

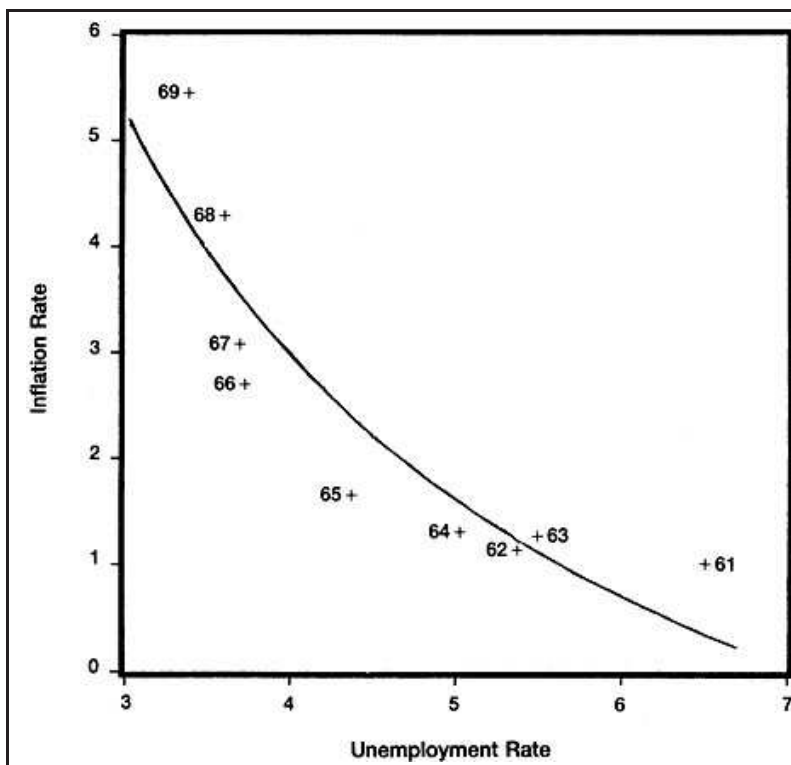
THE PHILLIPS CURVE

I The Phillips Curve in the Data

A The Original Phillips Curve

PHILLIPS CURVE. The relationship between unemployment (or sometimes output) and inflation.

Phillips, an economist in Britain, plotted inflation vs. unemployment in Britain in the 1960's. The result was a negative correlation:



Relationship appeared to be so strong that policy choices were made on the curve. Some central banks favored low unemployment at the expense of higher inflation and some the reverse.

Next, output and unemployment are closely negatively correlated. As output increases, say in an economic boom, more workers are needed to produce the higher output, and thus unemployment falls.

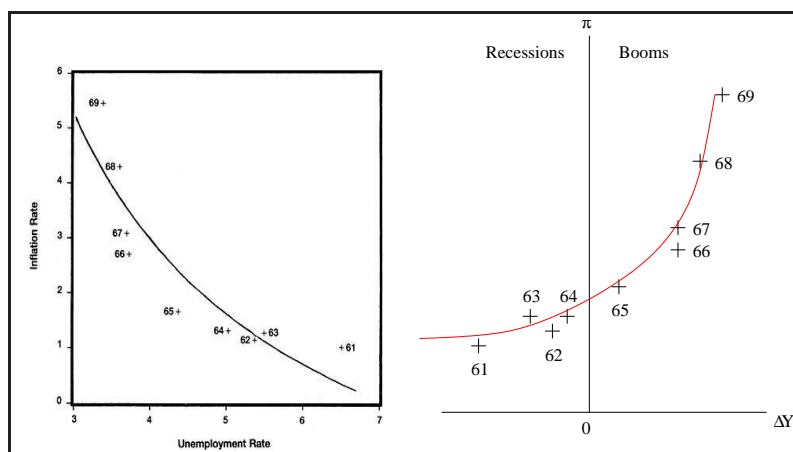
OKUN'S LAW: Output and Unemployment are negatively correlated.

We will use the following version of Okun's law:

$$U = NR - k\Delta Y \tag{64}$$

Here NR is the natural rate of unemployment or the long run average.

