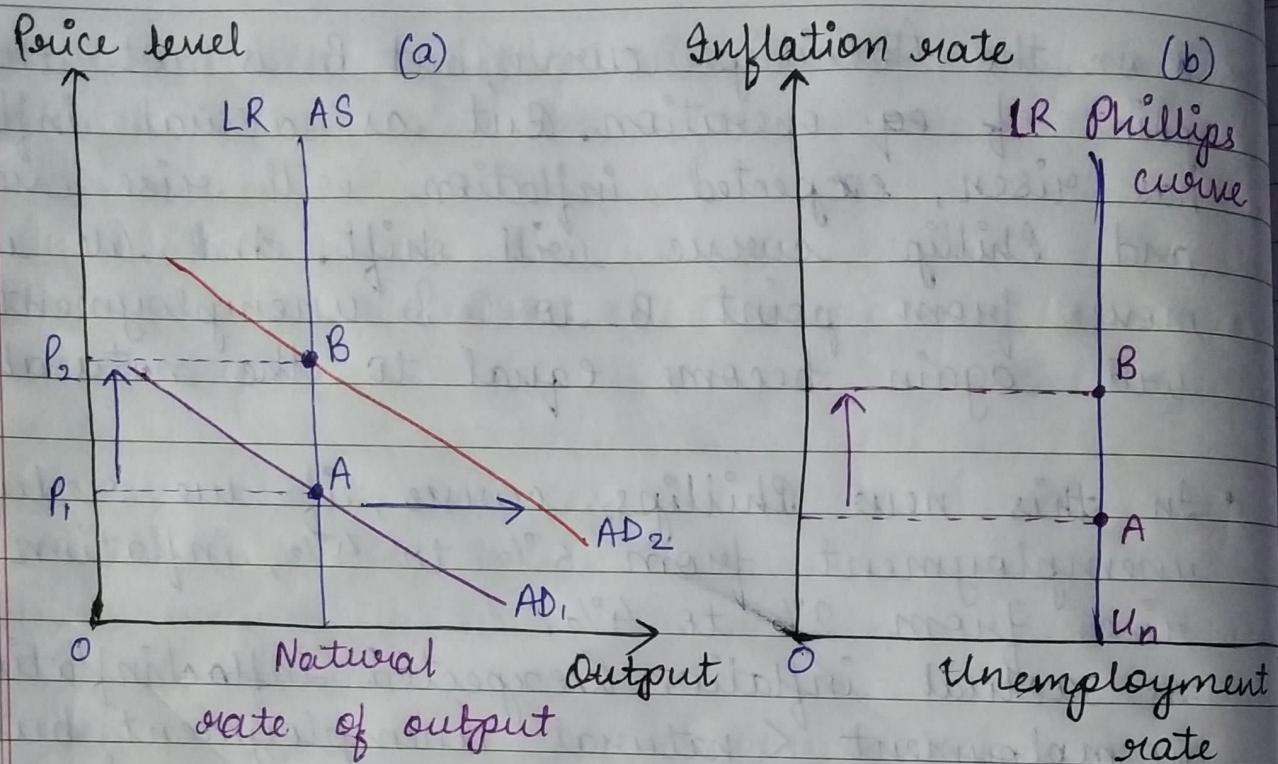
- Given an expected inflation rate, there is a

trade-off b/w inflation & unemployment i.e. if inflation is to be decreased, unemployment will rise.

- The wage contract b/w employer and employee is guided by the expected inflation rate.
- When actual inflation rate $>$ ~~not~~ expected inflation rate, employers take advantage of the situation. Real wage falls, so employers employ more labour to produce more output. As a result, unemployment falls.
- But after some time, the workers will realise that the inflation has already risen above the expected inflation, so they will expect a higher inflation to prevail in future.
- In a time period, the expected inflation depends upon the inflation inertia i.e. on the previous actual inflation rate.
∴ As the current inflation has risen from 0% to 2%, the expected inflation will correspondingly rise to 2%.
- With the new value of expected inflation rate, Phillips curve will shift towards right.
- ∴ In the short run, we move from point A to

B on the ~~the~~ Phillips curve, but B is not the final point of ~~the~~ operation. But as actual inflation has risen, expected inflation will rise eventually and Phillips curve will shift. And we will move from point B to C & unemployment rate will again become equal to the natural rate.

