

Output, Employment, and Inflation (Chapter 13)

Inflation as Interpreted by AI



Inaflation Rembrandt style (by Dall-E)



Inflation, Money, Growth van Gogh style (by Dall-E)

Questions

How is GDP related to inflation and monetary policy?

How to move from short-run sticky prices to medium-run with inflation?

Outline

From short run to medium run and to long run

- ▶ inflation

The Phillips curve

- ▶ inflation and unemployment

Okun's law

- ▶ unemployment and output

Foundations of the Phillips curve

Aggregate Supply Curve

What is Inflation?

Rate of increase in the price level

- ▶ rate at which money loses its value

When the price level rises, nominal wages rise too

- ▶ wages chase prices (and in turn prices chase wages)
- ▶ at the same time there may also be productivity growth

Ultimate source

- ▶ CBs ability to create money

What is Inflation?

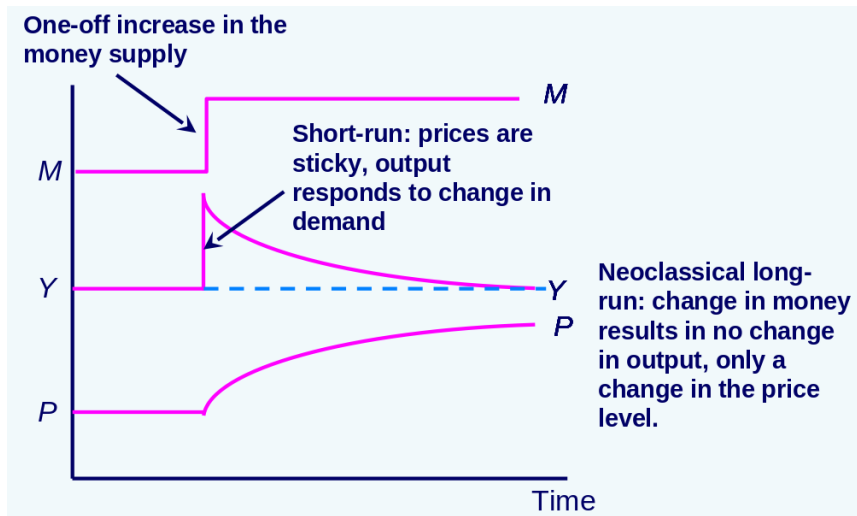
Neoclassical assumption

- ▶ prices are fully flexible
- ▶ correct in the long run
- ▶ Keynesian assumption makes sense in the short run

Example: $M = kPY$ and 10% an increase in the money supply M

- ▶ short-run: real GDP (Y) increases by 10%
- ▶ long-run: price level (P) increases by 10%
- ▶ the process: first rise of output, then prices start to adjust, and output decreases

From the Short to the Long Run



Inflation

Inflation $\pi = \Delta P / P$

- ▶ $P = M / (kY)$, P price level, Y real income, PY nominal income
- ▶ k is the portion not used for transactions, $1/k$ is the velocity of money
- ▶ kPY is money demand

Inflation when money supply and output change

- ▶ $\pi \approx \Delta M / M - \Delta Y / Y = \mu - g$
- ▶ reminder (logarithmic differential): if $f(t) = g(t)h(t)$ then $f'(t)/f(t) = g'(t)/g(t) + h'(t)/h(t)$
- ▶ μ is the growth rate of money
- ▶ g is the growth of real GDP

Money Supply and Monetary Policy

Taylor rule $i = \bar{i} + a(\pi - \bar{\pi}) + b \left(\frac{Y - \bar{Y}}{\bar{Y}} \right)$

- ▶ in the long run $i = \bar{i}$; $M/P = k(\bar{i})Y$ and $\Delta P/P = \bar{\pi}$
- ▶ in the long run money is neutral; g does not depend on money growth
- ▶ it follows that $\mu = g + \bar{\pi}$

Money targeting

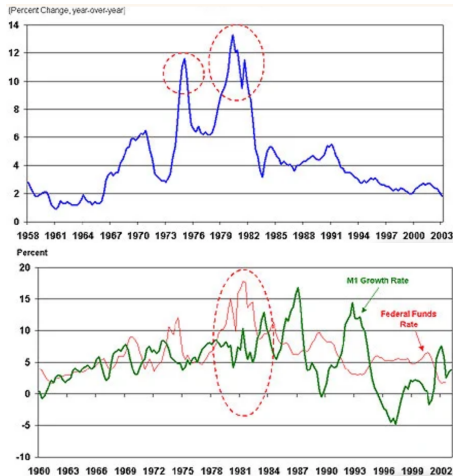
- ▶ central bank sets μ

Interest targeting

- ▶ central bank sets π

Does it matter which to target?

