An hourglass-shaped graphic with a globe inside. The top bulb is dark blue, and the bottom bulb is light blue. The globe is centered in the narrow neck of the hourglass. The text is centered within the hourglass.

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Report RL33734

*Economic Growth, Inflation, and Unemployment: Limits to
Economic Policy*

Brian W. Cashell, Government and Finance Division

November 20, 2006

Abstract. This report examines the relationships among the rates of economic growth, inflation, and unemployment.

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Economic Growth, Inflation, and Unemployment: Limits to Economic Policy

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November 20, 2006

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Summary

For some time, economic growth has been steady, unemployment has been low, and inflation has been subdued. Absent other considerations, faster economic growth is desirable, as are lower unemployment and inflation rates. However, there may be limits to how compatible those goals are. The success of macroeconomic policy cannot be measured by just one of these variables in isolation, because they are interdependent.

Over the long run, the faster the economy grows, the better off people are materially. In the short run, however, the rate of growth has consequences for other economic variables. If growth persists at too rapid a rate, there is a risk that inflation may accelerate. If growth is too slow, then there is a risk of rising unemployment. Although rising unemployment is typically associated with economic contractions, or recessions, it is entirely possible for the economy to be growing but not rapidly enough to prevent the unemployment rate from rising.

There is an inverse relation between economic growth and unemployment. A simple statistical analysis suggests that the critical rate of economic growth between 1950 and 2005 was 3.4%. Growth above that rate tended to push the unemployment rate down, and growth below that rate was associated with an increase in the unemployment rate. Because labor force growth is expected to slow somewhat in coming years, the rate of economic growth needed to prevent the unemployment rate from rising might be expected to be closer to 3% for the foreseeable future.

There is also a relationship between unemployment and inflation. For some time, it was believed that there was a trade-off between inflation and unemployment that policymakers could exploit. That is no longer widely considered to be a sustainable policy. 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.

It seems safe to say, given recent evidence, that an unemployment rate of 2% is too low if a rising rate of inflation is to be avoided. Similarly an unemployment rate of 8% would appear to be unnecessarily high. Most estimates suggest that an unemployment rate somewhere between 5% and 6% might be consistent with a stable rate of inflation. While inexact, it may be a guide that policymakers use in an effort to benefit the overall economy.

This report will not be updated.

Contents

Introduction	1
Economic Growth and Unemployment	1
Unemployment and Inflation.....	5
The Phillips Curve.....	5
The Natural Rate	6
What Determines the Natural Rate?.....	10
Estimates of the Natural Rate.....	12
Implications for Policymakers.....	15

Figures

Figure 1. Economic Growth and the Unemployment Rate	4
Figure 2. Inflation and Unemployment Rates, 1960 to 1969	6
Figure 3. Inflation Expectation and the Phillips Curve	8
Figure 4. Inflation and Unemployment, 1970 – 1982	10
Figure 5. Actual Unemployment Rate and the NAIRU.....	12

Tables

Table 1. Selected Growth Rates.....	4
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Contacts

Author Contact Information	16
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<http://wikileaks.org/wiki/CRS-RL33734>

Introduction

Although not all of the economic news in recent years has been good, from a macroeconomic perspective, there have been worse times. For some time, economic growth has been steady, unemployment has been low, and inflation has been subdued. Absent other considerations, faster economic growth might be considered desirable, as would lower unemployment and inflation rates. However, there may be limits to how compatible those goals are. The success of macroeconomic policy can not be measured by just one of these variables in isolation, because they are interdependent. Understanding that there may be limits that influence the behavior of these variables is critical.

In the long run, real economic growth is the means by which the nation achieves higher living standards. Over the long run, the faster the economy grows, the better off people are materially. In the short run, however, the rate of growth has consequences for other economic variables. If growth persists at too rapid a rate, there is a risk that inflation may accelerate. If growth is too slow, then there is a risk of rising unemployment. Although rising unemployment is typically associated with economic contractions, or recessions, it is entirely possible for the economy to grow yet not rapidly enough to prevent the unemployment rate from rising. Knowing the rate of economic growth is necessary to reduce the unemployment rate, or at least to keep it from rising, would be of considerable use to policymakers.

