

# Phillips Curve

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Macroeconomics  
Cunningham

# Original Phillips Curve

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- **A. W. Phillips (1958), “The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957”, *Economica*.**
- **Wage inflation vs. Unemployment**
- **New Zealander at London School of Economics**
- **Missing Equation of Keynesian economics?**

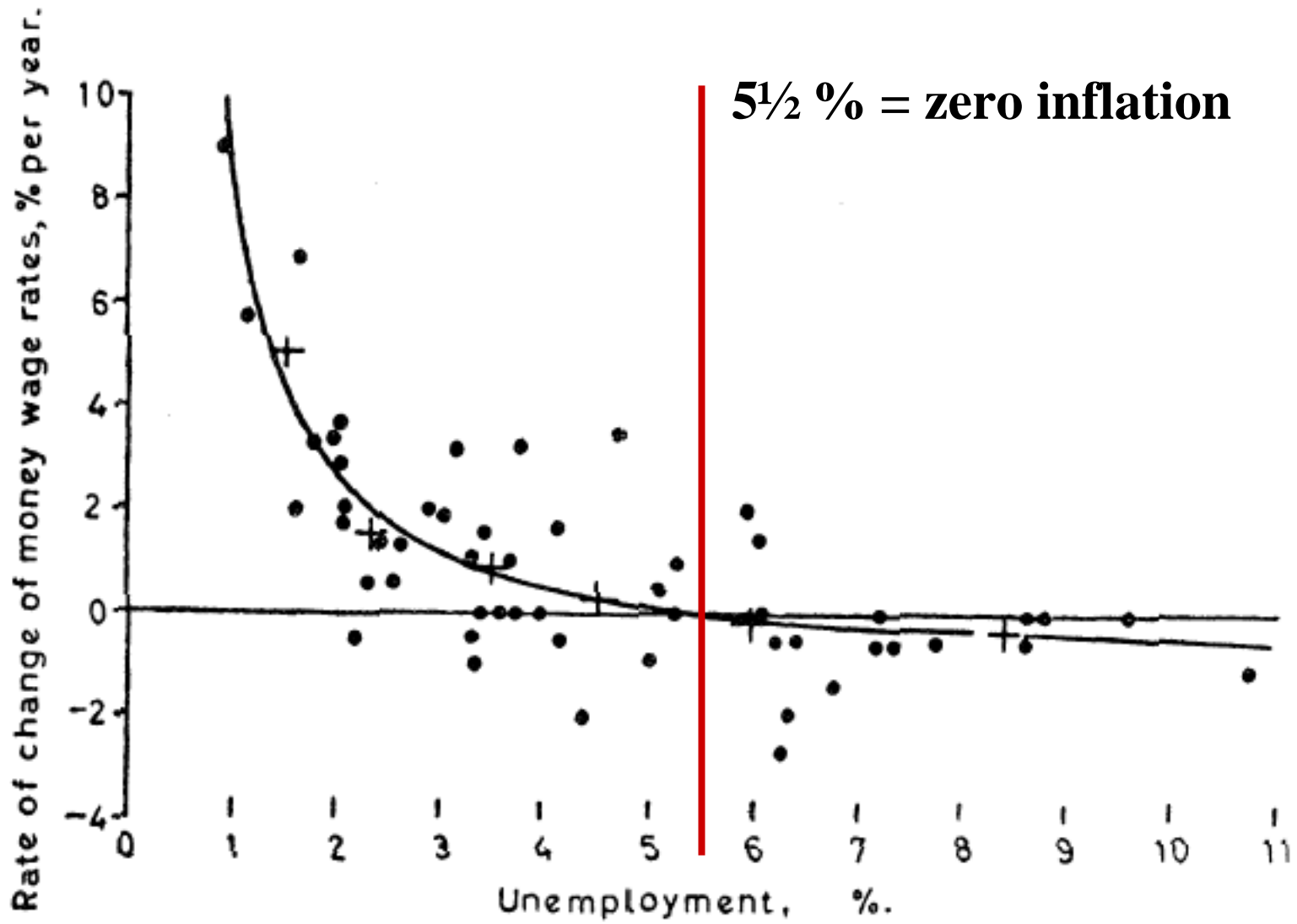
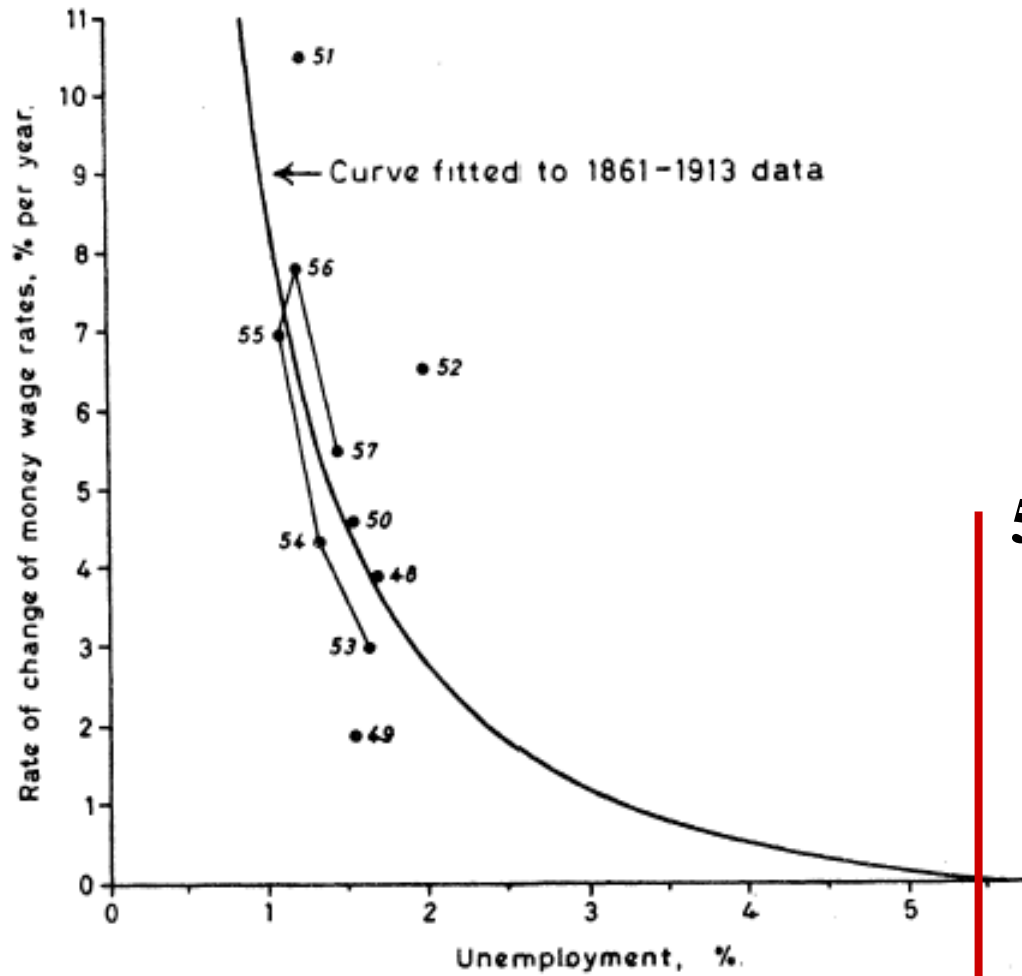