Money Targeting by Fed 1979–1982



The incredible Volcker disinflation by Goodfriend and King

Labor Markets

Pictures in the following slides

A equilibrium in the labor market corresponding in the long run

Short run: demand shifts to $Y < \bar{Y}$, point B (sticky wages)

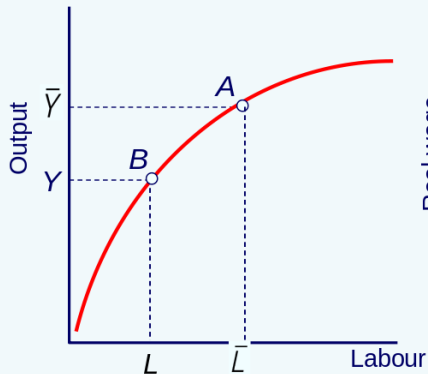
- ▶ involuntary unemployment BA
- ▶ profits are not maximized

Long run: nominal wages and prices adjust

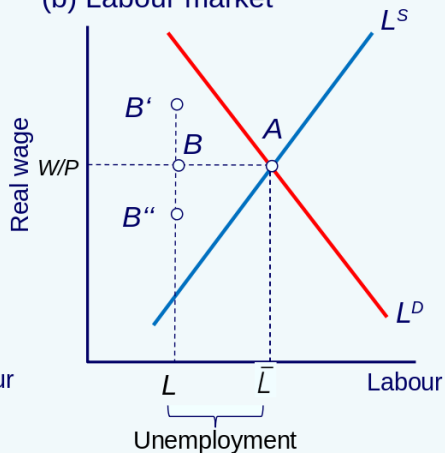
- ▶ return to point A ; firms cut prices, real wages rise (B') but decline in the long run
- ▶ decline in prices increases demand
- ▶ **flexible exchange rate**: declining prices lowers interest rates (by Taylor rule), real depreciation, demand restores
- ▶ **fixed exchange rate**: declining prices imply real exchange rate depreciation (reduced demand for imports and higher foreign demand)

Output and the Labor Market in the Long Run

(a) Production function



(b) Labour market



From the Short-Run to Long-Run

- ▶ Demand disturbances dominate in the short-run
- ▶ But are eliminated in the long run
- ▶ Price adjustments gradually substitute for quantity adjustments

Inflation and Unemployment

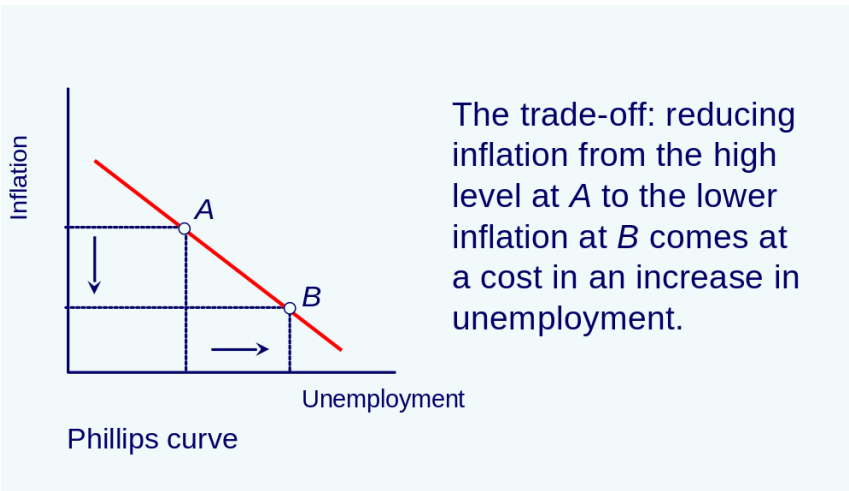
A.W. Phillips observed negative correlation between unemployment and inflation

