Aggregate Supply

Some possibilities:

1) W's & P's always immediately adjust to clear markets, so $Y = \bar{Y}$ at all times.

Justification:

If $Y < \bar{Y}$, $L < \bar{L}$, excess supply in product and/or factor (labor) markets, so $P \downarrow$, $W \downarrow$

Implication:

All observed movements in Y are changes in $\bar{Y}$

2) Keynesian (1930s – 1950s):

W & P fixed in "short-run"

W & P adjust to make $Y = \bar{Y}$ in "long-run"

Implication:

Some (most) observed movements in Y are $Y - \bar{Y}$ caused by changes in M, G, T, π^e

$\Rightarrow$ A theory of business cycles

Aggregate Supply (cont.)

3) Original Phillips curve

in logs

price level that makes $Y = \bar{Y}$

$$\pi_t = \lambda (Y - \bar{Y})_t \Rightarrow p_t = p_{t-1} + \lambda (Y - \bar{Y})_t$$

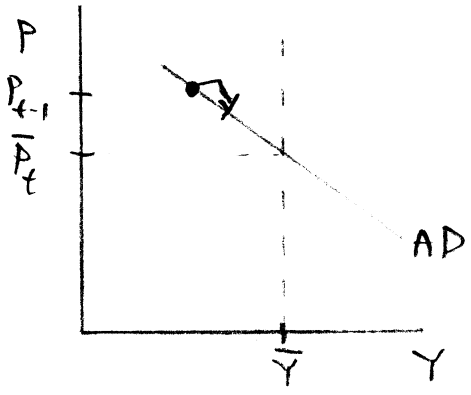
$p_t - p_{t-1}$

Justification:

Every period, wages or prices adjust part of the way to $\bar{p}$

$$p_t - p_{t-1} = \Psi(\bar{p}_{t-1} - p_{t-1}) \quad \text{where} \quad 0 < \Psi < 1$$

and $\bar{p}_{t-1} - p_{t-1} = -\frac{\partial p}{\partial Y}(Y - \bar{Y})_t$ slope of AD



hence $p_t - p_{t-1} = \Psi\left(-\frac{\partial p}{\partial Y}\right)(Y - \bar{Y})_t$

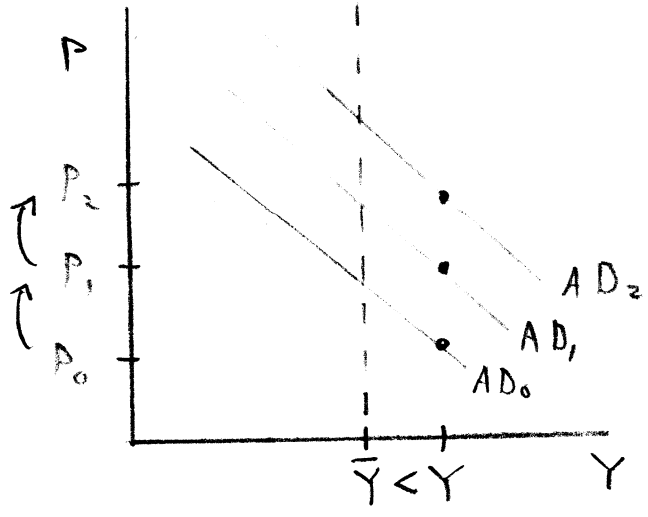
$$p_t = p_{t-1} + \underbrace{\Psi\left(-\frac{\partial p}{\partial Y}\right)}_{\lambda}(Y - \bar{Y})_t$$

Implication:

You can keep $Y > \bar{Y}$ forever at cost of a little inflation, by making M grow steadily, keep AD moving up steadily as P rises steadily.

or

"nominal" thing (M growth) can affect "real things" (Y & L) in LRSS as well as "short run."



year, an increase of 7·6 per cent. in 1900 and in 1910, and an increase of 7·0 per cent. in 1872. In no other year between 1861 and 1913 was there an increase in import prices of as much as 5 per cent. If the hypothesis stated above is correct the rise in import prices in 1862 may just have been sufficient to start up a mild wage-price spiral, but in the remainder of the period changes in import prices will have had little or no effect on the rate of change of wage rates.

