

Economics 442

Macroeconomic Policy

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Is the Phillips Curve Dead?

And if so, why are we studying it?

“The relationship between the slack in the economy or unemployment and inflation was a strong one 50 years ago ... and has gone away,” Powell said Thursday during his testimony before the Senate Banking Committee. He added the strong tie between unemployment and inflation was broken at least 20 years ago and the relationship “has become weaker and weaker and weaker.”

Yun Li, The Fed chairman says the relationship between inflation and unemployment is gone, CNBC July 11, 2019

<https://www.cnbc.com/2019/07/11/the-fed-chairman-says-the-relationship-between-inflation-and-unemployment-is-gone.html>

Could It Reappear?

- Powell adds:

“At the end of the day, there has to be a connection because low employment will drive wages up and ultimately higher wages will drive inflation, but we haven’t reached that point. In many cases, that connection between the two is quite small these days,” the Fed chief says.

Yun Li, The Fed chairman says the relationship between inflation and unemployment is gone, CNBC July 11, 2019

<https://www.cnbc.com/2019/07/11/the-fed-chairman-says-the-relationship-between-inflation-and-unemployment-is-gone.html>

Motivation

- In order to understand why the relationship now appears weaker, we need to understand the theory
- This will also help us understand when the relationship might look stronger
- So... the Phillips curve is not dead, but merely hibernating
- ***Or***, we are mis-estimating what is actually there

Outline

- Recap: Phillips Curve, IS-LM-PC
- Phillips Curve and Expectations

Recap: Phillips Curve, IS-LM-PC

From Wage & Price Equations to Phillips Curve

- Recall the wage determination equation (7.1):

$$W = P^e F(u, z) \quad (7.1)$$

and the price determination equation (7.3):

$$P = (1 + m)W \quad (7.3)$$

From Wage & Price Equations to Phillips Curve

- Assume a specific form for F :

$$F(u, z) = 1 - \alpha u + z$$

so that the *relation between the price level, the expected price level, and the unemployment rate* is:

$$P = P^e(1 + m)(1 - \alpha u + z) \tag{8.1}$$

From Wage & Price Equations to Phillips Curve

- Equation (8.1) with time subscripts becomes:

$$P_t = P_t^e (1 + m)(1 - \alpha u_t + z)$$

- Divide both sides by P_{t-1} :

$$\frac{P_t}{P_{t-1}} = \frac{P_t^e}{P_{t-1}^e} (1 + m)(1 - \alpha u_t + z) \quad (8A.1)$$

- Rewrite P_t/P_{t-1} as $1 + \pi_t$ and do the same for the expected inflation rate, equation (8A.1) becomes:

$$(1 + \pi_t) = (1 + \pi_t^e)(1 + m)(1 - \alpha u_t + z)$$

$$\frac{(1 + \pi_t)}{(1 + \pi_t^e)(1 + m)} = 1 - \alpha u_t + z$$

- If the left side is not large, it becomes $1 + \pi_t - \pi_t^e - m$ and so:

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

Expectations Augmented Phillips Curve

- *An increase in π^e leads to an increase in π .*
- *Given π^e , an increase in m , or an increase in z , leads to an increase in π .*
- *Given π^e , a decrease in u leads to an increase in π .*
- Equation (8.2) with a time index t :

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t \quad (8.3)$$

Options for Expectations

- Static or Anchored Expectations

$$\pi_t^e = \bar{\pi}$$

$$\pi_t = \bar{\pi} + (m + z) - \alpha u_t \quad (8.4')$$

(If expected inflation is always zero then)

$$\pi_t = (m + z) - \alpha u_t \quad (8.4)$$

- Adaptive

$$\pi_t^e = \varphi_1 \pi_{t-1} + \varphi_2 \pi_{t-2}$$

$$\pi_t = \varphi_1 \pi_{t-1} + \varphi_2 \pi_{t-2} + (m + z) - \alpha u_t \quad (8.4'')$$

Options for Expectations

- Accelerationist (is adaptive setting $\varphi_1=1$
And $\varphi_2=0$)

$$\pi_t^e = \pi_{t-1}$$

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

$$\pi_t - \pi_{t-1} = (m + z) - \alpha u_t \quad (8.6)$$

Static or Adaptive Expectations or Accelerationist

- Suppose expected inflation this year depends on a constant value $\bar{\pi}$ with weight $1 - \theta$, and partly on inflation last year with weight θ :

$$\pi_t^e = (1 - \theta)\bar{\pi} + \theta\pi_{t-1} \quad (8.5)$$

- When $\theta=0$, $\pi_t = \bar{\pi} + (m + z) - \alpha u_t$
- When $\theta > 0$, $\pi_t = [(1 - \theta)\bar{\pi} + (m + z)] + \theta\pi_{t-1} - \alpha u_t$
- When $\theta = 1$, $\pi_t - \pi_{t-1} = (m + z) - \alpha u_t$, (8.6)