- ▶ originally UK 1861–1957

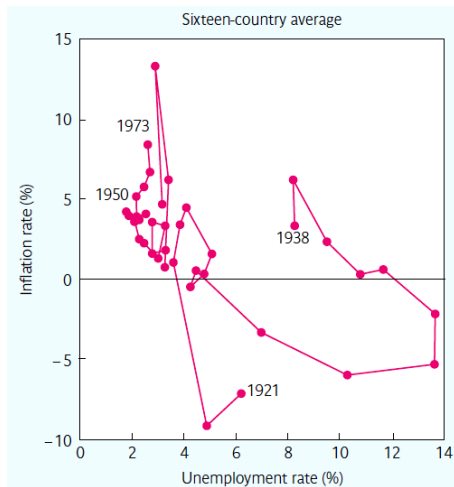
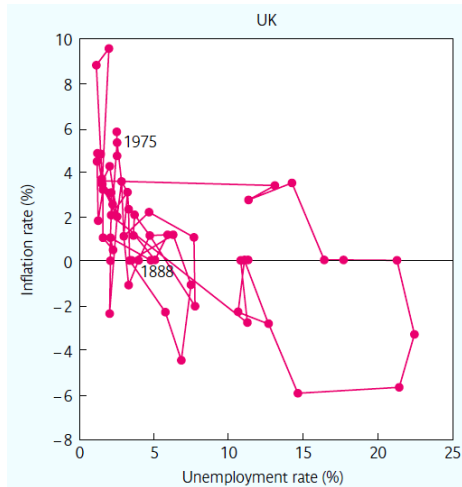
Became popular because

- ▶ missing theoretical relationship for Keynesian framework
- ▶ practical tool for policy makers: the policy is to choose a point on the Phillips curve, use monetary and fiscal policy but either inflation is high or unemployment is high (Phillips trade-off)

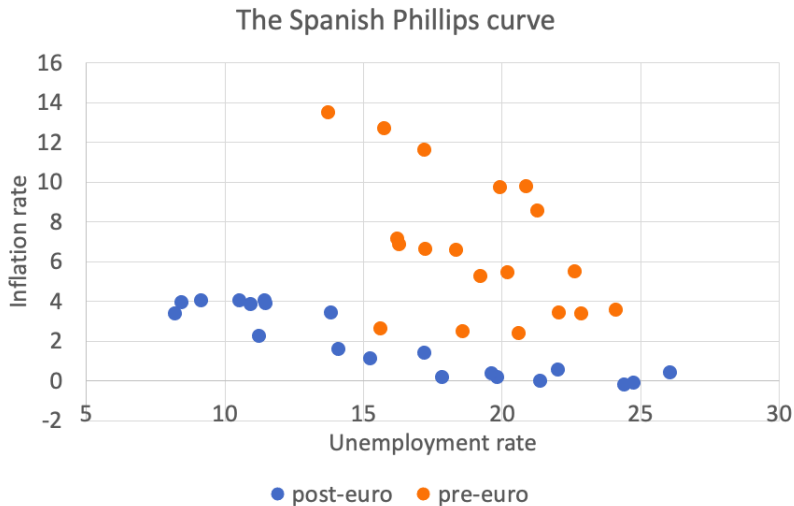
Phillips Curve in Theory



The Phillips Curve in Reality

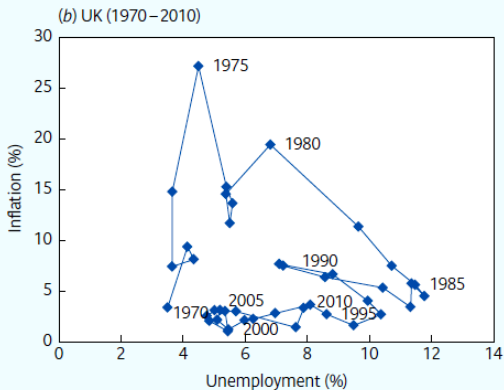
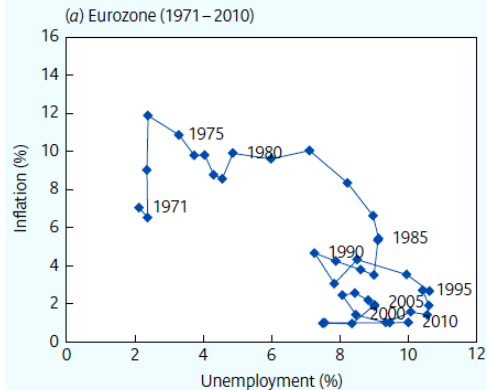


