

# MA Advanced Macroeconomics:

## 8. The Phillips Curve

Karl Whelan

School of Economics, UCD

Spring 2016

# Getting Monetary Policy Into the Model

- The RBC model is a good training ground for learning the language and methods of DSGE modelling but the model itself has many shortcomings.
- In particular, it has little relevance for analysis of macroeconomic policy.
- We could add monetary policy but, in the absence of any price of wage frictions, it would have no real effects. Monetary policy could not change the real interest rate or influence real output.
- To allow for a realistic model of monetary policy, we need a framework in which prices don't simply follow the money supply and nominal interest rates and inflation don't just move together one-for-one.
- In this kind of “Keynesian” model, prices are sticky, so real interest rates can be influenced by the central bank. Real interest rates can affect the performance of the economy, which in turn influences inflation via a Phillips curve relationship.
- We will describe a modern New Keynesian model of this type but will start with some history on the last point, i.e. the Phillips curve.

# The Phillips Curve

- The idea that there is some sort of positive relationship between inflation and output has been around a very long time.
- But the modern incarnation of this relationship is usually traced to a late 1958 study by the LSE's A.W. Phillips.
- Phillips showed that low unemployment was associated with high inflation, presumably because tight labour markets stimulated wage inflation.
- A 1960 study by Solow and Samuelson replicated these findings for the US.
- The Phillips curve tradeoff quickly became the basis for the discussion of macroeconomic policy.
- Policy faced a tradeoff: Lower unemployment could be achieved, but only at the cost of higher inflation.
- I strongly recommend reading the paper on the website by Robert Gordon on the History of the Phillips Curve.

# A. W. Phillips's Graph

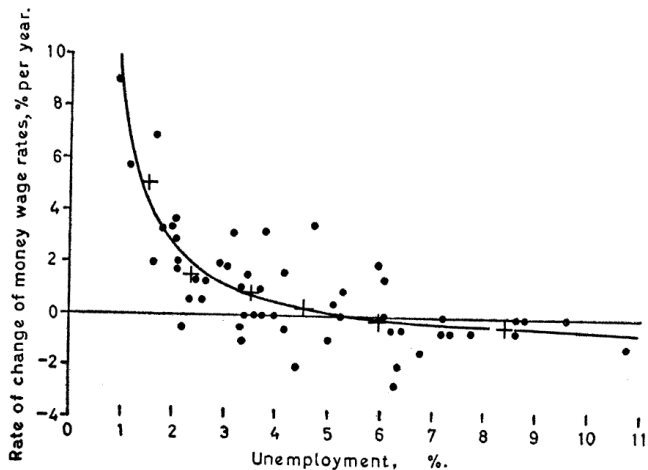


Fig.1.1861 - 1913

# Solow and Samuelson's Description of the Phillips Curve

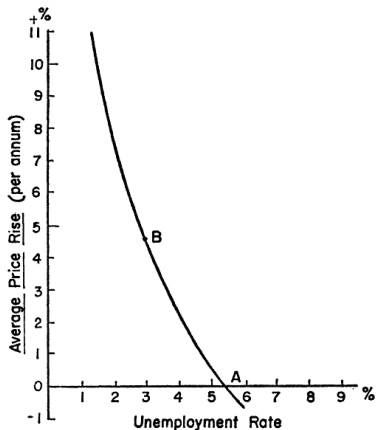


FIGURE 2

MODIFIED PHILLIPS CURVE FOR U.S.

This shows the menu of choice between different degrees of unemployment and price stability, as roughly estimated from last twenty-five years of American data.

## Friedman's 1967 AEA Presidential Address

- “At any moment of time, there is some level of unemployment which has the property that it is consistent with equilibrium in the structure of real wage rates. At that level of unemployment, real wage rates are tending on the average to rise at a “normal” secular rate ... ”
- “A lower level of unemployment is an indication that there is an excess demand for labor that will produce upward pressure on real wage rates. A higher level of unemployment is an indication that there is an excess supply of labor that will produce downward pressure on real wage rates.”
- “The “natural rate of unemployment” in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections ...”

# Friedman's 1967 AEA Presidential Address

- “At any moment of time, there is some level of unemployment which has the property that it is consistent with equilibrium in the structure of real wage rates. At that level of unemployment, real wage rates are tending on the average to rise at a “normal” secular rate ... ”
- “A lower level of unemployment is an indication that there is an excess demand for labor that will produce upward pressure on real wage rates. A higher level of unemployment is an indication that there is an excess supply of labor that will produce downward pressure on real wage rates.”
- “The “natural rate of unemployment” in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections ...”