The Phillips Curve and Natural Rate of Unemployment

- Suppose $\pi = \pi^e$ and solve for u_n in equation (8.3):

$$u_n = \frac{m + z}{\alpha} \quad (8.9)$$

- Rewrite equation (8.3) as

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

so equation (8.9) can be rewritten as

$$\pi_t - \pi_t^e = -\alpha(u_t - u_n) \quad (8.10)$$

Wage Contracts, Indexation and Phillips Curve

- **Wage indexation** is a provision that automatically increases wages in line with inflation.
- Suppose λ a proportion of labor contracts that is indexed, so nominal wages move one-for-one with changes in the actual price level, equation (8.10) becomes

$$\pi_t = [\lambda\pi_t + (1 - \lambda)\pi_{t-1}] - \alpha(u_t - u_n) \quad (8.11)$$

Wage Contracts, Indexation and Phillips Curve

- When $\lambda=0$, equation (8.11) becomes equations (8.10).
- When $\lambda>0$, equation (8.11) becomes:

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

- *Wage indexation increases the effect of unemployment on inflation.*
- Without wage indexation, lower unemployment increases wages, which in turn increases prices.

9.1 The IS-LM-PC Model (1 of 3)

- In Chapter 6, output in the short run is determined by demand (IS curve):

$$Y = C(Y - T) + I(Y, r + x) + G \quad (9.1)$$

$$r_t \approx i_t - \pi_{t+1}^e \quad (6.4)$$

- In Chapter 8, the relation between inflation and unemployment is called the Phillips curve:

$$\pi - \pi^e = -\alpha(u - u_n) \quad (9.2)$$

- When $u = u_n$, natural employment is $N_n = L(1 - u_n)$
- When $u = u_n$, **potential output** is $Y_n = L(1 - u_n)$
- Output gap: $Y - Y_n = L((1 - u) - (1 - u_n)) = -L(u - u_n)$

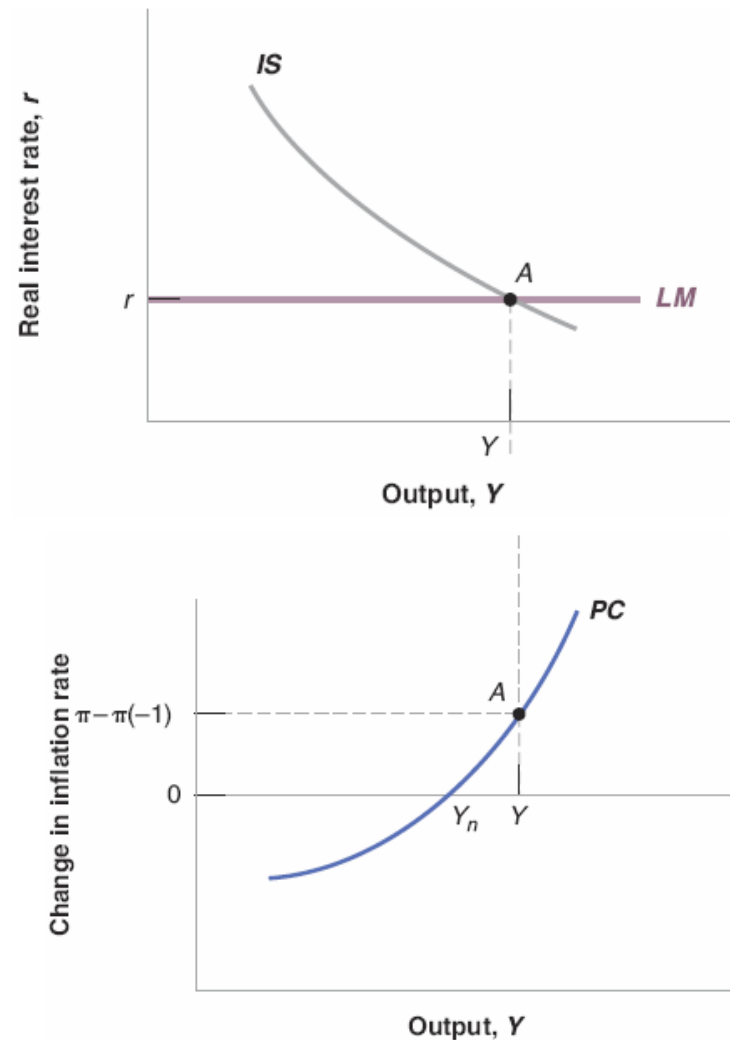
9.1 The IS-LM-PC Model (2 of 3)

Figure 9.1 The IS-LM-PC Model: Output and Inflation

Short-run equilibrium

Top graph: A low policy rate leads to higher output.

Bottom graph: A higher output leads to a larger change in inflation.



9.1 The IS-LM-PC Model (3 of 3)

- Output $Y - Y_n = L((1 - u) - (1 - u_n)) = -L(u - u_n)$
- gap:
• Replacing $u - u_n$ in equation (9.2) gives:

$$\pi - \pi^e = (\alpha/L)(Y - Y_n) \quad (9.3)$$

- Assume wage setters expect inflation this year to be the same last year:

$$\pi - \pi(-1) = (\alpha/L)(Y - Y_n) \quad (9.4)$$

- When output is above potential (positive output gap), inflation increases, and vice versa.