The Phillips Curve in Reality: Spain



Source: P. Krugman, Stagflation revisited

The Phillips Curve in Reality: Eurozone and UK



Challenges of the Phillips Curve

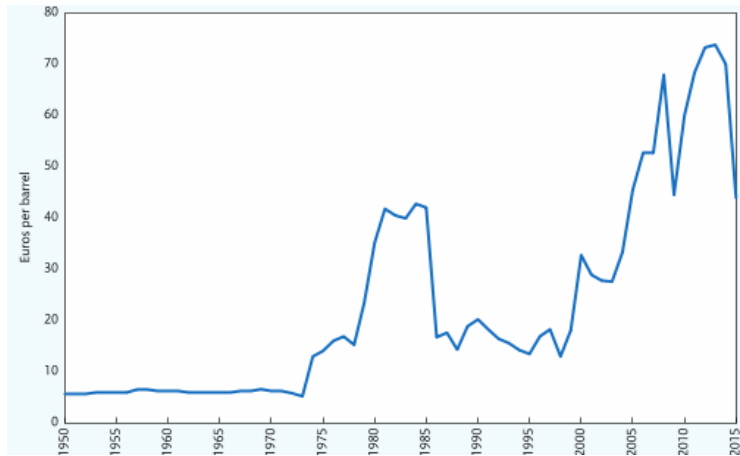
In 1970's Phillips curve seemed to disappear

- ▶ inflation increased but unemployment stayed high
- ▶ stagflation: high inflation and high unemployment
- ▶ CBs started money targeting (FED 1979–1982)

Theoretical questions

- ▶ Phillips curve can be only a temporary phenomenon because in the long run money is neutral
- ▶ money illusion: firms and workers acting only on their own prices, ignoring the nominal price levels

Nominal Oil Price (Euro/barrel)

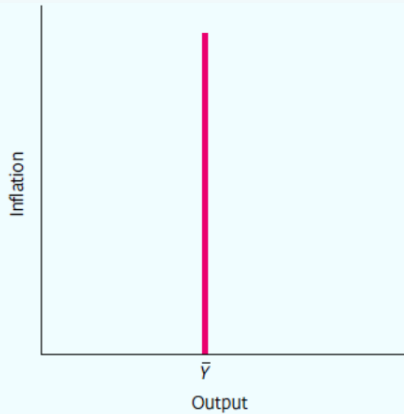


The Long Run

(a) Phillips curve

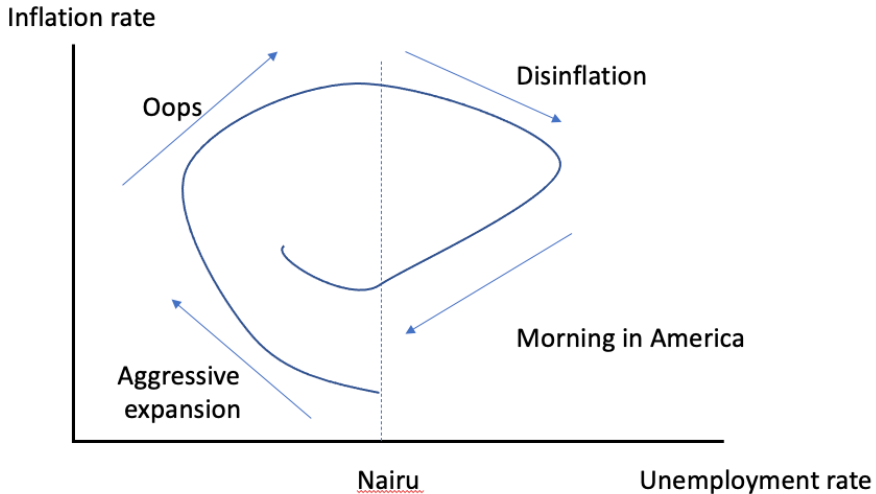


(b) Aggregate supply

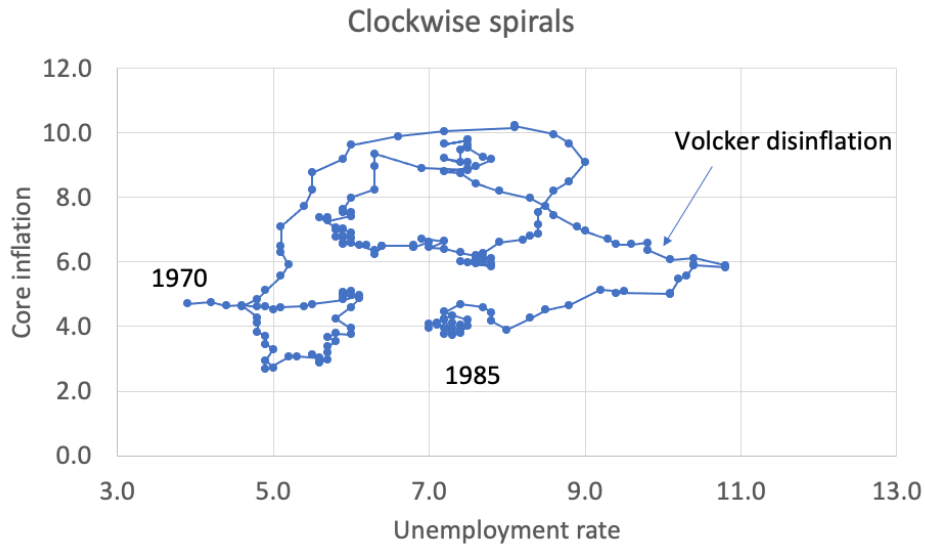


Friedman-Phelps Critique

Impossible to decrease unemployment in the long run without accelerating inflation