If inflation and unemployment have a negative correlation, then inflation and output have a positive correlation.

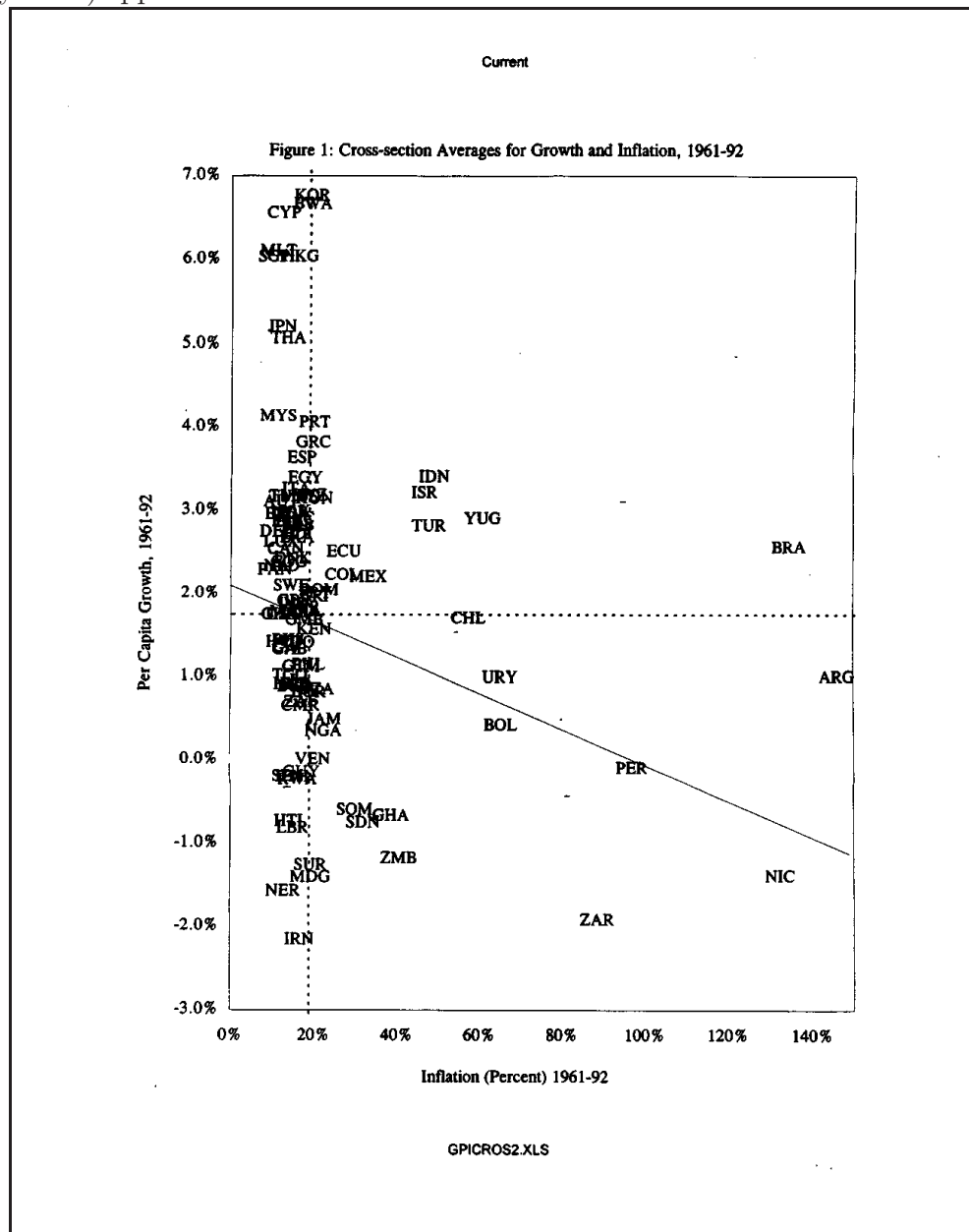


Usually the Phillips curve relates inflation and unemployment, but we will sometimes use the output and inflation version as well.