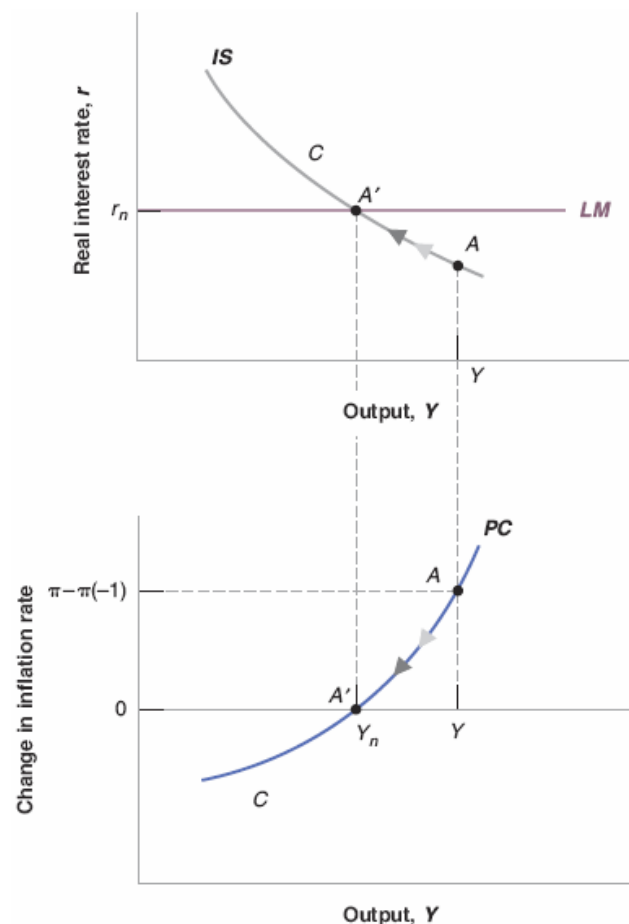
9.2 From the Short to the Medium Run (1 of 2)

Figure 9.2 Medium-Run Output and Inflation

Over the medium run, the economy converges to the natural level of output and stable inflation.

At the medium-run equilibrium (point A'), r_n is called the **natural, neutral, or Wicksellian rate of interest**.

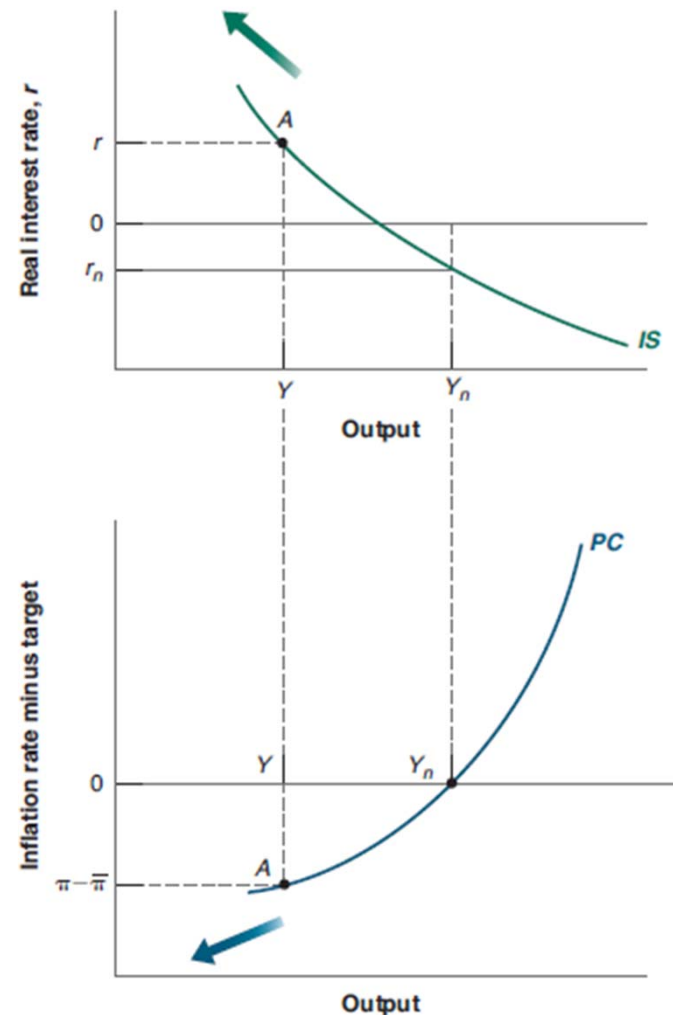
If the central bank wants to achieve a constant level of inflation, then the initial boom must be followed by a recession.



