

CRS Report for Congress

Received through the CRS Web

Inflation and Unemployment: What is the Connection?

Updated April 8, 2004

Brian W. Cashell
Specialist in Quantitative Economics
Government and Finance Division

Inflation and Unemployment: What is the Connection?

Summary

Even at times when the inflation rate shows little indication that it is about to rise significantly, many economists feel that there is some risk of that happening as unemployment rate falls to near 5%. There are those who consider an unemployment rate below 5% to be unsustainable, or at least incompatible with continued low rates of inflation. It might seem strange that an economy with both low unemployment and low inflation could be considered a source of concern. But, many economists believe that it may not be possible to keep them both low for very long.

The experience of the United States in the 1960s suggested that there was a trade-off between the unemployment rate and the rate of inflation. This trade-off was known as the Phillips curve, and was based on the fact that unexpected increases in prices reduced real wages, increasing the demand for labor and reducing unemployment.

But, any trade-off that may have existed in the 1960s disappeared in subsequent years. Moreover, that the failure of the trade-off to persist had been predicted contributed to the wide acceptance of what is now known as the natural rate hypothesis.

The trade-off along the Phillips curve was based on errors in inflation expectations. But, as the price level rises, workers eventually realize that real wages are falling and adjust their nominal, or money, wage demands to reflect the higher level of prices and so preserve their real incomes. The increase in real wage demands tends to reverse the drop in the unemployment rate. In the long run, the unemployment rate tends toward a level that is consistent with a stable rate of inflation. This has been dubbed the "natural" rate.

Most current point estimates of the natural rate of unemployment fall between 5% and 6%. During the 1990s, the unemployment rate was at or below those levels for some time, which led many economists to expect signs of an accelerating in the rate of inflation. But, the expected rise in inflation failed to materialize. In fact, perhaps to the surprise of many, the inflation rate fell.

Although the inflation rate failed to increase at a time when the actual unemployment rate was well below most estimates of the natural rate, not all adherents of the natural rate model have rejected it. It may be that a number of temporary factors, including an acceleration in productivity growth which was not yet reflected in wage demands, or falling prices for oil (in 1997 and 1998) and imported goods and services (from 1995 to 1998) muted the inflation response to tight labor markets.

Contents

The Phillips Curve	2
The Natural Rate Hypothesis	3
What Determines the Natural Rate?	7
Critics of the Natural Rate Hypothesis	11
The 1990s: An Empirical Challenge to the Natural Rate?	12
Estimates of the Natural Rate	15
Conclusions	18

List of Figures

Figure 1. Inflation and Unemployment in the 1960s	3
Figure 2. Inflation Expectations and the Phillips Curve	5
Figure 3. Inflation and Unemployment, 1970 - 2003	7
Figure 4. Actual Unemployment and the NAIRU	11

Inflation and Unemployment: What is the Connection?

The relation between unemployment and inflation has long held the attention of economists. For some time, it was believed that there was a trade-off between the two that policymakers could exploit. In other words, a lower unemployment rate could be had by tolerating a higher rate of inflation. That notion is no longer widely held, at least as regards the long run. While minimal unemployment might seem a desirable policy goal, few economists would define full employment as employment for everyone who wants a job. Instead, many would argue that full employment is the lowest rate of unemployment consistent with a stable rate of inflation. This rate is known as the natural rate of unemployment.

Some idea of what that rate of unemployment is could be extremely useful to economic policymakers. Inflation tends to be slow to respond to those changes in policy which affect it. The effects of an expansionary monetary policy on inflation, for example, might not become apparent for some time. Similarly, at times when the inflation rate is relatively high it is likely to respond only slowly to policies designed to bring it down. In part because of this characteristic, and because policies aimed at reducing inflation may have short-term economic costs, it seems to be the prevalent view that it would be better to avoid increases in inflation altogether.

Perhaps the key characteristic of the natural rate is that it is the lowest rate of unemployment that is sustainable. If the natural rate model is correct, policymakers seeking to maintain the actual unemployment below the natural rate would eventually have to contend with an accelerating rate of inflation.

Because inflation tends only gradually to respond to changes in underlying economic conditions, a way of predicting it or of identifying the conditions that are likely to lead to an increase in the inflation rate, would be extremely useful to policymakers. The natural rate of unemployment has been viewed by many economists as a means of measuring tightness in the labor market and thus the risk of future increases in the inflation rate.¹

From the middle of 1997 through September 2001, the civilian unemployment rate was below 5%. Over that time, the inflation rate remained modest. Continued low inflation in the face of what appeared to be tight labor markets led to some skepticism about the merits of the natural rate theory altogether. But many, who still see it as a meaningful way of looking at the world, are unsure whether temporary

¹ There remain questions about whether or not the natural rate is a useful guide to economic policy. See: CRS Report RL32274, *A Changing Natural Rate of Unemployment: Policy Issues*, by Marc Labonte.

factors may have helped to restrain inflation or if the natural rate itself may have fallen so that an unemployment rate below 5% is a realistic long-run policy goal.

This report discusses the evolution of the notion of "full employment" as well as those factors that are believed to determine the level of the natural rate of unemployment. Recent estimates of it are presented as well as an examination of the current uncertainties. This report will be updated as economic developments warrant.

The Phillips Curve

In a 1958 article that was to become a frequently cited reference in the economics literature, economist A.W. Phillips reported evidence of an inverse relationship between the rate of increase in wages and the rate of unemployment. Comparing rates of increase in wages with unemployment rates in Britain between 1861 and 1957, Phillips found that as the labor market tightened, and the unemployment rate fell, money wages tended to rise more rapidly. Because wage increases are closely correlated with price increases, that relationship was widely interpreted as a trade-off between inflation and unemployment.² The implication was that, given a trade-off between inflation and unemployment, policymakers could "buy" a lower rate of unemployment at the cost of a higher rate of inflation.