The relation between unemployment and inflation is also of interest to 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 is no longer widely considered to be a sustainable policy. 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 define full employment as the lowest rate of unemployment consistent with a stable rate of inflation.

Some idea of what that rate of unemployment is would also be useful to policymakers. Inflation tends to be slow to respond to those changes in policy that 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. This report examines the relationships among the rates of economic growth, inflation, and unemployment.

Economic Growth and Unemployment

That there is a stable relationship between the rate of economic growth and changes in the unemployment rate was most famously argued by economist Arthur Okun. It has become one of a number of “core ideas” that are widely accepted in the economics profession.¹

¹ Alan Blinder, “Is There A Core of Practical Macroeconomics That We Should All Believe,” *American Economic Review*, vol. 87, no. 2, May 1997, pp. 240-243.

The key to the relationship between the rate of economic growth and the unemployment rate is the rate of growth of what economists refer to as “potential output.” Potential output is a measure of the capacity of the economy to produce goods and services given the available resources, namely, labor and capital.

Just as the level of potential output depends on the amount of labor and capital available, the rate of growth of potential output depends on the rates of growth of both labor and capital. But the contributions of labor and capital are not fixed. Each addition to the stock of capital increases the output a given quantity of labor is able to produce. Technological progress improves the contribution of both labor and capital to production. Growth in potential output is the sum of growth in the labor force and increases in the ability of labor to produce, or labor productivity.

The growth rate of the contribution of labor to economic output is determined by the size of the population, the age distribution of the population, the share of the working-age population that is in the labor force (the labor force participation rate), the share of the labor force that is actually employed, and the hours worked by those who are employed. Ultimately, labor is measured in terms of hours. Because hours worked by those who are employed do not vary tremendously over time, the contribution of labor to total output depends mainly on the size of the labor force and the proportion of it that is employed.

The labor force consists of those who are either working or who are looking for work. *In the absence of productivity growth*, as long as each new addition to the labor force is employed, growth in total output will just equal the growth in the labor force. If growth in the demand for goods and services falls below the rate of growth of the labor force, job creation will not be sufficient to accommodate additions to the labor force. The proportion of the labor force that is employed will fall, and the unemployment rate will rise.

If demand for goods and services grows more rapidly than the labor force, some of the new jobs being created will be filled by drawing workers from the ranks of the unemployed, and the unemployment rate will fall. If there is considerable slack in the economy, and the unemployment rate is relatively high, this does not pose a problem, and moreover would be desirable. But if unemployment is already at relatively low levels, the increased demand for labor is more likely to be satisfied by pushing up wages than by reducing unemployment. Furthermore, if firms find it hard to increase production, any increase in the demand for goods and services is likely to be met by rising prices.

If labor productivity is rising, over time it will take fewer and fewer workers to produce a given quantity of goods and services. If growth in the output of goods and services only matched the growth rate of the labor force, then growth in the labor force would exceed what is necessary to produce the higher levels of output. The share of the labor force employed would fall, and the unemployment rate would rise. Only as long as the growth in output, or the demand for it, equals the combined growth rates of the labor force and labor productivity will the unemployment rate remain constant. Knowing what that growth rate is would be useful to policymakers. Depending on conditions in the labor market, it might be desirable to strive for actual economic growth at, above, or even below that rate of growth.

History bears out the expected relationship between economic growth and the unemployment rate. Each point plotted in **Figure 1** represents both the annual rate of economic growth and the percentage point change in the unemployment rate for each quarter since 1950. It is clear that there is an inverse relation between the two variables. A simple statistical analysis of these data

suggests that the critical rate of economic growth over the period was 3.4%. Growth above that rate tended to push the unemployment rate down, and growth below that rate was associated with an increase in the unemployment rate.