Fig.1. 1861 - 1913



5½ %

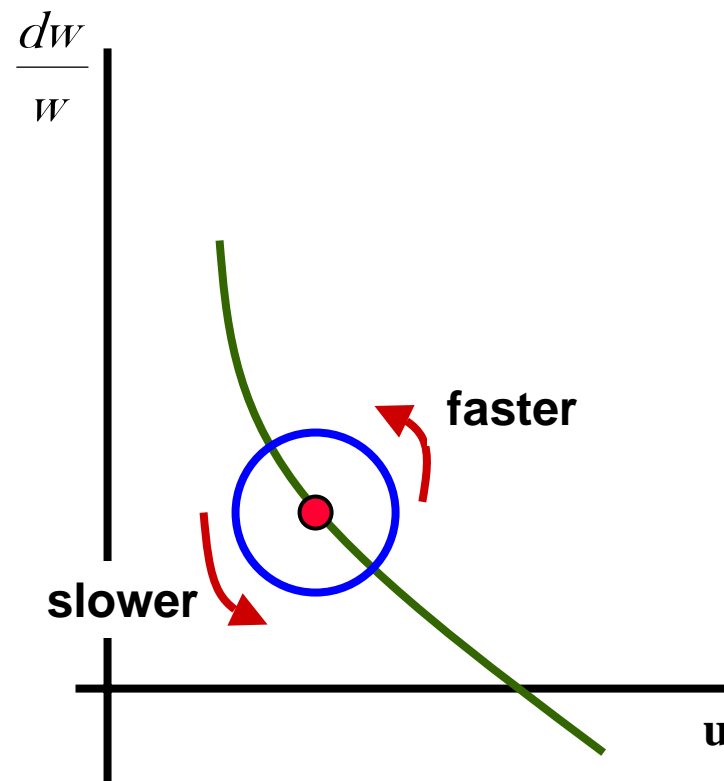
Fig. 10. 1948-1957

# Phillips' Conclusions

- **There exists a stable relationship between the variables. The relationship has not substantially changed for over 100 years.**
- **Negative, nonlinear correlation.**
- **Wages remain stable/stationary ( $\frac{dw}{w} = 0$ ) when unemployment is 5½%.**

# Conclusions, Continued

- From the dispersion of the data points, Phillips concluded that there was a countercyclical “loop”:
  - Money wages rise faster as  $du/dt$  decreases,
  - Money wages fall slower as  $du/dt$  increases
  - Implies an inflationary bias, and is consistent with sticky wage theory.



# Problems with Phillips' Study

- **Empirical method suspect.**
- **Is this an empirical result in search of a theory?**
- **To tie to theory, need a way to relate this to real wages in order to connect this to labor market conditions.**
- **R.G. Lipsey (1960) attempts to address these points in “The Relationship Between Unemployment and the Rate of Change of Money Wage Rates in the UK, 1862-1957: A Further Analysis”.**

# Lipsey's Phillips Curve

Derives the Phillips curve from supply-demand analysis of the labor market.

$$N^s = N + U$$

$$N^d = N + V$$

Where  $U$  refers to the number unemployed,  
 $V$  refers to the number of job vacancies.

Excess demand  $N^d - N^s = X = V - U.$

So

$$\frac{X}{N^s} = \frac{V}{N^s} - \frac{U}{N^s} = x = v - u$$

Where  $v$  is the vacancy rate and  $u$  is the unemployment rate.

# Lipsey, Continued

## Step One. Wage Adjustment Function

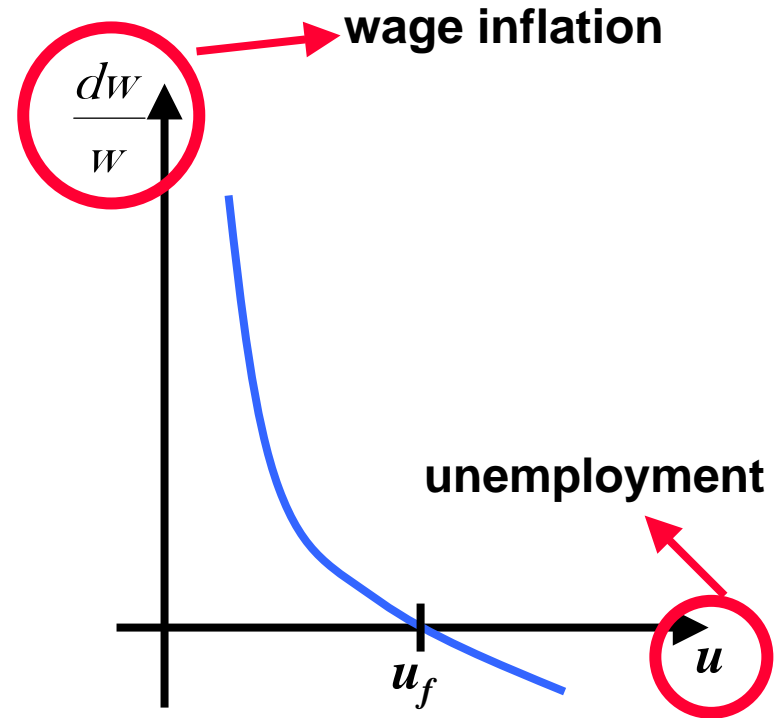
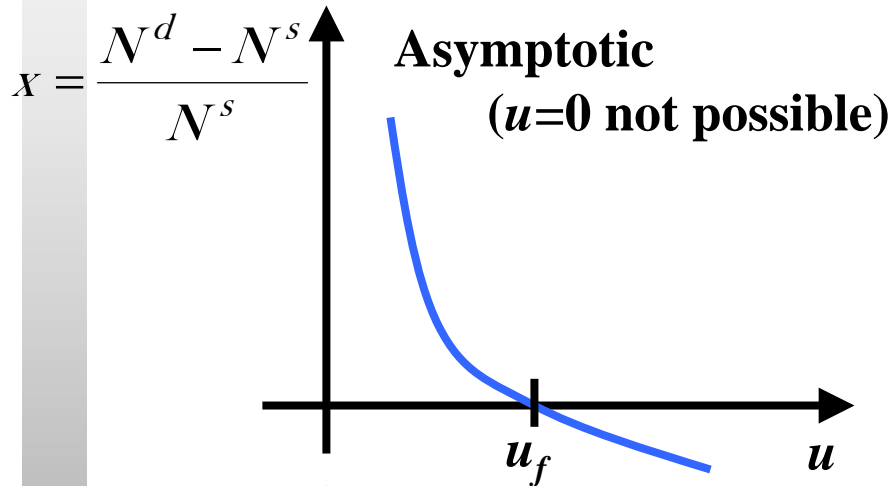
$$w = \frac{dw}{dN} = k \times \left[ \frac{N^d - N^s}{N^s} \right]$$