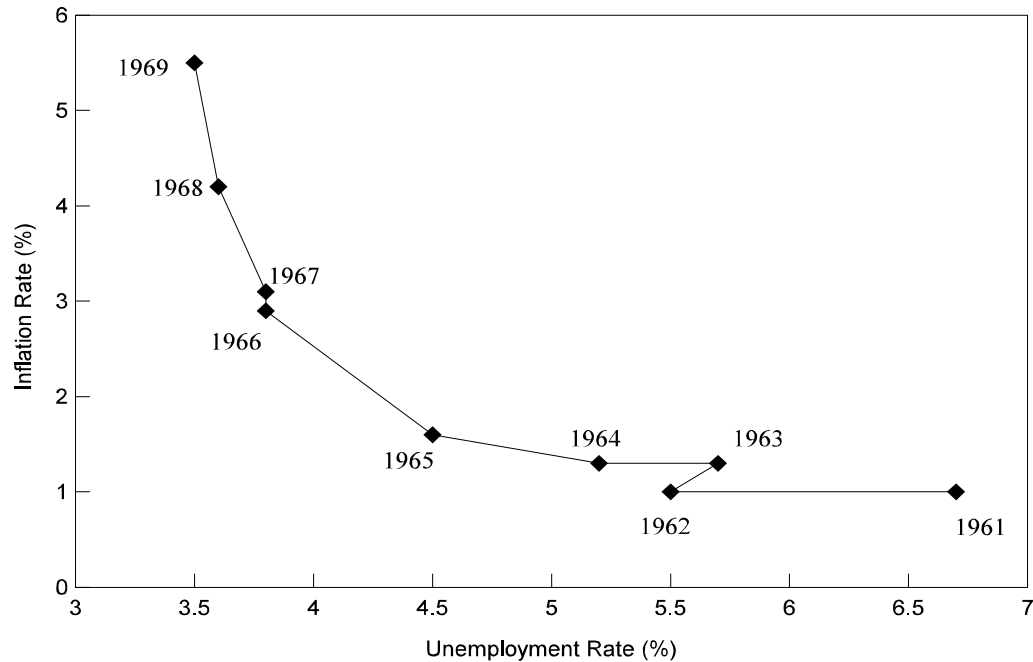
The curve describing this trade-off became known as the "Phillips curve." A stable Phillips curve would mean that policymakers might choose one among several combinations of inflation and unemployment rates that seemed to be most palatable and set that as the goal of macroeconomic policy. The U.S. experience of the 1960s did little to disprove that view.

Figure 1 plots annual U.S. unemployment rates and consumer price inflation together for the 1960s. These data suggested that there was a trade-off for the United States similar to the one found by Phillips in Britain, and that policymakers could target among several combinations of unemployment and inflation rates, depending on their relative distastes for those two economic evils.

The theoretical explanation for the downward-sloping line describing the trade-off between unemployment and inflation depends on the notion of excess demand. As long as aggregate demand exceeds economic capacity, the unemployment rate will tend to fall, and vice versa. Similarly, demand in excess of supply will tend to push up both wages and prices, so that rising prices tend to be correlated with falling unemployment.³

² The difference between wage increases and price increases is largely accounted for by changes in labor productivity.

³ See: Richard G. Lipsey, "The Relation Between Unemployment and the Rate of Change of Money Wages in the United Kingdom, 1862-1957: A Further Analysis," *Economica*, Feb. 1960, pp.1-31.

Figure 1. Inflation and Unemployment in the 1960s

Source: Department of Labor, Bureau of Labor Statistics.

The Natural Rate Hypothesis

In the late 1960s, in spite of the statistical correlation, two economists suggested that there was more to the Phillips curve than met the eye. They predicted a breakdown of the Phillips curve. They argued that monetary and fiscal policy could be manipulated in such a way as to realize a particular combination of unemployment and inflation in the short run, but that it would only be a temporary accomplishment.⁴

This view contended that the trade-off along the Phillips curve was based on the fact that *unexpected* increases in prices reduced real wages. A reduction in real wages induces an increase in the demand for labor and the unemployment rate falls. As a result, a rise in prices would be associated with lower unemployment than under price stability – but only until workers caught on to their loss in buying power. Consequently, there is not just a single Phillips curve, but a Phillips curve for every different possible expectation of inflation.

⁴ See: Milton Friedman, “The Role of Monetary Policy,” *The American Economic Review*, vol. lvii, no. 1, Mar. 1968, pp. 1-17. Also, Edmund Phelps, “Phillips Curve, Expectations of Inflation and Optimal Employment Over Time,” *Economica*, Aug. 1967, pp. 254-281.

Similarly, an unexpected increase in the rate of inflation would, temporarily, reduce the rate of increase in real wages and contribute to a decrease in the unemployment rate. Again, as long as workers fail to notice the effects of rising prices on their money wages, there is likely to be a drop in unemployment due to a fall in real wages. But eventually they will adjust their wage demands to reflect the higher price level, or the higher rate of inflation. This increase in real wage demands will tend to reverse the drop in the unemployment rate. In the long run, the unemployment rate tends toward a level that represents an equilibrium between the supply of labor and demand for it. This level was dubbed the "natural" rate, and is the rate of unemployment consistent with a stable rate of inflation.⁵ It is the level to which the unemployment rate tends when the public is not fooled by inflation.

Some economists prefer a more clinical term, the "non-accelerating inflation rate of unemployment," or NAIRU. At times, the natural rate is more loosely referred to as the full-employment rate of unemployment. The term "structural" unemployment is also used to distinguish long-term effects from business cycle and normal turnover variations in the unemployment rate.

With no efforts to manage demand through fiscal or monetary policy, wage adjustments would always be working to move the economy to its natural rate of unemployment – either from a higher rate or a lower one. If a policy of managing demand is pursued, however, the adjustment to the natural rate can either be assisted or hindered, depending on whether or not the policy is synchronized with those wage adjustments.

Fiscal or monetary policies may shift the economy from one point to another along the original Phillips curve only as long as workers fail to appreciate changes in the price level or the rate of inflation. A higher rate of inflation would not mean a permanent decline in the unemployment rate. Eventually, other things being equal, expectations would adjust and the unemployment rate would tend to return to its natural rate.