B Modern Phillips Curves in the Data

Primarily the data given by Phillips is just a few periods in the 1960s. Over longer periods, the data looks quite different. For example here is the data across countries.

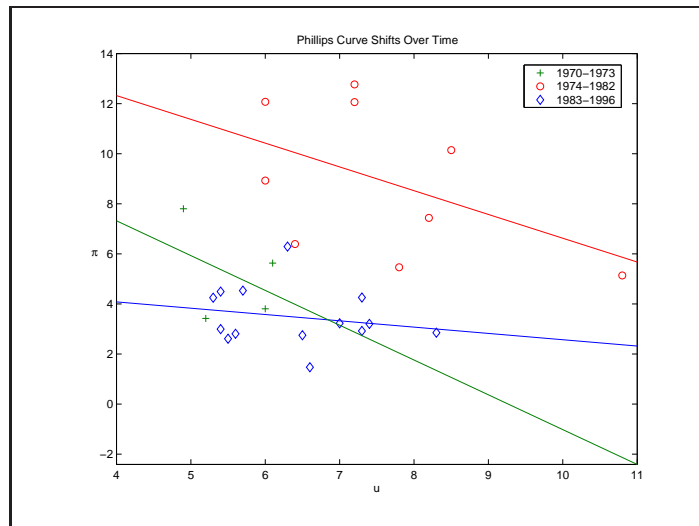
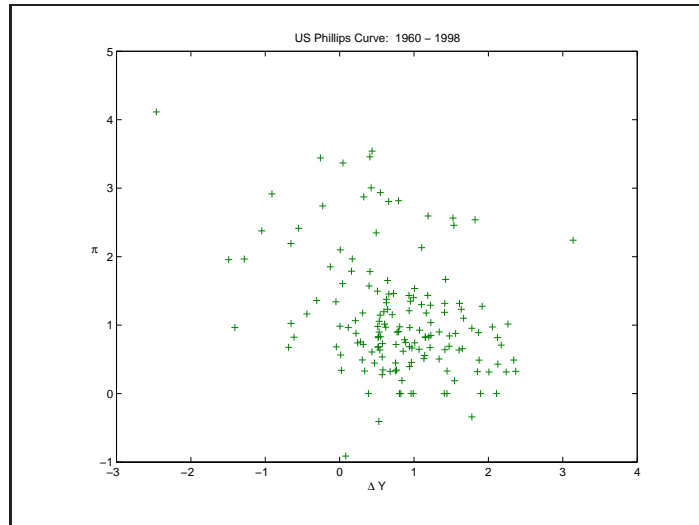
Figure 1: Inflation and long run growth. Graph is Figure (1) from Bruno, M. and William Easterly "Inflation Crises and Long Run Growth," *Journal of Monetary Economics*, vol. 41 (February 1998): pp. 3-26.



Inflation and output are essentially unrelated for low (less than 20%) inflation countries in the long run. For high inflation countries, inflation and output are *negatively* related (notice that the axes are reversed in the above graph). Most likely, this results from the causality working the other way: countries with low growth have low tax receipts and are therefore tempted to print money as a revenue source, causing inflation. Nonetheless, for

low inflation countries, there is little evidence of a long term relationship between output or unemployment and inflation.

The original Phillips curve used a very small data set: just a decade. When we increase the number of observations:



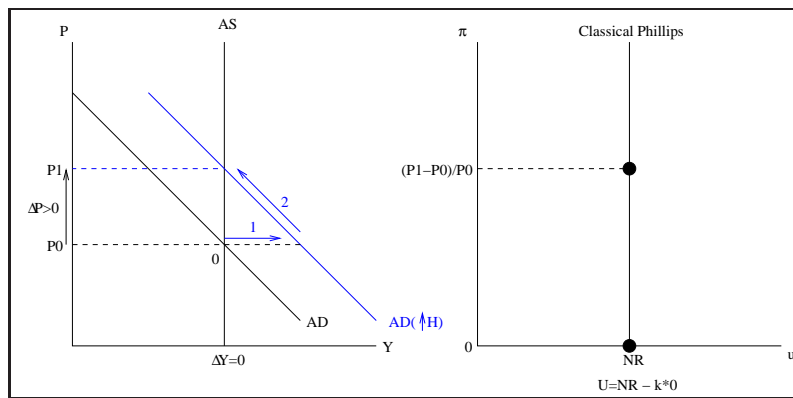
The Phillips curve seems to “shift up,” especially in times of high inflation. In addition, during the long period of low inflation from the 1980s to present, the Phillips curve flattened (the slope moved closer to zero). Note also that I chose these years very carefully. For many other sets of years, the Phillips curve is not even downward sloping. In spite of the mixed data on the Phillips curve, many policy makers and media types believe the Phillips curve