## Friedman's 1967 AEA Presidential Address

- “At any moment of time, there is some level of unemployment which has the property that it is consistent with equilibrium in the structure of real wage rates. At that level of unemployment, real wage rates are tending on the average to rise at a “normal” secular rate ... ”
- “A lower level of unemployment is an indication that there is an excess demand for labor that will produce upward pressure on real wage rates. A higher level of unemployment is an indication that there is an excess supply of labor that will produce downward pressure on real wage rates.”
- “The “natural rate of unemployment” in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections ...”



## Friedman's 1967 AEA Presidential Address

- “You will recognize the close similarity between this statement and the celebrated Phillips Curve. The similarity is not coincidental. Phillips’ analysis of the relation between unemployment and wage change is deservedly celebrated as an important and original contribution. But, unfortunately, it contains a basic defect—the failure to distinguish between nominal wages and real wages.”
- “Implicitly, Phillips wrote his article for a world in which everyone anticipated that nominal prices would be stable and in which that anticipation remained unshaken and immutable whatever happened to actual prices and wages. Suppose, by contrast, that everyone anticipates that prices will rise at a rate of more than 75 per cent a year ... Then wages must rise at that rate simply to keep real wages unchanged. An excess supply of labor will be reflected in a less rapid rise in nominal wages than in anticipated prices, not in an absolute decline in wages.”

## Friedman's 1967 AEA Presidential Address

- “You will recognize the close similarity between this statement and the celebrated Phillips Curve. The similarity is not coincidental. Phillips' analysis of the relation between unemployment and wage change is deservedly celebrated as an important and original contribution. But, unfortunately, it contains a basic defect—the failure to distinguish between nominal wages and real wages.”
- “Implicitly, Phillips wrote his article for a world in which everyone anticipated that nominal prices would be stable and in which that anticipation remained unshaken and immutable whatever happened to actual prices and wages. Suppose, by contrast, that everyone anticipates that prices will rise at a rate of more than 75 per cent a year ... Then wages must rise at that rate simply to keep real wages unchanged. An excess supply of labor will be reflected in a less rapid rise in nominal wages than in anticipated prices, not in an absolute decline in wages.”

# Friedman's 1967 AEA Presidential Address

- “Restate Phillips’ analysis in terms of the rate of change of real wages—and even more precisely, anticipated real wages—and it all falls into place.”
- Describes an attempt to keep unemployment below the natural rate by monetary stimulus: “Income and spending will start to rise. To begin with, much or most of the rise in income will take the form of an increase in output and employment rather than in prices ..... Employees will start to reckon on rising prices of the things they buy and to demand higher nominal wages for the future.”
- “In order to keep unemployment at its target level [below the natural rate], the monetary authority would have to raise monetary growth still more ... the “market” rate can be kept below the “natural” rate only by inflation. And ... only by accelerating inflation.”
- Friedman predicted the Phillips curve relationship would collapse. And he turned out to be right.

## Friedman's 1967 AEA Presidential Address

- “Restate Phillips’ analysis in terms of the rate of change of real wages—and even more precisely, anticipated real wages—and it all falls into place.”
- Describes an attempt to keep unemployment below the natural rate by monetary stimulus: “Income and spending will start to rise. To begin with, much or most of the rise in income will take the form of an increase in output and employment rather than in prices ..... Employees will start to reckon on rising prices of the things they buy and to demand higher nominal wages for the future.”
- “In order to keep unemployment at its target level [below the natural rate], the monetary authority would have to raise monetary growth still more ... the “market” rate can be kept below the “natural” rate only by inflation. And ... only by accelerating inflation.”
- Friedman predicted the Phillips curve relationship would collapse. And he turned out to be right.