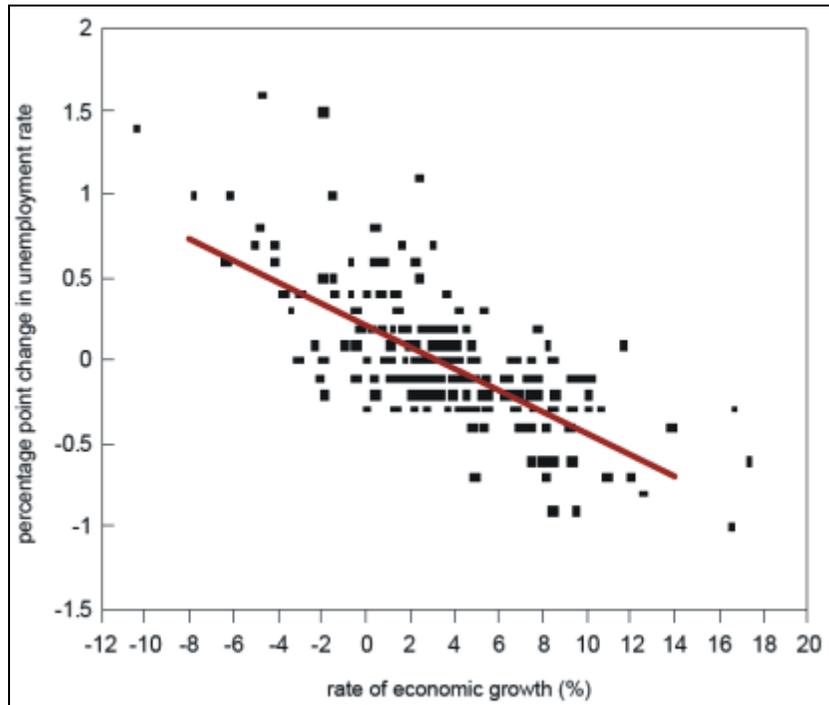
Over the course of a year, a one percentage point difference in the economic growth rate led to a change in the unemployment rate of about 0.3 percentage points. In other words, while economic growth of 3.4% was sufficient to maintain a stable unemployment rate, an increase in the growth rate to 4.4% was associated with a one-year decline in the unemployment rate of 0.3 percentage points. Similarly, a drop to an annual growth rate of 2.4% was associated with a one-year increase in the unemployment rate of 0.3 percentage points.

There are times, however, when the relationship breaks down. Changes in productivity growth tend not to be correlated with changes in unemployment. In the short run, a rise in productivity can produce an increase in the economic growth rate without necessarily pushing down the unemployment rate. For example, in 1992, the unemployment rate increased from 6.8% in the previous year to 7.5%. But at the same time, economic growth accelerated from -0.2% to 3.3%. The reason was a surge in productivity growth in 1992.² Productivity growth more than offset the effects of the rise in unemployment on growth in total output. In the short run, productivity growth may vary significantly from its trend rate of growth causing the relationship to appear to break down.

In the long run, labor market conditions are important determinants of the unemployment rate. Changes in the labor market may also cause the relationship between economic growth and the unemployment rate to break down. Neither labor force growth nor productivity growth has been constant since 1950, and it is likely that there have been some shifts in the economic growth rate consistent with a constant rate of unemployment.

² David Altig, Terry Fitzgerald, and Peter Rupert, "Okun's Law Revisited: Should We Worry about Low Unemployment?," Federal Reserve Bank of Cleveland, *Economic Commentary*, May 15 27, 1997, <http://www.clevelandfed.org/research/Com97/0515.htm>.

Figure I. Economic Growth and the Unemployment Rate



Sources: Department of Commerce and Department of Labor.

While productivity growth has cyclical characteristics, its long-run trend rate of growth is considered to be of particular significance. Economists have identified two instances in the post-World War II era where the trend rate of growth of productivity changed. In 1973, productivity growth slowed for reasons still not clearly understood, and in 1995, it appears to have accelerated due at least in part to investments in computers and their falling prices.³ The data in **Table 1** illustrate these changes.

Table 1. Selected Growth Rates

Interval	Annual Rate of Growth In:			
	Real GDP	Real GDP Per Employed Person	Employment	Labor Force
1950 to 1973	4.0	2.3	1.6	1.6
1973 to 1995	2.8	1.1	1.8	1.8
1995 to 2005	3.2	1.9	1.3	1.2

Sources: Department of Commerce, Bureau of Economic Analysis; Department of Labor, and Bureau of Labor Statistics.

The figures show that growth in real GDP per employed person, a measure of labor productivity, fell after 1973, then picked up again after 1995. The figures also show that employment and the

³ CRS Report RL32456, *Productivity: Will the Faster Growth Rate Continue?*, by Brian W. Cashell.

labor force grew at nearly identical rates during the three intervals. That is because each of the three break points were at roughly the same stage of the business cycle, and so similar shares of the labor force were employed. In addition, the data show that while productivity picked up after 1995, growth in the labor force and in employment fell, somewhat offsetting the effect of productivity growth on GDP growth.

