Lecture Notes: Chapter 12: The Phillips Curve and Expectations

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Aggregate Supply and the Phillips Curve

Unemployment

Okun's law, which you will recall is the simple yet strong relationship between the unemployment rate and real GDP. Letting u stand for the unemployment, u* for the economy's natural rate of unemployment at which there is neither upward nor downward pressure on inflation, Y stand for real GDP, and Y* stand for potential output, then Okun's law is:

$$u - u^* = -0.4 \times \left(\frac{Y - Y^*}{Y^*} \right)$$

Because of Okun's Law, we do not have to separately keep track of what is happening to real GDP (relative to potential output) and to the unemployment rate. Using Okun's law, you can easily go back and forth from one to the other. It is usually more convenient to work with the unemployment than with the output gap—real GDP relative to potential output—if only because the unemployment rate is easier to measure.

We looked at the aggregate supply relationship. We looked at it in one way, and saw that when real GDP is greater than potential output the price level is likely to be higher than people had expected, so aggregate supply related the price *level* (relative to the previously-expected price level) to the *level* of real GDP (relative to potential output):

$$\frac{Y - Y^*}{Y^*} = \theta \times \left(\frac{P - P^e}{P^e} \right)$$

We looked at it a second way, and saw aggregate supply as a relationship between the inflation *rate* (relative to the previously-expected inflation rate) and the *level* of real GDP (relative to potential output).

$$\frac{Y - Y^*}{Y^*} = \theta \times \left(\pi - \pi^e\right)$$

Because inflation this year minus what inflation had been expected to be is the same as the proportional difference between the price level now and what the price level had been expected to be, these are both different ways of looking at the same economic process.

We can use Okun's law to look at aggregate supply in yet a third way. Because

$$\frac{Y - Y^*}{Y^*} = -2.5 \times (u - u^*)$$

we can substitute the right-hand side of the equation above for (Y-Y*)/Y in our aggregate supply function

$$-2.5 \times (u - u^*) = \theta \times \left(\pi - \pi^e\right)$$

If we rearrange to put the inflation rate by itself on the left-hand side:

$$\pi = \pi^e - \frac{2.5}{\theta} \times (u - u^*)$$

and then define the parameter $\beta = 2.5/\theta$, the resulting function:

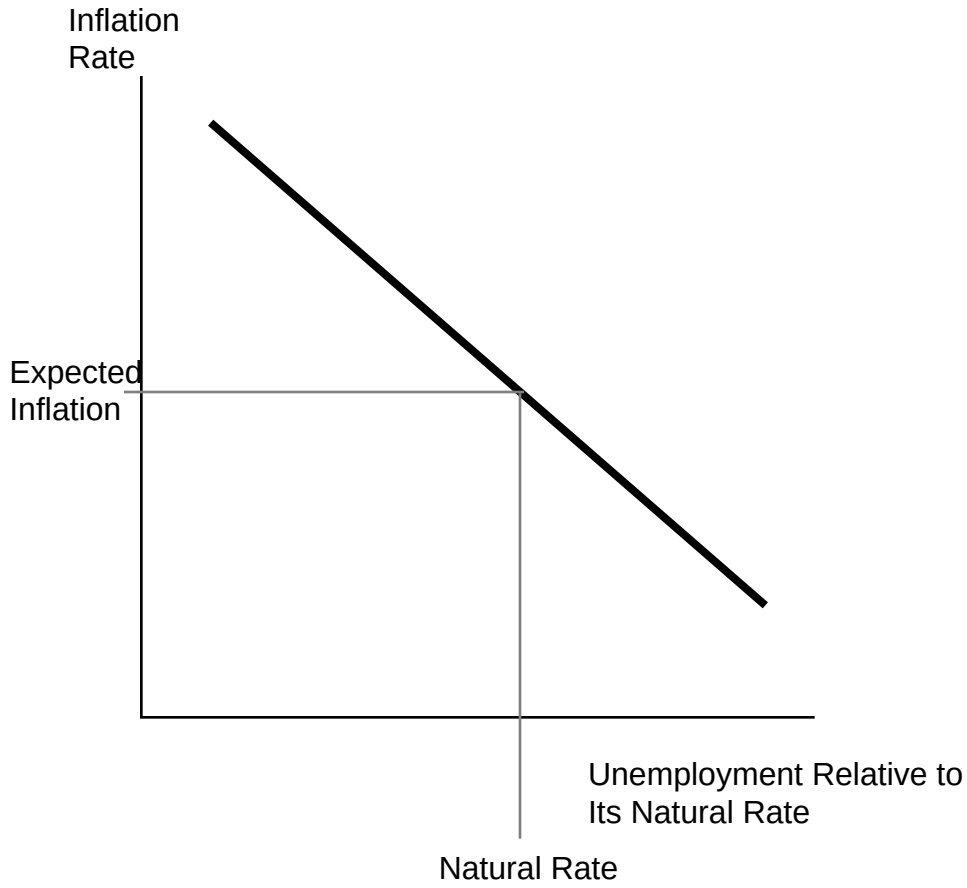
$$\pi = \pi^e - \beta \times (u - u^*)$$

is called the Phillips curve, after the New Zealand economist A.W. Phillips, who first wrote back in the 1950s of the relationship between unemployment and the rate of change of prices. In general we will want to add an extra term to the Phillips curve:

$$\pi = \pi^e - \beta \times (u - u^*) + \varepsilon^s$$

where ε^s represents supply shocks—like the 1973 oil price increase—that can directly affect the rate of inflation.