- In this new Phillips curve, if we reduce unemployment from 6% to 4%, inflation will rise from 2% to 4%. As actual inflation > expected inflation, unemployment < natural unemployment but soon decreased real wage will be realised and expected inflation will rise causing the Phillips curve to shift again.
- The downward sloping Phillips curve is drawn for given expected inflation rates, whereas, the long run Phillips curve shows the relationship between inflation and unemployment when expected inflation has time to adjust to the actual inflation rate ($\pi = \pi^e$) \rightarrow when inflation is fully anticipated - Phillips curve becomes vertical.
- In the long-run, $\pi^e = \pi$, hence $u = u^*$.
- The change in expected inflation shifts the Phillips curve.



An increase in the money supply increases aggregate demand which leads to rise in price from P_1 to P_2 and increases the inflation rate but leaves output and unemployment at their natural rates.

Panel (a) shows the model of aggregate demand and aggregate supply with a vertical = aggregate = supply curve. When expansionary monetary policy shifts the aggregate - demand curve to the right from AD_1 to AD_2 , the eq. moves from point A to point B. The price level rises from P_1 to P_2 , while output remains the same.

Panel (b) shows the long-run Phillips curve which is vertical at the natural rate of unemployment. In the long-run, expansionary

monetary policy moves the economy from lower inflation (point A) to higher inflation (point B) without changing the rate of unemployment.

There ↗

According to Friedman and Phelps, the trade-off exists only in the short-run but not in the long-run.

Policy makers can pursue expansionary monetary policy to lower unemployment but ultimately, unemployment returns to its natural rate and hence, more expansionary monetary policy leads only to higher inflation.

Monetary Neutrality: The Classical proposition.

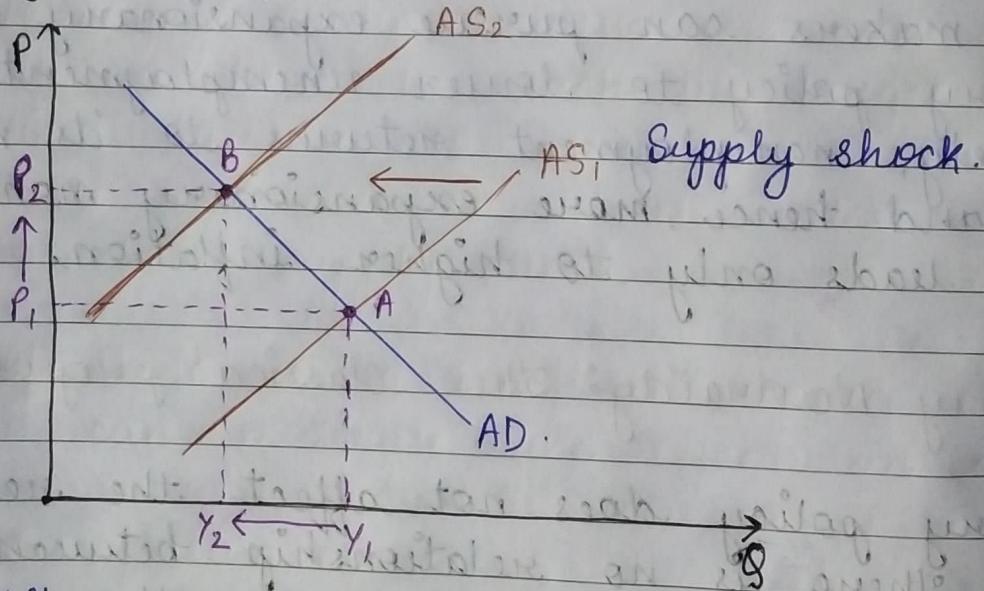
Monetary policy does not affect the real output. There is no relationship between inflation and unemployment in the long-run.

Unemployment does not depend on money growth and inflation in the long-run.

∴ The trade-off b/w unemployment & inflation does not exist in the long-run.