9.3 Complications and How Things Can Go Wrong (2 of 3)

Figure 9.3 The Deflation Spiral

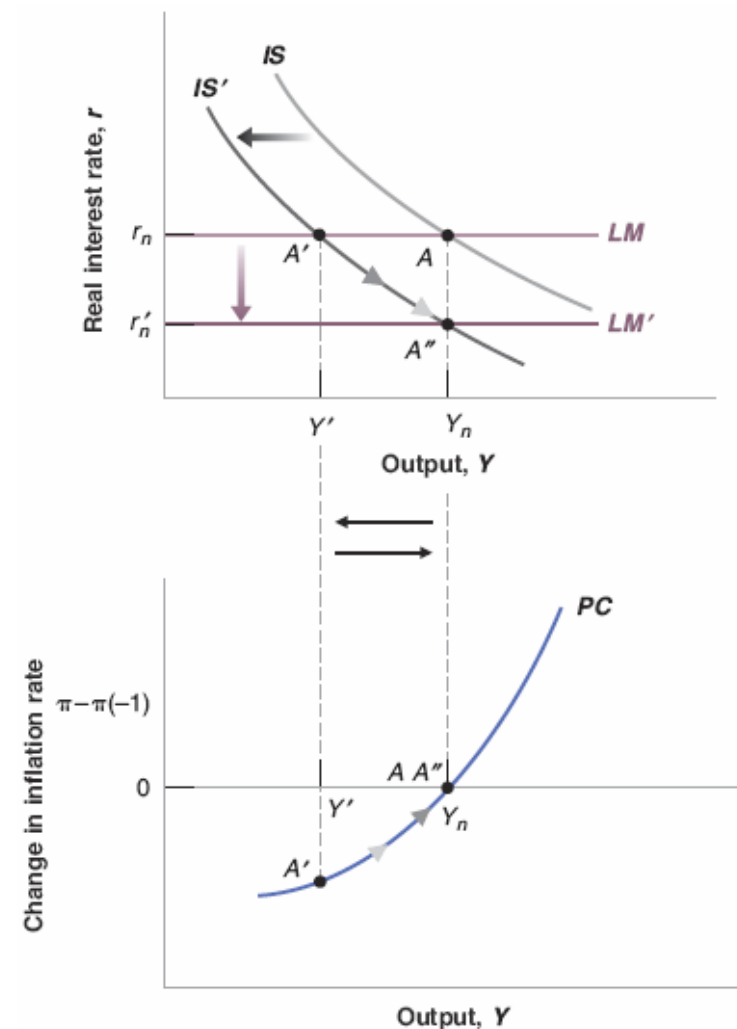
- If the zero lower bound prevents monetary policy from increasing output back to potential, the result may be a deflation spiral. More deflation leads to a higher real rate, which in turn leads to lower output and more deflation.



9.4 Fiscal Consolidation Revisited

Figure 9.4 Fiscal Consolidation in the Short and the Medium Run

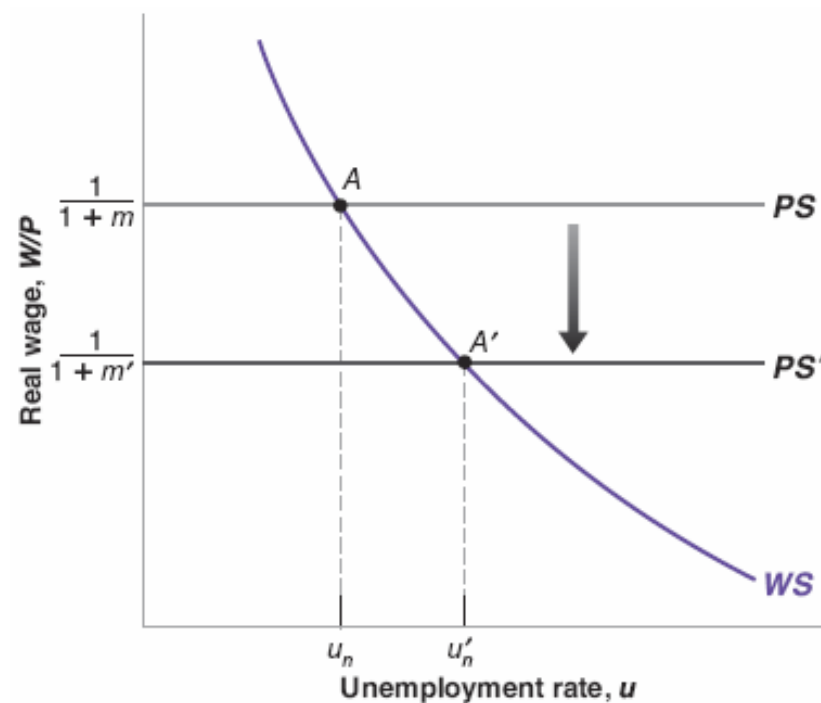
Fiscal consolidation leads to a decrease in output in the short run. In the medium run, output returns to potential, and the interest rate is lower.