is always downward sloping. Nonetheless, it is reasonably consistent with the data to say that, for low to moderate inflation countries, the Phillips curve is:

- Downward sloping in the short run.
- Vertical in the long run.
- Shifts up after a period of high inflation.
- Becomes flatter after a long period of low inflation.

II Classical Phillips Curve

Suppose an increase in high powered money. Then we see that inflation rises while there is no change in output.

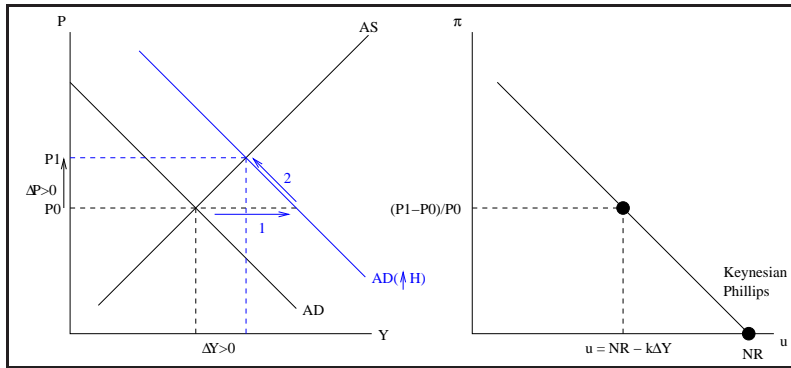


The Phillips curve in the Classical model is vertical. An increase in high powered money results in lower interest rates, which increases investment demand. However, supply is unchanged since wages are unchanged. Prices therefore rise and we have higher inflation with no change in output or unemployment.

III Keynesian Phillips Curve

Suppose an increase in high powered money. Then we see that inflation rises while there is an increase in output.

The Keynesian Phillips curve is in fact downward sloping. An increase in high powered money causes interest rates to fall and investment demand to rise. Since $AD > AS$ prices rise, but as prices rise real wages fall. As real wages fall, firms demand more labor, increasing production and reducing unemployment.



In summary, the Keynes does a good job replicating the short run Phillips curve. This makes sense: the primary assumption of the Keynes model is that wages are fixed, which is true in the short run. Similarly, the classical model does a good job replicating the long run Phillips curve. This makes sense as the primary assumption of the classical model is that wages are flexible. But neither does a good job explaining changes in slope or shifts of the Phillips curve.

IV Lucas Monetary Misperceptions

Here we modify the classical model to include monetary misperceptions. Introducing monetary misperceptions will allow the model to better represent shifts and changes in slope in the observed Phillips curve. Further, the classical model will be more realistic because the model will have a major cost of inflation: price confusion leads to a misallocation of resources.

A Monetary Misperceptions

First we review the idea of monetary misperceptions. Consider a seller faced with an increase in demand from consumers. One possibility: the product is better/cooler than others.

RELATIVE CHANGE IN DEMAND. Change in demand for one product relative to others.

In response to to a relative change in demand, producers reduce production of low demand goods in favor of high demand goods. In a sense, this is why free markets work: resources naturally gravitate towards things that consumers most want, leading to high satisfaction among consumers. In response to a relative increase in demand, producers increase output and also raise prices somewhat.

NOMINAL CHANGE IN DEMAND. Change in demand due simply to an increase in cash in hands of consumers, from an increase in the money supply.

