Inflation, Unemployment, and the Phillips Curve

Many people think there is a trade-off between inflation and unemployment, i.e.

\[ \pi_t = c - \beta u_t, \beta > 0, c \] is a constant

The idea originated in 1958 when A.W. Phillips showed a negative relationship between unemployment and nominal wage growth in Britain.

Since then economists have looked at the relationship between unemployment and inflation.

In the 1950s and 1960s many nations seemed to have a negative relationship between the two variables.
The Phillips curve and the U.S. economy during the 1960s
Inflation, Unemployment, and the Phillips Curve

\[ \pi_t = \pi^e_t - \beta(u_t - \bar{u}_t), \beta > 0 \]

The expectations augmented Phillips curve states that \( \pi \) depends on

- expected inflation, \( \pi^e \).
- cyclical unemployment \( u \): the deviation of the actual rate of unemployment \( u \) from the natural rate \( \bar{u} \).

Due to **M. Friedman** and **E. Phelps**
Deriving the EA Phillips curve from SRAS

Let $\bar{Y}_t = Y_t^{LRAS}$

$$\frac{dY_t}{Y_t} = \frac{d\bar{Y}_t}{\bar{Y}_t} + b \left( \frac{dP_t}{P_t} - \frac{dP^e_t}{P^e_t} \right)$$

$$\frac{dY_t}{Y_t} = \frac{d\bar{Y}_t}{\bar{Y}_t} + b(\pi_t - \pi^e_t)$$

$$\pi_t = \pi^e_t + \frac{1}{b} \left( \frac{dY_t}{Y_t} - \frac{d\bar{Y}_t}{\bar{Y}_t} \right)$$

Use Okun’s law $\frac{dY_t}{Y_t} = \frac{d\bar{Y}_t}{\bar{Y}_t} - 2(u_t - \bar{u}_t)$

$$\pi_t = \pi^e_t - \frac{2}{b} (u_t - \bar{u}_t)$$

Let $\beta = \frac{2}{b}$

$$\pi_t = \pi^e_t - \beta (u_t - \bar{u}_t)$$
SRAS and EA Phillips curve

\[ Y_t = \bar{Y}_t + b(P_t - P_t^e) \]  \hspace{1cm} (SRAS)

\[ \pi_t = \pi_t^e - \beta(u_t - \bar{u}_t) \]  \hspace{1cm} (Phillips)

- **SRAS curve**: Output is related to unexpected movements in the price level.

- **EA Phillips curve**: Unemployment is related to *unexpected* movements in the inflation rate

The EA Phillips curve suggests the relationship between inflation and the unemployment rate is NOT stable.
The Phillips curve and the U.S. economy during the 1960s
Inflation and unemployment in the United States, 1970-2005s
Unemployment and Inflation: Is There a Trade-off?

- For a given expected rate of inflation, the Phillips curve shows the trade-off between cyclical unemployment and actual inflation.
- Higher expected inflation implies a higher Phillips curve.
- A higher natural rate of unemployment shifts the Phillips curve to the right.
- A supply shock increases both expected inflation and the natural rate of unemployment.
The shifting Phillips curve: an increase in expected inflation

- **Expected inflation increases from 3% to 12%**
The shifting Phillips curve: an increase in the natural unemployment rate

Natural rate increases from 6% to 7%
Unemployment and Inflation: Is There a Trade-off?

- The original relationship between inflation and unemployment holds up as long as expected inflation and the natural rate of unemployment are approximately constant.
- This was true in the United States in the 1960s, so the Phillips curve appeared to be stable.
- The Phillips curve is unstable in periods with many supply shocks: the Phillips curve began breaking down in the 1970s:
  - minimum wage - unionization - babyboomers - sectoral shifts, all raised the natural rate of unemployment in the 1970s.
- Monetary policy was expansionary in the 1970s, leading to high and volatile inflation.
The EA Phillips Relationship
EA Phillips and the Lucas critique

Can the Phillips curve be exploited by policymakers?

