

MACROECONOMICS 042EC

03 – Analysis in the medium run

Links between inflation and unemployment (Ch 8)

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Questions we will ask

- We will learn that, in the mid-run, the level of output (=income, = living standards) depends on the natural level of unemployment
- What determines the natural level of unemployment?
- Is the natural level of unemployment related to a «natural» level of output?
- What happens when the unemployment rate of an economy (and its level of output) lie ABOVE or BELOW the natural benchmark?
 - In the short run, both unemployment and output can be off their NATURAL level
 - If that happens, there is a transition TOWARDS the natural level.

Inflation, Expected Inflation, and Unemployment

- We start from the wage-setting and price-setting system WS-PS:

$$\text{WS: } W = P^e F(u, z)$$

(-) (+)

$$\text{PS: } P = (1 + m) W$$

- We now assume that future **price levels are not fully known** to agents involved in wage-setting
- We substitute W in the PS equation using the WS equation: **$P = P^e(1 + m)F(u, z)$**
- As anticipated, we assume a linear form for F , such as $F(u, z) = 1 - \alpha u + z$
- Hence we get
$$P = P^e (1 + m)(1 - \alpha u + z)$$
 - A relationship between current prices, expected prices, unemployment, mark-up & other factors who tend to push wages up

$$P = P^e (1 + m)(1 - \alpha u + z)$$

- Instead of price levels, we want to focus on price changes from year to year

Divide both sides by P_{t-1} :
$$\frac{P_t}{P_{t-1}} = \frac{P_t^e}{P_{t-1}} (1 + m)(1 - \alpha u_t + z)$$

Use this equivalence:
$$\frac{P_t}{P_{t-1}} = 1 + \frac{P_t - P_{t-1}}{P_{t-1}} = 1 + \pi_t$$

Then I can write:
$$1 + \pi_t = (1 + \pi_t^e)(1 + m)(1 - \alpha u_t + z)$$

If π , π^e and m are sufficiently small, this can be re-written as

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t$$

Appendix p.185

WS:

$$W = P^e F(u, z)$$

(-)(+)

PS:

$$P = (1 + m)W$$

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t$$

Phillips
relationship

- A crucial relationship, outlined by Alban William Phillips (1914-1975)
- **An increase in π^e leads to an increase in π (actual inflation).**
 - If future prices are expected to increase, this expectation is embedded in wage negotiations \rightarrow higher wages \rightarrow firms set higher prices \rightarrow prices are actually higher \rightarrow wage negotiations ask for higher wages \rightarrow firms set higher prices \rightarrow ...
 - $\uparrow \pi^e \Rightarrow (\uparrow W \Rightarrow \uparrow P \Rightarrow \uparrow W \Rightarrow \uparrow P \dots) \Rightarrow \uparrow \pi$
- At constant π^e , an increase in m , or an increase in z , leads to an increase in π .
 - $\uparrow m \Rightarrow (\uparrow P \Rightarrow \uparrow W \Rightarrow \uparrow P \Rightarrow \uparrow W \dots) \Rightarrow \uparrow \pi$
 - $\uparrow z \Rightarrow (\uparrow W \Rightarrow \uparrow P \Rightarrow \uparrow W \Rightarrow \uparrow P \dots) \Rightarrow \uparrow \pi$
- At constant π^e , an increase in u leads to a decrease in π .
 - $\uparrow u \Rightarrow (\downarrow W \Rightarrow \downarrow P \Rightarrow \downarrow W \Rightarrow \downarrow P \dots) \Rightarrow \downarrow \pi$

WS: $\uparrow \boxed{W} = P^e F(\underbrace{u}_{(-)} \underbrace{z}_{(+)})$

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t$$

Phillips
relationship

PS: $\uparrow \boxed{P} = (1 + m) \boxed{W} \uparrow$

- An alternative way of reading this relationship

$$\uparrow \boxed{\pi_t} - \pi_t^e = m + z - \alpha \boxed{u_t} \downarrow$$

- Interpretation: after the inflation-expectations are set, **if the unemployment rate in the economy is lower**, the spread between realized and expected inflation will be higher