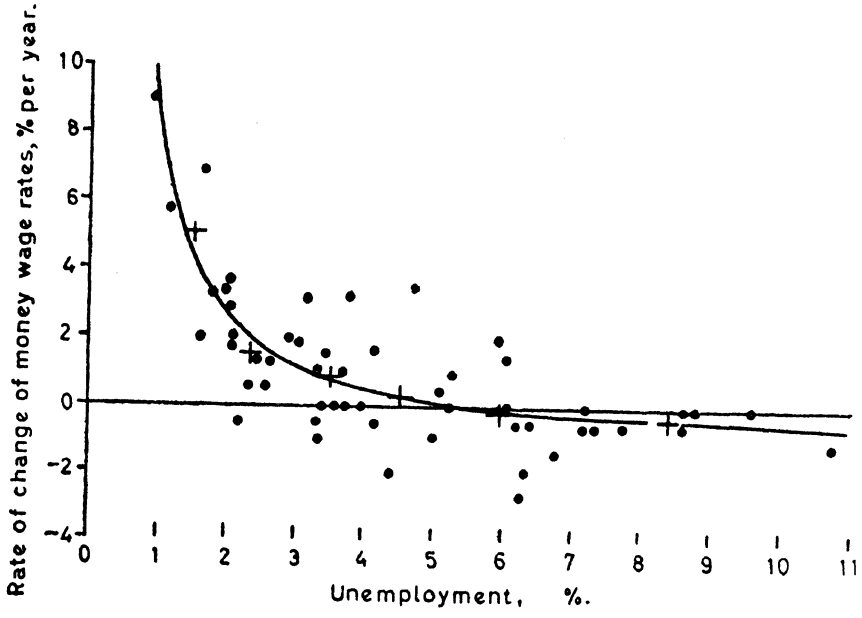


Fig.1. 1861 – 1913

A scatter diagram of the rate of change of wage rates and the percentage unemployment for the years 1861-1913 is shown in Figure 1. During this time there were 6½ fairly regular trade cycles with an average period of about 8 years. Scatter diagrams for the years of each trade cycle are shown in Figures 2 to 8. Each dot in the diagrams represents a year, the average rate of change of money wage rates during the year being given by the scale on the vertical axis and the average unemployment during the year by the scale on the horizontal axis. The rate of change of money wage rates was calculated from the index of hourly wage rates constructed by Phelps Brown and Sheila Hopkins,[1] by expressing the first central difference of the index for each year as a percentage of the index for the same year. Thus the rate of change for 1861 is taken to be half the difference between the index for 1862 and the index for 1860 expressed as a percentage of the index

[1] E. H. Phelps Brown and Sheila Hopkins, "The Course of Wage Rates in Five Countries, 1860-1939," *Oxford Economic Papers*, June, 1950.

