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The Natural Rate of Interest

A key question for monetary policymakers, as well as participants in financial markets, is: "Where are interest rates headed?" In the long run, economists assume that nominal interest rates will tend toward some equilibrium, or "natural," real rate of interest plus an adjustment for expected long-run inflation.

Unfortunately, the "natural" real rate of interest is not observable, so it must be estimated. Monetary policymakers are interested in estimating it because real rates above or below it would tend to depress or stimulate economic growth; financial market participants are interested because it would be helpful in forecasting short-term interest rates many years into the future in order to calculate the value and, therefore, the yields of long-term government and private bonds. This *Economic Letter* describes factors that influence the natural rate of interest and discusses different ways economists try to measure it.

Defining the natural rate of interest

In thinking about the natural rate of interest, economists generally focus on real interest rates. They believe that movements in those rates, more so than in nominal rates, influence businesses' decisions about investment spending and consumers' decisions about purchases of durable goods, like refrigerators and cars, and new housing, and, therefore, economic growth.

Over 100 years ago, Wicksell defined the natural rate this way:

> There is a certain rate of interest on loans which is neutral in respect to commodity prices, and tends neither to raise nor to lower them. (1936 translation from 1898 text, p. 102.)

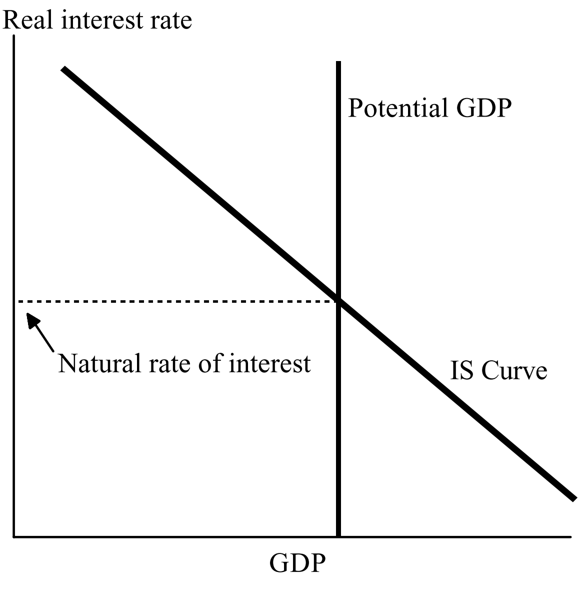
Since then, various definitions of the natural rate of interest have appeared in the economics literature. In this *Letter,* the natural rate is defined to be the real fed funds rate consistent with real GDP equaling its potential level (potential GDP) in the absence of transitory shocks to demand. Potential GDP, in turn, is defined to be the level of output consistent with stable price inflation, absent transitory shocks to supply. Thus, the natural rate of interest is the real fed funds rate consistent with stable inflation absent shocks to demand and supply.

This definition of the natural rate takes a "long-run" perspective in that it refers to the level expected to prevail in, say, the next five to ten years, after any existing business cycle "booms" and "busts" underway have played out. For example, the U.S. economy is still at a relatively early part of its recovery from the 2001 recession, so the natural rate refers not to the real funds rate expected over the next year or two, but rather to the rate that is expected to prevail once the recovery is complete and the economy is expanding at its potential growth rate.

Figure 1 shows what determines the natural rate in a stylized form. The downward-sloping line, called the IS (investment = saving) curve shows the negative relationship between spending and the real interest rate. The vertical line indicates the level of potential GDP, which is assumed to be unrelated to the real interest rate for this diagram. (In principle, potential GDP is also a function of the real rate, but this modification does not affect the basic point.) At the intersection of the IS curve and the potential GDP line, real GDP equals potential, and the real interest rate is the natural rate of interest.

Importantly, the natural rate of interest can change, because highly persistent changes in aggregate supply and demand can shift the lines. For example,

Figure 1
Determination of the natural rate of interest



in a recent paper, Laubach (2003) finds that increases in long-run projections of federal government budget deficits are related to increases in expected long-term real interest rates; in Figure 1, an increase in long-run projected budget deficits would be represented by a rightward shift in the IS curve and a higher natural rate. In addition, economic theory suggests that when the trend growth rate of potential GDP rises, so does the natural rate of interest (see Laubach and Williams (2003) for supporting evidence).

Measuring the natural rate of interest

Although it is relatively straightforward to define the natural rate of interest, it is less straightforward to measure it. If the natural rate were constant over time, one might estimate it simply by averaging the value of the real funds rate over a long period. For example, the average real fed funds rate over the past 40 years has been about 3%, so if history were a good guide, then one would expect real interest rates to return to 3% over the next five to ten years.