Dollars are in fact worth less, so in response to a nominal change in demand producers should increase prices. No resources need shifting: all goods increase in demand so all producers raise prices. So in response to a nominal change in demand producers should not increase output.

Misperceptions occur when some sellers mistake a nominal change in demand for a relative change in demand. It is very easy for sellers to see an increase in demand, and not having checked CNBC for any FED money supply action that day, and just assume it is a relative change in demand. Thus some producers mistakenly increase output in response to a nominal change in demand. This illustrates a major cost of inflation: price confusion leads to a misallocation of resources.

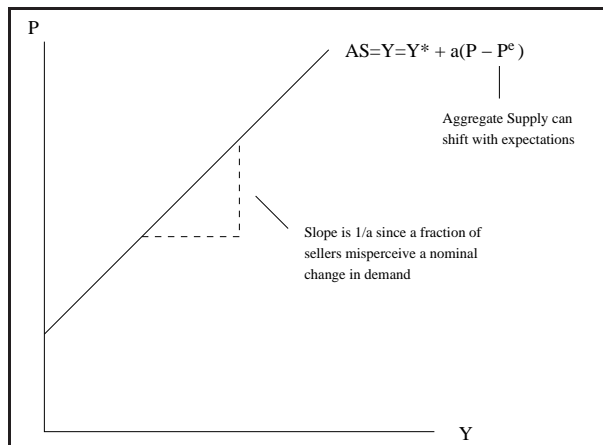
Unanticipated or unobserved money supply increases leads to increased demand for workers and an increase in Y , due to the assumption that the demand change was relative. Aggregate supply in this case is related to price expectations of the seller.

$$Y = Y^* + a(P - P^e) \tag{65}$$

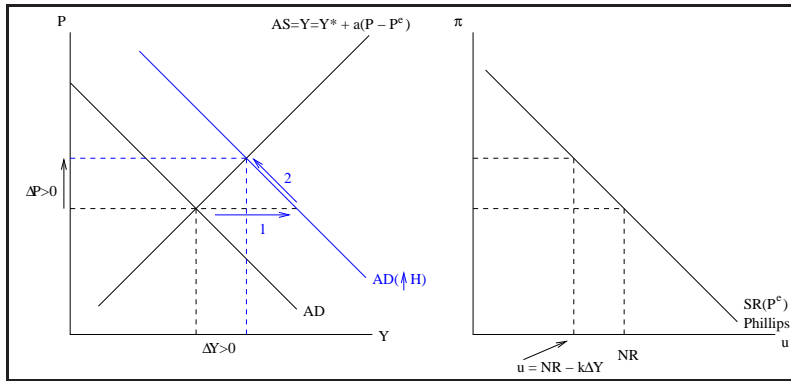
Here a can be thought of as the fraction of sellers that misperceive, and therefore increase output.

B Phillips Curve

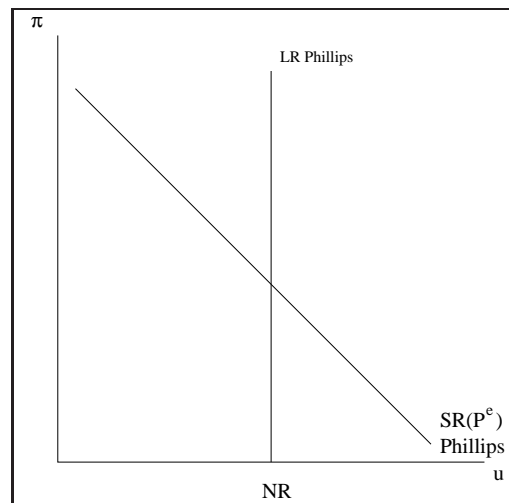
Here is the Aggregate Supply curve for the classical model with monetary misperceptions:



Aggregate supply increases with prices because a fraction of sellers confuse a nominal increase in demand with a relative increase in demand and increase output. So the Phillips curve of the classical model with misperceptions has a downward slope:



In the long run, the Phillips curve is again vertical as there are no misperceptions ($P^e = P$) and thus $Y = Y^*$ and $u = NR$.