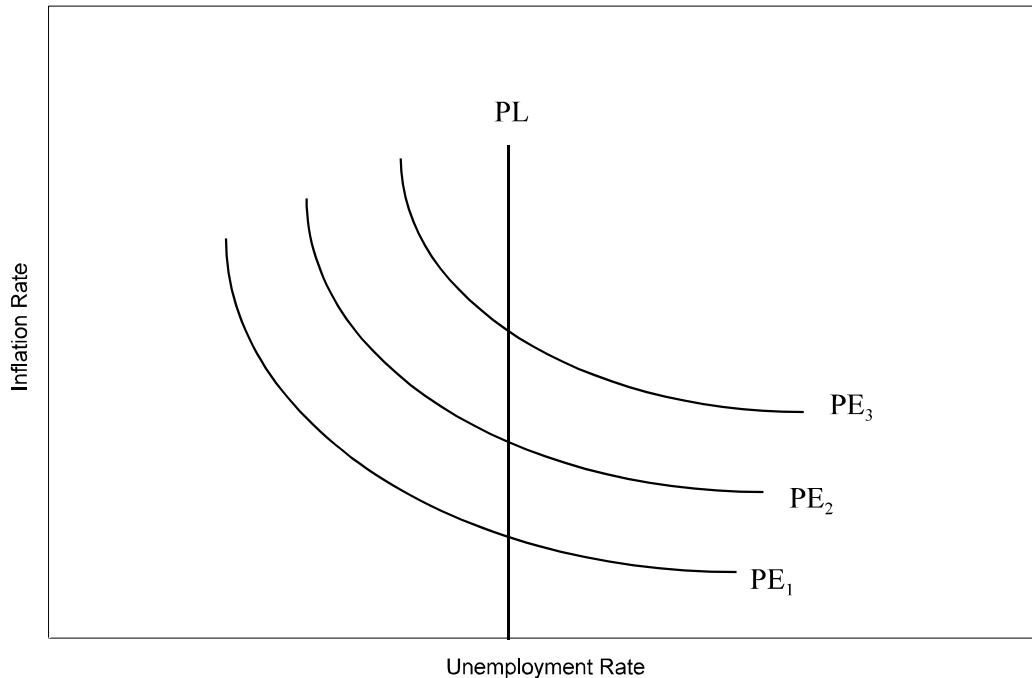
If policy were to push unemployment below the natural rate, the rate of inflation would wind up permanently higher after workers raised their expectation of inflation, and there would be a new Phillips curve describing the trade-off consistent with that higher expected rate of inflation. Any short-term trade-off between inflation and unemployment would now involve higher rates of inflation than before. This process of shifting the trade-off could continue as long as policymakers keep trying to push the unemployment rate below its natural level.

The implication of a constantly shifting Phillips curve is that in the long run there is no trade-off, and that the long-run Phillips curve is vertical at the natural rate. Policymakers cannot expect to choose a point on any one Phillips curve above, or below, the natural rate of unemployment and stay there.

⁵ The term 'natural rate' was originally applied, in a similar way, to interest rates by turn-of-the-century economist Knut Wicksell. See: M. Blaug, *Economic Theory in Retrospect*, Richard D. Irwin, Inc., Homewood, Illinois, 1962, pp. 562-563.

Figure 2 illustrates this point. Each Phillips curve (PE_1 - PE_3) is associated with a rate of expected inflation. Unexpected increases in inflation can result in movement along any one of the Phillips curves. But, unless workers can be perpetually 'fooled,' an increase in expected inflation will result in an upward shift of the entire curve describing the short-term trade-off between unemployment and inflation. In the long run, the Phillips curve (PL) is vertical at the natural rate of unemployment, the only unemployment rate consistent with a stable rate of inflation.

Figure 2. Inflation Expectations and the Phillips Curve



If errors in inflation expectations are random and not systematic, then there will be no trade-off. The long-run Phillips curve, the vertical line, indicates the unemployment rate when inflation expectations turn out to have been correct. To the left of the vertical line, workers underestimate the inflation rate, and the decline in the real wage demanded will tend to reduce unemployment. To the right of the vertical line, inflation expectations turn out to be too high and the rise in real wage demands will tend to increase unemployment.

Only if workers persistently underpredict inflation can the unemployment rate be held below the natural rate. But, if inflation simply rises to a higher rate and stays there, it is hard to believe that wage demands would not eventually come to accurately reflect that new rate.

Most economic models incorporating the natural rate hypothesis assume some form of "adaptive" expectations. In other words, when expectations of inflation turn out to have been too low, then they will be revised upwards, and vice versa. As long

as the inflation rate is steadily rising, expectations of inflation will tend to be too low. Adaptive expectations tend to be characterized by systematic errors.

If expectations are formed adaptively, they adjust to fluctuations in the rate of inflation only after some time has passed. An ever-accelerating rate of inflation would imply that inflation would be continually underpredicted. In that case real wage demands would tend to fall below levels consistent with the natural rate of unemployment and the actual rate of unemployment could be held below the natural rate.⁶

According to this view, there is a way for policymakers to keep the unemployment rate below the natural rate in the long run but it would require pursuing a policy of ever-accelerating inflation. In this way, assuming that workers are not able to anticipate increases in the rate of inflation, increased demand for money wages would always lag slightly behind increases in prices and the real wage would tend to remain below the average level consistent with the natural rate. But a policy of constantly accelerating inflation would seem to be prohibitively costly. Because of this aspect of the model, the natural rate hypothesis is sometimes also referred to as "accelerationist"⁷

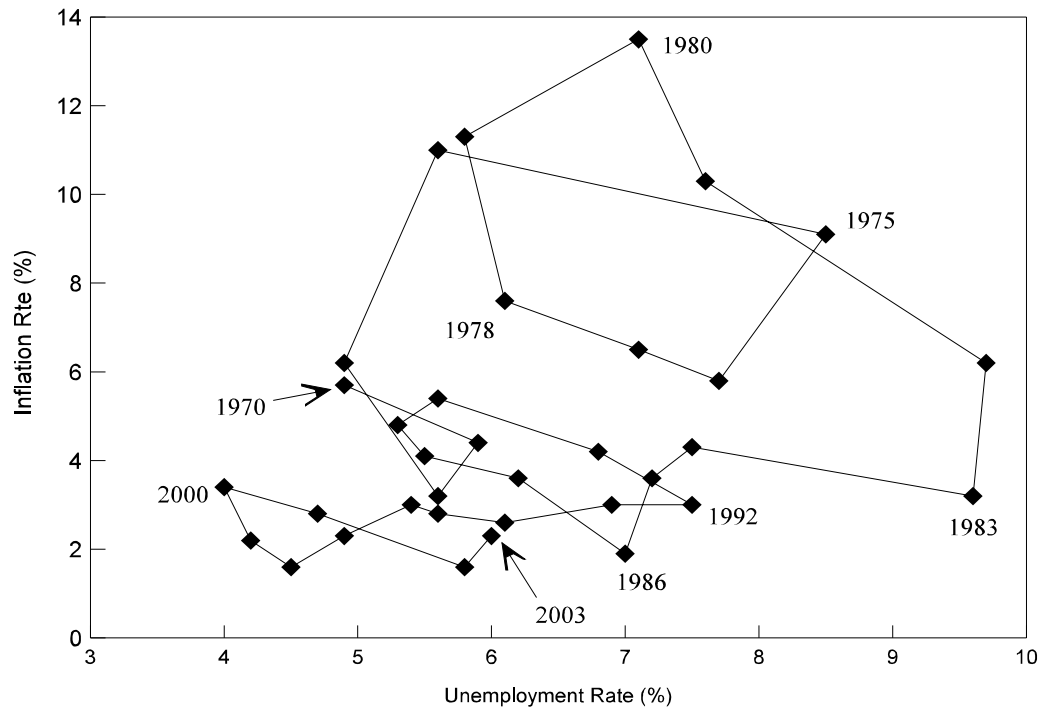
This view has become widely accepted and is presented in most macroeconomics textbooks. One reason for its success is that the argument was made when the original Phillips curve idea still appeared valid but nonetheless it correctly predicted the breakdown of the apparent trade-off.