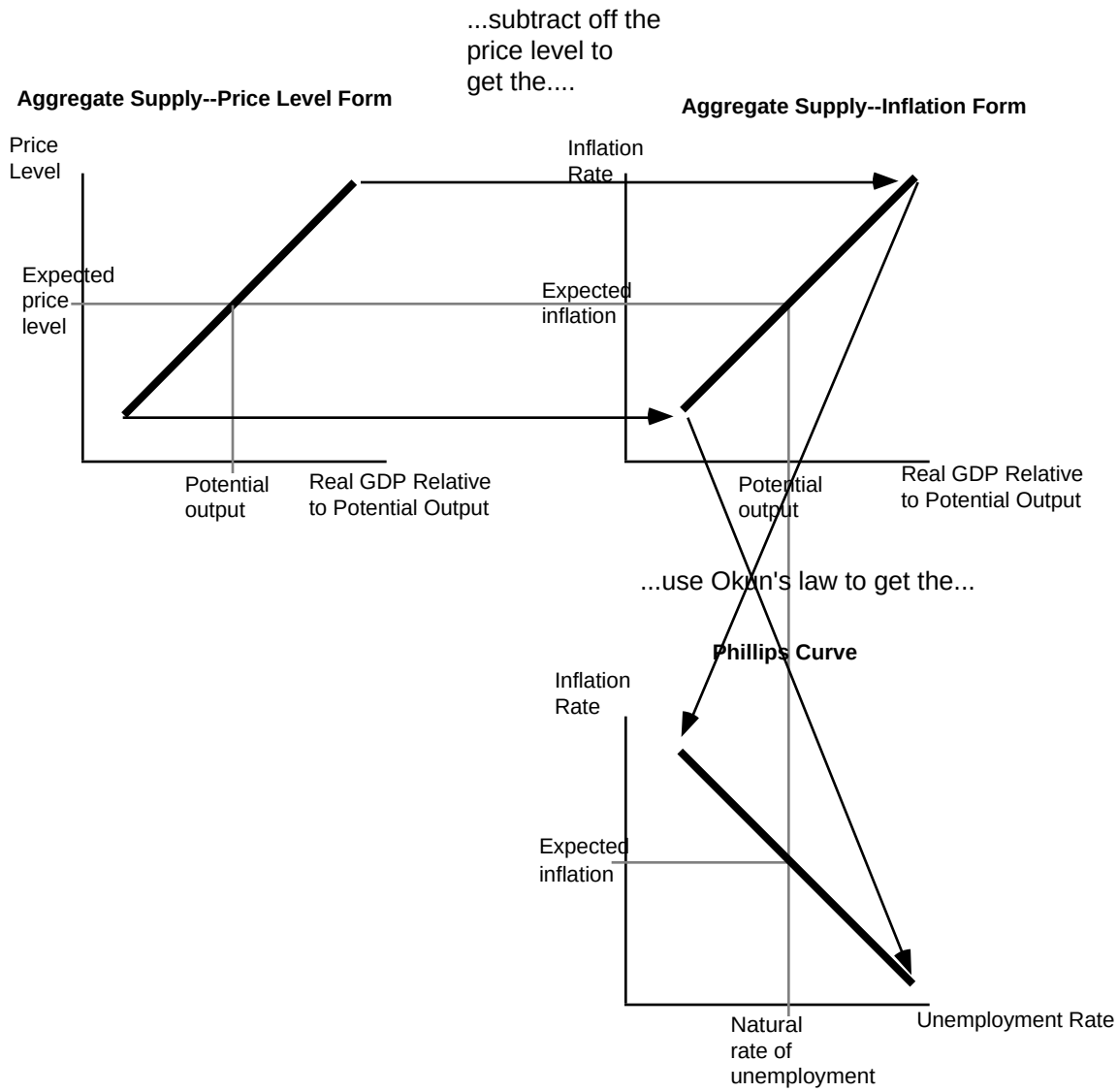
The Phillips Curve



Legend: When inflation is higher than expected inflation and production is higher than potential output, the unemployment rate will be lower than the natural rate of unemployment. There is an inverse relationship in the short run between inflation and unemployment.

From this point on, we will almost always use the unemployment-inflation Phillips curve form. It is simply more convenient than the other forms.

Three Faces of Aggregate Supply



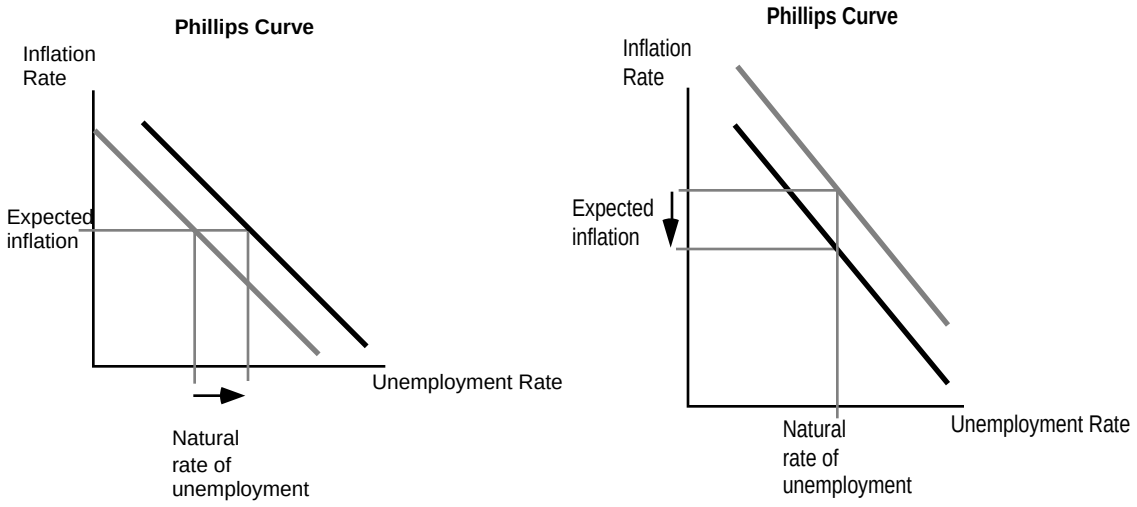
Legend: You can think of aggregate supply either as a relationship between production (relative to potential output) and the price level, between production (relative to potential output) and the inflation rate, or between unemployment (relative to the natural rate of unemployment) and the inflation rate. These are three different views of what remains the same single relationship.

The Phillips Curve Examined

The slope of the Phillips curve depends on how sticky wages and prices are. The stickier are wages and prices, the smaller is the parameter β, and the flatter is the Phillips curve. The parameter β varies widely from country to country and era to era. In the U.S. today it is about 0.5. When the Phillips curve is flat, even large movements in the unemployment rate have little effect on the price level. When wages and prices are less sticky, the Phillips curve is nearly vertical. Then even small movements in the unemployment rate have the potential to cause large changes in the price level.

Whenever unemployment is equal to its natural rate, inflation is equal to expected inflation. Thus we can determine the position of the Phillips curve if we know the natural rate of unemployment and the expected rate of inflation. A higher natural rate moves the Phillips curve right. Higher expected inflation moves the Phillips curve up. If the past forty years have made anything clear, it is that the Phillips curve shifts around substantially as *both* expected inflation and the natural rate change. Neither is a constant. The current natural rate of unemployment u* is between 4.5 and 5 percent. The current rate of expected inflation π^e is about 2 percent per year. But both will be different in the future. One other important factor affects the position of the Phillips curve. Adverse supply shocks (like the 1973 tripling of world oil prices) move the Phillips curve up. Favorable supply shocks (like the 1986 worldwide declines in oil prices) move the Phillips curve down.

Shifts in the Phillips Curve



Legend: When expected inflation changes, the position of the Phillips Curve

changes too.

Aggregate Demand and Inflation

In the last chapter, Chapter 11, we combined the IS curve with this Taylor rule for setting monetary policy and produced an aggregate demand function that showed how real GDP depended on the inflation rate. This monetary policy reaction function [MPRF] was:

$$Y = Y_0 - \phi' \times (\pi - \pi')$$

However, we would prefer an aggregate demand equation with the unemployment rate on the left-hand side so we can use it along with the Phillips curve. So we use Okun's law to replace real GDP by the unemployment rate on the left-hand side:

$$u = u_0 + \phi \times (\pi - \pi')$$

where the parameter ϕ is the product of three different things:

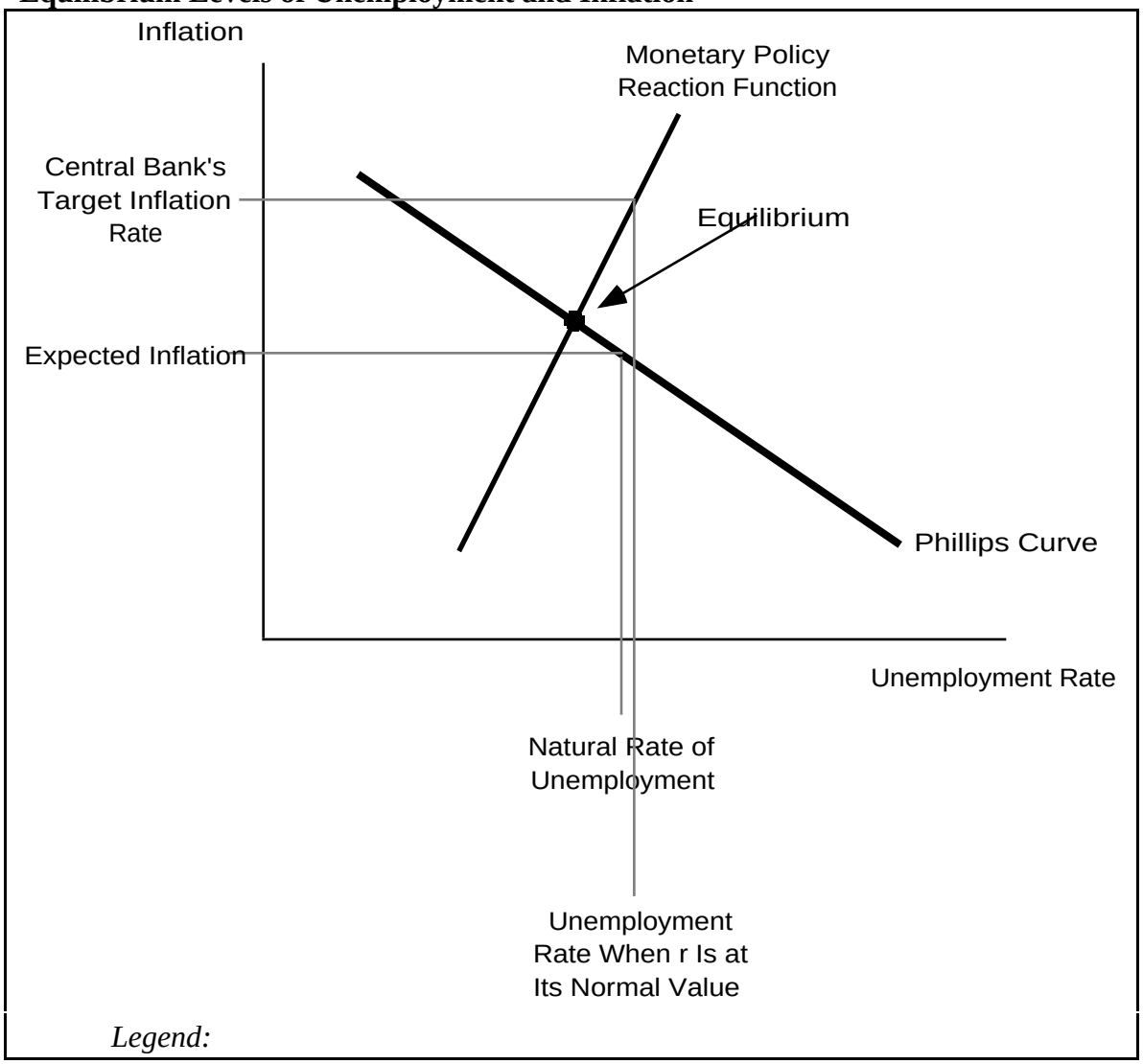
- How much the central bank raises the real interest rate in response to a rise in inflation.
- The slope of the IS curve—how much real GDP changes in response to a change in the real interest rate.
- And the Okun's law coefficient—how large a change in unemployment is produced by a change in real GDP.

Together, this unemployment form of the aggregate demand relationship and the Phillips curve equation:

$$\pi = \pi^e - \beta(u - u^*) + \varepsilon^s$$

allow us to determine what the inflation and unemployment rates will be in the economy. (And when we have determined the unemployment rate, Okun's law allows us to immediately calculate real GDP as well.) Once again, the economy's equilibrium is where the curves cross: the Phillips curve determines inflation as a function of the unemployment rate, the MPRF determines the unemployment rate as a function of the inflation rate, and the two must be consistent.

Equilibrium Levels of Unemployment and Inflation



As we have seen before, the position of the Phillips curve depends on:

- u*, the natural rate of unemployment.
- π^e, the expected rate of inflation.
- ε^s, whether there are any current supply shocks affecting inflation.

The position of the aggregate demand curve, the MPRF, depends on:

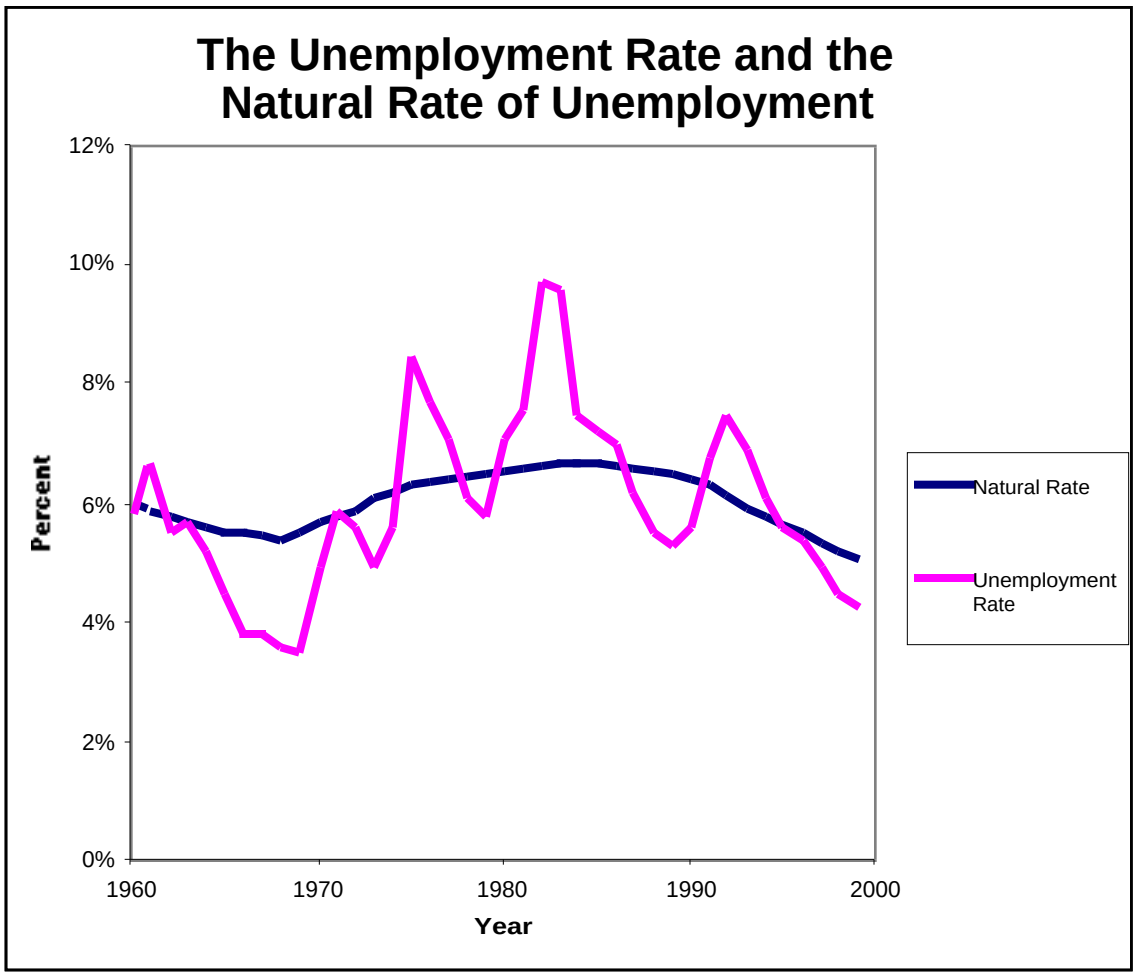
- u_0, the level of unemployment when the real interest rate r is at what the central bank thinks of as its long-run average rate.