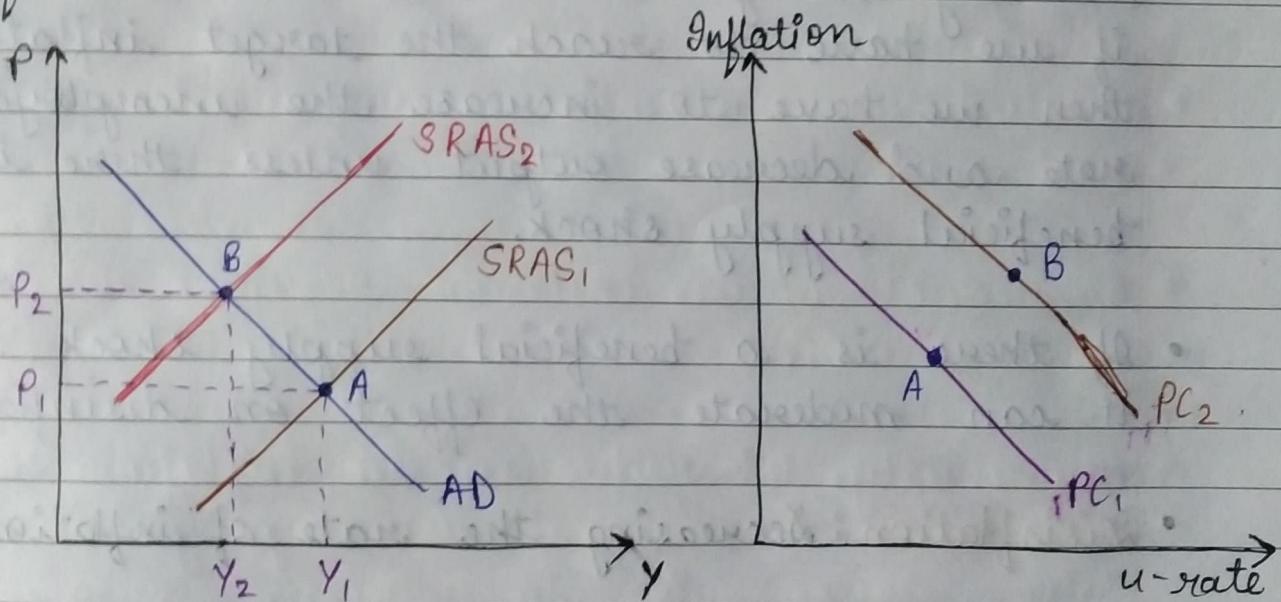
* Shift in the Phillips Curve: Role of Supply Shock.

- In 1968, π^e was treated as a factor to shift the Phillips. In 1974, OPEC supply shock came up.
- Supply shock reduces the output at any given price level.



- When supply falls, AS curve shifts from AS₁ to AS₂ i.e. price rises from P₁ to P₂ & output falls from Y₁ to Y₂.
- This is a situation of stagflation i.e. price is increasing on one side but on the other side there is fall in output.
- There is a policy dilemma in this case. Rise in AD to lower unemployment causes inflation to rise. Fall in AD to reduce inflation will cause unemployment to rise.

- In this case, we have to live with higher inflation with a given rate of unemployment or higher unemployment with a given rate of inflation or a combination of the two (higher inflation and higher unemployment).
- How an adverse supply shock shifts the PC.
- SRAS shifts left, prices rise, output & unemployment fall.



- Inflation & u-rate both increase as the PC shifts upwards.

* Disinflation and sacrifice Ratio

- Supply shock can be of both types. If it is a favourable supply shock, Phillips curve shifts towards left. If it is an adverse supply shock, Phillips curve shifts towards right.
- Rightward shift in Phillips curve is making

the trade-off difficult. Shift in the Phillips curve can make the trade-off less pronounced.

- If we want to decrease the inflation rate then there is the sacrifice of decreasing output & increasing unemployment.
- If $u = u^*$, $u = 6\%$, Target $u = 2\%$. Following Phillips curve, one can state that if we have to reach the target inflation then we have to increase the unemployment rate and decrease output unless there is beneficial supply shock.
- If there is a beneficial supply shock, then it can moderate the effect on disinflation.
- Disinflation:** Decreasing the rate of inflation.
- In India, over the years, the govt. and policy makers have focussed mainly on controlling the inflation. Unemployment can be of many types: open unemployment, disguised unemployment, educated unemployment, etc. & there is no standard way of measuring it.
- People are also concerned about decreasing inflation because high inflation rate leads to low purchasing power.