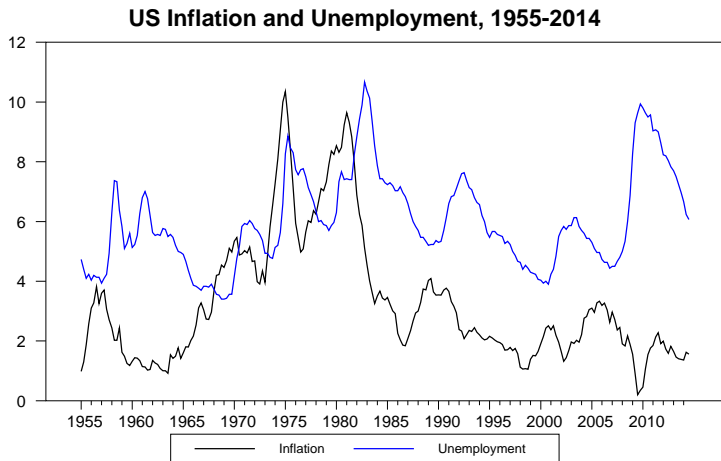
## Friedman's 1967 AEA Presidential Address

- “Restate Phillips’ analysis in terms of the rate of change of real wages—and even more precisely, anticipated real wages—and it all falls into place.”
- Describes an attempt to keep unemployment below the natural rate by monetary stimulus: “Income and spending will start to rise. To begin with, much or most of the rise in income will take the form of an increase in output and employment rather than in prices ..... Employees will start to reckon on rising prices of the things they buy and to demand higher nominal wages for the future.”
- “In order to keep unemployment at its target level [below the natural rate], the monetary authority would have to raise monetary growth still more ... the “market” rate can be kept below the “natural” rate only by inflation. And ... only by accelerating inflation.”
- Friedman predicted the Phillips curve relationship would collapse. And he turned out to be right.

## Friedman's 1967 AEA Presidential Address

- “Restate Phillips’ analysis in terms of the rate of change of real wages—and even more precisely, anticipated real wages—and it all falls into place.”
- Describes an attempt to keep unemployment below the natural rate by monetary stimulus: “Income and spending will start to rise. To begin with, much or most of the rise in income will take the form of an increase in output and employment rather than in prices ..... Employees will start to reckon on rising prices of the things they buy and to demand higher nominal wages for the future.”
- “In order to keep unemployment at its target level [below the natural rate], the monetary authority would have to raise monetary growth still more ... the “market” rate can be kept below the “natural” rate only by inflation. And ... only by accelerating inflation.”
- Friedman predicted the Phillips curve relationship would collapse. And he turned out to be right.

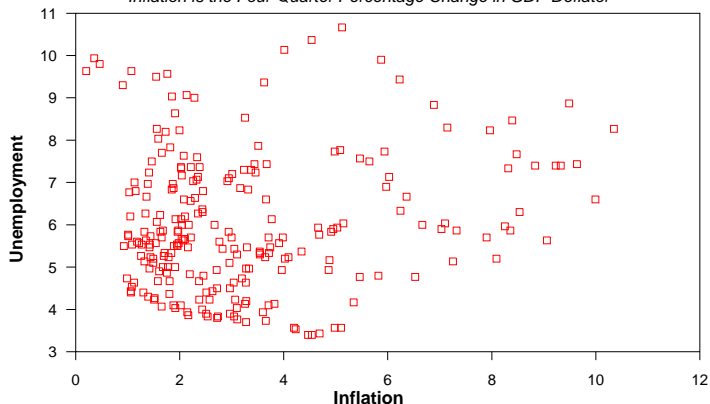
# The Evolution of US Inflation and Unemployment



# The Failure of the Phillips Curve

## US Inflation and Unemployment, 1955-2014

*Inflation is the Four-Quarter Percentage Change in GDP Deflator*





# The Expectations-Augmented Phillips Curve

- Friedman didn't use equations in his AEA address.
- But a rough model of his ideas is the following:

$$\pi_t = \pi_t^e - \gamma(U_t - U^*)$$

- Friedman pointed out if policy-makers tried to exploit an apparent Phillips curve tradeoff, then the public would get used to high inflation and come to expect it:  $\pi_t^e$  would drift up and the tradeoff between inflation and output would worsen.
- In the long-run, you can't fool the public ( $\pi_t^e \approx \pi_t$ ) so you can't keep unemployment away from its "natural rate"  $U_t \approx U^*$ .