The 1970s are now well known for the onset of "stagflation," the simultaneous increase in inflation and unemployment. It became evident that policymakers did not have the option of settling for a higher rate of inflation in order to reach a lower rate of unemployment. Despite widespread public and press perceptions that stagflation was unexplainable and unexpected, it had in fact been predicted by the natural rate hypothesis several years before it occurred.

Figure 3 shows what happened to the relationship between the civilian unemployment rate and consumer price inflation. What seems clear is that any trade-off that may have existed during the 1960s did not persist. There is no unique rate of unemployment associated with any particular rate of inflation.

⁶ See: Adrian Throop, "An Evaluation of Alternative Models of Expected Inflation," Federal Reserve Bank of San Francisco *Economic Review*, Summer 1988. Adaptive expectations are not the only way of explaining a short-run trade-off between inflation and the unemployment rate. See: Stanley Fischer, "On Activist Monetary Policy with Rational Expectations," in *Rational Expectations and Economic Policy*, edited by Stanley Fischer. National Bureau of Economic Research, 1980, pp. 211-235.

⁷ Evidence from hyperinflations suggests that eventually even ever-increasing inflation ceases to fool workers.

Figure 3. Inflation and Unemployment, 1970 - 2003

Source: Department of Labor, Bureau of Labor Statistics.

Note that, in shifting, the "trade-off" has moved in a distinct clockwise pattern. The clockwise cycling of unemployment and inflation is believed to be due to the combination of expectations adjustments and policy changes. Unemployment falls and inflation rises when policymakers attempt to exploit the "trade-off." Then, as inflation expectations rise, unemployment tends to rise as wages adjust and inflation continues to increase. Contractionary policy designed to combat higher inflation causes unemployment to rise further but causes price increases to moderate. Finally, as contractionary policy comes to an end and unemployment begins to fall, inflation continues to fall as expectations adjust downward.

One implication of the absence of any durable tradeoff is that fiscal and monetary policy are limited in their ability to reduce unemployment. If unemployment cannot be pushed below the natural rate for very long without generating continuing increases in the rate of inflation, that suggests that policymakers might as well aim to keep inflation rates low and find ways to reduce the natural rate itself.

What Determines the Natural Rate?

If the rate of inflation does not affect the long-run unemployment rate, the question naturally arises as to what does. The short answer is that unemployment is

determined the same way the use of all other commodities is – by the interaction of supply and demand. The answer is complicated by the fact that the aggregate labor market consists of many different labor markets that are differentiated by, among other things, the nature of skills, the level of skills, and by geography.

There are a number of factors that regularly put people out of work. Anti-inflationary monetary policy or an oil price shock may result in a substantial increase in joblessness. In a dynamic economy, changes in tastes will affect the desired composition of output of goods and services. As the mix of goods and services being produced changes, demand for labor will decline in some sectors and rise in others. Naturally, it takes time for labor to shift from industries that are in decline into those that are growing. Similarly, changes in technology will raise productivity in some sectors more than in others. Those firms experiencing relatively more rapid productivity growth will have relatively less need for labor, which can be better employed in firms experiencing slower productivity growth and requiring more workers per unit of output.

Just as these forces are eliminating some jobs, others jobs are opening up in those sectors that experience increasing demand. The ease with which displaced workers are able to find new employment depends on a variety of factors.

If the new jobs being created require substantially different skills from those jobs that have disappeared, then it may be difficult for displaced workers to get rehired. Some of those jobseekers may have skills that are easily transferred from one job to another and thus may not experience long-term unemployment. Those with skills that have become outmoded or are less applicable in those industries that are expanding may have more difficulty finding new work. If the general trend is for a decline in demand for less-skilled labor and an increase in demand for highly skilled labor, then this is more likely to be the case. The more of a mismatch in skills there is between available jobs and jobseekers the longer it will take for displaced workers to find new jobs and the higher the natural unemployment rate will tend to be.⁸

The longer it takes to overcome any mismatch in the labor market, the higher the natural rate will tend to be. The extent of retraining, regulations, or physical relocation required will all affect the time it takes to fill job vacancies as they occur.

There are a number of factors that may cause the mismatch between skills demanded and those available to persist. Training for some jobs may only be available within individual firms. But, employers may limit the amount of time and money they are willing to spend on training because of the risk that, having spent those resources on training, the employee will not remain with the firm. If firms are reluctant to train new employees, that is likely to perpetuate any mismatch in the supply of and demand for skills in the labor market.

⁸ See: Robert J. Gordon, *Macroeconomics*, Scott, Foresman and Company, 1990, pp. 331-334. Also, Edmund Phelps, *Inflation Policy and Unemployment Theory*, Macmillan, 1972.

Educational institutions may be slow to keep up with trends in the firms' requirements for skilled labor. Limited access to educational programs may represent another constraint to developing a better match between those skills that are required and those that are available. Some prospective students may find it difficult or impossible to acquire financing to pay for a college education.

Legal requirements faced by employers may make firms reluctant to hire someone until they are reasonably sure that the employee will be needed for some time and is likely to stay. Similarly, some employers may be reluctant to hire women during their child-bearing years for fear that they will not remain long with the firm. Because these tendencies restrict the supply of labor from which employers are willing to hire, they push wages higher and tend to increase unemployment above what it would otherwise be.

Limits to geographical mobility may also account for some of the mismatches in the labor market. There are costs, both monetary and emotional, associated with pulling up stakes and moving to another part of the country in order to get a new job. It may also be the case that the further removed a job prospect is, geographically, the less likely it is that a jobseeker will even hear about it. The increased prevalence of two-earner households in recent years may have reduced the geographical mobility of the labor force.