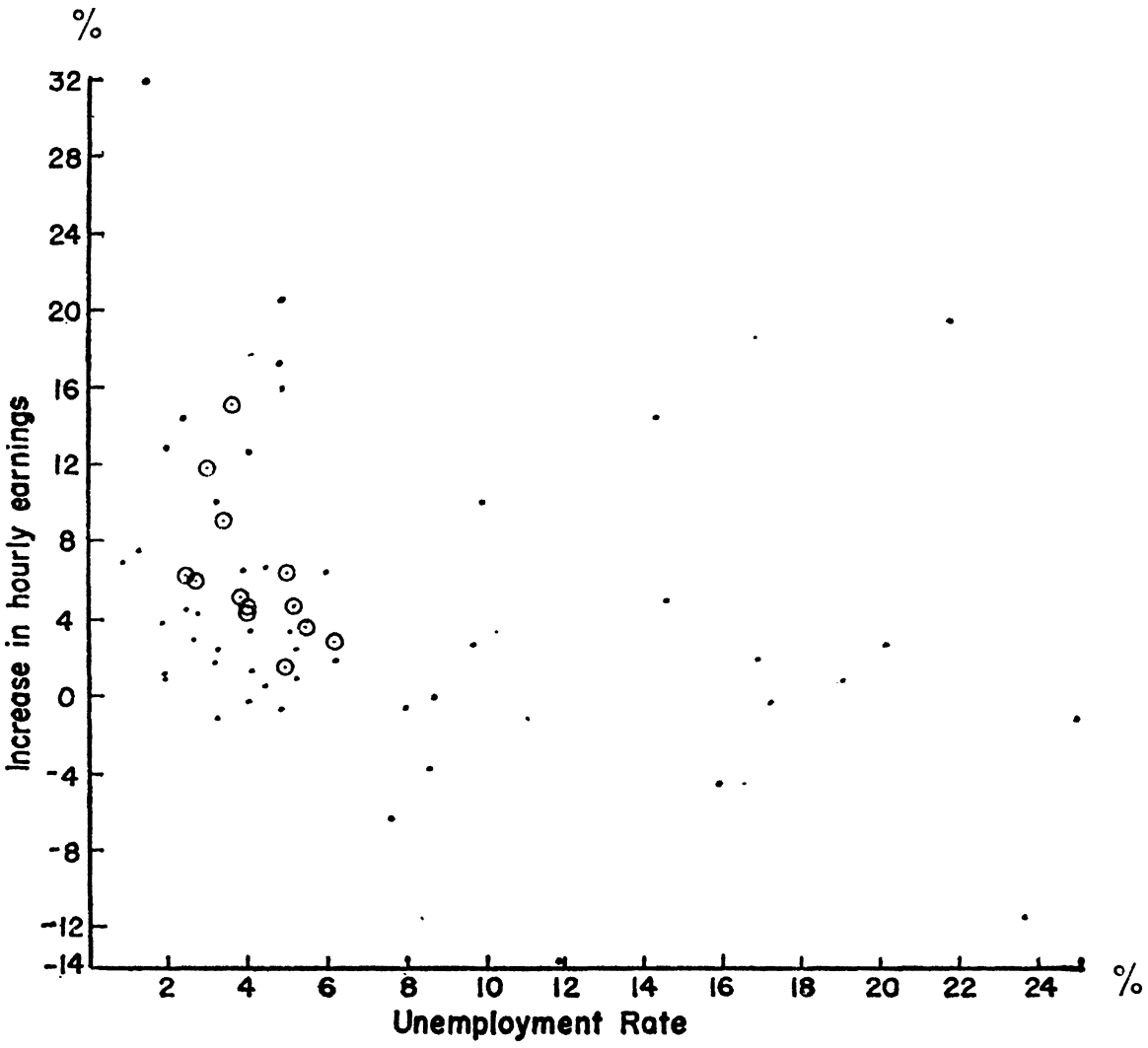


FIGURE 1

PHILLIPS SCATTER DIAGRAM FOR U.S.
(The circled points are for recent years.)

simple excess demand in the other sectors. It is probably true that if we had an unemployment rate for manufacturing alone, it would be somewhat higher during the postwar years than the aggregate figure shown. Even if a qualitative statement like this held true over the whole period, the increasing weight of services in the total might still create a bias. Another defect is our use of annual increments and averages, when a full-scale study would have to look carefully into the nuances of timing.

A first look at the scatter is discouraging; there are points all over the place. But perhaps one can notice some systematic effects. In the first place, the years from 1933 to 1941 appear to be *sui generis:* money wages rose or failed to fall in the face of massive unemployment. One may attribute this to the workings of the New Deal (the 20 per cent wage increase of 1934 must represent the NRA codes); or alternatively

against degree of unemployment into a related diagram showing the different levels of unemployment that would be "needed" for each degree of price level change, we come out with guesses like the following:

1. In order to have wages increase at no more than the 2½ per cent per annum characteristic of our productivity growth, the American economy would seem on the basis of twentieth-century and postwar experience to have to undergo something like 5 to 6 per cent of the civilian labor force's being unemployed. That much unemployment would appear to be the cost of price stability in the years immediately ahead.