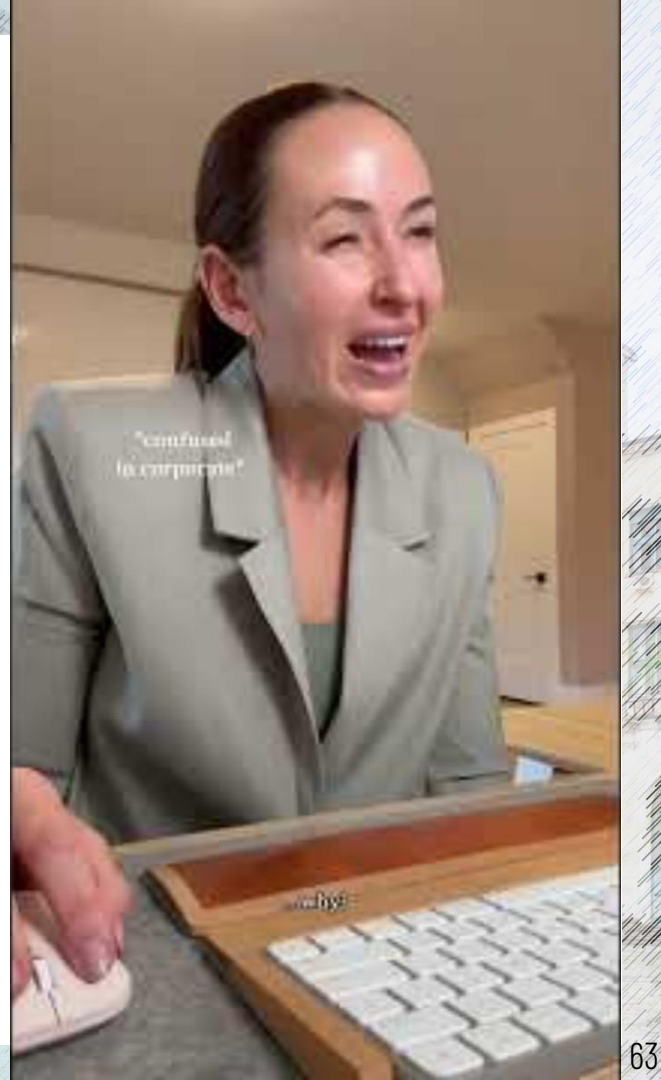
$$\downarrow u \Rightarrow (\uparrow W \Rightarrow \uparrow P \Rightarrow \uparrow W \Rightarrow \uparrow P \dots) \Rightarrow \uparrow \pi$$

How to form inflation expectations π_t^e ?

- π^e could be formed based on fixed convictions (a number π^* time-invariant). **“Anchoring of expectations”**
- π^e could be based on the inflation observed in the previous year (π_{t-1}). “Adaptive expectations”
- π^e is based on both. But with what weights? It depends on contingent consensus.

Phillips relationship

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t$$



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- Part of society θ will have “adaptive expectations”; the rest $(1-\theta)$ will be based on anchored expectations π^* .

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

- **if $\theta = 0 \Rightarrow$ expectations are independent from past experience: $\pi_t^e = \pi^*$**

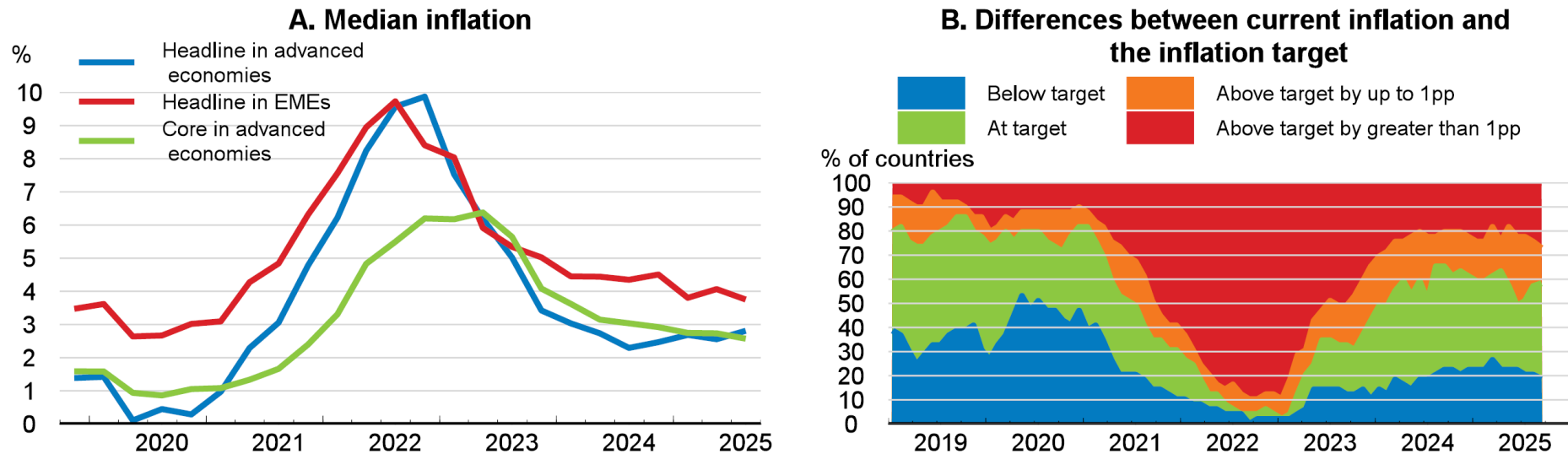
$$\pi_t = \pi^* + (m + z) - \alpha u_t$$