- π', the central bank's target level of inflation.

All five of these factors together, along with the parameters ϕ and β--the slopes of the monetary policy reaction function and of the Phillips curve—determine the economy's equilibrium inflation and unemployment rates.

The Natural Rate of Unemployment

In English, the word "natural" normally carries strong positive connotations of normal and desirable, but a high natural rate of unemployment is a bad thing. Unemployment cannot be reduced below its natural rate without accelerating inflation, so a high natural rate means that expansionary fiscal and monetary policy are largely ineffective as tools to reduce unemployment.



Legend: The natural rate of unemployment is not fixed. It varies substantially from decade to decade. Moreover, variations in the natural rate in the United States have been much smaller than variations in the natural rate in other countries.

Today, most estimates of the current U.S. "natural" rate of unemployment lie between 4.5 and 5.0 percent. But all agree that uncertainty about the level of the natural rate is substantial. And the natural rate has fluctuated substantially over the past two generations. Broadly, four sets of factors have powerful influence over the natural rate.

Demography and the Natural Rate

First, the natural rate changes as the relative age and educational distribution of the labor force changes. Teenagers have higher unemployment rates than adults; thus an economy with a lot of teenagers will have a higher natural rate. More experienced and more skilled workers find looking for a job an easier experience, and take less time to find a new job when they leave an old one, thus the natural rate of unemployment will fall when the labor force becomes more experienced and more skilled. Women used to have higher unemployment rates than men--although this is no longer true in the U.S. The more educated tend to have lower rates of unemployment than the less well educated. African-Americans have higher unemployment rates than whites.

A large part of the estimated rise in the natural rate from 5 percent or so in the 1960s to 6 to 7 percent by the end of the 1970s was due to changing demography. Some component of the decline in the natural rate since was due to the increasing experience at searching for jobs of the very large baby-boom cohort. But the exact, quantitative relationship between demography and the natural rate is not well understood.

Institutions and the Natural Rate

Second, institutions have a powerful influence over the natural rate. Some economies have strong labor unions; other economies have weak ones. Some unions sacrifice employment in their industry for higher wages; others settle for lower wages in return for employment guarantees. Some economies lack apprenticeship programs that make the transition from education to employment relatively straightforward; others make the school-to-work transition easy. In each pair, the first increases and the second reduces the natural rate of unemployment. Barriers to worker mobility raise the natural rate, whether the barrier be subsidized housing that workers lose if they move (as in Britain in the 1970s and the 1980s), or high taxes that a firm must pay to hire a worker (as in France from the 1970s to today).

However, the link between economic institutions and the natural rate is neither simple nor straightforward. The institutional features many observers today point to as a source of high European unemployment now were also present in the European economies in the 1970s--when European unemployment was low. Once again the quantitative relationships are not well understood.

Productivity Growth and the Natural Rate

Third, in recent years it has become more and more likely that a major determinant of the natural rate is the rate of productivity growth. The era of slow productivity growth from the mid-1970s to the mid-1990s saw a relatively high natural rate. By contrast, rapid productivity growth before 1973 and after 1975 seems to have generated a low natural rate.

Why should a productivity growth slowdown generate a high natural rate? A higher rate of productivity growth allows firms to pay higher real wage increases and still remain possible. If workers' aspirations for real wage growth themselves depend on the rate of unemployment, then a slowdown in productivity growth will increase the natural rate. If real wages grow faster than productivity for an extended period of time, profits will disappear. Long before that point is reached businesses will begin to fire workers, and unemployment will rise. Thus if productivity growth slows, unemployment will rise. Unemployment will keep rising until workers' real wage aspirations fall to a rate consistent with current productivity growth.

Expected Inflation

The natural rate of unemployment and expected inflation together determine the location of the Phillips curve because it passes through the point where inflation is equal to expected inflation and unemployment is equal to its natural rate. Higher expected inflation would move the Phillips curve upward. But who does the expecting? And when do people form expectations relevant for this year's Phillips curve?

Economists work with three basic scenarios for how managers, workers, and investors go about forecasting the future and forming their expectations:

- **Static expectations.** Static expectations of inflation prevail when people ignore the fact that inflation can change.

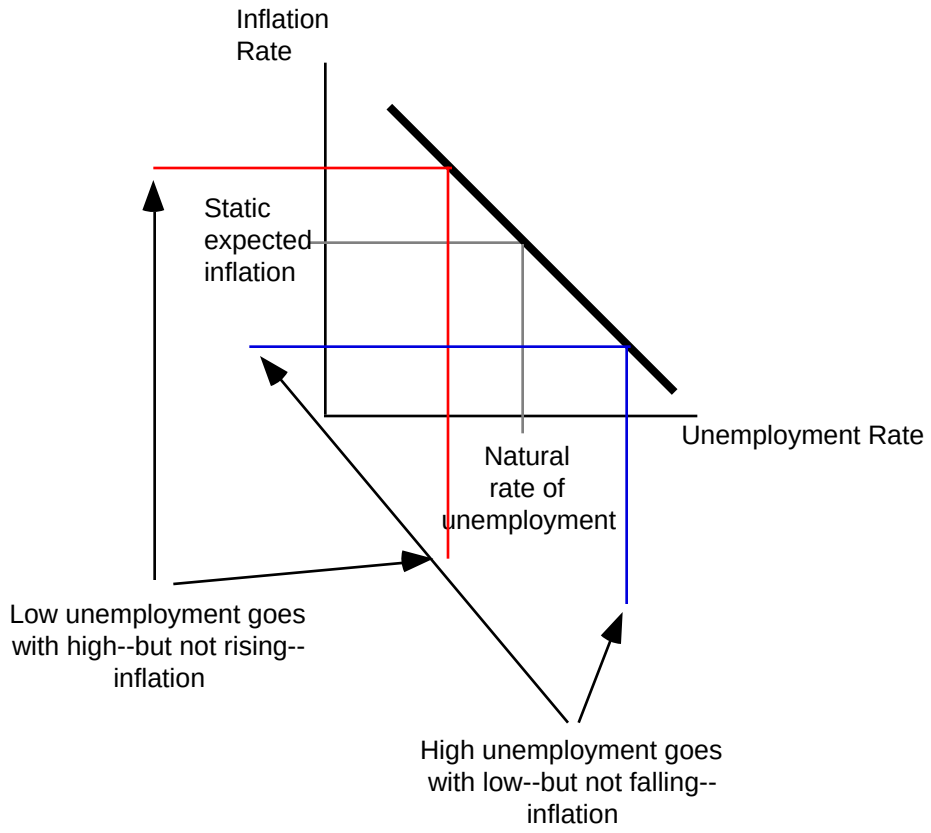
- **Adaptive expectations.** Adaptive expectations prevail when people assume the future will be like the recent past.
- **Rational expectations.** Rational expectations prevail when people use all the information they have as best they can.