Some of the mismatch may be deliberate. Individuals may remain unemployed for some time not because a job is unavailable, or because they lack training, but because they believe that they can find a better job than any that have been offered so far. As long as jobseekers believe that they can do better than any wage offered so far, they will continue to search and remain unemployed. It may also be that some unemployment is due to individuals in an irregular line of work who remain idle so as to be available when a particular job begins, or a person may know a particular position is expected to become available and wait for that opportunity. Some of this type of unemployment is inevitable.

Race, wage, or other forms of discrimination in hiring would also tend to exacerbate any existing mismatches in the labor market. If an employer shrinks the pool of labor from which he is willing to hire, that reduces the chances that he will find someone with the appropriate skills.

While some unemployment is attributable to mismatches between the supply of and the demand for labor, there is also a chronic component to the level of unemployment. Some individuals' skills are so low that what a firm might be willing to pay them is not enough to make it worth their while to work. Some argue that this problem is exacerbated by the minimum wage standard which may prevent some from accepting work at very low wage rates even if they wanted to.

Those who are characterized by chronic unemployment may also be influenced by the availability of welfare benefits which enables them to pass up opportunities for work.

The generosity of unemployment insurance benefits as well as their longevity might also have an effect on the natural rate. Employers may find it easier to lay off

workers knowing that there is a safety net of sorts for the unemployed. At the same time, job seekers receiving unemployment benefits may be able to spend more time searching for employment. Unemployment insurance may encourage some to enter the labor market who would not otherwise have done so. Perversely, unemployment insurance may encourage job seekers to accept employment that is likely to be temporary. In addition, the availability of unemployment insurance may tend to raise the average wage individuals require to accept employment. This is known as the "reservation wage."⁹

If labor market imperfections affect some groups of the labor force more than others, then it might be expected that changes in the demographic composition of the labor force would be a factor explaining variations in the natural rate over time. Two major demographic shifts affected the labor force during the 1970s. One was the large increase in the labor force participation rate of women. The second was the entrance into the labor force of the baby-boom generation.

Why should demographic shifts have any effect on the natural rate? Some groups have historically experienced higher than average rates of unemployment. An increase in the labor force share of any one of these groups would tend, other things being equal, to increase the overall unemployment rate.

The rising labor force participation rate of women does not appear to have had much effect on the increase in the natural rate during the 1970s. A study published by the Labor Department reported that between 1959 and 1989 women aged 25 and over actually experienced below-average rates of unemployment, suggesting that an increase in their participation rates would have been an unlikely reason for any increase in overall unemployment. Instead most of the change in unemployment attributable to demographic factors was found to be due to the increased share of young people in the labor force.¹⁰

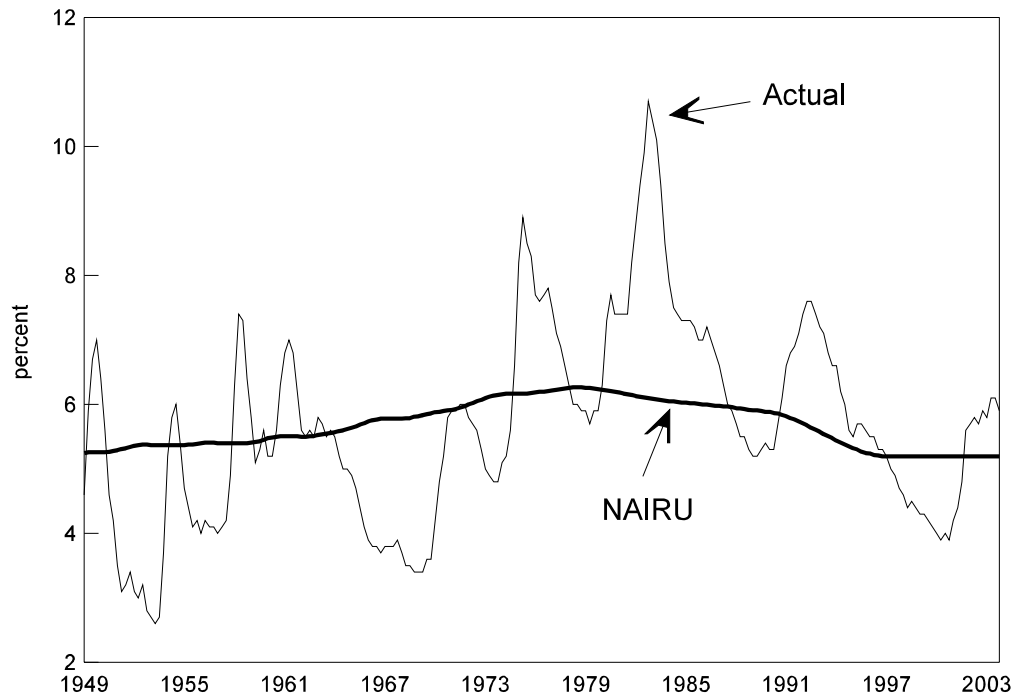
The effect these factors have on the level of the natural rate of unemployment varies over time. Figure 4 shows the natural rate, as estimated by the Congressional Budget Office (CBO), since 1949, as well as the actual rate of civilian unemployment.¹¹ Two trends in this estimate of the natural rate are apparent. The natural rate rose steadily through the 1970s, and then declined somewhat since the early 1980s.¹²

⁹ See: Anthony B. Atkinson and John Micklewright, "Unemployment Compensation and Labor Market Transitions: A Critical Review," *Journal of Economic Literature*, vol. xxix, Dec. 1991, pp. 1679-1727.

¹⁰ Paul O. Flaim, "Population changes, the baby boom, and the unemployment rate," *Monthly Labor Review*, Aug. 1990, pp. 3-10.

¹¹ CBO refers to it as the NAIRU.

¹² Not all analysts believe that the natural rate has declined much since the 1980s. See: Brian Motley, "Has There Been a Change in the Natural Rate of Unemployment?," Federal Reserve Bank of San Francisco *Economic Review*, Winter 1990, pp. 3-16.

Figure 4. Actual Unemployment and the NAIRU

Sources: Congressional Budget Office; Department of Labor, Bureau of Labor Statistics.

Although the natural rate may be insensitive to fiscal and monetary policy shifts, there are other policies that may have some effect. Since public policy is unlikely to have much effect on demographic shifts, policymakers hoping to reduce the natural rate might focus on the labor market itself. A number of labor market policies have been suggested such as categorical employment or training subsidies, reducing or eliminating the minimum wage (or establishing a youth sub-minimum wage), loans for vocational training, and youth apprenticeships.