9.5 The Effects of an Increase in the Price of Oil (3 of 4)

Figure 9.6 The Effects of an Increase in the Price of Oil on the Natural Rate of Unemployment

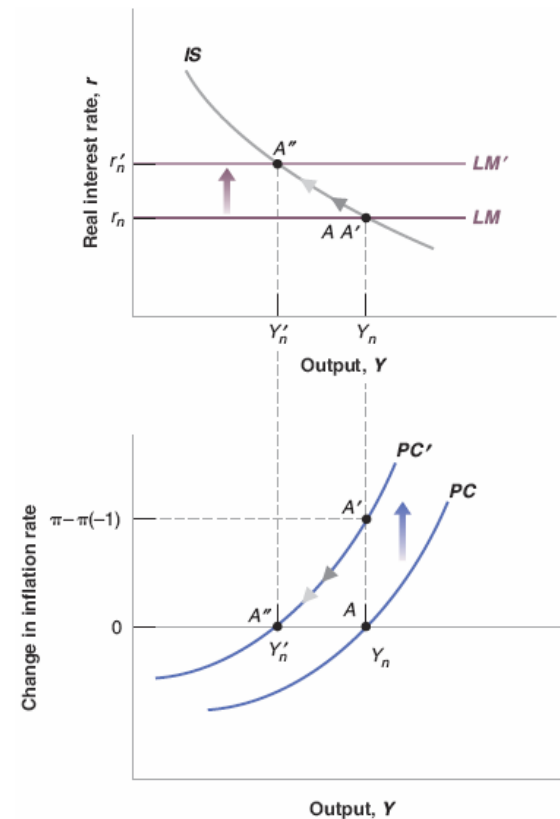
An increase in the price of oil is equivalent to an *increase in the markup*. It leads to lower real wages and a higher natural rate of unemployment.



9.5 The Effects of an Increase in the Price of Oil (4 of 4)

Figure 9.7 Short- and Medium-Run Effects of an Increase in the Price of Oil

- In the short run, an increase in the price of oil leads to higher inflation. If the price increase is permanent, it leads to lower output in the medium run.
- **Stagflation** (lower output and higher inflation) occurs along the way.



Phillips Curve and Expectations

Phillips curve estimates have looked “unstable”

- Over time, the estimates of α have appeared to change substantially
- Sometimes the “slack” (either $u-u_n$ or $Y-Y_n$) variable doesn’t seem to be statistically important
- Estimation of the Phillips curve requires a proxy for “expected inflation” π_t^e
- What should we use?
- Lucas uses FIRE (full information rational expectations)
- Coibion, Gorodnichenko, Kamdar use survey data

Summary: Coibion, Gorodnichenko, Kamdar

“While the rational expectations revolution has allowed for great leaps in macroeconomic modeling, the surveyed empirical microevidence appears increasingly at odds with the full-information rational expectation assumption.”

“...we demonstrate how incorporating survey data on inflation expectations can address a number of otherwise puzzling shortcomings that arise under the assumption of full-information rational expectations.”

FIRE vs. Alternatives

- FIRE = “Full Information Rational Expectations”
- In steady state equilibrium, ex post realizations should be an unbiased measure of expected inflation
- Could have big variance, but mean zero errors
- This is what we teach in basic macro, finance; allows the “McCallum replacement” ...

Alternatives to FIRE

- Sticky information (Mankiw - Reis): Infrequent updating, but when done, goes to FIRE
- Noisy information/rational inattention: Either observe variables with noise, or limit attention to certain variables.
- Both predict mean forecast will under-respond relative to actual variable
- Empirical implication: Mean ex post forecast errors will be predictable
- Coibion and Gorodnichenko show survey data conform to these predictions

Implication

- The instability should disappear with better measure of expected inflation
- Need to run regression:

$$\pi = \beta_1 \pi^e + \beta_2 (u - u_n) + error$$

- To get unbiased estimates, need expected inflation measured well, measurement error uncorrelated with error term
- But how do we get the best measure?