The Phillips curve behaves very differently under each of these three scenarios.

The Phillips Curve and Expectations

If inflation expectations are *static*, expected inflation never changes. People just don't think about inflation. There will be some years in which unemployment is relatively low; in those years inflation will be relatively high. There will be other years in which unemployment is higher, and then inflation will be lower. But as long as expectations of inflation remain static (and the natural rate of unemployment unchanged), the trade-off between inflation and unemployment will not change from year to year.

Static Expectations of Inflation



Legend: If inflation expectations are static, the economy moves up and to the left and down and to the right along a Phillips curve that does not change its position.

If inflation has been low and stable, businesses will probably hold static inflation expectations. Why? Because the art of managing a business is complex enough as it is. Managers have a lot of things to worry about: what their customers are doing, what their competitors are doing, whether their technology is adequate, and how applicable technology is changing. When inflation has been low or stable, everyone has better things to focus their attention on than the rate of inflation.

Suppose that the inflation rate varies too much for workers and businesses to ignore it completely. What then? As long as inflation last year is a good guide to inflation this year, workers, investors, and managers are likely to hold *adaptive* expectations and forecast inflation by assuming that this year will be like last year. Adaptive forecasts are good forecasts as long as inflation changes only slowly; and adaptive expectations do not absorb a lot of time and energy that can be better used thinking about other issues.

Under such adaptive inflation expectations, the Phillips curve can be written:

$$\pi_t = \pi_{t-1} - \beta(u_t - u_t^*) + \varepsilon_t^s$$

where π_{t-1} stands in place for π_t^e because expected inflation is just equal to inflation last year. Under such a set of *adaptive expectations,* the Phillips curve will shift up or down depending on whether last year's inflation was higher or lower than the previous year's. Under adaptive expectations, inflation accelerates when unemployment is less than the natural unemployment rate, and decelerates when unemployment is more than the natural rate. Hence this Phillips curve is sometimes called the accelerationist Phillips curve.

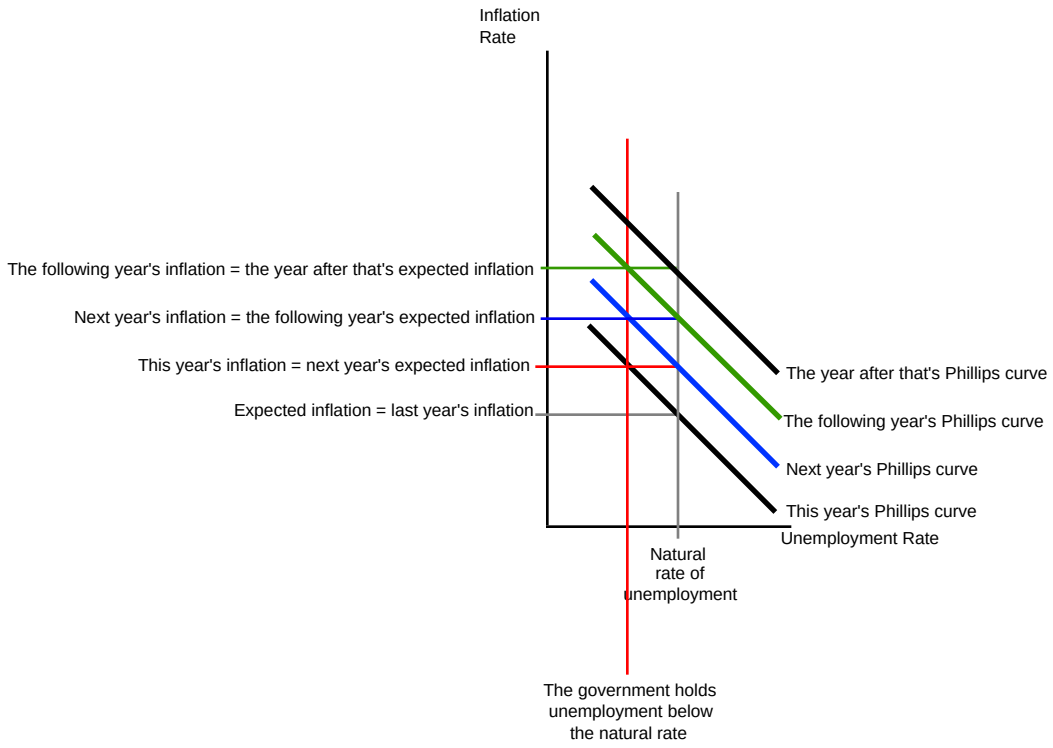
Example: A High-Pressure Economy Under Adaptive Expectations

Suppose the government tries to keep unemployment below the natural rate for long in an economy with adaptive expectations, then year after year inflation will be higher than expected inflation, and so year after year expected inflation will rise. Suppose that the government pushes the economy's unemployment rate down two percentage points below the natural rate, that the β parameter in the Phillips curve is 1/2, and that last year's inflation rate was 4%. Then because each year's expected inflation rate is last year's actual inflation rate, and because:

$$\pi_{t-1} + \beta \times 2 = \pi_t$$

Then this year's inflation rate will be:	$4 + 1/2 \times 2 = 5$
Next year's inflation rate will be:	$5 + 1/2 \times 2 = 6$
The following year's inflation rate will be:	$6 + 1/2 \times 2 = 7$
The year after that's inflation rate will be:	$7 + 1/2 \times 2 = 8$