Friedman-Phelps Critique



Okun's Law

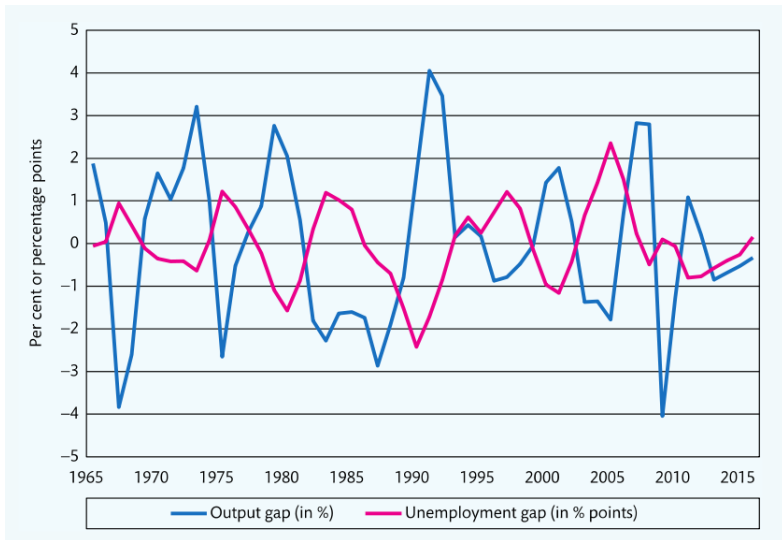
Negative relationship between output and unemployment

- ▶ note: intuitively plausible that higher output leads to lower unemployment
- ▶ in recessions output decreases and unemployment increases

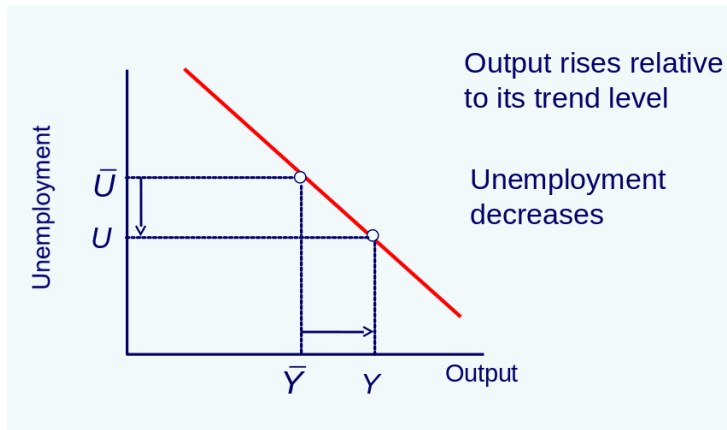
Stylized representation

- ▶ $U_{\text{gap}} = U - \bar{U}$, where \bar{U} is equilibrium unemployment
- ▶ output gap $\bar{Y}_{\text{gap}} = (Y - \bar{Y})/\bar{Y}$
- ▶ Okun's law $U_{\text{gap}} = -hY_{\text{gap}}$
- ▶ in practice h about 0.1–0.3

Output Gap and Unemployment in Germany



Okun's Law in Theory



Okun's Law in Reality: USA and Germany



Costs

Unit costs

- ▶ cost per unit produced
- ▶ unit costs = unit labour costs + unit non-labor costs
- ▶ labor costs ranges from 50% to 70 %
- ▶ in the following focus on labour costs

Nominal unit labour costs WL/Y

- ▶ average gross hourly labour costs W
- ▶ number of hours worked L

Real unit labour costs $WL/(PY)$

- ▶ the share of GDP that goes to labor

Wage Share of Value Added

Country	Total	Manufacturing	Construction	Finance	Basic Metal	Wholesale
Belgium	57.1	63.5	50.5	44.4	80.2	56.3
Czech Rep.	44.4	45.9	40.6	33.3	53.1	51.5
Denmark	60.5	57.1	76.4	47.5	84.1	71.0
Germany	56.5	62.9	61.4	64.5	69.2	69.0
Italy	44.4	60.5	41.6	40.0	65.9	42.3
Japan	52.1	54.2	71.0	49.9	46.8	53.6
Netherlands	55.1	54.9	61.8	43.4	59.2	52.9
Poland	42.2	45.7	32.0	36.7	49.7	28.8
Spain	51.8	57.1	50.1	51.0	70.5	56.5
USA	55.2	46.9	63.5	57.2	62.1	62.0