The growth rate of the labor force in the near term can be known with a certain degree of confidence. Absent dramatic changes in immigration or labor force participation rates, the labor force for the next few years is simply a function of the current population and the age distribution. The Bureau of Labor Statistics (BLS) of the Department of Labor projects that the average growth rate of the civilian labor force will be 1.0% through 2014.⁴ That would suggest that other things being equal, the growth rate consistent with a stable rate of unemployment would be slightly below what it has been in recent years.

Projections of productivity growth are necessarily much less certain. One source of productivity gains is capital investment and a rising capital-to-labor ratio. Historically, that has been a relatively stable source of gains in labor productivity. But a much less predictable contributor to productivity growth is technology. Technological innovations, such as the internal combustion engine or the personal computer, do not come about at regular predictable intervals. Neither can the effects of technological innovations on the economy be foreseen. Because of those difficulties, forecasts of productivity growth usually reduce to projections of recent trends. Given that, and barring any unexpected changes, the rate of economic growth needed to prevent the unemployment rate from rising might be expected to remain near 3% for the foreseeable future.

Unemployment and Inflation

Having established the approximate relationship between the rates of economic growth and unemployment leaves a second important question. What rate of unemployment is desirable? Considered in isolation, the lower the rate of unemployment the better. But history and economic theory suggest that there may be a rate of unemployment that is too low, which can not be sustained without imposing other significant costs.

The Phillips Curve

In a famous article published in 1958, economist A.W. Phillips claimed to have found 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.⁵ The implication was that policymakers could “buy” a lower rate of unemployment by tolerating a higher rate of inflation.

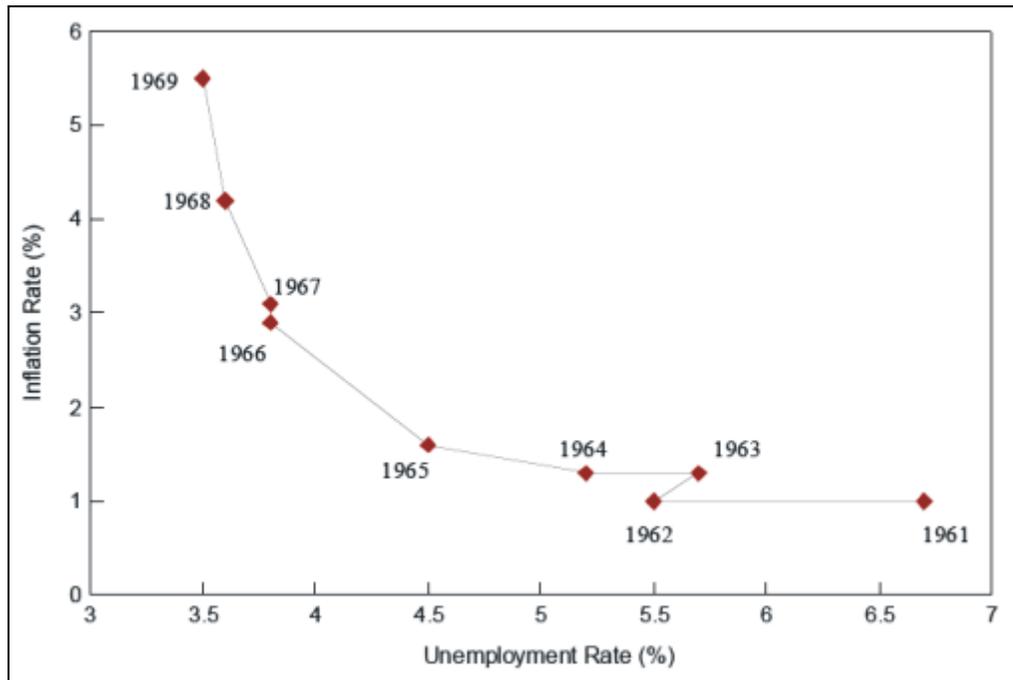
⁴ Norman C. Sanders, “A Summary of BLS Projections to 2014,” *Monthly Labor Review*, Nov. 2005, pp. 3-9.