- **if $\theta = 1 \Rightarrow$ we expect current inflation to be equal to the past: $\pi_t^e = \pi_{t-1}$**

$$\pi_t = \pi_{t-1} + (m + z) - \alpha u_t \Rightarrow \pi_t - \pi_{t-1} = (m + z) - \alpha u_t$$

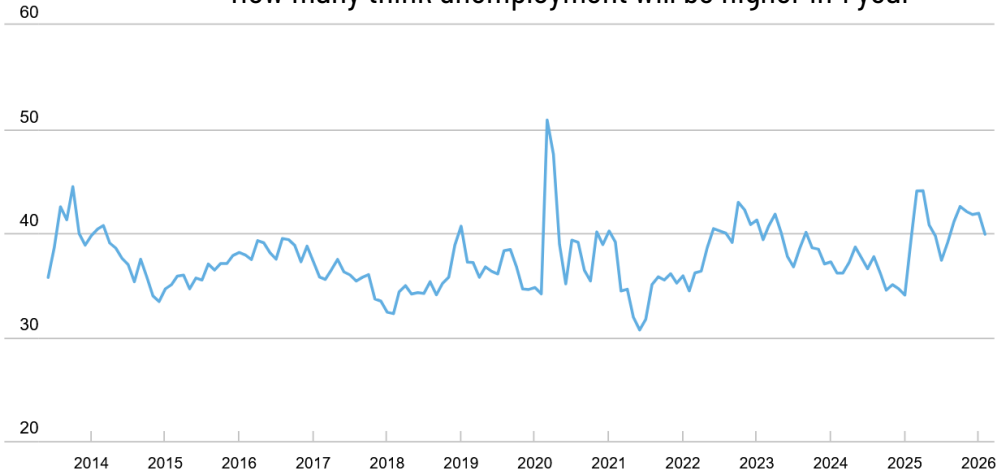
OECD economic outlook / dec 2025

Figure 1.13. Disinflation has levelled off in some economies partly due to higher goods inflation



How many think unemployment will be higher in 1 year

Percent



Source: New York Fed Survey of Consumer Expectations

Inflation rate in 1 year

Percent



Source: New York Fed Survey of Consumer Expectations

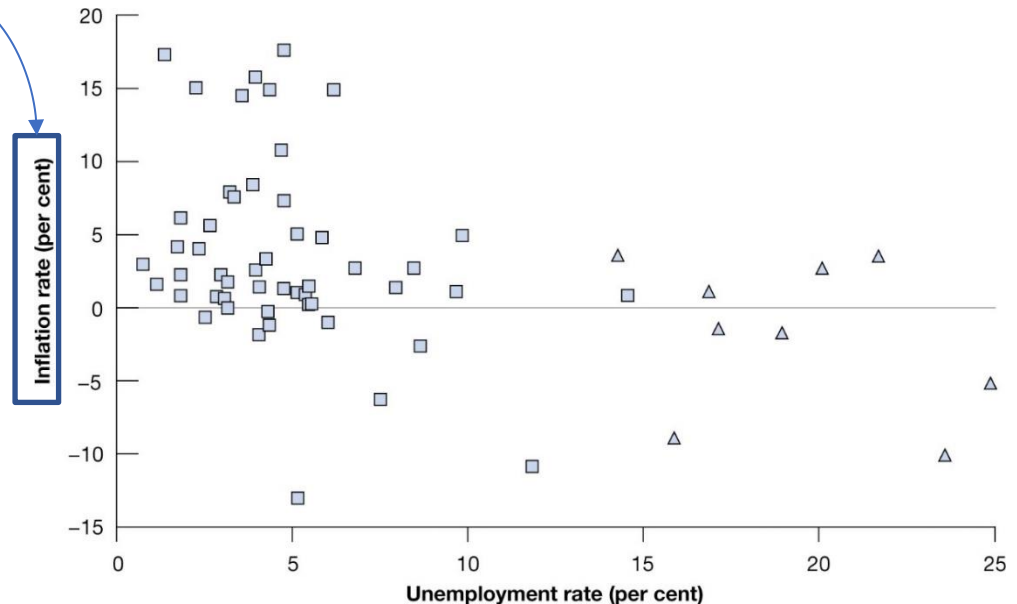
Note: Collection of data for the five-year-ahead inflation expectation began in January 2022.