A Little Algebra for Conventional Curve

$$(1) \quad \pi_t = \beta E_t \pi_{t+1} + \kappa X_t + shock_t$$

 α in the textbook

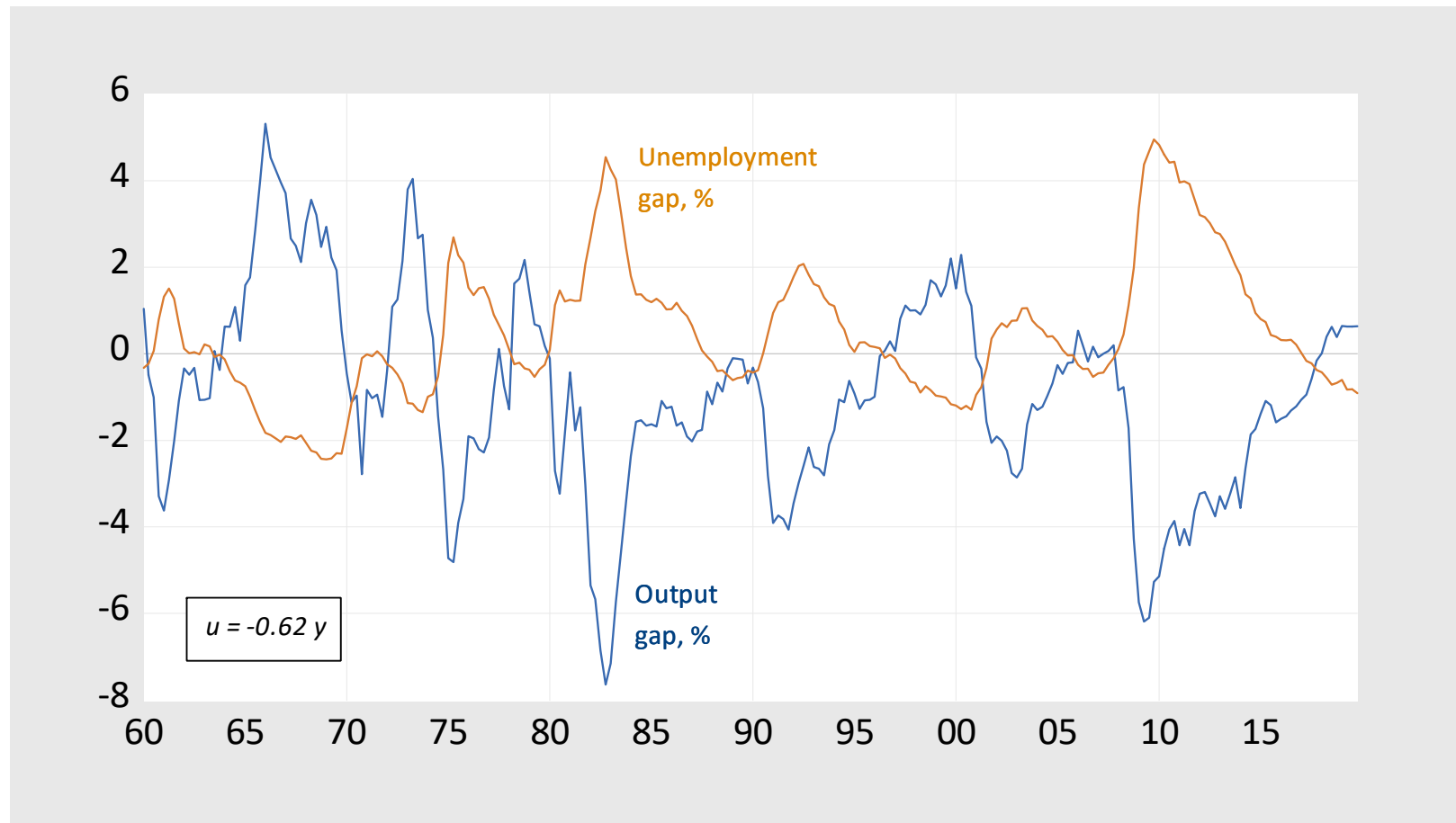
where π_t is the rate of inflation at time t , $E_t \pi_{t+1}$ is the mathematical (FIRE) expectation of inflation at time $t + 1$ given information available at time t , β is the discount factor, X_t is the output gap (more generally, a measure of slack in the economy), κ measures the slope of the Phillips curve and is a function of structural parameters, and $shock_t$ is a “cost-push” shock.

Alternatives:

- Could substitute lagged inflation (accelerationist)
- or distributed lag of inflation, what's called adaptive, termed "naïve" in article.
- Or could substitute survey based expectations