This amounts to saying that the change in the money wage rate is proportional to the excess demand for labor.

**Step Two. Establish a theoretical negative correlation between the excess demand for labor and the rate of unemployment.**

# Lipsey, Continued

## Individual Labor Market Conditions



$x = \frac{N^d - N^s}{N^s}$

# Lipsey, Continued

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- **The result is a Phillips curve for an individual market.**
- **Next, aggregate across markets for the aggregate Phillips curve.**

# Samuelson-Solow (1960)

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P. Samuelson and R. Solow. “The Problem of Achieving and Maintaining a Stable Price Level: Analytical Aspects of Anti-Inflation Policy,” *American Economic Review* (May 1960), 177-94.

- Popularized the curve.
- Made relevant to policymakers.
- Relation is **general price level inflation** vs. unemployment.
- Recommended to policymakers as a trade-off.

# Samuelson-Solow, Continued

- Key transformation from Phillips-Lipsey to S-S is through **mark-up pricing**.
  - Firms set prices by adding a fixed mark-up to labor costs.
  - The mark-up = the industry-wide profit margin + depreciation of fixed K

$$P_t = (1 + a) \frac{W_t N_t}{y_t}$$

mark-up  $\leftarrow$   $(1 + a)$   $\leftarrow$   $\frac{W_t N_t}{y_t}$   $\leftarrow$  unit labor costs

# Samuelson-Solow, Continued

$$P_t y_t = (1 + a) W_t N_t$$

nominal  
output (GDP)

nominal  
wage bill

Let  $\Lambda_t = \frac{y_t}{N_t}$  (labor productivity)

Substituting:

$$P_t = (1 + a) \frac{W_t}{\Lambda_t}$$

In logs:

$$\log P_t = \log(1 + a) + \log W_t - \log \Lambda_t$$

# Samuelson-Solow, Continued

This implies:

$$\frac{\Delta P_t}{P_t} = \frac{\Delta W_t}{W_t} - \frac{\Delta \Lambda_t}{\Lambda_t}$$

or  $\pi = w - \lambda$

**inflation rate = wage inflation rate  
– growth rate of labor productivity**

- **Increases in wages matched by productivity increases are *not* inflationary.**
- **There is a relationship between wage inflation and goods price level inflation.**

# Samuelson-Solow, Continued

Generalize further in the form of a Phillips curve relation:

$$w = \pi^e + bu^{-1} + \beta\lambda, \quad b > 0, \quad 0 \leq \beta \leq 1$$



demand  
pressure

offsetting productivity gains

inflation expectations  
(assumed “stable”, i.e., equal to zero)

Substitute:  $\pi = w - \lambda$

# Samuelson-Solow, Continued

$$\pi = \pi^e + bu^{-1} - (1 - \beta)\lambda$$

- **This is the modern Phillips curve.**
- **Technical relation between inflation and unemployment.**
- **Each point is an equilibrium state of the economy.**