⁵ The difference between wage increases and price increases is largely accounted for by changes in labor productivity.

The curve describing this trade-off became known as the “Phillips curve.” A stable Phillips curve would mean that policymakers might choose from among several combinations of inflation and unemployment rates the one that seemed most palatable and set that as the goal of macroeconomic policy. The U.S. experience of the 1960s seemed to provide evidence for the existence of such a trade-off.

Figure 2 plots annual U.S. unemployment and consumer price inflation rates together for the 1960s. These data suggested that there was a trade-off for the United States, and that policymakers could choose from among a number of combinations of unemployment and inflation rates, depending on their relative distastes for the two.

Figure 2. Inflation and Unemployment Rates, 1960 to 1969



Source: Department of Labor, Bureau of Labor Statistics.

The theoretical explanation for the downward-sloping line describing the trade-off between unemployment and inflation relied on the simple relationship between supply and demand. As long as aggregate demand is growing more rapidly than the economy’s capacity to produce, the unemployment rate will tend to fall, and vice versa. Furthermore, 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.⁶ But that explanation eventually proved to be incomplete.

The Natural Rate

In the late 1960s, in spite of the evidence for a Phillips curve that policymakers could exploit, two economists suggested that there had to be more to it than a simple trade-off between inflation and

⁶ 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.

unemployment. They predicted a breakdown of the Phillips curve. They argued that while monetary or fiscal policy might be conducted in such a way as to realize a particular combination of unemployment and inflation in the short run, it would not necessarily be a sustainable combination.⁷

This new argument contended that the trade-off along the Phillips curve was dependent on the fact that *unexpected* increases in the price *level* would reduce real wages. A reduction in real wages would tend to increase the demand for labor and push down the unemployment rate. A rise in prices could still result in lower unemployment as Phillips had suggested, but only until workers realized that the purchasing power of their wages was falling. This new view argued that there was not just a single Phillips curve, but a unique Phillips curve for every different possible expectation of inflation.

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. A faster rate of inflation causes workers to underestimate the effects of rising prices on their money wages, and unemployment declines due to a fall in real wages. But, unless workers *never* catch on (an unlikely prospect), at some point they will adjust their wage demands to reflect the higher rate of inflation. This increase in real wage demands will tend to reverse the drop in the unemployment rate due to the inflation surprise. In the long run, in this model, 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 it is the rate of unemployment consistent with a stable rate of inflation.⁸ If the inflation rate is zero, then the natural rate is also the unemployment rate consistent with a stable price *level*.⁹

In the absence of deliberate policy changes, 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. Depending on the conduct of economic policy, however, the adjustment to the natural rate can either be assisted or hindered.

According to the natural rate model, fiscal or monetary policy 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 attempted 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

⁷ See Milton Friedman, “The Role of Monetary Policy,” *The American Economic Review*, vol. 57, 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.

⁸ 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.

⁹ Some economists use a more clinical term for the natural rate, the “non-accelerating inflation rate of unemployment,” or NAIRU. At times, the natural rate is more casually referred to as the full-employment rate of unemployment.

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.

For example, suppose that the unemployment rate is 5% and the inflation rate is 3%. In addition, suppose that workers are fully aware of the inflation rate and fully expect that their wages will increase at the same rate.¹⁰ Now suppose that policy seeks to lower the unemployment rate by tolerating a more rapid rate of inflation. Say the inflation rate rises to 5%, which means that nominal wages that are rising at a 3% rate are falling at a 2% rate, in real terms. Those falling real wages increase the demand for labor, and the unemployment rate will fall below 5%. But, as seems likely, eventually workers will realize that inflation has accelerated and adjust their wage demands to match. As wages rise again and catch up with prices, the demand for labor will slacken and the unemployment rate will tend back to 5%.

The implication of a shifting Phillips curve is that in the long run there is no trade-off between inflation and unemployment, 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.