- Unemployment is accepted more than high inflation rate.
- The sacrifice ratio is an economic ratio that measures the effect of rising and falling inflation on a country's total production and output.
- Costs are associated with the slowing of economic output in response to a drop in inflation.
- The cost of output reduction is to be compared with the benefits of lowering inflation.
- When prices fall, companies are less incentivized to produce goods and may cut back on production.
- The sacrifice ratio in terms of output: % of a year's real output foregone for reducing inflation by 1%.

$$\text{Sacrifice Ratio} = \frac{\text{Dollar cost of Production losses}}{\text{Percentage change in Inflation}}$$

- A typical ratio is 5:1 i.e. when we try to reduce inflation by 1%, we face a fall in output by 5%.

- Sacrifice Ratio in terms of unemployment:
Okun's law.
(1% ~~change~~ point change in unemployment leads to 2% point change in GDP).
- Hence, reducing inflation by 1% requires 2.5% point cyclical unemployment.
- For 2% rise in GDP, there is 1% fall in unemployment.
- 1% reduction in inflation requires 5% fall in real GDP.
- 4% reduction in inflation requires 20% fall in real GDP.
- Equivalently, 4% reduction in inflation requires 10% rise in cyclical ~~to~~ unemployment.
- The disinflation may take various forms.
- It is better to divide the reduction in inflation over a period of time. Gradual ~~in~~ disinflation lowers the worse effects caused by it as it is distributed over a longer period of time.
- Ex: Rapid Disinflation: Lowering output by 10% for 2 years.
Moderate Disinflation: Lowering output by 5%

for 4 years.

Gradual Disinflation: Lowering output for 2% for 10 years.

- US economy empirically proves that when inflation is target, the economy is bound to sacrifice output, ~~&~~ and have higher unemployment.
- This can be called cost or a consequence of inflation. Inflation itself ~~is~~ has a cost & containing inflation has a cost i.e. reduction in output & increase in the unemployment rate.

* Costs of Inflation

Fall in purchasing power / inflation fallacy.

Shoeleather cost

Menu cost

Relative price variability and misallocation of resources.

Inflation induced tax distortions

Arbitrary redistribution of wealth.

- It fall in purchasing power: The inflation fallacy

When inflation occurs,

- Buyers pay more or buy fewer goods.
- As inflation rises, it reduces the purchasing power ~~or~~ of the value of money & real income possessed by the people. Indicates a decline in standard of living.
- But the sellers earn more. As most of the people earn selling their services like labour, their is inflation income.
- The sellers of services will also earn more. Hence, inflation does not in itself reduce people's purchasing power. Some people will also realise rise in purchasing power.
- Menu cost.
- When inflation/deflation occurs, the prices are to be changed, which costs the economy.
- On the basis of an expected inflation rate, an MRP has already been decided for a product and printed on its package. Now, when the inflation rate will rise, MRP of all the products across the

economy will change. ~~and changing~~

- When there is inflation, the ~~is~~ input prices of several goods will change and MRP of all the goods & changing the MRP of all the goods requires a cost called the Menu cost.
- Menu cost applies to all kinds of businesses.
- When inflation rate changes more frequently, then the logistic and transition costs on the part of the seller are quite high & this is the menu cost.
- Shoeleather cost.
- When inflation occurs, it erodes the real value of the money one holds.
- Nominal interest rate rises.
- People like to hold ~~less~~ real balances and keep more wealth in interest-bearing savings accounts.
- As real-value of money falls, people keep more money in the banks in order to earn interest. They frequently visit the bank.

- Visiting the bank frequently will involve ~~transaction~~ travel cost, etc. And the ~~per~~ person will lose the income he would have earned that day, etc.
- The cost of reducing the money holding is the shoeleather cost.
- Relative price variability and misallocation of resources.
- If a particular restaurant prints a new menu with new prices once in a year.
- If annual inflation rate is 24%, its relative prices will fall by 2% per month.
- Market economies rely on relative prices to allocate scarce resources.
- A consumer should consume goods X & Y such that

$$\frac{MU_x}{MU_y} = \frac{P_y}{P_x}$$

- Consumers consume more of a product whose price is low and less of a product whose price is high.
- If price of X, P_x is not changing but P_y is changing rapidly, then relative price, P_x/P_y will change, which will affect consumer.

decisions and will lead to misallocation of resources.

- When inflation distorts relative prices, consumer's and producer's decisions are distorted and it leads to misallocation of resources.