Accelerating Inflation



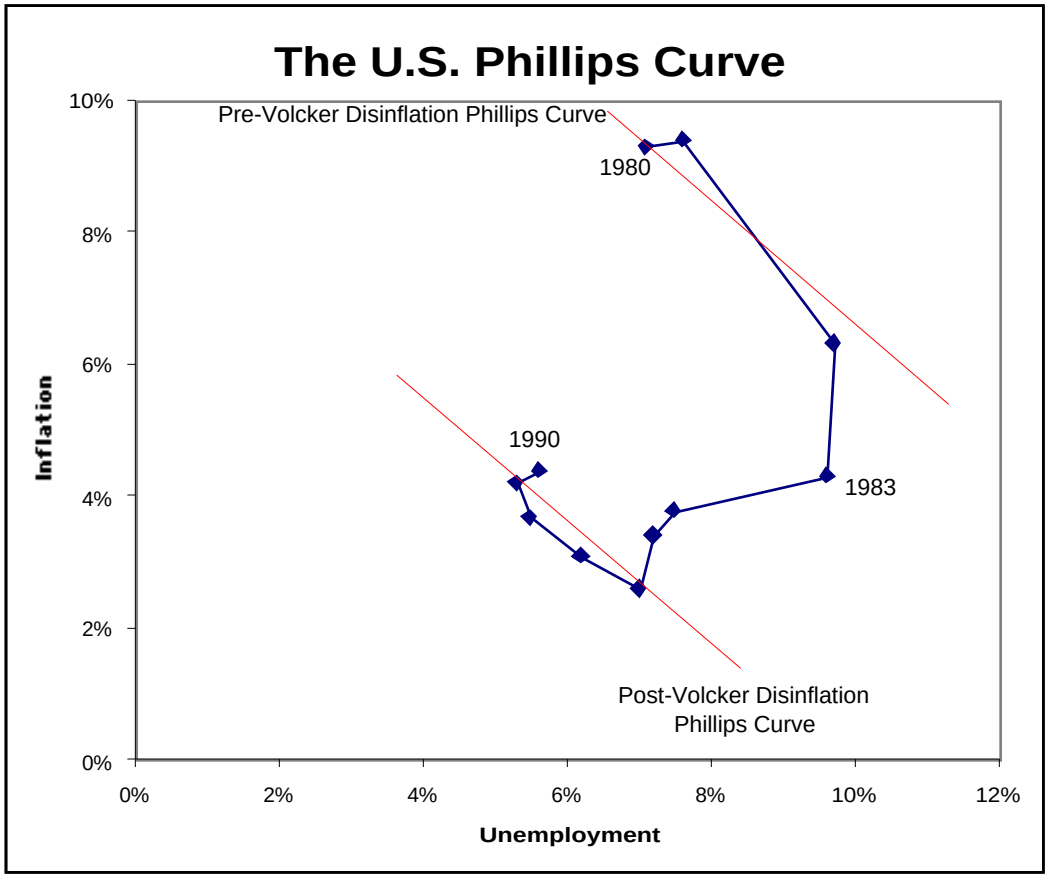
And so on and so forth. As long as expectations of inflation remain adaptive, inflation will increase by one percent per year for every year that passes. But expectations of inflation will not remain adaptive forever if the inflation rate keeps rising and rising.

Economic Policy: Adaptive Expectations and the Volcker Disinflation

At the end of the 1970s the high level of expected inflation gave the United States an unfavorable short-run Phillips curve tradeoff. Between 1979 and the mid-1980s, the Federal Reserve under its chair Paul Volcker reduced inflation in the United States from 9 percent per year to about 3 percent.

Because inflation expectations were adaptive, the fall in actual inflation in the early 1980s triggered a fall in expected inflation as well. The early 1980s also saw a downward shift in the short-run Phillips curve, a downward shift that gave the United States a much more favorable short-run inflation-unemployment tradeoff by the mid-1980s than it had had in the late-1970s.

The Phillips Curve Before and After the Volcker Disinflation



To accomplish this goal of reducing expected inflation, the Federal Reserve raised interest rates sharply, discouraging investment, reducing aggregate demand, and pushing the economy to the right along the Phillips curve. Unemployment rose, and inflation fell. Reducing annual inflation by 6 percentage points required "sacrifice": during the disinflation unemployment averaged some 1 1/2 percentage points above the natural rate for the seven years between 1980 and 1986. Ten percentage point-years of excess unemployment above the natural rate--that was the cost of reducing inflation from near ten to below five percent.

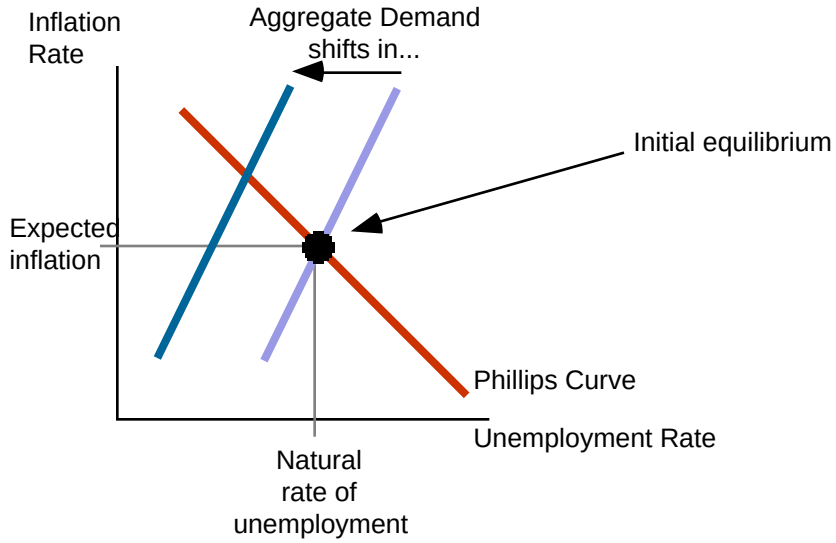
What happens government policy and the economic environment are changing rapidly enough that adaptive expectations lead to significant errors, and are no longer good enough for managers or workers? Then the economy will shift to “rational” expectations. Under rational expectations, people form their forecasts of future inflation not by looking backward at what inflation was, but by looking forward. They look at what current and expected future government policies tell us about what inflation will be.

Under rational expectations the Phillips curve shifts as rapidly as, or faster than, changes in economic policy that affect the level of aggregate demand. This has an interesting consequence: anticipated changes in economic policy turn out to have no effect on the level of production or employment.

Consider an economy where the central bank’s target inflation π’ rate is equal to the current value of expected inflation π^e, and where u_0, the unemployment rate when the real interest rate is at its normal value, is equal to the natural rate of unemployment u*. In such an economy, the initial equilibrium has unemployment equal to its natural rate and inflation equal to expected inflation.

Suppose that workers, managers, savers, and investors have rational expectations. Suppose further that the government takes steps to stimulate the economy: it cuts taxes and increases government spending in order to reduce unemployment below the natural rate, and so reduces the value of u_0. What is likely to happen to the economy?

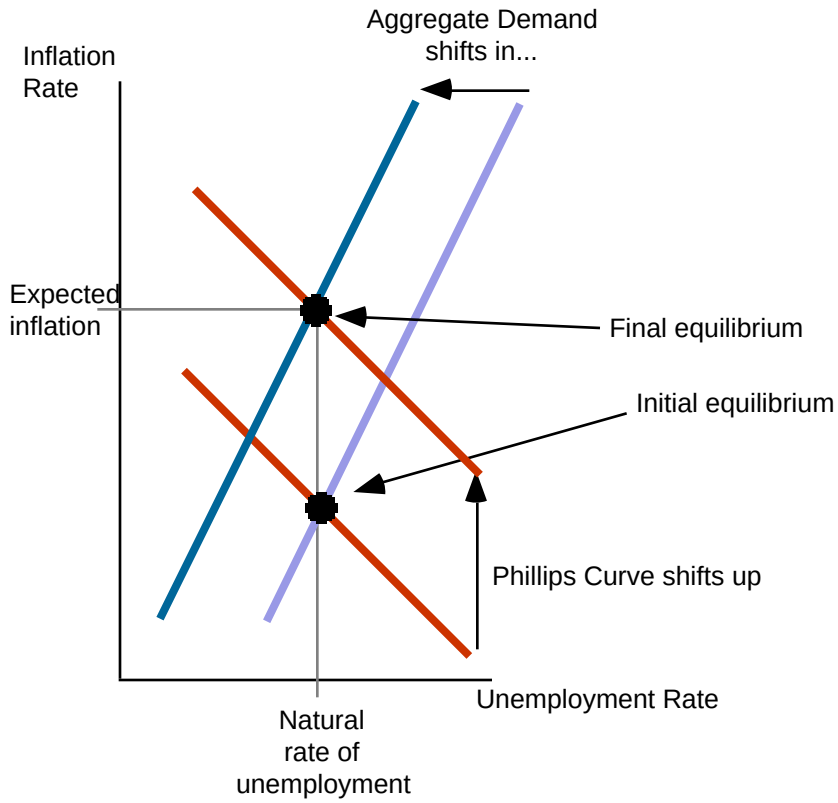
The Government Attempts to Stimulate the Economy



Legend: A government pursuing an expansionary economic policy shifts the aggregate demand curve. Remember that on the Phillips curve diagram an increase in production is associated with a reduction in unemployment, so an expansionary shift is a shift to the left in Phillips-curve diagram aggregate-demand!