Mark-Up Pricing

Firms have some market power

- ▶ prices exceed marginal costs, this difference is called mark up
- ▶ firms set their prices to $(1 + \theta)MC$, where θ is the mark up

Optimality of mark up pricing

- ▶ monopolistic competition
- ▶ large number of firms selling differentiated products

$$P = (1 + \theta)[WL/Y]$$

Wage Setting

Bargaining over nominal wages

- ▶ uncertainty related to inflation, expected price P^e
- ▶ wages fixed for a period of time
- ▶ workers aim at large wage share, limited by firms' labour demand

Wages determine unit labour costs as a mark-up γ over the expected price level

- ▶ $WL/Y = (1 + \gamma)\bar{s}_L P^e$
- ▶ \bar{s}_L normal share (division of income in normal times)
- ▶ γ may vary in different times, on average $\gamma = 0$

$$P = (1 + \theta)(1 + \gamma)\bar{s}_L P^e$$

- ▶ combine above equations

Cyclical Behavior of Mark-Ups

Behavior of θ

- ▶ when competition increases, θ decreases
- ▶ in good times competition tends to increase
- ▶ in good times demand is high
- ▶ effect on θ is ambiguous

Behavior of γ

- ▶ during booms employment increases, bargaining power of workers improves
- ▶ higher mark-ups in booms

Procyclical mark-up $(1 + \theta)(1 + \gamma)$

- ▶ in boom times actual price level increases above its expected level
- ▶ foundation of the Phillips curve
- ▶ evidence: $WL/(PY)$ increases in booms

Roots of Inflation

1. Change of mark-ups
2. Expected inflation

$$\pi = \Delta(\text{mark} - \text{ups}) + \pi^e$$

- ▶ $\pi \approx \Delta\theta/(1 + \theta) + \Delta\gamma/(1 + \gamma) + \Delta s_L/s_L + \Delta P^e/P^e$
- ▶ procyclicality of mark-ups $\Delta\theta/(1 + \theta) + \Delta\gamma/(1 + \gamma) = aY_{\text{gap}}, a > 0$
- ▶ note: there is no single expected inflation, expectation may depend on the present
- underlying inflation $\tilde{\pi}$
- ▶ hence $\pi = \tilde{\pi} + aY_{\text{gap}}$
- ▶ by Okun's law $Y_{\text{gap}} = -U_{\text{gap}}/h$

$$\Rightarrow \pi = \tilde{\pi} - bU_{\text{gap}} \text{ (Phillips curve)}$$

Underlying Inflation

Broader concept than inflation expectations

- ▶ both backward and forward looking components

Example

- ▶ expected inflation 3% and 1% expected gain in labour productivity at the time when wage contract is signed (4% wage increase), realized inflation 5%, workers feel cheated!
- ▶ same setup but realized inflation 1% employers feel cheated!
- ▶ realized inflation impacts wage negotiations (leading to a backward looking component)

Expectations Augmented Phillips Curve

$$\pi = \tilde{\pi} - bU_{\text{gap}} + s$$

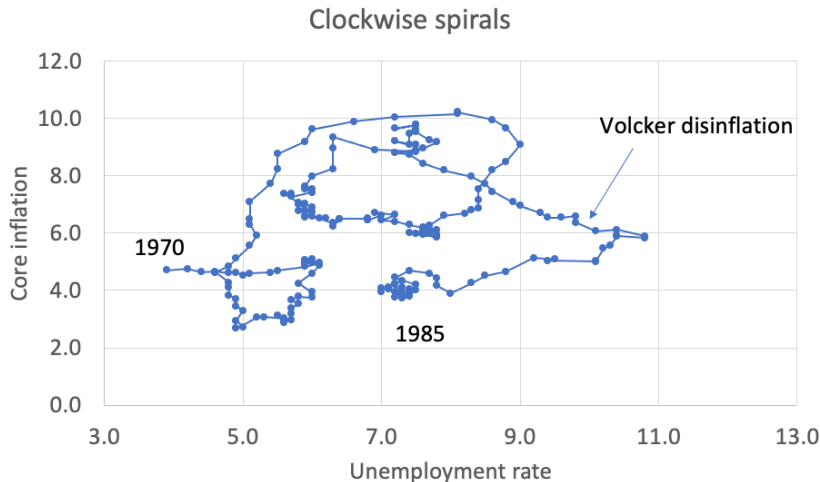
- ▶ inflation may be affected by supply shocks
- ▶ $\tilde{\pi}$ captures expectations
- ▶ note: U_{gap} contains \bar{U}