Note that we shift the curve when we change P^e .

C Examples

1 Example 1: Inflation above expectations

Suppose the FED sets a credible inflation target of 2%. A number $a = 2$ of sellers believe the target inflation, and increase prices by 2%. Now suppose the FED actually increases the money supply by a larger amount, and those sellers that observed the FED policy increase prices by 4%. After the initial period, suppose inflation remains at 4% and $\pi_{t+1}^e = \pi_t$.

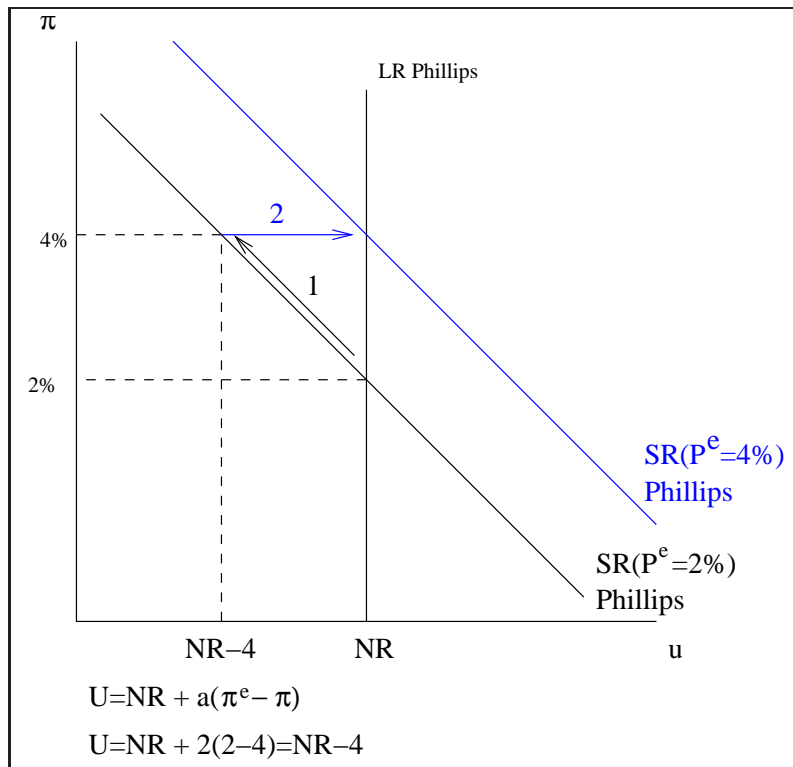
According to the misperceptions idea, sellers that increase prices by 2% will see increased demand: their prices went up by less. But rather than simply raise prices, these sellers misperceive the nominal change in demand for a relative change in demand, and increase output,

decreasing unemployment. So inflation rises and unemployment falls, but expectations are for now unchanged.

We are moving variables on the axis, inflation and unemployment, so we move along the Phillips curve (move number 1 on the figure below). The change in unemployment is:

$$u = NR + a(\pi_0^e - \pi_0) = NR + 2(2 - 4) = NR - 4 \quad (66)$$

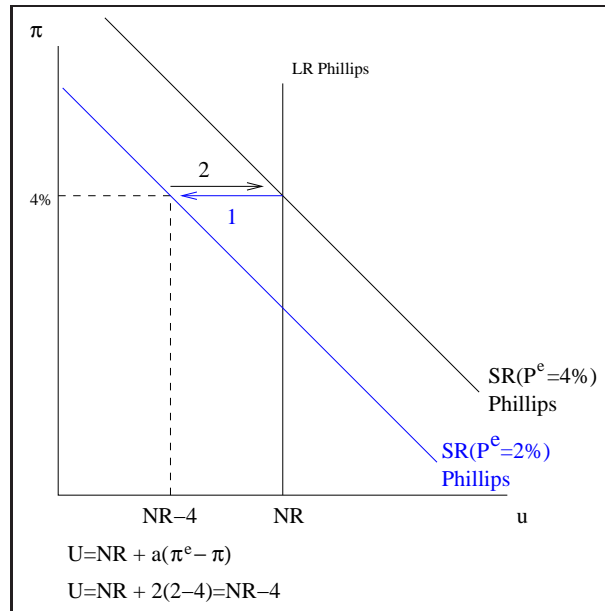
Now in the next period, $\pi_1^e = \pi_0 = 4\%$. Sellers quickly raise expectations after the increase in inflation. Now expectations are once again equal to actual inflation (4%) so unemployment returns to the natural rate. So we move to the point $[NR, 4\%]$. Since we are changing expectations which are not on either axis, we need to shift the Phillips curve (Second arrow on the figure below). Thus shifting expectations can alter the short run Phillips curve, as appears to be the case in the data.