If the government's policy is *anticipated*--if the expectations of inflation that matter for this year's Phillips curve are formed after the decision to stimulate the economy is made and becomes public--then workers, managers, savers, and investors will take the stimulative policy into account when they form their expectations of inflation. The inward shift in the MPRF will be accompanied, under rational expectations, by an upward shift in the Phillips curve as well. How large an upward shift? The increase in expected inflation has to be large enough to sufficient to keep expected inflation after the demand shift equal to actual inflation. Otherwise people are not forming their expectations rationally.

If the Shift in Policy Is Anticipated…



Legend: If the expansionary policy is *anticipated*, than workers, consumers, and managers will build what the policy will do into their expectations: the Phillips curve will shift up as the aggregate demand curve shifts in, and so the expansionary policy will raise inflation without having any impact on unemployment (or production).

Thus an anticipated increase in aggregate demand has, under rational expectations, no effect on the unemployment rate or on real GDP. Unemployment does not change: it remains at the natural rate of unemployment because the shift in the Phillips curve has neutralized in advance any impact of changing inflation on unemployment. It will, however, have a large effect on the rate of inflation. Economists will sometimes say that under rational expectations "anticipated policy is irrelevant." But this is not the best way to express it. Policy is very relevant indeed for the inflation rate. It is only the effects of policy on real GDP and the unemployment rate--effects that are associated with a divergence between expected inflation and actual inflation--that are neutralized.

When have we seen examples of rational inflation expectations? The standard case is that of France immediately after the election of Socialist President Francois Mitterand in 1981. Throughout his campaign Mitterand had promised a rapid expansion of demand and production to reduce unemployment. Thus when he took office French businesses and unions were ready to mark up their prices and wages in anticipation of the expansionary policies they expected. The result? From mid-1981 to mid-1983 France saw a significant acceleration of inflation, but no reduction in unemployment. The Phillips curve had shifted upward fast enough to keep expansionary policies from having any effect on production and employment.

What Kind of Expectations Do We Have?

If inflation is low and stable, expectations are probably static: it is not worth anyone's while to even think about what one's expectations should be. If inflation is moderate and fluctuates, but slowly, expectations are probably adaptive: to assume that the future will be like the recent past--which is what adaptive expectations are--is likely to be a good rule of thumb, and is simple to implement.

When shifts in inflation are clearly related to changes in monetary policy, swift to occur, and are large enough to seriously affect profitability, then people are likely to have rational expectations. When the stakes are high--when people think, "had I known inflation was going to jump, I would not have taken that contract"--then every economic decision becomes a speculation on the future of monetary policy. Because it matters for their bottom lines and their livelihoods, people will turn all their skill and insight into generating inflation forecasts.

Thus the kind of expectations likely to be found in the economy at any moment depend on what has been and is going on. A period during which inflation is low and stable will lead people to stop making, and stop paying attention to, inflation forecasts--and tend to cause expectations of inflation to revert to static expectations. A period during which inflation is high, volatile, and linked to visible shifts in economic policy will see expectations of inflation become more rational. An intermediate period of substantial but slow variability is likely to see many managers and workers adopt the rule-of-thumb of adaptive expectations.

Persistent Contracts

The way that people make contracts and form and execute plans for their economic activity are likely to make an economy behave *as if* expectations in it are less "rational" than expectations in fact are. People do not wait until December 31 to factor next year's expected inflation into their decisions and contracts. They make decisions about the future, sign contracts, and undertake projects all the time. Some of those steps govern what the company does for a day. Others govern decisions for years or even for a decade or more.

Thus the "expected inflation" that determines the location of the short-run Phillips curve has components that were formed just as the old year ended, but also components that were formed two, three, five, ten, or more years ago. People buying houses form forecasts of what inflation will be over the next thirty years--but once the house is bought, that decision is a piece of economic activity (imputed rent on owner occupied housing) as long as they own the house, no matter what they subsequently learn about future inflation. Such lags in decision making tend to produce "price inertia." They tend to make the economy behave as if inflation expectations were more adaptive than they in fact are. There will always be a large number of projects and commitments already underway that cannot easily adjust to changing prices. It is important to take this "price inertia" into account when thinking about the dynamics of inflation, output, and unemployment.

From the Short Run to the Long Run

Rational Expectations

Our picture of the determination of real GDP and unemployment under sticky prices is now complete. We have a comprehensive framework to understand how the aggregate price level and inflation rate move and adjust over time in response to changes in aggregate demand, production relative to potential output, and unemployment relative to its natural rate. There is, however, one loose end. How does one get from the short-run sticky-price patterns of behavior that have been covered in Section IV to the long-run

flexible price patterns of behavior that were laid out in Section III? How do you get from the short run to the long run?

In the case of an anticipated shift in economic policy under rational expectations, the answer is straightforward: you don't have to get from the short run to the long run; the long run is now. An inward (or outward) shift in the monetary policy reaction function on the Phillips curve diagram caused by an expansionary (or contractionary) change in economic policy or the economic environment sets in motion an offsetting shift in the Phillips curve. In the absence of supply shocks:

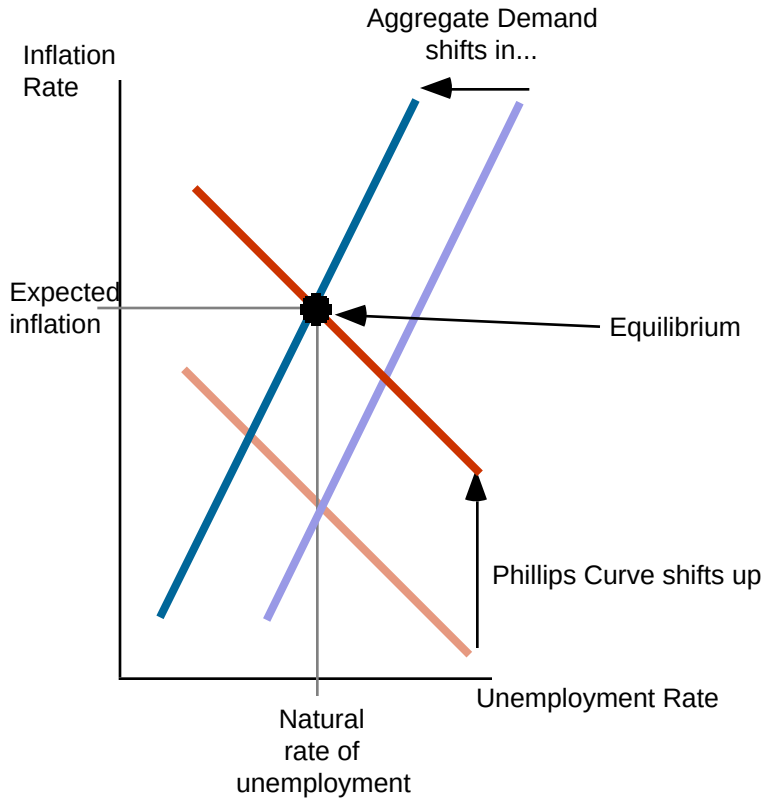
$$\pi = \pi^{e} - \beta \times (u - u^{*})$$