Shifts of Phillips curve

- ▶ supply shock s (e.g. oil crises)
- ▶ shock may affect $\tilde{\pi}$
- ▶ \bar{U} may change

Reinterpretation of Cycles

Cycles observed after the oil crisis were due to shifting expectations and supply shocks



Aggregate Supply Curve

$$\pi = F(Y; \tilde{\pi}, s, \bar{Y}), \quad \pi = \tilde{\pi} + aY_{\text{gap}} + s$$

- ▶ output gap increases inflation
- ▶ underlying inflation increases inflation
- ▶ GDP fluctuates around its trend but in the long run real forces determine the growth of GDP

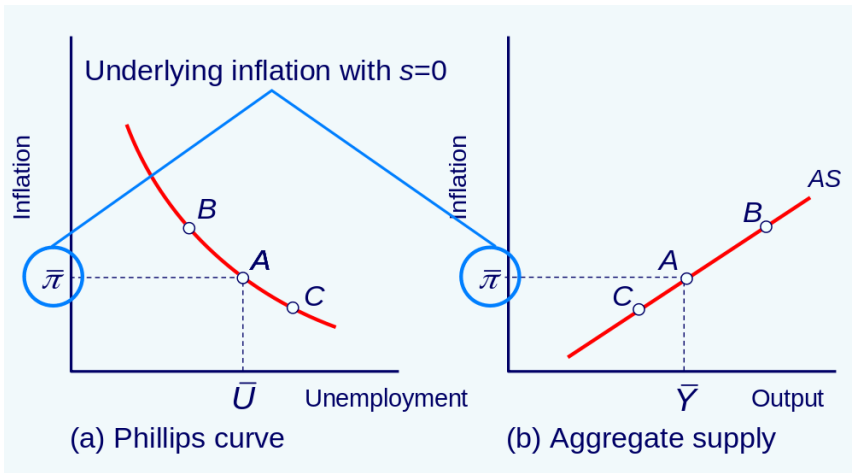
Why positive slope?

- ▶ intuition: keep prices of inputs fixed, assume price of output to increase, then there is opportunity for additional profits by producing more

Aggregate supply is shifted by

- ▶ shifts in $\tilde{\pi}$, \bar{Y} , and s

Augmented Phillips and Aggregate Supply Curve



Equilibrium Unemployment Rates

Country	1970	1980	1990	2000	2010	2015
Austria	2.1	2.5	3.7	4.1	4.4	4.5
Belgium	2.8	6.4	7.9	8.0	8.0	8.0
Denmark	2.0	5.5	6.7	5.5	6.0	6.3
Finland	3.6	4.9	7.4	10.2	8.0	7.4
France	2.1	5.4	8.2	8.6	8.7	9.2
Germany	0.9	4.3	7.2	7.6	6.7	4.9
Hungary				6.4	10.2	8.4
Ireland	5.8	9.9	13.8	8.4	10.0	10.7
Italy	5.8	6.0	8.9	9.3	8.0	9.1
Japan	1.6	1.8	2.4	3.9	4.1	3.8
Netherlands	2.9	5.9	7.5	4.9	5.2	5.9
Norway	1.6	2.1	4.3	3.6	3.3	3.3
Portugal	2.4	7.0	6.0	6.3	10.4	11.7
Spain	4.3	7.9	14.3	13.6	16.8	18.6
Sweden	2.8	3.2	5.1	7.0	7.5	7.5
Switzerland		0.6	1.7	3.2	3.9	4.0
United Kingdom	2.3	7.6	8.8	6.2	6.4	6.0
United States	4.9	7.3	5.9	5.6	5.6	5.4

Summary: Neoclassical Synthesis

Short-run expected augmented Phillips curve

- ▶ Phillips curve that can shift

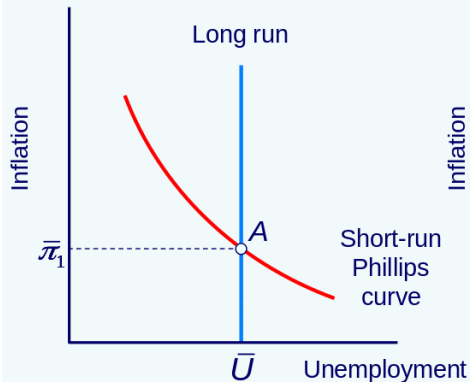
Long-run Phillips curve

- ▶ vertical Phillips curve
- ▶ in the long run it is impossible to reduce unemployment by letting inflation increase
- ▶ example: increase in inflation, decrease in unemployment, increase in expected inflation, Phillips curve shifts, unemployment returns, in the end only inflation expectations have changed