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t$$

- if $\theta = 0 \Rightarrow$ expectations are independent from past experience: $\pi_t^e = \pi^*$

$$\pi_t = \pi^* + (m + z) - \alpha u_t$$

- An increase in unemployment leads to lower inflation
- This has been a good representation of reality for the period 1900-1960
 - Inflation has been varying around an average value of zero since 1900s
 - It was reasonable that agents believed inflation in the next year would not be much affected by the inflation of the previous year

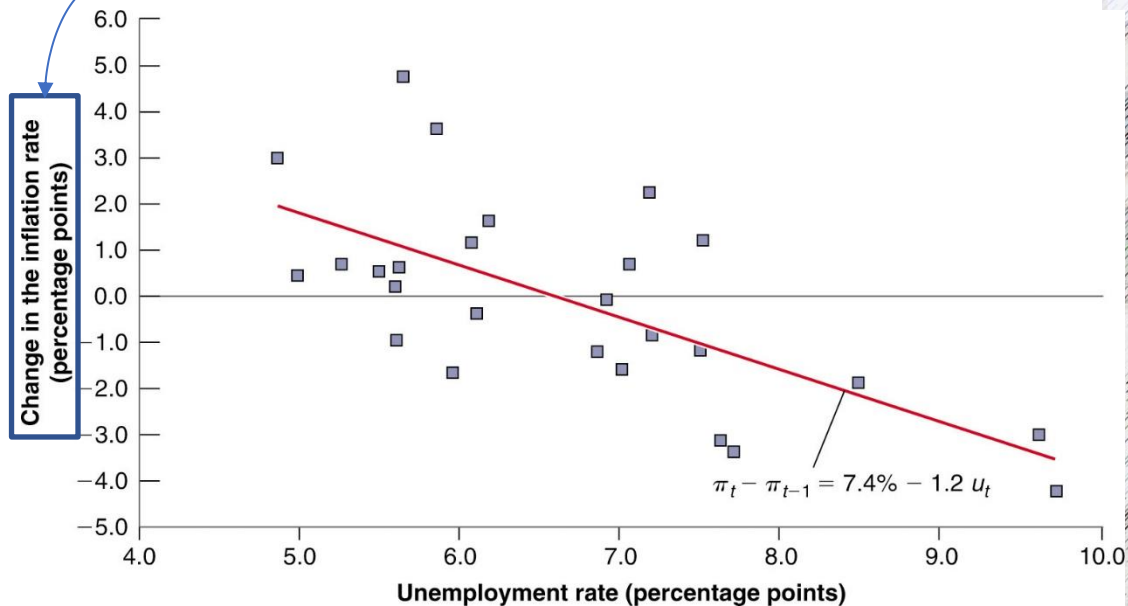


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- An increase in unemployment reduces the increase in inflation over time
- This has been a good representation of reality from 1970 to 1995
 - High inflation in one year became more likely to be followed by high inflation the next year.
 - People started to expect the persistence of inflation
 - They started thinking: because inflation last year was higher than in the previous year, this year will be higher than last year as well



$$\pi_t = \pi_t^e + (m + z) - \alpha u_t$$

- if $\theta = 0 \Rightarrow$ expectations are independent from past experience: $\pi_t^e = \pi^*$

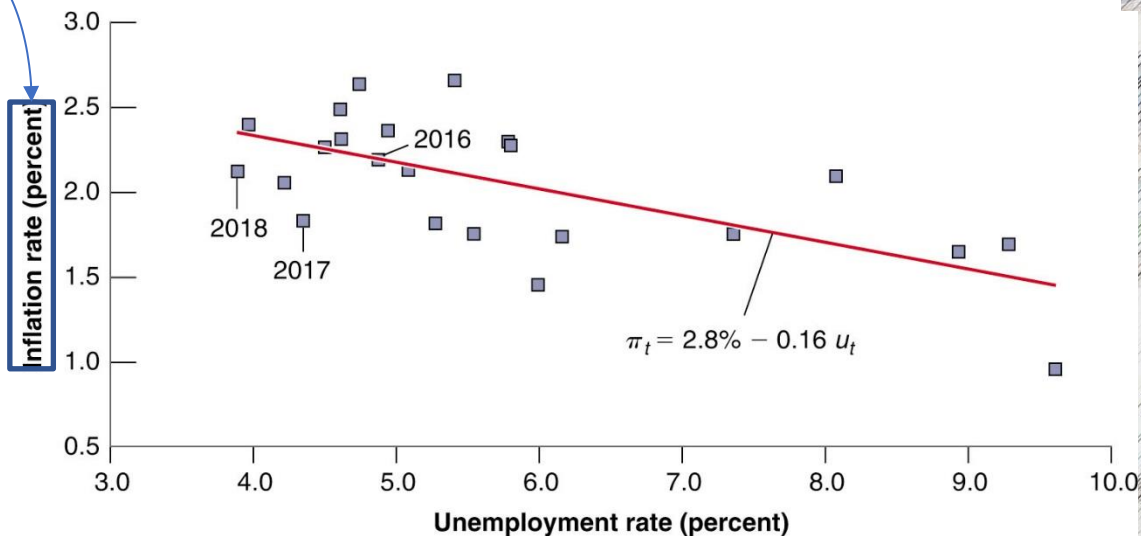
$$\pi_t = \pi^* + (m + z) - \alpha u_t$$

- This has again turned to be a good representation of reality for 1996-2018

- central banks increasingly emphasized their commitment to maintaining low and stable inflation.