# Friedman-Phelps Phillips Curve

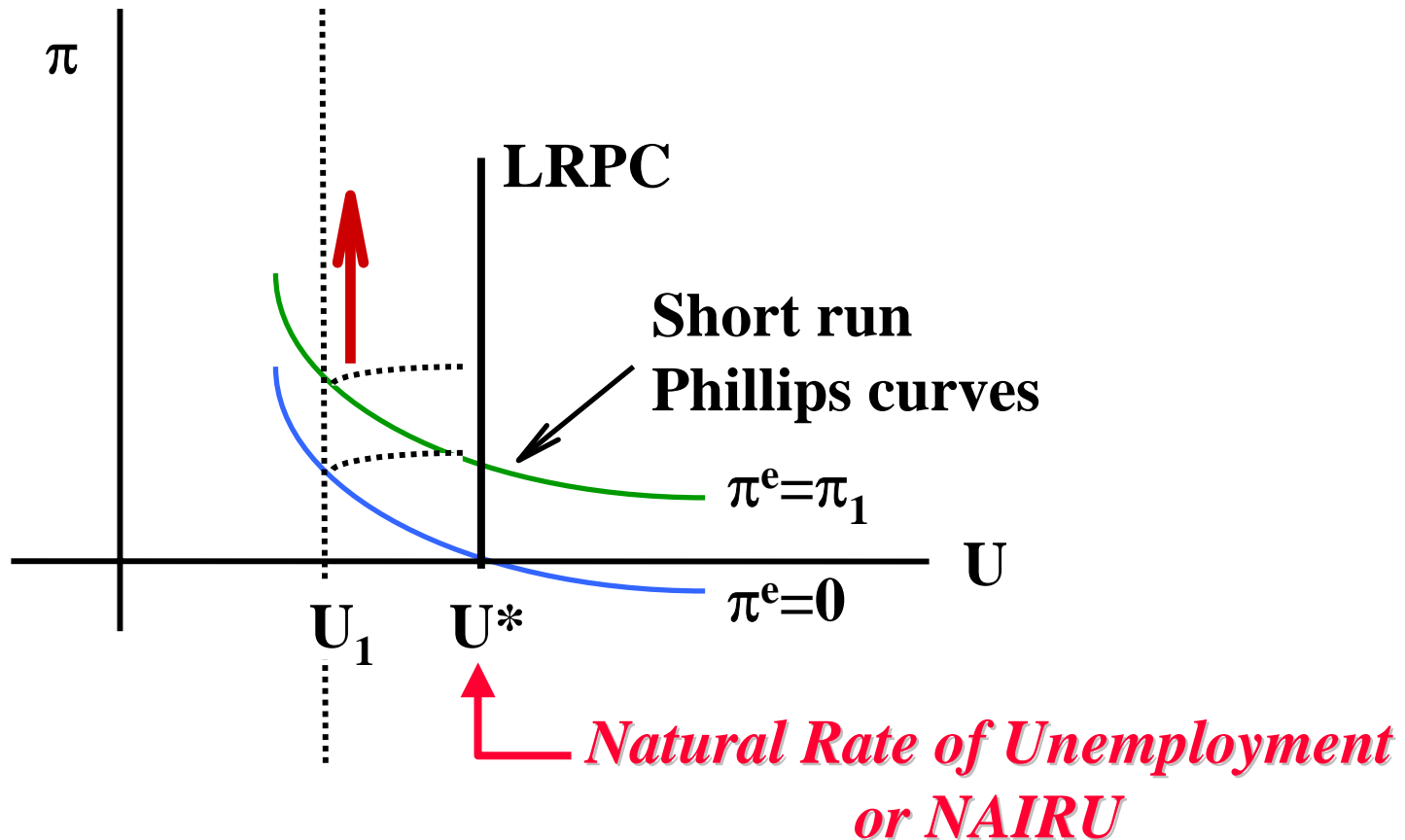
Milton Friedman. “The Role of Monetary Policy,” *American Economic Review* (March 1968), 1-17.

Edmund Phillips. “Phillips Curves, Expectations of Inflation and Optimal Employment Over Time,” *Economica* (August 1967), 254-81)

- **They question the stability of the relationship. They conclude:**
  - The trade-off is short-run.
  - Different Phillips curves exist for different inflation rates
  - Changes in inflation expectations shift the short-run Phillips curve.

# Friedman-Phelps Phillips Curve

$$\pi = f(u) + \pi^e$$



# Friedman's Accelerationist Hypothesis

$$\pi = f(u) + \pi^e$$

**Accelerationist Hypothesis:**

let  $f(u) = -b(u_t - u^*)$

**Use adaptive expectations:**

$$\pi_t^e = \theta\pi_{t-1} + (1 - \theta)\pi_{t-1}^e$$

**So that**

$$\pi_t = \theta\pi_{t-1} + (1 - \theta)\pi_{t-1}^e - b(u_t - u^*)$$

**Problem:**  $\pi_{t-1}^e$  is not observable.

# Friedman's Accelerationist Hypothesis

Lag one period, multiply by  $(1 - \theta)$

$$(1 - \theta)\pi_{t-1} = (1 - \theta)\pi_{t-1}^e - b(1 - \theta)(u_{t-1} - u^*)$$