Figure 3. Inflation Expectation and the Phillips Curve

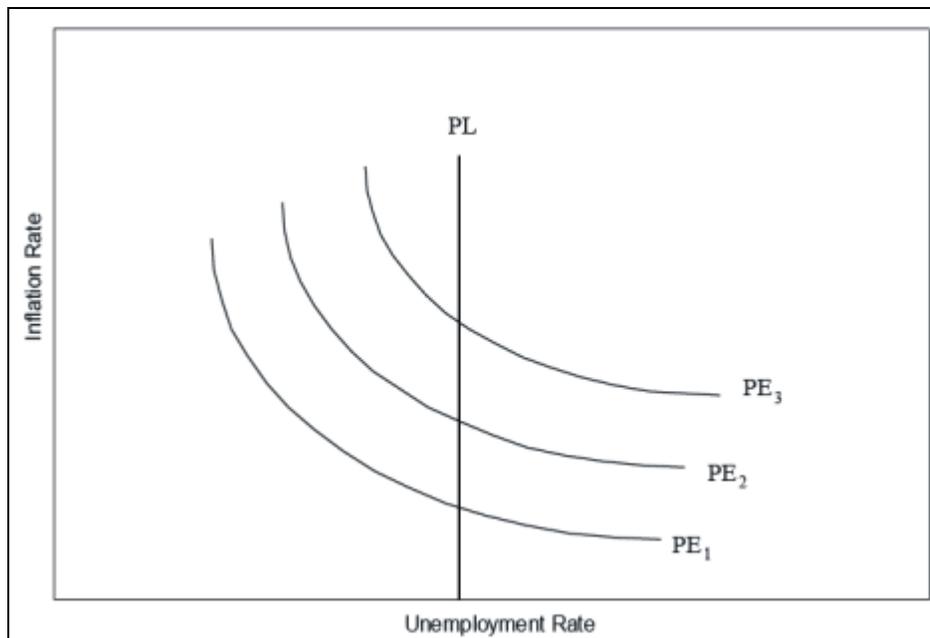


Figure 3 illustrates this point. Each Phillips curve ($PE_1 - PE_3$) is associated with a rate of expected inflation. Unexpected increases in inflation can result in movement along any one of the Phillips curves. But, an increase in expected inflation will result in an upward shift of the entire curve describing the short-term trade-off. 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.

¹⁰ For clarity and simplicity, this discussion ignores the effects of productivity growth on wages.

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 err on the high side and increasing real wage demands will tend to push up unemployment. Only if workers persistently underestimate inflation can the unemployment rate be held below the natural rate. But, once the inflation rises, it is unlikely 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 should 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 underestimated. 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.¹¹

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.”¹²

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

An unpleasant characteristic of the economy in the 1970s was “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. That was what had been predicted by the natural rate hypothesis several years before.

Figure 4 shows what happened to the relationship between the civilian unemployment rate and consumer price inflation beginning in 1970. It seems clear that any trade-off that may have existed during the 1960s, as was shown in **Figure 2**, was temporary. The experience of the 1970s

¹¹ 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.

¹² Evidence from hyperinflations suggests that eventually even ever-increasing inflation ceases to fool workers.

and early 1980s reinforced the view that there is no unique rate of unemployment permanently associated with any particular rate of inflation.

Figure 4. Inflation and Unemployment, 1970 – 1982



Source: Department of Labor, Bureau of Labor Statistics.

As the terms of the “trade-off” shifted, the data moved in a 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, by pursuing stimulative monetary or fiscal policies, attempt to exploit the “trade-off.” At first the rise in inflation may be unexpected, but as inflation expectations adjust and wage demands rise to maintain their purchasing power, the unemployment rate tends to go back up. Contractionary policies designed to combat higher inflation causes unemployment to rise further but also 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.

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 determined—by the interaction of supply and demand. That 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.

A number of factors 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 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.¹³

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.

A number of factors may cause the mismatch between skills demanded and those available to persist. Training for some jobs may only be available within individual firms. Educational institutions may be slow to keep up with trends in firms' requirements for skilled labor. 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. Limits to geographical mobility may also account for some of the mismatches in the labor market. Some of the mismatch may be deliberate. Individuals may remain unemployed for some time because they believe that they can find a better job than any that have been offered so far.

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.