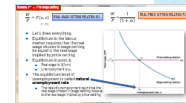
- Many of them indicated that they would maintain inflation close to a given target, typically around 2%.

- So $\pi^* = 2\%$



Back to the natural rate of unemployment

- We previously said the natural rate of unemployment is such that the real wage chosen in wage setting is equal to the real wage implied by price setting
 - Assumption was: future prices are fully predicted during wage-setting negotiations
 - We do not make this hypothesis anymore.
- We can now define the **natural rate of unemployment** as:
the rate of unemployment such that the realised rate of inflation π_t happens to match the expected rate of inflation π^e which was expected at the time of wage-negotiations (**$\pi = \pi^e$**)
 - This is called a DYNAMIC DEFINITION of natural rate of unemployment
 - Alternative STATIC DEFINITION: the rate of unemployment such that the realised price level P is equal to the price level P^e which was expected at the time of wage-negotiations (**$P = P^e$**)



Phillips
relationship

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t$$

- The natural rate of unemployment u_n makes $\pi_t = \pi_t^e$
- If $\pi_t = \pi_t^e$, then the Phillips relationship becomes

$$0 = (m + z) - \alpha u_n$$

- Which means $u_n = \frac{m + z}{\alpha}$

- The higher the mark-up, m , or the higher the factors that affect wage setting, z , the higher is the natural rate of unemployment.

Phillips relationship

$$u_n = \frac{m + z}{\alpha}$$

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t$$

- Can we make the Phillips relationship a function of u_n as well?
- We manipulate it by multiplying and dividing $(m+z)$ by α

$$\pi_t = \pi_t^e + \alpha \frac{(m + z)}{\alpha} - \alpha u_t = \pi_t^e - \alpha \left(u_t - \underbrace{\frac{(m + z)}{\alpha}}_{u_n} \right)$$

$$\pi_t - \pi_t^e = -\alpha(u_t - u_n)$$

- REMEMBER THIS EQUATION
- If unemployment is at the natural rate, then inflation will be equal to expected inflation.
- If unemployment is below the natural rate, inflation will be higher than expected. If unemployment is instead above the natural rate, inflation will be lower than expected.

$$\pi_t - \pi_t^e = -\alpha(u_t - u_n)$$

- If expectations are adaptive (non-anchored), $\pi_t^e = \pi_{t-1}$, then

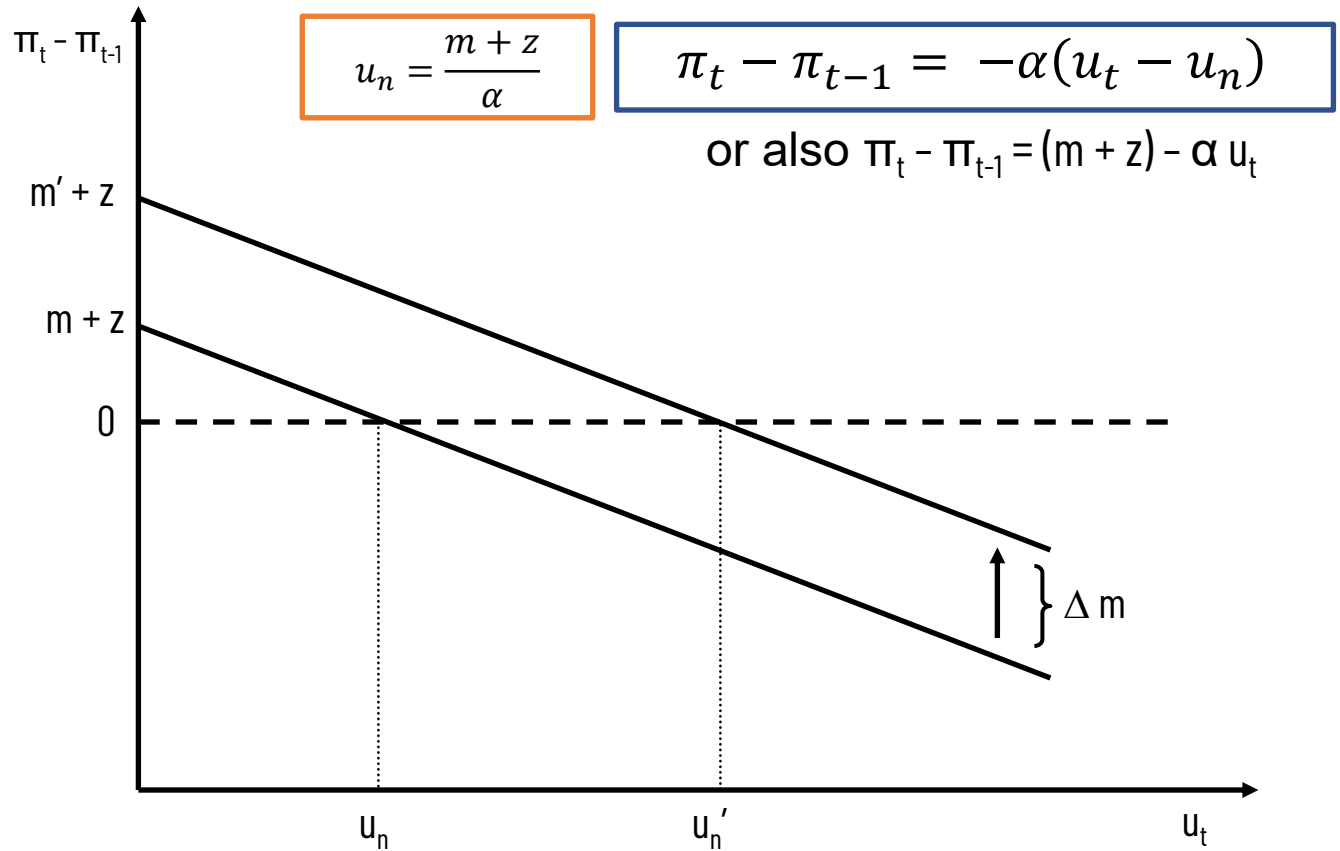
$$\pi_t - \pi_{t-1} = -\alpha(u_t - u_n)$$