2. In order to achieve the nonperfectionist's goal of high enough output to give us no more than 3 per cent unemployment, the price index might have to rise by as much as 4 to 5 per cent per year. That much price rise would seem to be the necessary cost of high employment and production in the years immediately ahead.

All this is shown in our price-level modification of the Phillips curve, Figure 2. The point *A*, corresponding to price stability, is seen to involve about 5½ per cent unemployment; whereas the point *B*, corre-

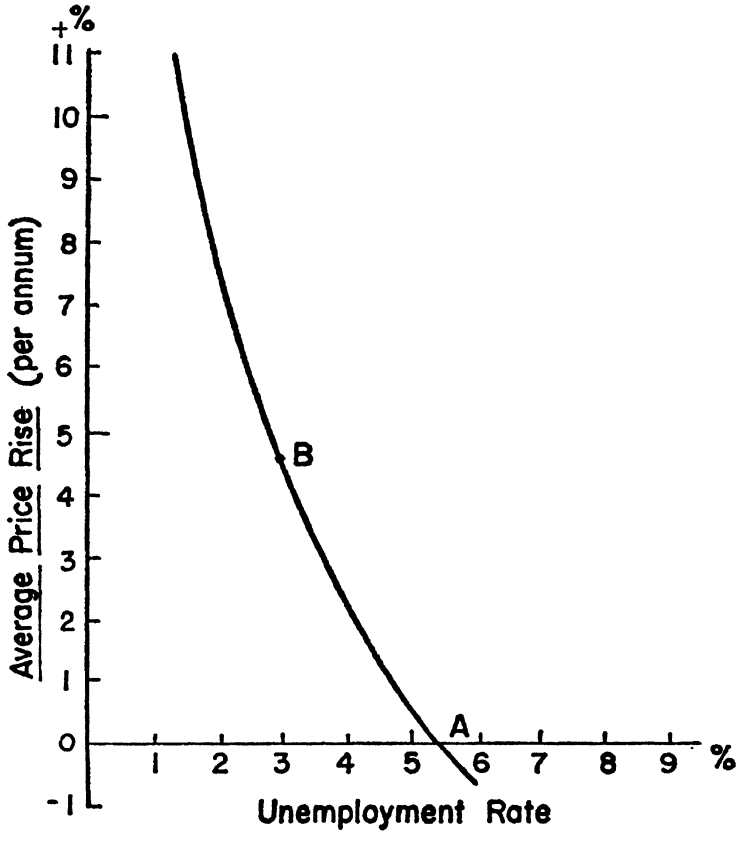
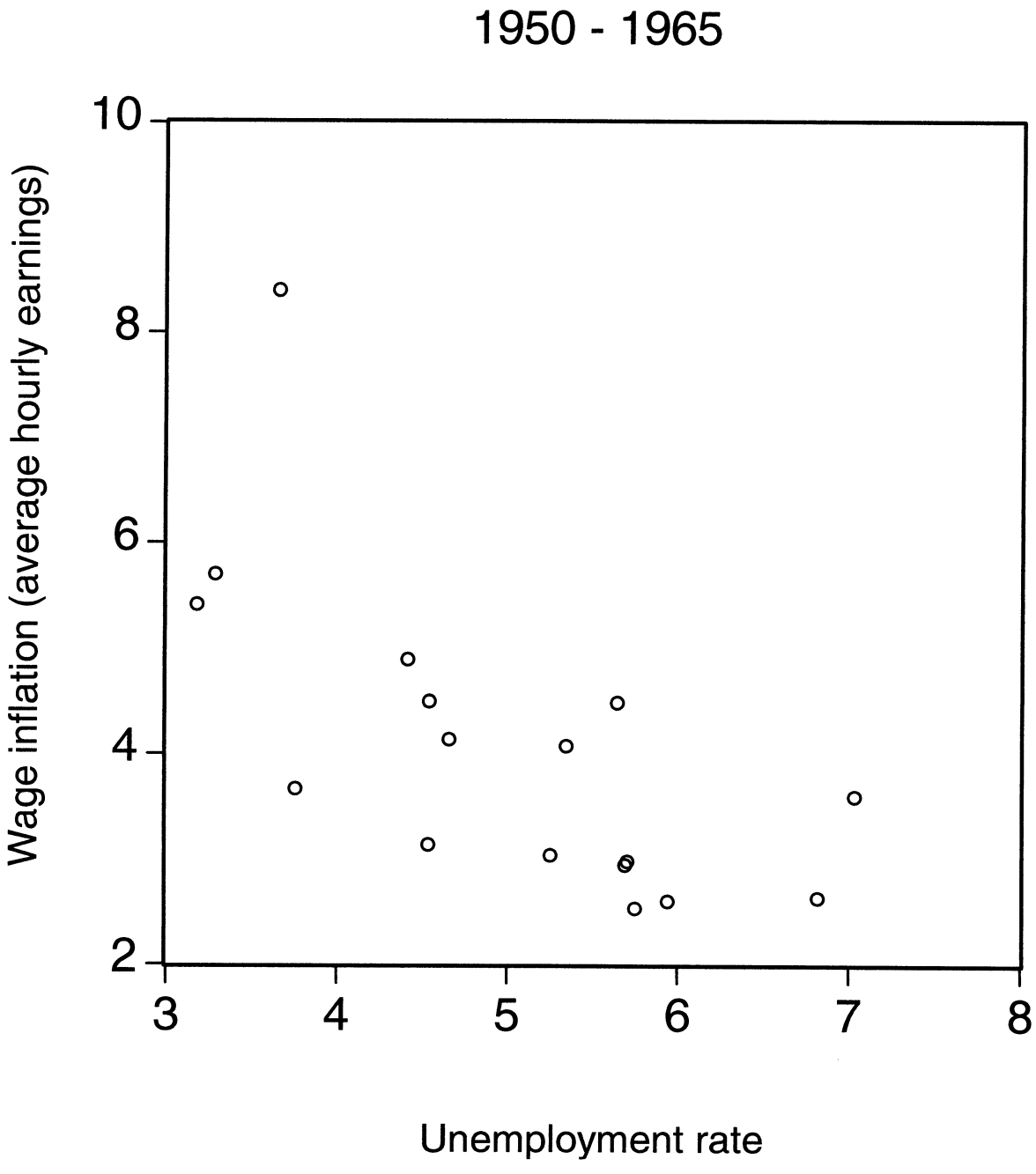