Critics of the Natural Rate Hypothesis

Although the natural rate hypothesis is today widely accepted in the economics profession, some remain skeptical. These economists maintain that there is still a trade-off between unemployment and inflation that persists in the long run, although not on as favorable terms as the short-run tradeoff.¹³

This view relies on evidence that nominal wages tend to be "sticky" downward. That is, they do not readily respond to changes in the relation between supply and demand. Ideally, the allocation of labor across different sectors of the economy depends on relative wages. Wages in declining sectors of the economy would tend

¹³ See: James Tobin, "Inflation and Unemployment," *American Economic Review*, vol. lxii, no. 1, Mar. 1972, pp. 1-18.

to fall and those in more vigorous industries would tend to rise. Changes in relative wages encourage labor to shift from declining industries into those that are more prosperous.

But, if nominal, or money, wages tend to be unresponsive to changes in the composition of demand, then just because an industry is in decline, wages may not fall. If this is the case, it might be argued that a little bit of inflation could be a good thing. If money wages are slow to decline in the face of falling demand in a particular sector of the economy, rising prices may nonetheless effect a decline in real wages which may enable declining firms to avoid the alternative to falling real wages, reducing employment. If inflation offsets inertia in money wages, then employment might be maintained at a higher level, and the unemployment rate might be sustained below the natural rate without experiencing accelerating rates of inflation. If there is any long-run trade-off that can be exploited in this way, it is much less favorable than the short-run trade off described above.

Such an outcome depends on the phenomenon, known as money illusion, that for some reason workers fail to fully appreciate the effects of inflation on their money wages. However, there is evidence to the contrary. One study found that money wages were substantially responsive to changes in the price level.¹⁴ A second study which focused on financial markets found some evidence of money illusion in that nominal rates of return did not fully reflect inflation. That tendency, however, was found to have diminished over time.¹⁵

The 1990s: An Empirical Challenge to the Natural Rate?

Seemingly, in the second half of the 1990s, the U.S. economy enjoyed the best of both worlds. Between 1992 and 2000, the civilian unemployment rate fell from as high as 7.8% to as low as 3.8%. For much of the time since the mid-1990s, the unemployment rate was at or below many estimates of the natural rate, which led many economists to expect signs of an accelerating in the rate of inflation. But, the expected rise in inflation failed to materialize. In fact, perhaps to the surprise of many, in some of those years the inflation rate fell.

To skeptics, the simultaneous low rates of inflation and unemployment confirmed their suspicions that the natural rate model was flawed. To adherents, it begged two questions. First, is the natural rate now lower than most estimates had suggested? Second, are there some other factors which are temporarily preventing the acceleration in inflation that many had expected?

¹⁴ For evidence concerning the "stickiness" of wages and prices, see: Robert J. Gordon, "A Century of Evidence on Wage and Price Stickiness in the United States, the United Kingdom, and Japan," *Macroeconomics, Prices, and Quantities*, edited by James Tobin. The Brookings Institution, 1983, pp. 85-121.

¹⁵ Lawrence H. Summers, "The Nonadjustment of Nominal Interest Rates: A Study of the Fisher Effect," *Macroeconomics, Prices, and Quantities*, edited by James Tobin, The Brookings Institution, 1983, pp. 201-241.

One argument that has been made is that the economy has been performing so well, with low rates of both inflation and unemployment, because the U.S. has been enjoying a surge in productivity growth, due perhaps to increased investment in computers.

Whether or not the trend rate of productivity growth has picked up, there are reasons to doubt that an increase in productivity would have the effect of permanently reducing the natural rate of unemployment.¹⁶

Firms set wages on the basis of the productivity of their employees. An increase in productivity would tend to increase the wages offered by employers since the contribution of each worker to total production would be greater. One might also presume that jobseekers would be aware of their increased value to employers and so demand a higher wage for a given job.¹⁷

But, suppose that jobseekers, at least initially, do not fully appreciate the increase in their productivity. In that case, they would not be expected to increase the wage at which they would be willing to accept employment. Given that there is a wide distribution of skill levels among those looking for work, that would tend to increase the pool of jobseekers that would be willing to accept a given job offer, and would increase the number of job offers an unemployed individual might be willing to accept, making it more likely that firms would be able to find new hires, and tending to shorten the time it takes to fill positions. In other words, the number of mismatches in the job market would tend to fall, and thus so might the natural rate.

But this asymmetry between employers and jobseekers, concerning improved productivity, may not last. It might be unreasonable to presume that jobseekers would remain ignorant of an improvement in productivity of which employers were fully aware. Once jobseekers learn of their increased value to employers their wage demands would likely adjust to reflect the new information. As a result, any decline in the natural rate of unemployment due to an increase in productivity would be likely to prove temporary.

Some of the improvement in productivity, however, might be in the labor market itself. If, for example, the time it takes for job seekers and employers to find matches were reduced because of the internet, that might yield a slight permanent reduction in the proportion of the labor force that was unemployed at any given time, and thus also yield a slight decline in the natural rate.

Another factor that has been suggested as a possible constraint on inflation is the fact that a number of other countries have not been enjoying the same vigorous economic growth as has occurred in the U.S. over the past few years. As a result, or so the argument goes, excess capacity has held down the prices of foreign goods. Lower-priced foreign-produced goods are then said to have held down the U.S.

¹⁶ Paul Gomme, "What Labor Market Theory Tells Us About the "New Economy," Federal Reserve Bank of Cleveland *Economic Review*, 3rd quarter 1998, pp. 16 -24.

¹⁷ Bharat Trehan, " Unemployment and Productivity," Federal Reserve Bank of San Francisco *Economic Letter*, no. 2001-28, Oct. 12, 2001.

inflation rate both directly, through low-priced imports, and indirectly because of the threat that if domestic producers raised the prices of their goods they would lose market share to foreign competition.

The direct effect of low-priced imports on domestic inflation is necessarily limited because of the small share of total U.S. consumption accounted for by imported goods and services. To the extent that imports are cheaper than domestically produced substitutes consumers may spend more on those cheaper substitutes. That increase in spending on imported goods and services, however, will translate into an increased supply of dollars in foreign exchange markets and an increase in demand for foreign currencies with which to buy those imports. The result is that the value of the dollar will tend to fall and that will tend to increase the price of imported goods and services to domestic consumers. Thus the direct effect of lower priced imports on domestic inflation is limited.

