

# Analysis of Business Cycles II : The Supply Side of the Economy

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# Introduction I

Aggregate supply behaves differently in the short-run than in the long-run.

- In the long-run, prices are flexible, and the aggregate supply curve is vertical.
  - shifts in aggregate demand curve affect the price level and output remains its natural level.
- In the short-run, prices are sticky, and the aggregate supply curve is not vertical.
  - shifts in aggregate demand curve affect the output and do cause fluctuations in output.

# Introduction II

- The aim is to understand upward sloping short-run AS curve.
- Some prices are sticky and others not.  
This is the better reflection of the real world.
- All prices are fixed (horizontal AS curve) is an extreme situation.

# The Basics I

- There are two types of market imperfection in the economy.
- These imperfections (frictions) cause the output of economy to deviate from its natural level.
- As a result of these imperfections, the short-run aggregate supply curve is upward sloping.
- As a result of upward sloping AS curve, shifts in aggregate demand curve cause output to fluctuate.
- This deviations of output from its natural level represent the booms and busts of the business cycle.
- The equation for the short-run AS curve :

$$Y = \bar{Y} + \alpha(P - EP)$$

# The Basics II

$$Y = \bar{Y} + \alpha(P - EP)$$

- The equation states that output deviates from its natural level when the price level deviates from the expected price level.
- $\alpha$  indicates how much output respond to unexpected changes in the price level.
- The model explains :  
why unexpected movements in the price level are related to fluctuations in aggregate output.

# The Sticky-Price Model I

- The model emphasizes that firms do not instantly adjust the prices they charge in response to changes in demand.
- Building the model
  - we first consider the pricing decisions of individual firms
  - then we add together the decisions of many firms to explain the behavior of the economy as a whole.
- Main assumption : Firms have at least some monopolistic control over the prices they charge.

## The Sticky-Price Model II

Desired price  $p$  depends on two macroeconomic variables:

- The overall level of prices :  $P$   
⇒ A higher price level implies that the firm's cost are higher.
- The level of aggregate income :  $Y$   
⇒ A higher level of income raises the demand for the firm's product.  
⇒ And marginal cost increases at higher levels of production.

Firms with flexible prices:

$$p = P + a(Y - \bar{Y})$$

$a > 0$  : measures how much the firm's desired price responds to the level of aggregate output.



# The Sticky-Price Model III

Firms with sticky prices:

$$p = EP + a(EY - E\bar{Y})$$

for simplicity, assume that these firms expect output to be at its natural level :  $a(EY - E\bar{Y}) = 0$

then, these firms set the price :  $p = EP$

## The Sticky-Price Model IV

In the overall economy, there are two pricing group as flexible and sticky.

The weighted average of the pricing :

$s$ : fraction of firms with sticky prices

$1-s$ : fraction with the flexible prices

Then the overall price level

$$p = sEP + (1 - s)[P + a(EY - E\bar{Y})]$$

subtract  $(1 - s)P$  from both sides

$$sP = sEP + (1 - s)[a(Y - \bar{Y})]$$

# The Sticky-Price Model V

divide both sides by  $S$

$$P = EP + [(1 - s)\frac{a}{s}](Y - \bar{Y})$$

- When firms expect a high price level, they expect high costs.
- When output is higher, the demand for goods is higher. So firms set prices higher.

When we use  $\alpha = \frac{s}{(1-s)a}$ ,

$$Y = \bar{Y} + \alpha(P - EP)$$

**The Result:** The sticky-price model says that the deviation of output from the natural level is positively associated with the deviation of price level from the expected price level.

# The Imperfect Information Model I

## Assumptions :

- Markets clear. (flexible prices)
- The short-run and long-run aggregate supply curves differ because of temporary misperceptions about prices.
- Each supplier in the economy produces single good and consume many goods.
- They monitor closely the prices of what they produce but less closely the prices of all the goods they consume.
- Because of imperfect information, they sometimes confuse changes in overall price level with changes in relative prices.

## The Imperfect Information Model II

**The result:** This confusion influences decisions about how much to supply, and it leads to positive relation between the price level and output in the short-run.