# The Accelerationist Phillips Curve

- Friedman thought that inflation expectations were determined *adaptively*.
- For instance, people use last year's inflation rate as a guide to what to expect this year.
- Set  $\pi_t^e = \pi_{t-1}$  and the expectations-augmented Phillips curve becomes

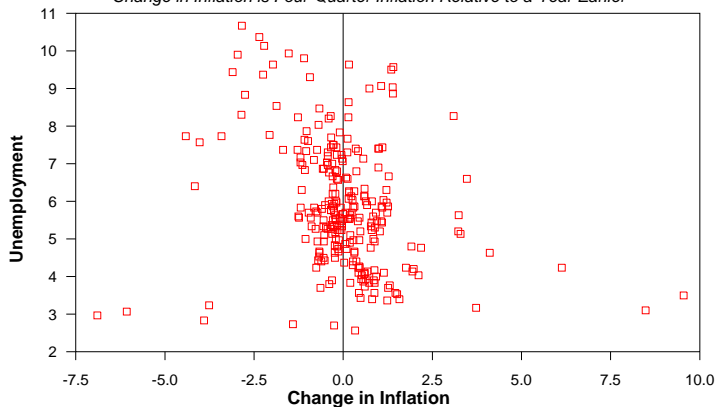
$$\pi_t = \pi_{t-1} - \gamma(U_t - U^*)$$

- This relates the *change* in inflation to the gap between unemployment and its natural rate. When unemployment is below its natural rate, inflation will be increasing; when it is above it, it will be decreasing.
- Unemployment below the natural rate implies an accelerating price level. This relationship is known as the accelerationist Phillips curve.

# The Success of the Accelerationist Phillips Curve

## Changes in US Inflation and Unemployment, 1955-2014

*Change in Inflation is Four-Quarter Inflation Relative to a Year Earlier*



## Empirical Implementation: The NAIRU

- In practice, there are a few complications.
- Inflation expectations likely to be better captured by weighted average of past inflation rates rather than just a single lag, implying:

$$\pi_t = \sum_{i=1}^N \beta_i \pi_{t-i} - \gamma(U_t - U^*)$$

where  $\sum_{i=1}^N \beta_i = 1$ .

- Don't know what the natural rate is. But we can estimate it from

$$\pi_t = \alpha - \gamma U_t + \sum_{i=1}^N \beta_i \pi_{t-i}$$

- Estimate natural rate from

$$\alpha - \gamma U^* = 0 \Rightarrow U^* = \frac{\alpha}{\gamma}$$

- Known as NAIRU (Non Accelerating Inflation Rate of Unemployment.)

# Use in Policy Analysis

- Model usually supplemented with additional “supply shock” terms recognizing that food and energy price inflation can change more rapidly.
- Modern variants also allow for the possibility of time variation in the NAIRU.
- Regularly used in policy analysis.
- Important implications for policy:
  - ▶ Inflation is highly inertial. A shock to inflation today takes a long time to disappear.
  - ▶ Inflation largely predetermined by backward-looking expectations at any point in time. Hard to get inflation down quickly without inflicting a lot of unemployment.
  - ▶ So probably best to have monetary policy act to reduce inflation gradually over time.

# Lucas Critique

- Lucas (1972) and Sargent (1972) criticized the assumption of adaptive expectations:
  - ① Argued that expectations should be based on perceived policy regime and not just on recent history.
  - ② If the policy regime changes, there is no need for people to use the recent past as their guide.
  - ③ Lucas (1976) Critique: Coefficients of all “reduced-form” econometric models (including Phillips curves) will change.
  - ④ Econometric models not reliable for analyzing effects of policy changes.
- Example: If policy credibly commits to keeping inflation close to 2% at all times, then random deviations from the target should not budge inflation expectations from 2%: No need for a large  $\rho$  in Phillips curve model.
- Critique implies that econometric NAIRU estimates are not useful.
- Need to have the correct “structural” model to do useful policy analysis.

# Critique of Keynesianism

- Consider expectations-augmented Phillips curve

$$\pi_t = \pi_t^e - \gamma(U_t - U^*)$$

- We can only have  $U_t \neq U^*$  when there is unexpected inflation so  $\pi_t \neq \pi_t^e$ .
- If expectations are rational, then these must be random and unpredictable based on publicly available information.
- So no room for systematic predictable (Keynesian) stabilization.
- Rational expectations school pioneered a different approach with models based on individual agents pursuing optimizing behaviour.
- Over time, many advocates of rational expectations came to believe that monetary policy had little to do with business cycles. Many turned to the theory that cycles were largely caused by real shocks to technology (real business cycle theory).
- But the Keynesians weren't quite down and out.