With regard to the indirect effects, it has been argued that increased sensitivity to competition from abroad, combined with excess capacity in foreign economies, has made it difficult for domestic producers to raise prices in the face of high levels of domestic demand.

There are reasons to doubt that this is the case. In the case of small firms exporting to the U.S., they are not likely to be a dominant factor in setting prices in the market for close substitutes for the goods they are selling. More likely their price setting behavior will be determined by domestic U.S. market conditions. In the case of larger firms that may have greater influence in the market, there is evidence that the prices charged to U.S. consumers tend to vary less than does the foreign exchange value of the dollar. This suggests that foreign firms only pass on a part of their fluctuations in costs to their export customers. In fact, there is evidence that suggests that there is very little in the way of consequences for U.S. inflation due to slack demand, or excess capacity, in foreign countries.¹⁸

Economist Robert Gordon attempted to estimate the extent to which temporary factors might have accounted for the non-acceleration of inflation in the late-1990s.¹⁹ He identified two supply-side factors which may have tended to hold prices down; declining food and energy prices (mainly oil prices), and the fall in prices of imports due largely to the appreciation of the dollar. In addition, Gordon identified three other temporary factors which may have helped offset any tendency of inflation to rise in the face of a booming economy. These were the rapid decline in computer prices, a drop in the rate of increase in medical care prices, and finally a change in the way the inflation statistics themselves were calculated. Gordon found that the combined effect of these five factors was to reduce measured inflation below what it otherwise would have been by over 1.5 percentage points per year between 1993 and 1998.

¹⁸ Geoffrey M. B. Tootell, "Globalization and U.S. Inflation," *New England Economic Review*, July/Aug. 1998, pp. 21-33.

¹⁹ Robert J. Gordon, "Foundations of the Goldilocks Economy: Supply Shocks and the Time-Varying NAIRU," Feb. 3, 1999 revision of the paper presented at the Brookings Panel on Economic Activity, Washington, D.C., September 4, 1998, 52 pp.

Estimates of the Natural Rate

For much of the eighties and early nineties many economists estimated the natural rate to be about 6%, if not a little bit higher.²⁰ Some policymakers apparently held similar views. In late 1987, in the fifth year of uninterrupted economic expansion, the civilian unemployment rate fell below 6%. Consumer price inflation, which had fallen to 1.1% for the 12 months ended in December 1986, accelerated to a 4.4% rate in 1987. In early 1988, the Federal Reserve decided on a change to a slightly more restrictive monetary policy in order to cool down an economy that showed signs of overheating. Between March 1988 and March 1989, short-term interest rates rose by over three percentage points. After 1988, the pace of economic growth slowed and in July 1990, the economy began a contraction which lasted until March 1991.

Again, beginning in early 1994 and continuing into 1995, the Federal Reserve engineered a 3 percentage point rise in short-term interest rates. This apparent tightening of monetary policy began at a time when the actual civilian unemployment rate was *above* 6%.

More recent economic experience suggests that the natural rate is at least below 6%. In September 1994, the civilian unemployment rate fell below 6%, and from June 1997 until September 2001 it was below 5%. For all of the 1990s, consumer price inflation remained under 3.5%, and in the middle of the long economic expansion, with unemployment rates falling, the rate of inflation fell as well.

That the unemployment rate has been so low for so long with no significant rise in the inflation rate has led some to suggest that the natural rate has fallen in recent years, and that unemployment rates below 6% might be compatible with a long-run stable rate of inflation.

One difficulty with the concept of the natural rate of unemployment is that it is not a number that can be specified with great accuracy. For example, one statistical analysis recently found that there was a 95% probability that the natural rate fell somewhere between 3.9% and 7.6% in the first quarter of 1994.²¹

A major source of uncertainty is the question of how to account for factors that may briefly change the way in which unemployment and inflation are related. For example, it has been suggested that during the 1990s, there may have been supply-side factors that kept the inflation rate from accelerating at a time when it might have been expected to do so. The equations used by economists to estimate the value of the natural rate yield different answers depending upon whether they include these

²⁰ See, for example: Stuart E. Weiner, "New Estimates of the Natural Rate of Unemployment," Federal Reserve Bank of Kansas City *Economic Review*, Fourth Quarter 1993, pp. 53-69.

²¹ Douglas Staiger, James H. Stock, and Mark W. Watson, "The NAIRU, Unemployment and Monetary Policy," *The Journal of Economic Perspectives*, vol. 11, no. 1, Winter 1997, pp. 33-49.

‘temporary’ factors or not. A drop in oil prices, for example, will temporarily reduce the inflation rate that might otherwise have obtained at *any* given level of unemployment. Thus, in a sense, the unemployment rate consistent with a stable rate of inflation may have fallen, if only temporarily. However, a natural rate that tends to vary significantly over short periods of time (even presuming it is known with some accuracy) might not be especially useful as a guide to economic policy.

Joseph Stiglitz, former chairman of the Council of Economic Advisors, argued that while the natural rate is subject to considerable uncertainty, given economic history since 1960 it is unlikely that the natural rate had ever been either much above 7% or below 5%.²² He goes on to say that there is evidence that the natural rate has probably fallen by as much as 1.5 percentage points since the early 1980s. That would put it no higher than about 5.5%.

Stiglitz argues that three factors account for the 1.5 percentage point decline in roughly equal proportions. First, demographic changes have affected the natural rate, most important has been the aging of the baby-boom generation. The second reason is that in the 1970s, when productivity growth slowed, workers were slow to moderate their wage demands and so that tended to push up the natural rate. Once workers recognized the slowdown in productivity, their expectations for wage increases have adjusted and the natural rate has come back down. Third, Stiglitz argues, is that product and labor markets have become increasingly competitive.

Another economist, Robert Gordon, has also published evidence that the natural rate may have fallen in recent years.²³ Gordon's earlier estimates of the natural rate, published in his popular economics textbook, were based on demographic changes in the labor force. For example, an increase in the share of the labor force accounted for by teenagers and women, who typically experience higher unemployment rates, would cause Gordon's estimated NAIRU to rise.

In the late 1980s, however, Gordon found that this demographic-based NAIRU did not do as well predicting inflation. Based rather on its statistical relationship with inflation, Gordon estimated the NAIRU to be about 6% for the entire decade.