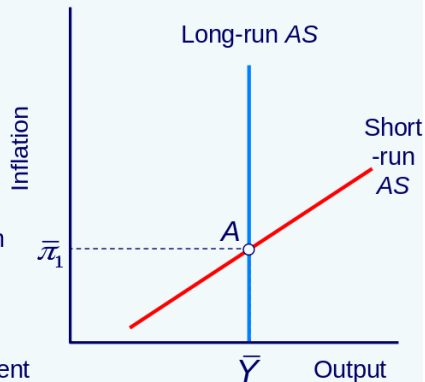
Corresponding aggregate supply curves

From the Short Run to the Long Run

Inflation equals underlying inflation, no supply shock.



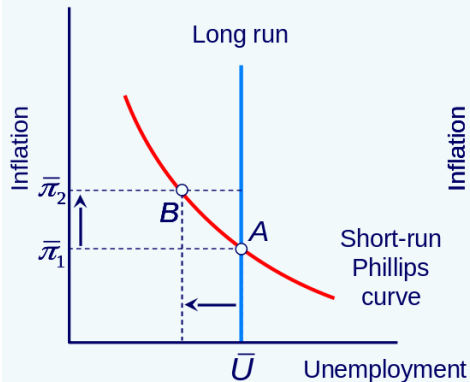
(a) Phillips curve



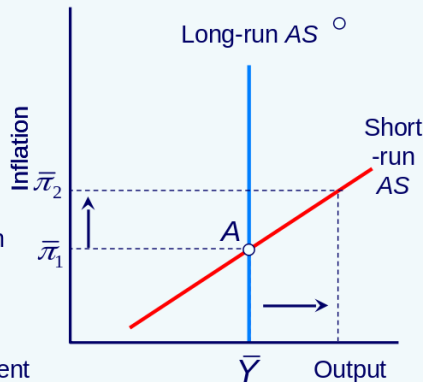
(b) Aggregate supply

From the Short Run to the Long Run

In the short run: trade-off between u and π



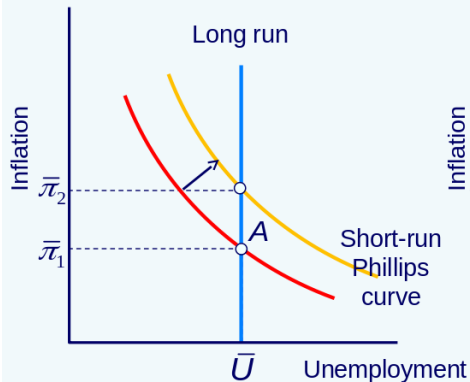
(a) Phillips curve



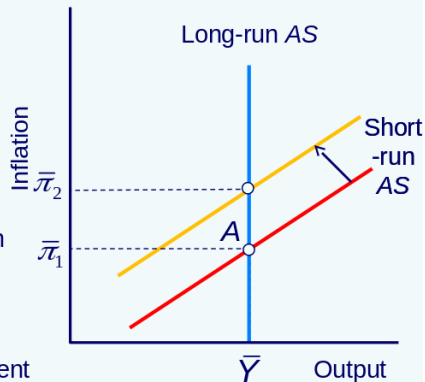
(b) Aggregate supply

From the Short Run to the Long Run

In the long run: underlying inflation will adjust.

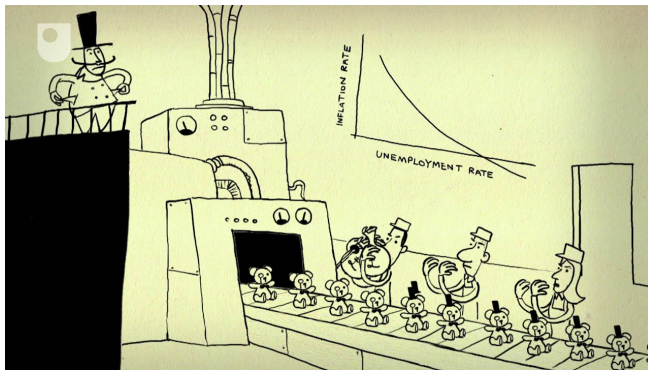


(a) Phillips curve



(b) Aggregate supply

Phillips Curve in 60 Seconds



Click picture to open link in Youtube