2 Example 2: Fall in Expectations

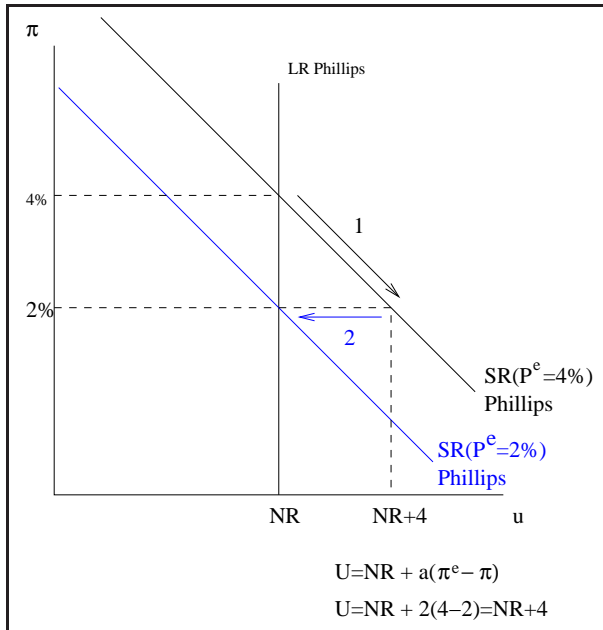
Suppose as in Example 1, except that initial inflation is 4%, and the FED introduces an inflation target of 2%. Inflation remains at 4%, but in the first period some sellers believe the FED and lower expectations to 2%. We then start with a fall in expectations, so inflation

remains unchanged but sellers who decreased expectations have lower prices and higher demand. These sellers mistakenly interpret the increase in demand as relative and increase output (decrease unemployment). Since expectations have changed, we have a shift in the Phillips curve (first arrow in the graph below). In the next period, expectations increase to $\pi_1^e = \pi_0 = 4\%$, so again the Phillips curve shifts, as shown by the second arrow.



3 Example 3: Decrease in Inflation

Suppose inflation is at 4%, but the FED desires to reduce inflation to 2%. After the reduction in inflation, $a = 2$ sellers do not observe the change in policy and continue to raise prices by 4%. Since these sellers raised prices by more than other sellers, they face a reduction in demand, which they mistakenly believe is a relative change in demand. They therefore reduce output and employment, causing more unemployment. A recession results (first arrow on the graph below). In the long run, expectations equal actual inflation of 2%, causing the Phillips curve to shift to the left (second arrow).



D Slope of the Phillips Curve

Monetary misperceptions also has implications for the slope of the Phillips curve. After a period during which inflation has been historically low, few sellers will pay much attention to changes in the money supply. The parameter a thus increases, which in turn means that $-1/a$, which is the slope of the Phillips curve, moves closer to zero. So the Phillips curve becomes flat.

A flat Phillips curve offers several advantages to the FED. First, the FED can increase the money supply resulting in misperceptions and an increase in output with little resulting inflation. Few firms will raise prices. Thus the FED can respond aggressively to recessions without much fear of inflation. Further, inflationary expectations are unlikely to shift, because inflation is low and few firms pay much of a penalty for misperceptions. This seems to fit the facts of the mid 1980s to present, a time period of low inflation.

One disadvantage of a flat Phillips curve is that a long recession will occur if the FED seeks to lower inflation. It will take years of misperceptions and high unemployment before firms begin to lower their price increases.