- If $u_t < u_n \rightarrow \pi_t > \pi_{t-1}$ increasing inflation
 - If $u_t > u_n \rightarrow \pi_t < \pi_{t-1}$ decreasing inflation
 - If $u_t = u_n \rightarrow \pi_t = \pi_{t-1}$ constant inflation
- The unemployment rate $u_t = u_n$ which allows for a constant rate of inflation over time ($\pi_t = \pi_{t-1}$) is called **NAIRU** (*Non Accelerating Inflation Rate of Unemployment*)

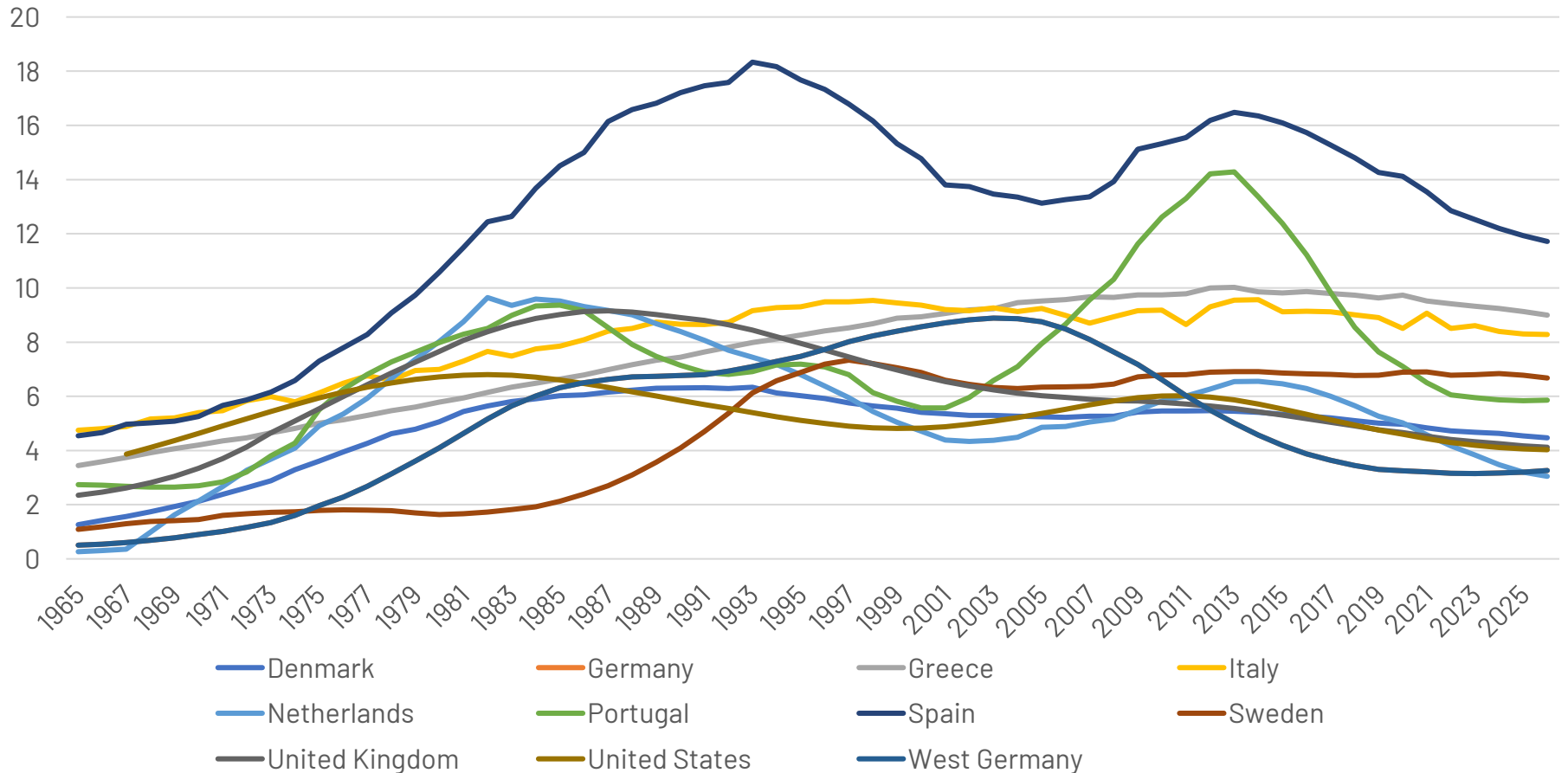
A summary

- The relation between unemployment and inflation in the United States today is well captured by a relation between the change in the inflation rate and the deviation of the unemployment rate from the natural rate of unemployment u_n (NAIRU)
 - $u_n = \frac{m+z}{\alpha}$
- The NAIRU has been estimated at 6% or 7% in the 1970s and 1980s to about 4% today
 - When the unemployment rate is above (below) the natural rate of unemployment, the inflation rate typically decreases (increases).