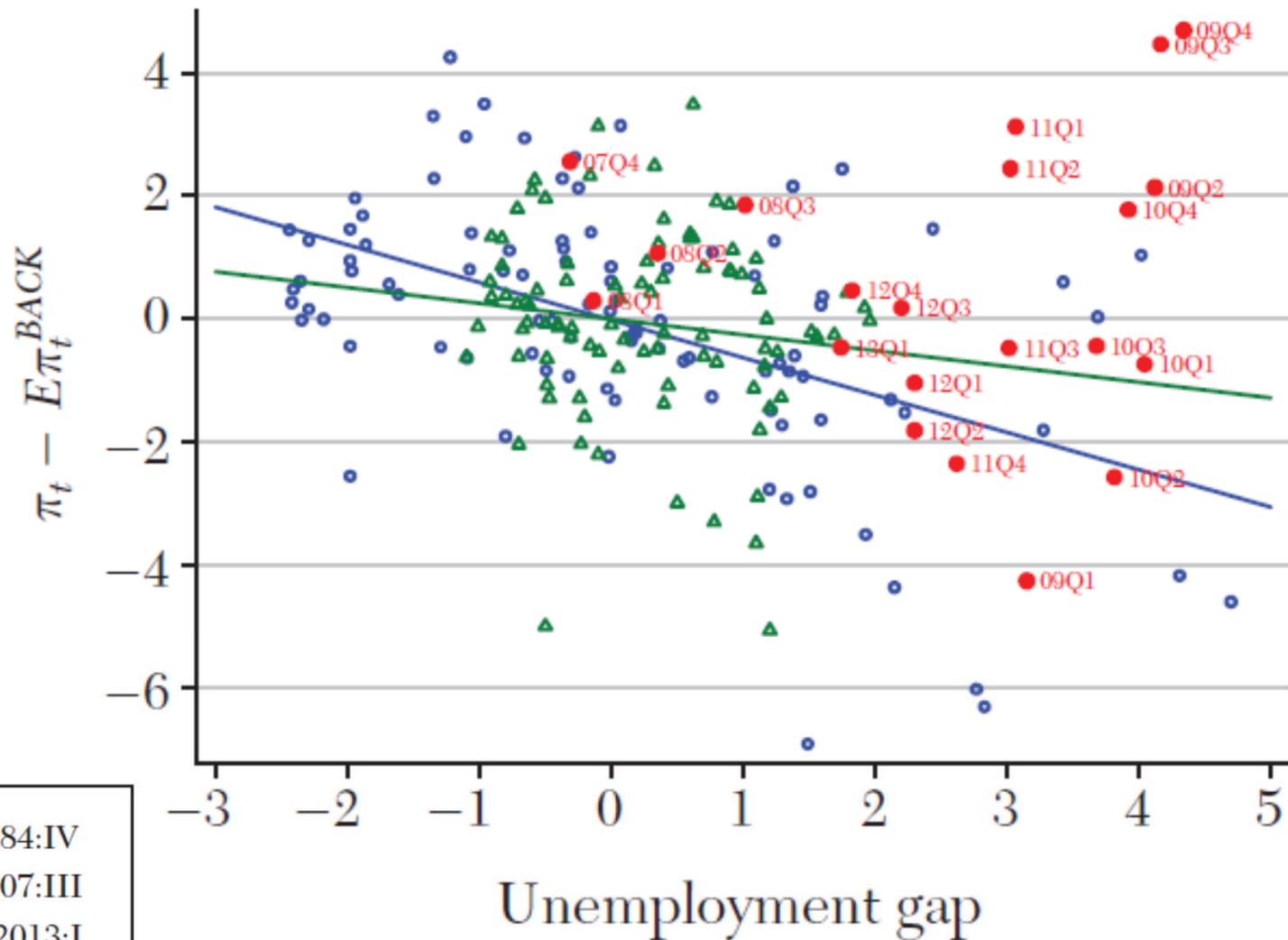
Phillips curve using unemployment

1960-2018



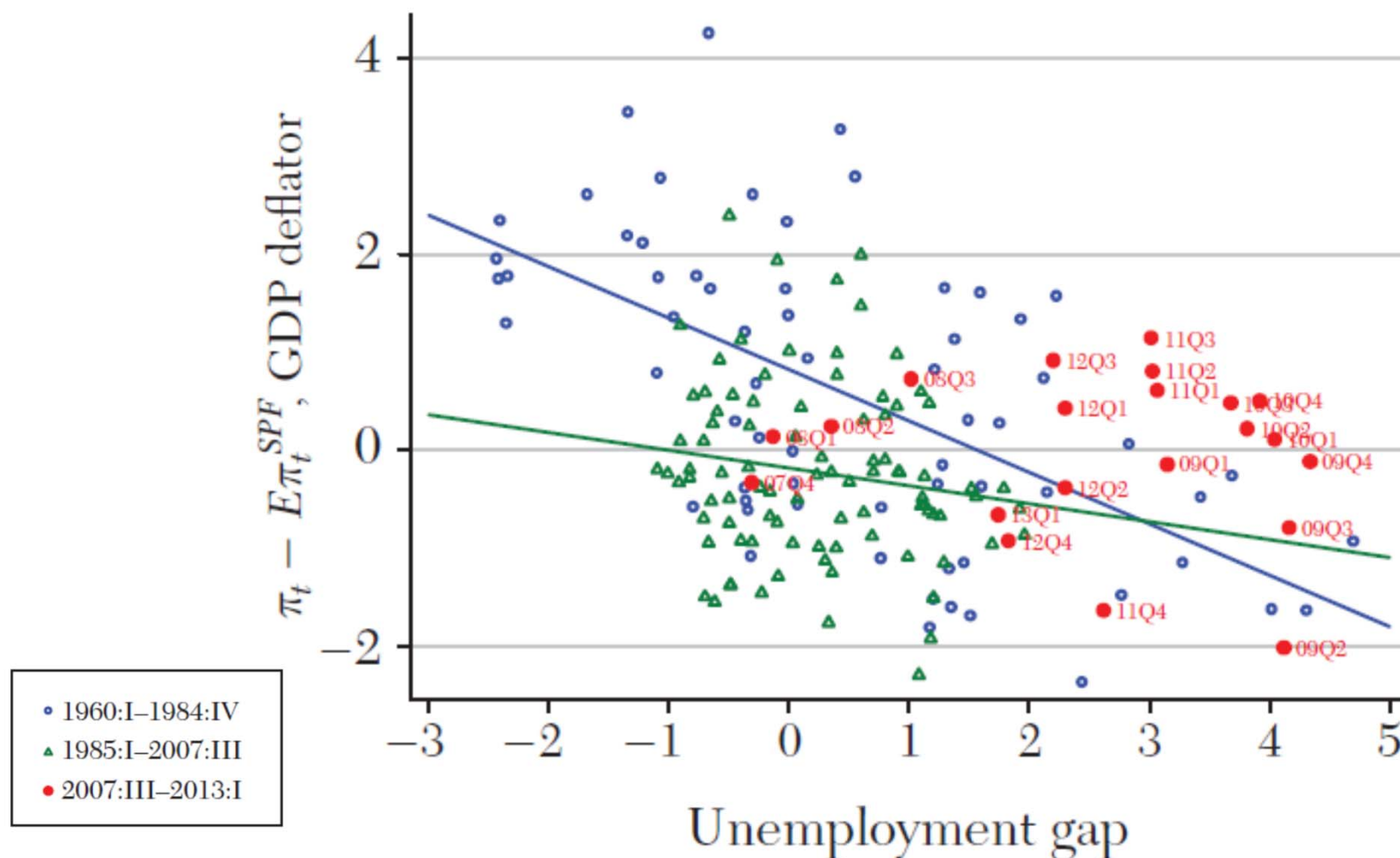
Adaptive expectations doesn't work

Panel A. Phillips curve with naïve expectations



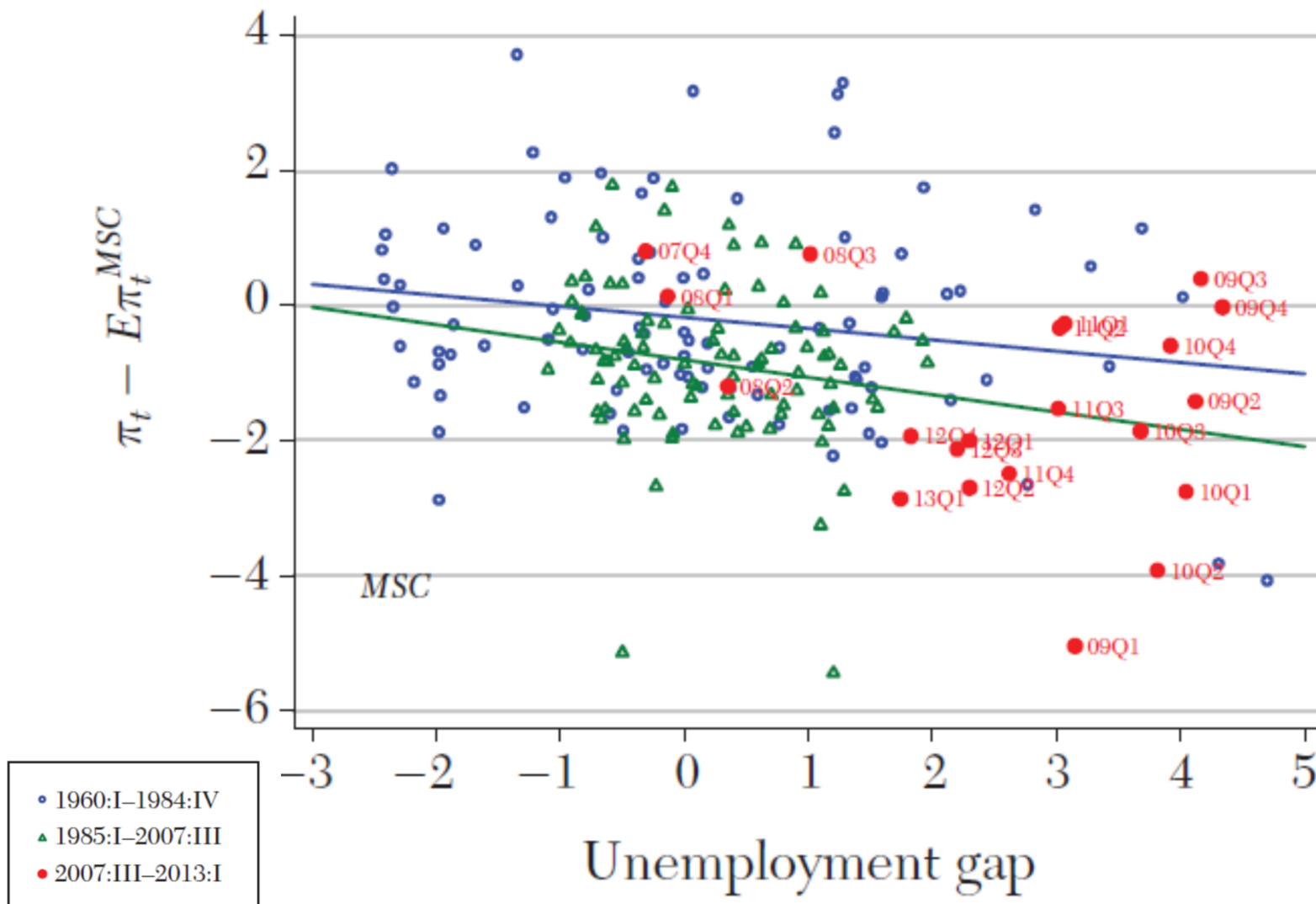
Using *Economists'* expectations doesn't work well either

Panel B. Phillips curve with SPF expectations



Household expectations do better

Panel C. Phillips curve with household inflation expectations



Conclusions

- With the partial sticky price model, adjustment of the price level takes place over time within the period t
- If the economy is away from the medium run (flexible price) equilibrium, the price level will adjust so as to return output to potential output
- Starting from medium run equilibrium, monetary and IS shocks can result in output deviating from potential temporarily
- Changes in current productivity or the disutility of work can affect potential GDP and short run aggregate supply permanently
- Depending on how expectations are formed, disinflation can be costless – or nearly so
- FIRE is not the best characterization of how expectations are formed

Next Lecture

- We examine whether in fact the Phillips Curve relationship is actually weaker now than before
- Examine cross-country evidence (Blanchard, Cerutti, Summers)
- Examine various theories as to why the Phillips Curve relationship might be weaker