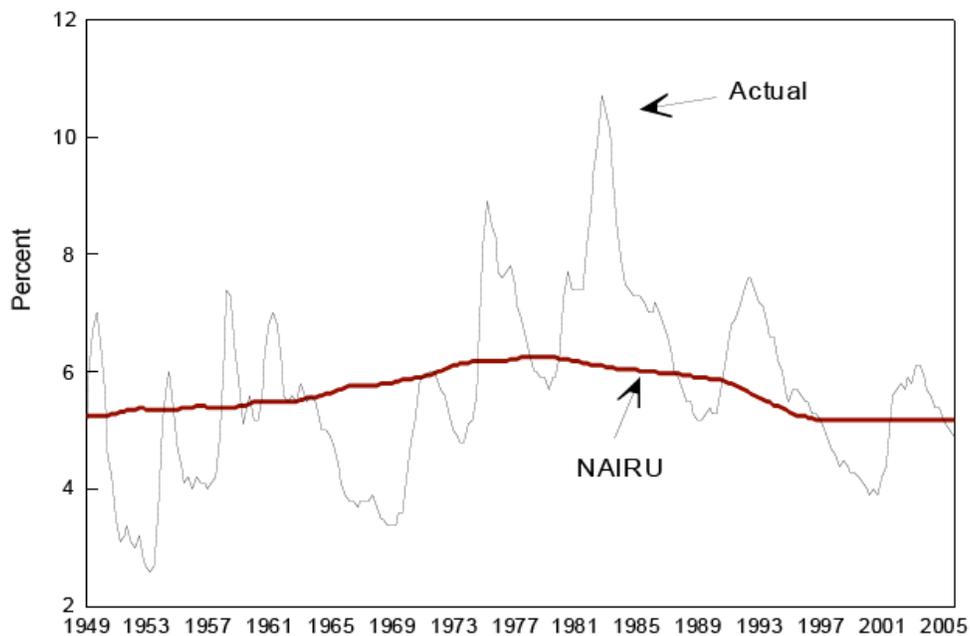
The rising labor force participation rate of women does not appear to have had much effect on the increase in the natural rate during the 1970s. A study published by the Labor Department reported

¹³ See Robert J. Gordon, *Macroeconomics*, Scott, Foresman and Company, 1990, pp. 331-334. Also, Edmund Phelps, *Inflation Policy and Unemployment Theory*, Macmillan, 1972.

that between 1959 and 1989, women aged 25 and older 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.¹⁴

The effect these factors have on the level of the natural rate of unemployment varies over time. **Figure 5** shows the natural rate, as estimated by the Congressional Budget Office (CBO), since 1949, as well as the actual rate of civilian unemployment.¹⁵ Two trends in this estimate of the natural rate are apparent. The natural rate rose steadily through the 1970s, then declined somewhat since the early 1980s.

Figure 5. Actual Unemployment Rate and the NAIRU



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

Estimates of the Natural Rate

For much of the 1980s and early 1990s, many economists estimated the natural rate to be about 6%, or a bit higher.¹⁶ At least a few 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

¹⁴ Paul O. Flaim, "Population changes, the baby boom, and the unemployment rate," *Monthly Labor Review*, Aug. 1990, pp. 3-10.

¹⁵ CBO refers to it as the NAIRU. CBO's estimates are based primarily on changes in the demographic composition of the labor force.

¹⁶ 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.

1986, accelerated to a 4.4% rate in 1987. In early 1988, the Federal Reserve decided on a change to a 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 that lasted until March 1991.

Again, beginning in early 1994 and continuing into 1995, the Federal Reserve, in order to prevent an acceleration in the rate of inflation, engineered a three percentage point rise in short-term interest rates. This 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 below 6%. In September 1994, the civilian unemployment rate fell below 6%, and with the exception of a brief interruption from late 2002 through the middle of 2003, it has remained below 6%. Between 1992 and 2005, consumer price inflation remained below 3.5%. Because the unemployment rate has been so low for so long with no significant rise in the inflation rate has convinced many that the natural rate has fallen since the 1980s, and that unemployment rates below 6% are compatible with a long-run stable rate of inflation. It is worth noting, however, that since mid-2004 the unemployment rate has been below 5.5% and since late 2005 has been below 5% while the inflation rate has picked up slightly. That might be evidence that the natural rate is currently at least above 5%.