- The natural rate of unemployment differ across countries due to, e.g., labor-market rigidities, and also over time.

- Suppose that m increases to m' from one year to another
- The NAIRU (u_n) will increase from u_n to u'_n



Not accelerating-wage rate of unemployment

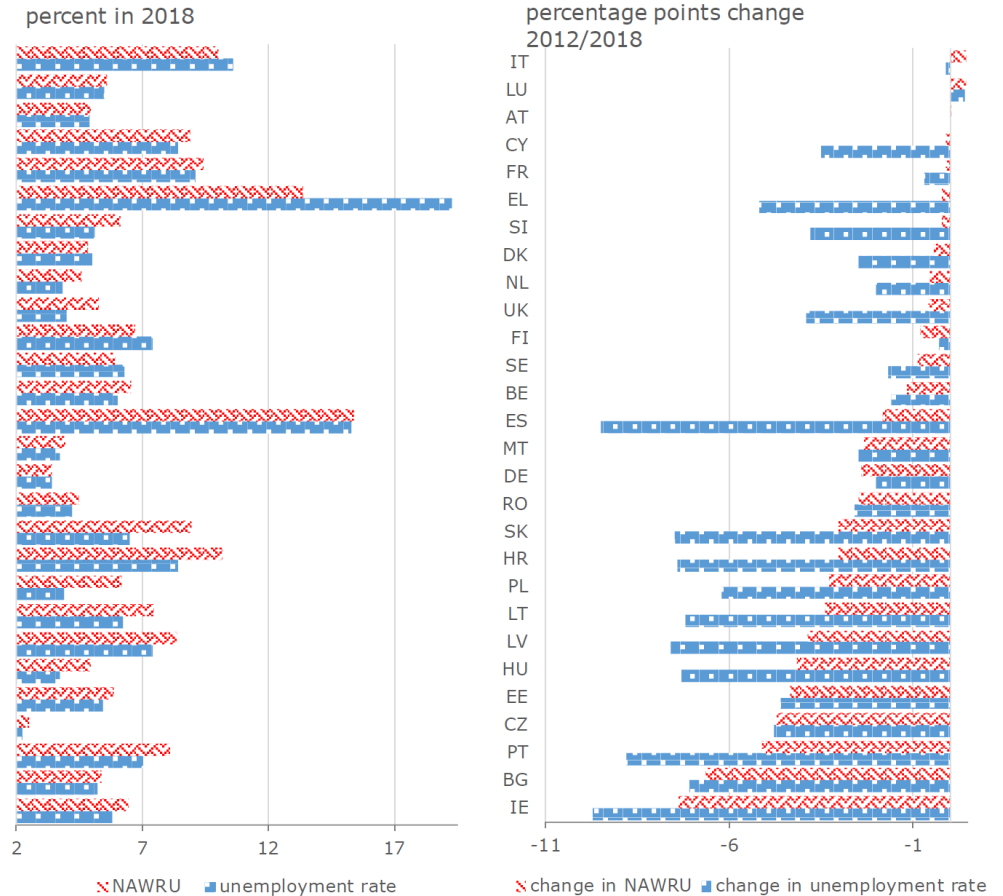


- Changes in $u_n = \frac{m+z}{\alpha}$ can be induced by changes in m or z across countries or over time
 - degree of monopoly power of firms
 - costs of inputs other than labour
 - structure of wage bargaining
 - system of unemployment benefits
- Reasons why NAIRU has declined in the US from 7% to 4%
 - Increased globalization and stronger competition between U.S. and foreign firms may have lowered the markup.
 - Increases in employment by temporary help agencies.
 - The aging U.S. population.
 - An increase in the incarceration rate.
 - The increase in the number of workers on disability.
 - The long-term effects of the 2008-2009 recession