- **Classical**: NO
  - **RBC**: never!
  - **Misperceptions**: The unemployment rate returns to its natural level quickly, as expectations adjust

- **Keynesians**: YES, temporarily
  - The $P^e$ in the Phillips curve is the forecast of inflation at the time the oldest sticky prices were set
  - It takes time for prices and expected prices to adjust, so unemployment may differ from the natural rate for some time
Consider the following simple economy:

\[ Y_t = b(P_t - P^e_t) + u_t \]  
\[ Y_t = \frac{1}{a}(M_t - P_t - v_t) \]  
\[ M_t = \gamma + P_{t-1} \]

where

- \( u_t \) is a random supply shock and \( u_t^e = 0 \)
- \( v_t \) is a random demand shock and \( v_t^e = 0 \)
- \( \gamma \) is the policy parameter of the central bank
\[ Y_t = \frac{1}{a} (M_t - P_t - \nu_t) \]
\[ \iff P_t = -aY_t + M_t - \nu_t \]
\[ \iff P_t = -a [b(P_t - P^e_t) + u_t] + M_t - \nu_t \]
\[ \iff P_t = -abP_t + abP^e_t - au_t + M_t - \nu_t \]
\[ \iff P_t = \frac{ab}{1 + ab} P^e_t - \frac{a}{1 + ab} u_t + \frac{1}{1 + ab} (M_t - \nu_t) \]

Under rational expectations

\[ P^e_t = \frac{ab}{1 + ab} P_t^e - \frac{a}{1 + ab} P^e_t + \frac{1}{1 + ab} (M^e_t - \nu^e_t) \]
\[ \iff P^e_t = \frac{ab}{1 + ab} P_t^e + \frac{1}{1 + ab} M^e_t \]
\[ \iff \frac{1}{1 + ab} P^e_t = \frac{1}{1 + ab} M^e_t \]
\[ \iff P^e_t = M^e_t \]
The Phillips Curve Lucas Critique Disinflation

\[ P_t^e = M_t^e \]
\[ \iff P_t^e = \gamma + P_{t-1} \]

Under rational expectations, people understand the structure of the economy and form their expectations based on the best possible information.

Note that price expectations depend on \( \gamma \), the central bank's policy parameter.

\[ Y_t = b(P_t - P_t^e) + u_t \]
\[ \iff Y_t = \phi + b(P_t - P_{t-1}) + u_t \]

where \( \phi = -b\gamma \).

Treating \( \phi \) constant, it appears there is a trade-off between inflation and output/unemployment.
\[ M_t = \gamma + P_{t-1} \quad \text{(Money supply rule)} \]

\[ \Leftrightarrow M_t - P_t = \gamma - (P_t - P_{t-1}) \]

\[ Y_t = \frac{1}{a}(M_t - P_t - v_t) \quad \text{(AD curve)} \]

\[ \Leftrightarrow Y_t = \frac{1}{a}(\gamma - (P_t - P_{t-1}) - v_t) \]

\[ \Leftrightarrow (P_t - P_{t-1}) = \gamma - aY_t - v_t \]

\[ Y_t = \phi + b(P_t - P_{t-1}) + u_t \quad \text{(SRAS curve)} \]

\[ \Leftrightarrow Y_t = \phi + b(\gamma - aY_t - v_t) + u_t \]

\[ \Leftrightarrow Y_t = \frac{\phi}{1 + ab} + \frac{b}{1 + ab}(\gamma - v_t) + \frac{1}{1 + ab}u_t \]
\[ Y_t = \frac{\phi}{1 + ab} + \frac{b}{1 + ab} (\gamma - v_t) + \frac{1}{1 + ab} u_t \]

A well-meaning central bank estimates:

- \( a \) the slope of the AD-curve
- \( \phi \) and \( b \), the intercept and slope of the AS-curve/Phillips curve

and believes it can increase output and lower unemployment by raising \( \gamma \).
\[ Y_t = \frac{\phi}{1 + ab} + \frac{b}{1 + ab} (\gamma - v_t) + \frac{1}{1 + ab} u_t \]

But Lucas critique: \( \phi = -b\gamma \) is not policy invariant!

People learn the central bank’s \( \gamma \) and readjust inflation expectations.

\[ Y_t = \frac{-b\gamma}{1 + ab} + \frac{b}{1 + ab} (\gamma - v_t) + \frac{1}{1 + ab} u_t \]

\[ \Leftrightarrow Y_t = -\frac{b}{1 + ab} v_t + \frac{1}{1 + ab} u_t \]

which is independent of \( \gamma \)
Consider 2 central bank policies:

- Policy H: high value of $\gamma$
- Policy L: low value of $\gamma$

Under rational expectations, both policies yield the same dynamics of output and unemployment.