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%.¹⁷ 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 argued that three factors accounted for the 1.5 percentage point decline in roughly equal proportions. First, demographic changes affected the natural rate, particularly the aging of the baby-boom generation. Second, in the 1970s, when productivity growth slowed, workers were slow to moderate their wage demands and that tended to push up the natural rate. Once workers realized growth in labor productivity had slowed, their expectations for wage increases adjusted and the natural rate fell. Third, Stiglitz argues, 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.¹⁸ 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.

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. Gordon's more recent estimates have been based on an equation that allows the

¹⁷ Joseph Stiglitz, "Reflections on the Natural Rate Hypothesis," *Journal of Economic Perspectives*, vol. 11, no. 1, winter 1997, pp. 3-10.

¹⁸ 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.

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 computer and medical care prices, as well as revisions in the way inflation is calculated.¹⁹

A major practical complication with the concept of the natural rate of unemployment, however, is that it is not a number subject to precise specification. For example, one statistical analysis found that there was a 95% probability that the natural rate fell somewhere between 3.9% and 7.6% in the first quarter of 1994.²⁰

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.²¹ 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%.

Ball and Mankiw examined the potential effects on the natural rate of variations in productivity growth.²² They showed 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 (as seems to have happened in 1992-93). 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 estimated that the natural rate may have been as low as 4% in 2000.

The natural rate model predicts that the actual 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 characterized by significant inertia.²³ 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 unemployment above the natural rate to bring about appreciable reductions in the inflation rate.

¹⁹ Robert 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, DC, Sept. 4, 1998.

²⁰ 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.

²¹ 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.

²² 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.

²³ 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.

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.²⁴ Gordon found that, other things being equal, if the actual unemployment rate is held one percentage point below the natural rate, inflation would rise by 0.3 percentage points per year.²⁵ 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. Because unemployment automatically tends back toward the natural rate, inflation can not confer any permanent benefit.

Implications for Policymakers

In an uncomplicated world, policy preferences would be clear. Faster economic growth is better than slower. Lower rates of unemployment are better than higher. Slower rates of inflation are better than faster. All of this is true, but only up to a point. There are practical limits to achieving faster growth, lower unemployment, and slower inflation rates at the same time. In the short run, when the capacity of the economy to produce goods and services is more or less fixed, faster economic growth may raise incomes but it also lowers the unemployment rate, and the evidence suggests that the unemployment rate can only fall so far without risking an acceleration in the inflation rate. The goal of policy might then be the fastest rate of economic growth and the lowest unemployment rate consistent with a low and stable rate of inflation. Over the longer run, policies designed to expand productive capacity (the supply side) might be expected to raise the economic growth rate that is consistent with stable rates of inflation.

While there is widespread agreement about the relationships among these variables, their critical values are not known with great precision. Neither is economic policy a precision instrument. It would seem that whatever understanding there is can only offer a rough set of guidelines. For example, it seems safe to say, given recent evidence, that an unemployment rate of 2% is too low if a rising rate of inflation is to be avoided. Similarly, an unemployment rate of 8% would appear to be unnecessarily high. Most estimates suggest that a growth rate near 3% and an unemployment rate somewhere between 5% and 6% might be consistent with a stable rate of inflation. But those figures are rough estimates and are mutable. Beyond that, the conduct of policy becomes a sort of balancing act.

Even if the natural rate is not known exactly, it may still be a useful guide to policy as long as it is not volatile in the short run, and there is no reason to think that it is given that demographic factors play such an important role. A modest acceleration in inflation, in the absence of any supply shocks like a spike in oil prices, might be a signal to policymakers that actual unemployment was too low. Similarly, declining rates of inflation might be taken as a signal that a more stimulative monetary policy could be pursued so as to reduce the rate of unemployment. Exact knowledge of what the natural rate is may not be necessary to avoid the experience of the 1970s depicted in **Figure 4**.

²⁴ Joseph Stiglitz, "Reflections on the Natural Rate Hypothesis," *Journal of Economic Perspectives*, vol. 11, no. 1, winter 1997, pp. 3-10.

²⁵ 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.

Other events can temporarily affect the relationships described here. In the short run, productivity growth can be highly variable, complicating the observed relationship between economic growth and unemployment. External shocks like oil price hikes can cause a temporary rise in the rate of inflation even with relatively high unemployment rates. Such complications may reduce the value of the natural rate of unemployment as a guide to policy in the short run, but it nonetheless remains useful.

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