- Actual vs natural rate of unemployment

IV. The natural rate of unemployment and its institutional determinants

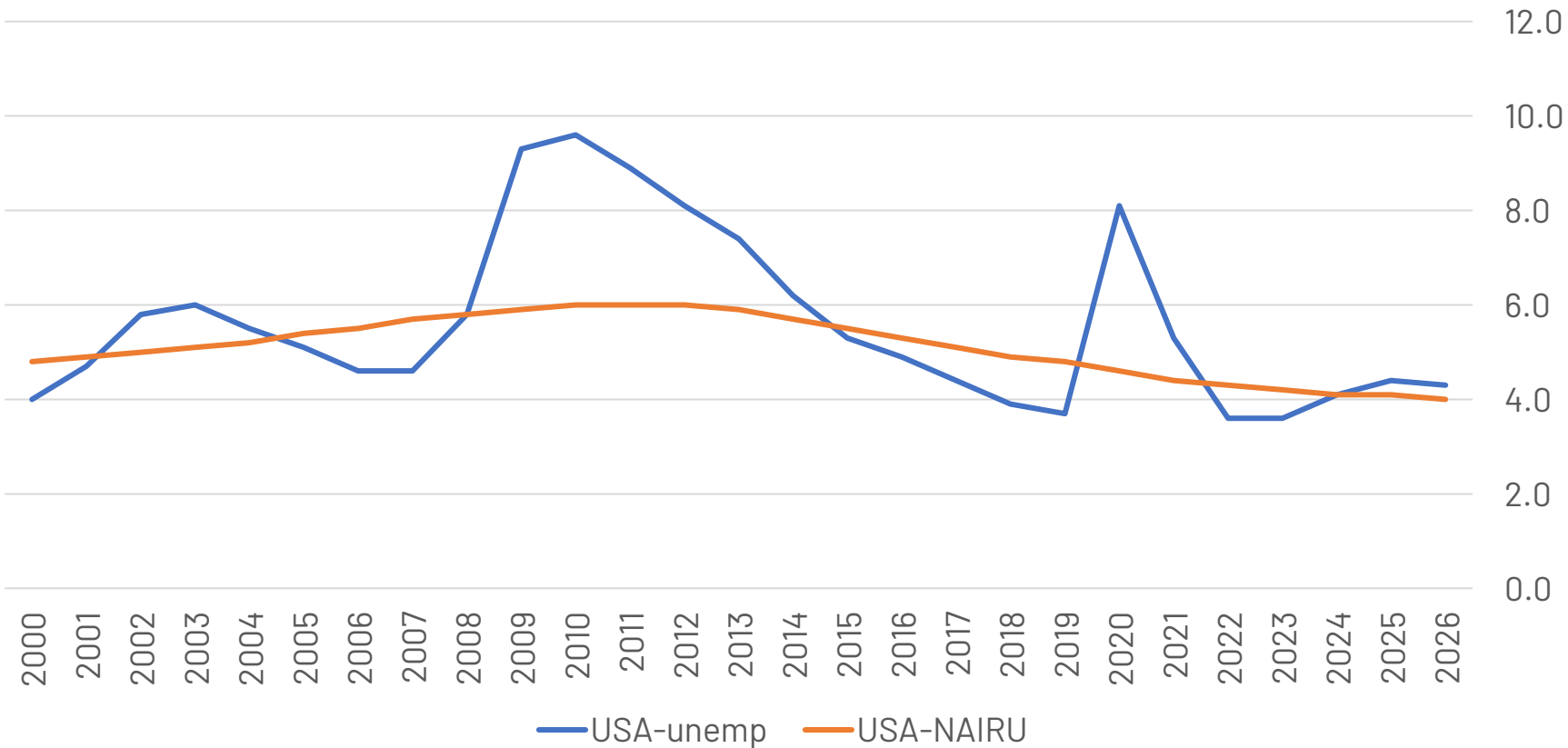
by Atanas Hristov and Werner Roeger



The natural rate refers to the nonaccelerating wage rate of unemployment (NAWRU) estimated according to the EU's commonly-agreed methodology (see Box 1). Countries are ranked according to the degree of change in their natural rates between 2012 and 2018.

Source: Eurostat, Ameco

actual vs natural unemployment rate - US (source: AMECO)





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