Actual prices exceed expected prices, suppliers raise their output :

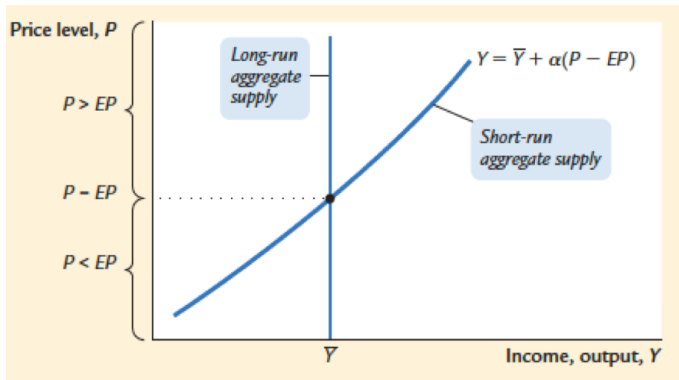
$$Y = \bar{Y} + \alpha(P - EP)$$

# Implications for the Model I

$$Y = \bar{Y} + \alpha(P - EP)$$

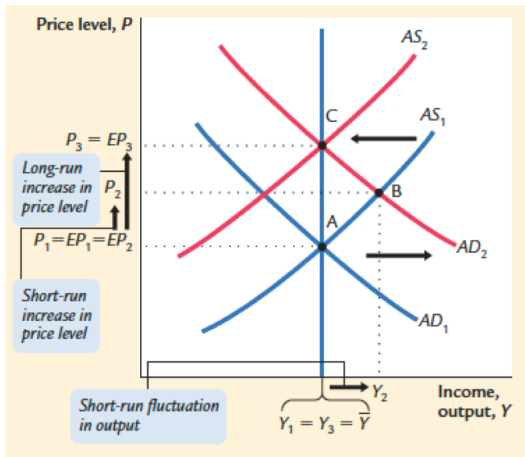
- If the price level is higher than the expected price level, output exceeds its natural.
- If the price level is lower than the expected price level, output falls short of its natural level.

## Implications for the Model II



# Implications for the Model III

Demand shock leads to short-run fluctuations in the economy.





## Phillips Curve

A.W.Phillips (1958), "The Relationship Between Unemployment and the Rate of Change of Money Wages in the United Kingdom: 1861-1957", *Economica* 25

*"periods of low unemployment were associated with rapid rises in wages, while periods of high unemployment were associated by low growth in wages"*

- Phillips curve shows the negative relationship between unemployment and inflation.
- When labor markets are tight (the unemployment rate is low)
  - firms may have difficulty hiring qualified workers and may have hard time keeping their present employees.
  - Because of shortage of workers in the labor market, firms will raise wages to attract needed workers and raise their prices at a more rapid rate.

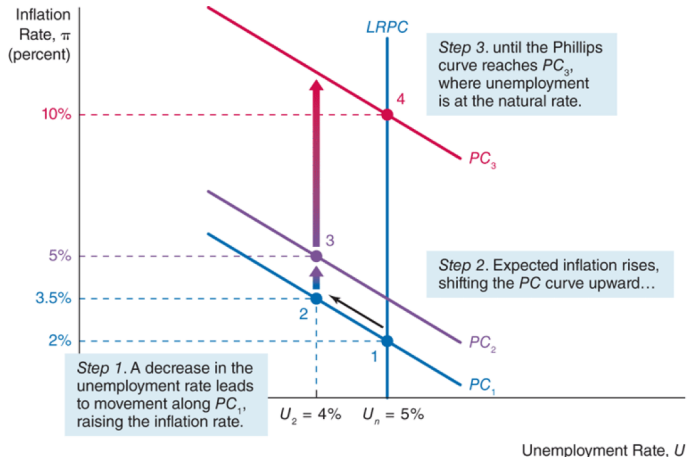
# Modern Phillips Curve I

M. Friedman (1967), "The Role of Monetary Policy", American Economic Review 58

E. Phelps (1968), "Money-Wage Dynamics and Labor-Market Equilibrium", Journal of political Economy 76

- Real wages  $\Rightarrow$  When workers and firms expect the price level to rise, they will adjust nominal wages upward so that the real wage does not decrease.
- The Long Run  $\Rightarrow$  In the long run, all wages and prices are flexible. This is called *natural rate of unemployment*
- $\pi = \pi^e - \omega(U - U_n)$

# Modern Phillips Curve II



## Modern Phillips Curve III

The short run and the long run :

- There is a short-run trade-off between inflation and unemployment.
- There is no long-run trade-off between inflation and unemployment.