FIGURE 2

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.


1950 - 1965
Wage inflation (average hourly earnings)
10
8
6
4
2
3
4
5
6
7
8
Unemployment rate

Aggregate Supply (cont.)

4) Expectations-augmented Phillips Curve

In 1968, Milton Friedman & Edmund Phelps publish separate papers arguing original Phillips curve must be wrong: true relation is

$$\pi_t = {}_{t-1}\pi_t^e + \lambda (Y - \bar{Y})_t \quad \text{or} \quad \underbrace{P_t - P_{t-1}}_{\pi_t} = \underbrace{{}_{t-1}P_t^e - P_{t-1}}_{{}_{t-1}\pi^e} + \lambda (Y - \bar{Y})_t$$

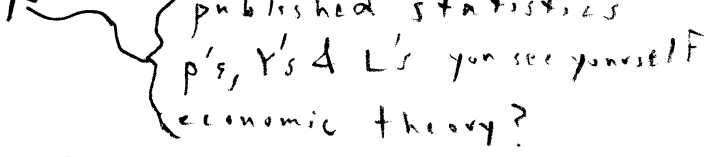
$$\Rightarrow P_t = {}_{t-1}P_t^e + \lambda (Y - \bar{Y})_t$$

Note: if ${}_{t-1}P_t^e = P_{t-1}$, this is equivalent to original Phillips curve

What is ${}_{t-1}\pi_t^e$? Possibilities:

"Adaptive expectations": ${}_{t-1}\pi_t^e = \pi_{t-1}$

"Rational expectations": ${}_{t-1}\pi^e$ is optimal forecast of π_t based on all information available at time $t-1$