Subtract from the original equation:

$$\pi_t = \pi_{t-1} + \underbrace{b(1 - \theta)(u_{t-1} - u^*)}_{\text{Replaces the expected inflation term}} - b(u_{t-1} - u^*)$$

Replaces the expected  
inflation term

When inflation is fully anticipated,

$$\pi_t = \pi_t^e, \pi_t = \pi_{t-1}, \text{ and } u_t = u_{t-1}.$$

# Friedman's Accelerationist Hypothesis

**Substituting,**

$$\pi_t - \pi_{t-1} = -b\theta(u_t - u^*) - b(1 - \theta)(u_t - u_{t-1})$$

**But**  $\pi_t = \pi_{t-1} \Rightarrow \pi_t - \pi_{t-1} = 0$

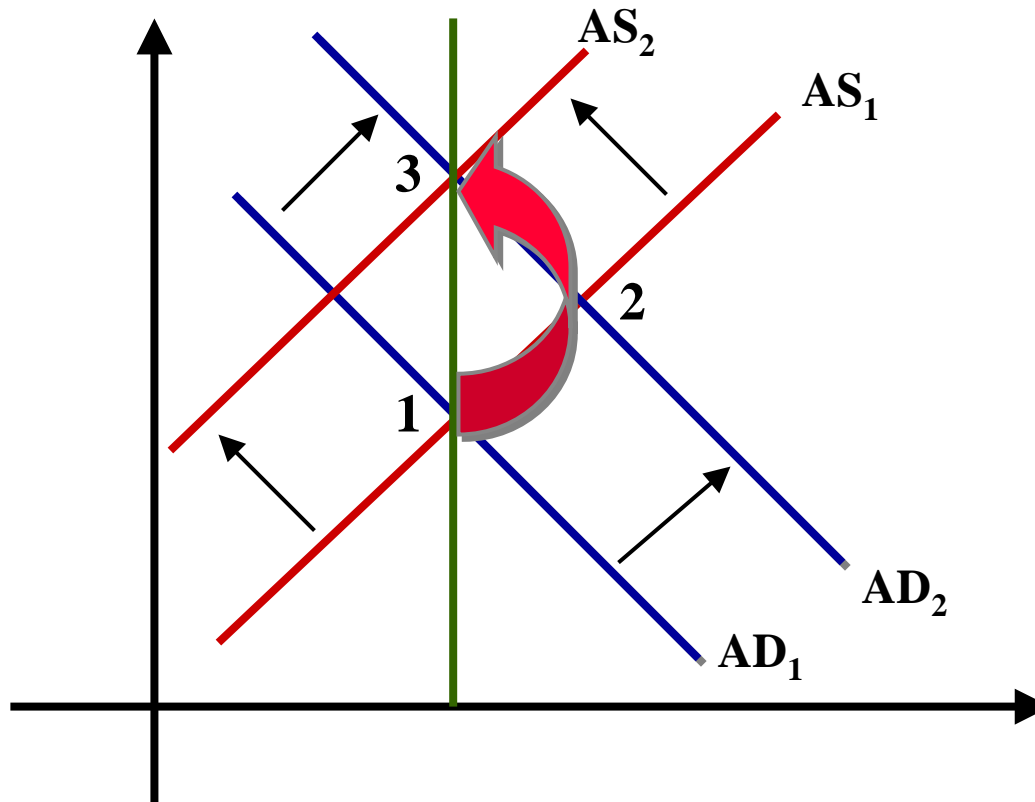
**and**  $u_t = u_{t-1} \Rightarrow u_t - u_{t-1} = 0.$

**So**  $0 = -b\theta(u_t - u^*)$

**and**  $u_t = u^* .$

**Which implies that unemployment reverts to the natural rate at the long run Phillips curve once inflation is fully anticipated.**

# Another view: Keynesian Perspective



# More Friedman

- **In his Nobel lecture, Friedman offered the possibility of a positively-sloped Phillips curve:**
  - “Stabilization” policy increases the inflation rate and variability.
  - This requires nominal contracts to be renegotiated to shorter lengths.
  - Efficiency is lowered.
  - Inventories grow.
  - Unemployment rises.
- **“The broadcast about relative prices is, at it were, being jammed by the noise coming from the inflation broadcast.”**