Under policy $H$, inflation is high.
Under policy $L$, inflation is low.

Since (expected) inflation is costly, policy L is the best policy.
But often central banks end up adopting policy $H$. Why?

1. Developing or war-torn countries may not be able to raise taxes or borrow, so they print money to finance spending.

2. Industrialized countries may try to use expansionary monetary policy to fight recessions, then not tighten monetary policy enough later.

3. **Time Inconsistency Problem:**
   - Suppose the central bank (CB) announces policy $L$ and firms set prices, workers sign wage contracts.
   - Once price are fixed, the CB can lower unemployment by adopting policy $H$.
   - If the central bank is known to care about unemployment, people will anticipate policy $H$.
   - The announcement by the CB is not credible/time consistent: people will expect policy $H$ instead.
   - Now to avoid a recession, the CB must adopt policy high $H$. 
How to move from policy $H$ to policy $L$?

Suppose people expect policy $H$, such that inflation expectations are high:

- Adopting policy $L$ means $P < P^e$ and the central bank creates a recession. It will lead to disinflation as people readjust their expectations and price setting policies are revised.
- Adopting policy $H$ means $P = P^e$ and there is no recession but high inflation.

Inflationary expectations are essential in macroeconomic policy making: people should be convinced that the central bank will adopt policy $L$.

The costs of disinflation could be reduced if expected inflation fell at the same time actual inflation fell.
How costly is disinflation?

- **Classical economics/Misperceptions Theory:**
  *Cold turkey:* just switch to policy $L$.
  The economy will adjust fairly quickly, with low costs of adjustment, if the policy is announced well in advance.

- **New Keynesian Theory:**
  Price stickiness due to menu costs and wage stickiness due to labor contracts make adjustment slow.
  Cold turkey disinflation would cause a major recession.
  *Gradualism* instead.
  The strategy might fail to alter inflation expectations, because if the costs of the policy are high (a big recession), the government will reverse the policy.
How costly is disinflation?

The **sacrifice ratio** is the number of percentage points of output lost in reducing inflation by one percentage point.

It is a short run cost that must be weighed against the longer run benefits of lower inflation.

Use Okuns law to translate this cost into unemployment.

There have been many instances of disinflation around the world:

- How high is the sacrifice ratio?
- Which one is the better approach: cold turkey or gradualism?
The U.S. disinflation of the 1980s and 1990s

Fed chairmen Volcker and Greenspan reduced the inflation rate in the 1980s and 1990s, i.e. switch from policy $H$ in the 1970s to policy $L$.

Inflation expectations were slow to decline initially (in the late 1970s and early 1980s) because Volcker and the Fed lacked credibility.

- U.S. inflation fell by 8.83% in the early 1980s, with a loss in output of 16.18% in output.
  Sacrifice ratio $= 16.18/8.83 = 1.832$
GDP and Fed Funds rate

![Graph showing GDP and Fed Funds rate from March 1959 to March 2004. The graph includes two lines: one for the Fed Funds rate and another for real GDP growth.](image-url)
Expected inflation rate, 1971 to 2006
The Phillips Curve Lucas Critique Disinflation

The U.S. disinflation of the 1980s and 1990s

The sacrifice ratio was large for the US.

But as inflation continued to fall, the Fed’s credibility increased, and inflation expectations declined gradually and remained low.

Ball studied the sacrifice ratios for many different disinflations around the world in the 1960s, 1970s, and 1980s:

- The sacrifice ratios varied substantially across countries, from less than 1 to almost 3
- One factor affecting the sacrifice ratio is the flexibility of the labor market: Countries with slow wage adjustment have higher sacrifice ratios
- Ball also found a lower sacrifice ratio from cold turkey disinflation than from gradualism!
How to keep inflation expectations low?

How to avoid time inconsistency trap and show credible commitment to policy $L$?

1. **CB Independence**: non-politicians are more credible in not caring about unemployment.

2. **More conservative CB’s** (i.e. caring less about employment) Price stability as primary/only objective is preferable.

3. **Reputation**: Credible commitment to low inflation policies.

4. Fixed exchange rates, currency boards, dollarization,...