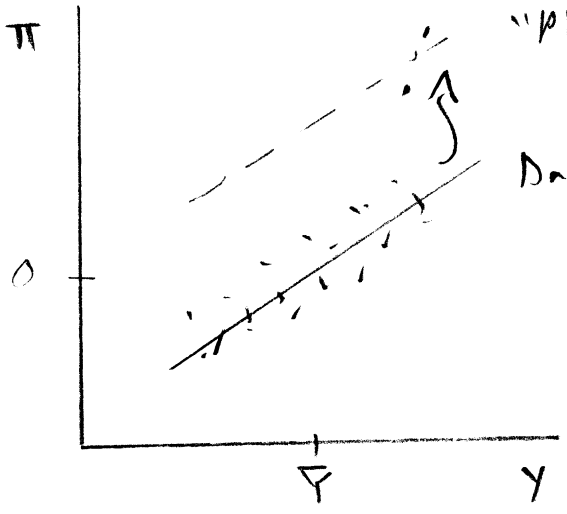
Either way, you can't have $Y > \bar{Y}$ & steady inflation:

- Under adaptive expectations, π gradually accelerates to ∞
- Under rational expectations, π can jump to ∞

Aggregate Supply

4) Expectations- augmented... (cont.)

In 1968 Friedman & Phelps forecast:



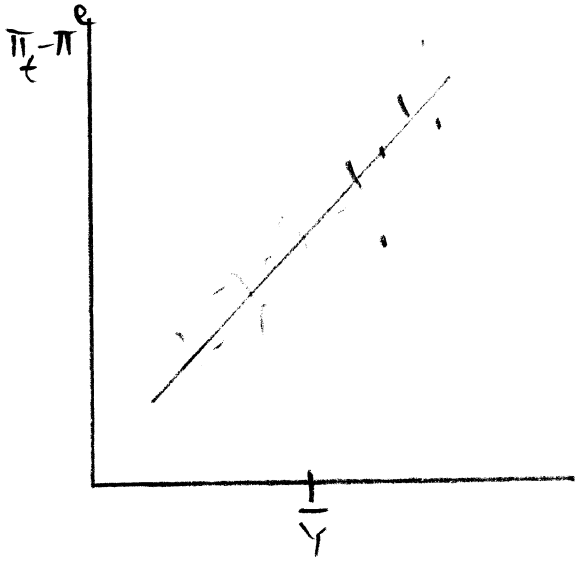
"Phillips curve will shift up" (as $\pi^e \uparrow$)

Data 1950-1968

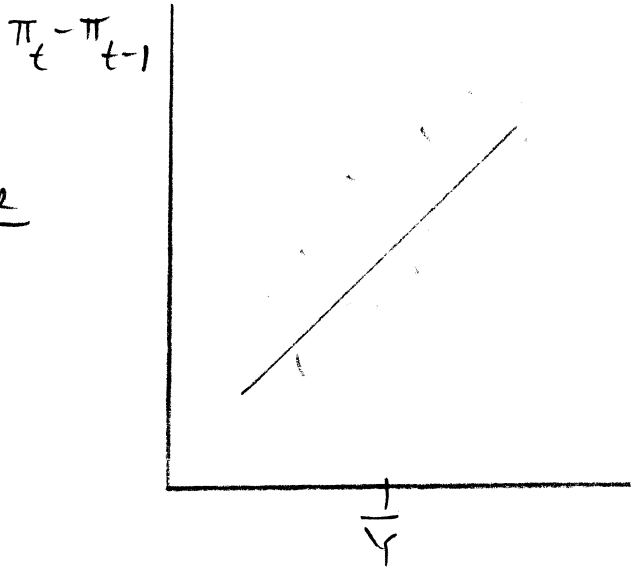
It happened!