If expectations are rational and if changes in economic policy are foreseen, then expected inflation will be equal to actual inflation:

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

Which means that the unemployment rate is equal to the natural rate. The economy is at full employment.

Under Rational Expectations, the Long Run Is Now…



Legend: Under rational expectations there simply is no short run, unless changes in policy come as a complete surprise.

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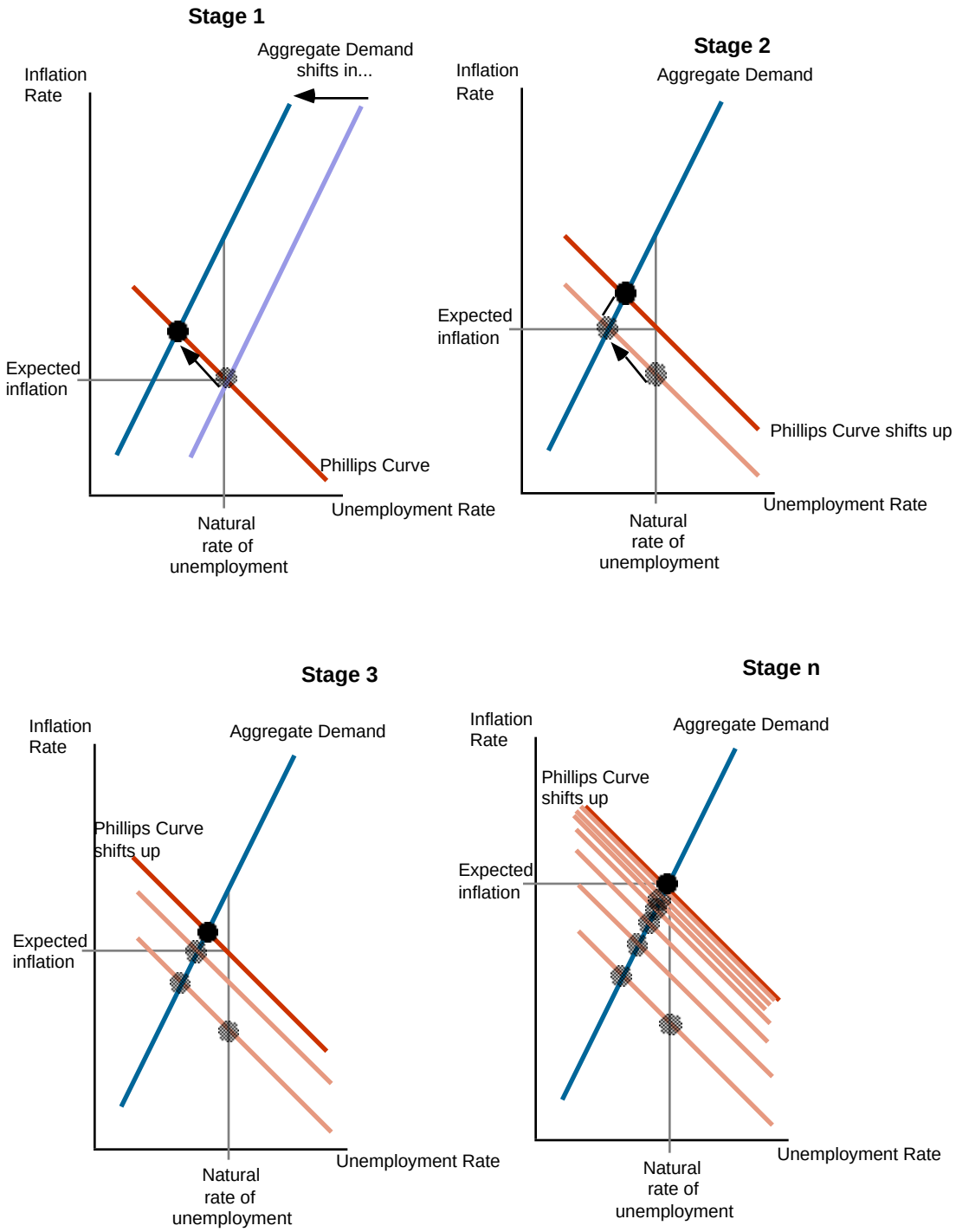
Adaptive Expectations

If expectations are and remain adaptive, then the economy approaches the long run equilibrium, but slowly. An expansionary initial shock that shifts the aggregate demand relation inward on the Phillips curve diagram generates a fall in unemployment, an increase in real GDP, and a rise in inflation. Call this stage 1. Stage 1 takes place before anyone has had any chance to adjust their expectations of inflation.

Then comes stage 2. Workers, managers, investors, and others look at what inflation was in stage 1 and raise their expectations of inflation. The Phillips curve shifts up by the difference between actual and expected inflation in stage 1. If the aggregate demand relation does not shift when plotted on the Phillips curve diagram, between stage 1 and stage 2 unemployment rises, real GDP falls, and inflation rises.

Then comes stage 3. Workers, managers, investors, and others look at what inflation was in stage 1 and raise their expectations of inflation. The Phillips curve shifts up by the difference between actual and expected inflation in stage 2. If the aggregate demand relation does not shift when plotted on the Phillips curve diagram, between stage 2 and stage 3 unemployment rises, real GDP falls, and inflation rises. As time passes the gaps between actual and expected inflation, between real GDP and potential output, and between unemployment and its natural rate shrink toward zero.

Convergence to the Long Run Under Adaptive Expectations



Legend: Under adaptive expectations, shifts in policy have strong initial effects on unemployment and production, but those effects on unemployment and production

slowly die off over time.

Under adaptive expectations, people's forecasts become closer and closer to being accurate as more and more time passes. Thus the "long run" arrives gradually. Each year the portion of the change in demand that is not implicitly incorporated in people's adaptive forecasts becomes smaller and smaller. Thus a larger and larger proportion of the shift is "long run," and a smaller and smaller proportion is "short run."

Static Expectations

Under static expectations, the long run never arrives: the analysis of chapters 6 through 8 never becomes relevant. Under static expectations, the gap between expected inflation and actual inflation can grow arbitrarily large as different shocks affect the economy. And if the gap between expected inflation and actual inflation becomes large, workers, managers, investors, and consumers will not remain so foolish as to retain static expectations.