Most simple estimates of the NAIRU rely on an analysis of the relationship between the unemployment rate and the inflation rate. For any given time period, a single value of the NAIRU is calculated. More recently, Gordon estimates have been based on an equation that allows the NAIRU to vary from year to year. Depending on the particular price index used to derive the estimate, Gordon put the NAIRU between 5.7% and 6% in 1998, after taking into account the short-term effects of

²² Joseph Stiglitz, “Reflections on the Natural Rate Hypothesis,” *Journal of Economic Perspectives*, vol. 11, No. 1, Winter 1997, pp. 3-10.

²³ Robert Gordon, “The Time-Varying Nairu and its Implications for Economic Policy,” *Journal of Economic Perspectives*, vol. 11, no. 1, Winter 1997, pp. 11-32.

computer and medical care prices, as well as revisions in the way inflation is calculated.²⁴

Similarly, economist Roger Brinner, after accounting for the temporary effects of import, energy, and medical care prices argues that inflation will eventually accelerate unless the unemployment rate rises to between 5.5% and 6.6%.²⁵

Rather than trying to make a single point estimate, Barnes and Olivei suggest that it may be more useful to think of the natural rate as a range.²⁶ They find that the short run trade-off between unemployment and inflation depends on whether actual unemployment is inside or outside an estimated range. Variations in the actual unemployment rate within the range have no appreciable effects on the inflation rate. If actual unemployment falls below the range, then inflation starts to accelerate, and if actual unemployment rises above the estimated range, then the inflation rate will tend to fall. Barnes and Olivei estimate the range to be from 4.0% to 7.5%.

If this view is correct, any unemployment rate within the range would be consistent with a stable rate of inflation. But, presumably, the lower end of the range would be preferable to the higher end. Given the uncertainty of the estimates, the range presents policymakers with many of the same problems associated with a point estimate of the natural rate.

Ball and Mankiw examine the potential effects on the natural rate of variations in productivity growth.²⁷ They show that changes in the growth rate of productivity can cause the short-term trade-off between unemployment and inflation to shift. In effect, an acceleration in productivity that is unmatched by a rise in wage demands can lead to a temporary decline in the natural rate. Similarly, a slowdown in productivity growth can temporarily push up the natural rate. By taking variations in productivity into account, and specifically the increase in productivity growth that began in 1995, Ball and Mankiw estimate that the natural rate may have been as low as 4% in 2000.

The natural rate model predicts that an unemployment rate cannot remain below the natural rate without a permanently accelerating rate of inflation. But, given an actual unemployment rate below the NAIRU, how soon will the increases in inflation begin and how rapidly will they happen? Inflation has generally been found to be

²⁴ Robert Gordon, "Foundations of the Goldilocks Economy: Supply Shocks and the Time-Varying Nairu," February 3, 1999 revision of the paper presented at the Brookings Panel on Economic Activity, Washington, D.C., September 4, 1998. 52 pp.

²⁵ Roger E. Brinner, "Is Inflation Dead?," *New England Economic Review*, Jan./Feb. 1999, pp. 37-49.

²⁶ Michelle L. Barnes and Giovanni P. Olivei, "Inside and Outside Bounds: Threshold Estimates of the Phillips Curve," *New England Economic Review*, Federal Reserve Bank of Boston, 2003 Issue, pp. 3-18.

²⁷ Laurence Ball and N. Gregory Mankiw, "The NAIRU in Theory and Practice," *Journal of Economic Perspectives*, Vol. 16, no. 4, Fall 2002, pp. 115-136.

characterized by significant inertia.²⁸ That is, the inflation rate has a strong tendency to stay where it is, so that it is slow to respond to changes in economic conditions. This works in both directions. The inflation rate may seem slow to rise when the economy is operating at more than full employment, but it may also take long periods of significant underemployment to bring about appreciable reductions in the inflation rate.

There are a number of quantitative estimates of the effect on inflation of maintaining the actual unemployment rate below the natural rate. Stiglitz found that if the actual rate remains below the natural rate for one year (he does not specify how much) the inflation rate would rise by somewhere between 0.3 and 0.6 percentage points.²⁹ Gordon found that, other things being equal, that if the actual unemployment rate is held one percentage point below the natural rate that measured inflation would rise by 0.3 percentage points per year.³⁰ Brinner estimates the inflation response to a one percentage point drop in unemployment to be about 0.5%.³¹ These estimates imply that the rate of acceleration is slow, a view which some might dispute. But, if the estimates are at least valid for the very short run, they suggest that a small policy mistake might not be immediately catastrophic. At the same time, even a gradually rising rate of inflation would presumably eventually reach unacceptable levels and the cost of reducing it, in terms of lost output and high unemployment, could be substantial.

Conclusions

A policy goal which can only be temporarily realized is only likely to satisfy those who have relatively short time-horizons. In isolation, an unemployment rate of 4% might seem like a good thing, but if it can only be had at the cost of spiraling inflation it may not seem like much of a bargain.

The natural rate model may not be the last word on the interaction between unemployment and inflation, and it has its share of weaknesses. But, although the recent performance of the economy has generated some doubts as to whether it remains a useful policy guide, it remains an important part of most economists' conception of how the economy works. Most current estimates of the natural rate continue to suggest that unemployment rates below 5% will eventually lead to a rising rate of inflation. The factors that prevented it from happening in the late 1990s are believed by many to have been temporary.

²⁸ See: Robert J. Gordon, "A Century of Evidence on Wage and Price Stickiness in the United States, the United Kingdom, and Japan," in *Macroeconomics, Prices and Quantities*, edited by James Tobin, The Brookings Institution, 1983, pp. 85-133.

²⁹ Joseph Stiglitz, "Reflections on the Natural Rate Hypothesis," *Journal of Economic Perspectives*, vol. 11, no. 1, Winter 1997, pp. 3-10.

³⁰ Robert Gordon, "The Time-Varying Nairu and its Implications for Economic Policy," *Journal of Economic Perspectives*, vol. 11, no. 1, Winter 1997, pp. 11-32.

³¹ Roger E. Brinner, "Is Inflation Dead?," *New England Economic Review*, Jan./Feb. 1999, pp. 37-49.

Moreover, just because rapid inflation fails to materialize as soon as the unemployment rate falls below the estimated natural rate may be little reason to remain unconcerned. Inflation may be slow to pick up in response to labor market tightness. Once the inflation rate rises significantly, it can also take time to respond to any labor market slack, making disinflation a costly process that might better be avoided altogether. Thus, any indicator that helped policymakers avoid higher inflation in the first place would be extremely useful.