1973-1979 Oil Price Shocks

- oil price shock → negative supply shock
- import price shock → cost-push shock
- workers push wages to keep nominal wages constant

$$\pi = \pi^e - \omega(U - U_n) + \rho$$

## Modern Phillips Curve

- Firms and households form their expectations about inflation by looking at past inflation.

$$\pi^e = \pi_{-1}$$

$$\pi = \pi_{-1} - \omega(U - U_n) + \rho$$

- Inflation expectations are formed by looking at the past and therefore change only slowly over time. (sticky)
- Negative unemployment gap (tight labor market) causes the inflation rate to rise :

$$\Delta\pi = \pi - \pi_{-1} = -\omega(U - U_n) + \rho$$

- $U = U_n$  : inflation stops accelerating (changing).  
NAIRU: non-accelerating inflation rate of unemployment

# Aggregate Supply Curve I

$U - U_n$  : Unemployment gap

$Y - Y_p$  : Output gap

A.M. Okun (1970), "The Political Economy of Prosperity"

Okun's Law :

*for each percentage point that output is above potential, the unemployment rate is one-half of a percentage point below the natural rate of unemployment.*

$$U - U_n = -0.5 \times (Y - Y_p)$$

## Aggregate Supply Curve II

We get the inflation equation :

$$\pi = \pi^e + \gamma(Y - Y_p) + \rho$$

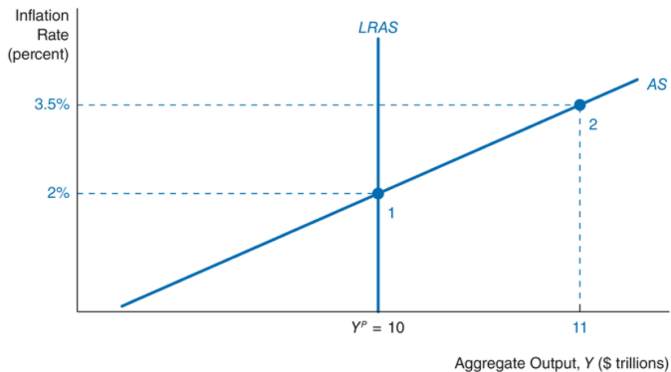
where

$$\pi^e = \pi_{-1}$$

$\gamma$  : how inflation respond to the output gap

higher  $\gamma \rightarrow$  more flexible wages ( $\omega \uparrow$ )  $\rightarrow$  steeper PC  $\rightarrow$  steeper AS

# The Short-Run and The Long-Run AS Curve





## Shifts in AS Curve

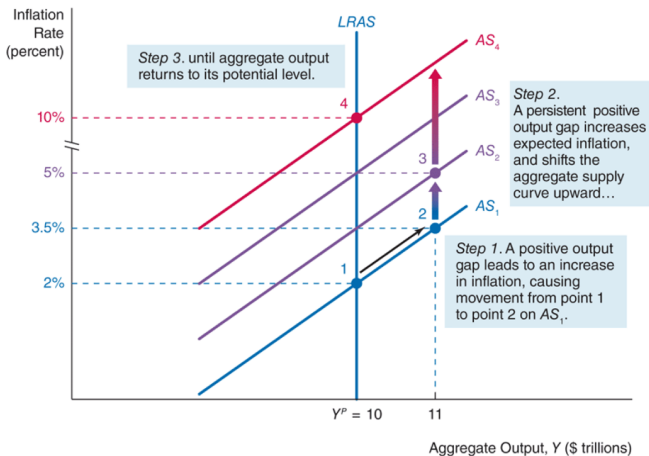
- The Short-Run : Inflation depends on inflation expectations, output gap and price shocks.

$$\pi = \pi^e + \gamma(Y - Y_p) + \rho$$

- The Long-Run : Output is determined by production function.

$$Y = F(K, L) = AK^\alpha L^\beta$$

# The relationship between the long-run and the short-run AS Curve



## References

- Mishkin, Macroeconomics: Policy and Practice, Chapter 11
- Mankiw, Macroeconomics, Chapter 13