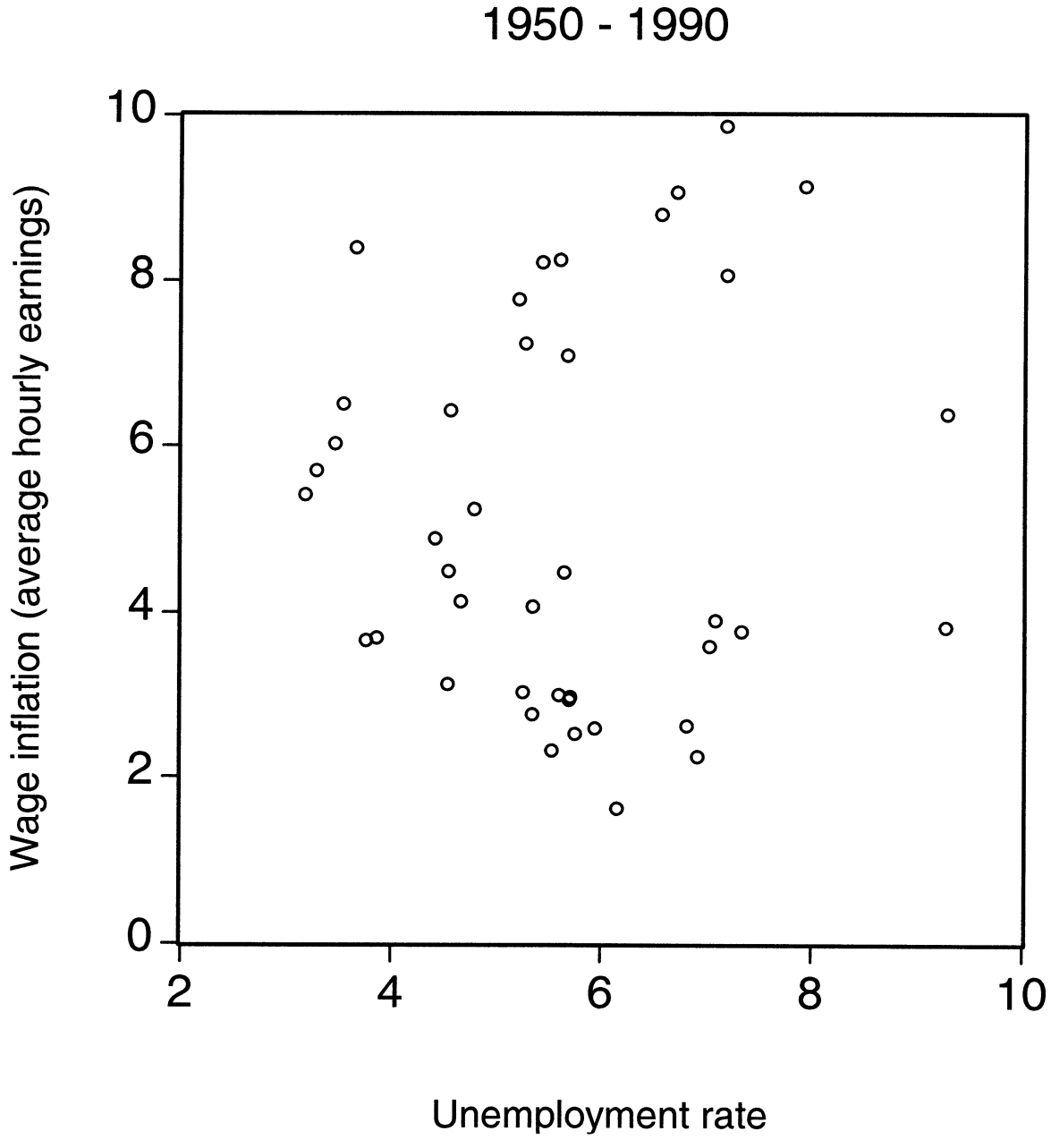
So now we think:

