Phillips Curve

Macroeconomics
Cunningham
Original Phillips Curve

- Wage inflation vs. Unemployment
- New Zealander at London School of Economics
- Missing Equation of Keynesian economics?
$5\frac{1}{2} \% = \text{zero inflation}$
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 \( \left( \frac{dw}{w} = 0 \right) \) 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

\[ \frac{X}{N_s} = \frac{V}{N_s} - \frac{U}{N_s} = X = \nu - \mu \]

Where \( \nu \) is the vacancy rate and \( \mu \) is the unemployment rate.
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.
Asymptotic \( u = 0 \) not possible

Individual labor market

Wage inflation

Unemployment
The result is a Phillips curve for an individual market.

Next, aggregate across markets for the aggregate Phillips curve.

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

\[ P_t = (1 + a) \frac{W_t N_t}{y_t} \]
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:

\[ \log P_t = \log(1 + a) + \log W_t - \log \Lambda_t \]
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.
Generalize further in the form of a Phillips curve relation:

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

- OFFSETTING PRODUCTIVITY GAINS
- DEMAND PRESSURE
- 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


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

\[ \pi = f(u) + \pi^e \]

**Natural Rate of Unemployment** or **NAIRU**
Friedman’s Accelerationist Hypothesis

\[ \pi = f(u) + \pi^e \]

Accelerationist Hypothesis:
let \( f(u) = -b(u_t - u^*) \)

Use adaptive expectations:
\[ \pi^e_t = \theta \pi^e_{t-1} + (1 - \theta)\pi_{t-1} \]

So that
\[ \pi_t = \theta \pi^e_{t-1} + (1 - \theta)\pi_{t-1} - b(u_t - u^*) \]

Problem: \( \pi^e_{t-1} \) is not observable.
Friedman’s Accelerationist Hypothesis

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

\[(1 - \theta)\pi_{t-1} = (1 - \theta)\pi^e_{t-1} - b(1 - \theta)(u_{t-1} - u^*)\]

Subtract from the original equation:

\[\pi_t = \pi_{t-1} + b(1 - \theta)(u_{t-1} - u^*) - b(u_{t-1} - u^*)\]

Replaces the expected inflation term

When inflation is fully anticipated,

\[\pi_t = \pi^e_t, \pi_t = \pi_{t-1}, \text{ and } u_t = u_{t-1}.\]
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
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.”