adaptive expectations

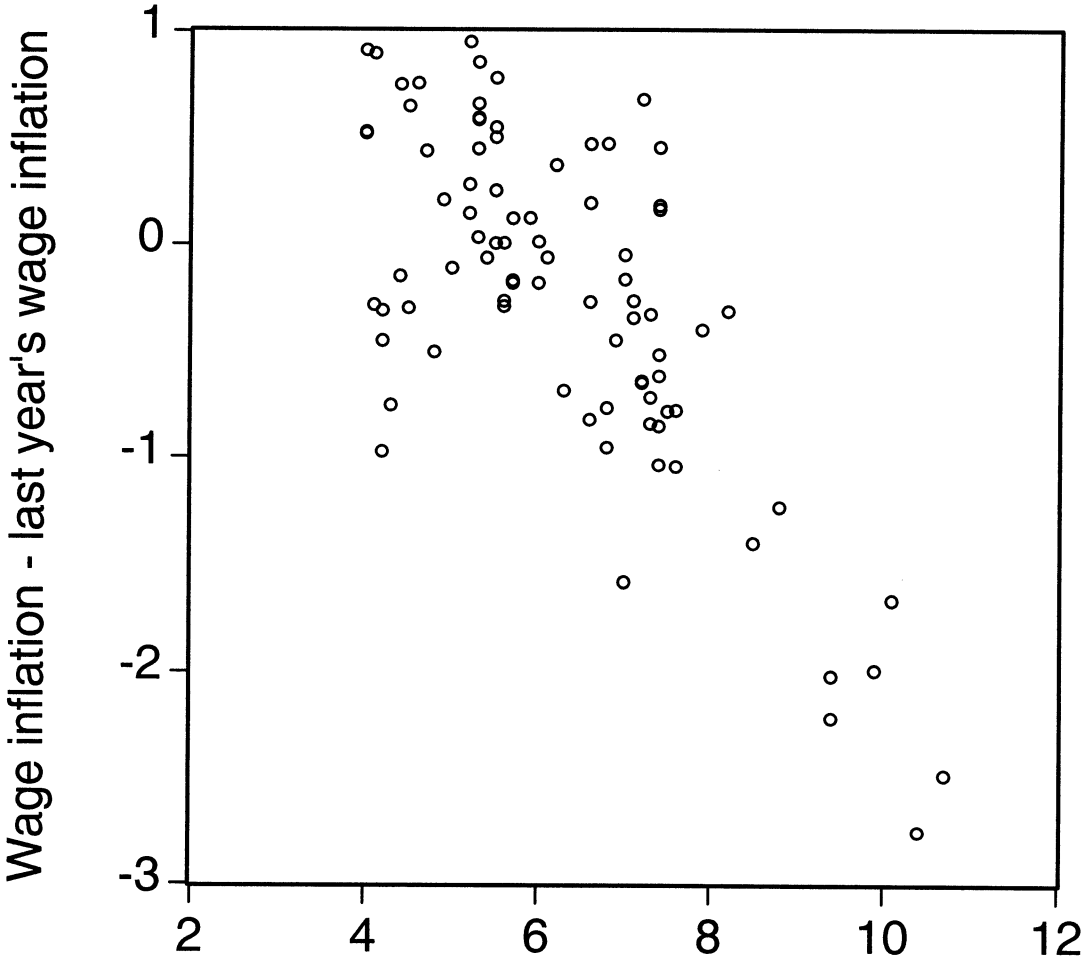


OR




1950 - 1990
Wage inflation (average hourly earnings)
10
8
6
4
2
0
2
4
6
8
10
Unemployment rate

Unemployment and acceleration in wage inflation
1981:1 - 2003:3



Aggregate Supply

5) "New Keynesian" Phillips Curve

Not $\pi_t = {}_{t-1}\pi_t^e + \lambda(y - \bar{y})_t$

but $\pi_t = {}_t\pi_{t+1}^e + \lambda(y - \bar{y})_t$

or $\pi_t = \frac{1}{2}\left({}_{t-1}\pi_t^e + {}_t\pi_{t+1}^e\right) + \lambda(y - \bar{y})_t$

or....

"Forward-looking" inflation expectations

↳ gives $p_t = \frac{1}{2}\left({}_tp_{t+1}^e + p_{t-1}\right) + \lambda(y - \bar{y})_t$

Note: in NK Phillips curve, information arriving at time t can have big, immediate effect on π_t because it affects ${}_t\pi_{t+1}^e$: π_t can jump if ${}_t\pi_{t+1}^e$ changes, with no move in $(y - \bar{y})_t$

In old Friedman-Phelps Phillips curve, information arriving at t <u>cannot</u> affect π_t except through $(y - \bar{y})_t$, because ${}_{t-1}\pi_t^e$ is set by information available at time $t-1$.