But predicting the natural rate using a long-term average is akin to using a baseball player's lifetime batting average to predict his batting average over the next season. This makes sense only if the likelihood of getting a hit doesn't change much over a career. In reality, the factors that affect a baseball player's performance—experience, age, and the quality of opponent pitching—change from year to year. For example, Barry Bonds's batting average over the past three seasons was well above his career average, suggesting an important change in the factors that determine whether Barry gets a hit. The leap in performance is even greater when looking at his home run hits: over the past three years, he has hit home runs at a rate over 50% higher than during the rest of his career. Indeed, Barry Bonds's performance during the 2003 season was much closer to his record over the past three seasons than his career statistics would predict, showing that long-term averages can be misleading predictors.

The same logic of time variation in batting averages of baseball players applies to the natural rate of interest. The factors affecting supply and demand evolve over time, shifting the natural rate around. If these movements are sufficiently large, the long-term average could be a poor predictor of the natural rate of interest.

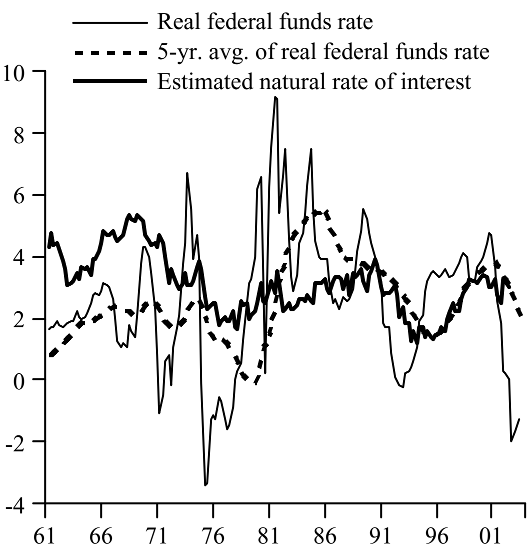
One way to allow for structural changes that may influence the natural rate of interest is to compute averages of past values of the real funds rate while putting less weight on older data. Figure 2 illustrates such a calculation, taking the average over the past five years. Other more sophisticated statistical approaches identify the natural rate by using weighted averages of past data, and they yield plots similar to those in the figure.

Although such averaging methods tend to work well at estimating the natural rate of interest when inflation and output growth are relatively stable, they do not work so well during periods of significant increases or declines in inflation when real interest rates may deviate from the natural rate for several years. For example, during the late 1960s and much of the 1970s, inflation trended steeply upward, which suggests that the real funds rate was below the natural rate on average. The averaging approach misses that point, however, and ascribes this pattern of low real rates to a low natural rate.

Estimating the natural rate of interest with an economic model

Since the averaging approach does not work well when interest rates deviate from the natural rate for long periods, economists also use other economic variables to estimate the natural rate. For example, Bomfim (1997) estimated the location and slope of the IS curve and potential output shown in Figure 1 using the Federal Reserve Board's large-scale model of the U.S. economy, and thereby derived estimates of the natural rate of interest. In terms of the baseball analogy, these methods try to estimate some aspect of a player's abilities, taking into account the effects of relevant observable char-

Figure 2
Estimates of the natural rate of interest



acteristics, say, the player's age and the quality of the opposing pitcher.

Laubach and Williams (2003) use a simple macroeconomic model to infer the natural rate from movements in GDP (after controlling for other variables, including importantly, the real fed funds rate). In their model, if the real fed funds rate is above the natural rate, monetary policy is contractionary, pulling GDP down, and, if it is below the natural rate, monetary policy is stimulative, pushing GDP up.

An important component of their procedure is a statistical technique known as the Kalman filter; this method works on the principle that you partially adjust your estimate of the natural rate of interest based on how far off the model's prediction of GDP is from actual GDP. If the prediction proves true, you do not change your estimate of the natural rate. If, however, actual GDP is higher than predicted, then monetary policy probably was more stimulative than you had thought, implying that the difference between the real fed funds rate and the natural rate of interest was more negative than you thought. The estimate of the natural rate goes up by an amount proportional to the GDP prediction error, or "surprise." If GDP is lower than predicted, the estimate of the natural rate is lowered. This procedure is designed to allow for the possibility of a change in the natural rate and also to protect against overreacting to every short-term fluctuation in GDP.

The final estimate for the natural rate of interest that Laubach and Williams get for mid-2002 is about 3%, coincidentally not far from the historical average of the real funds rate (Figure 2). But, for other periods, the estimates range from a little over 1% in the early 1990s to over 5% in the late 1960s. The high estimates in the late 1960s reflect the fact that output was growing faster than expected, given the history of real interest rates and the prevailing estimates of the natural rate of interest. The natural rate estimates fell during the early 1990s owing to the slow recovery from the recession of 1990–1991 even with low real fed funds rates.

These results show that the procedure for estimating the natural rate using the Kalman filter was not "fooled" by the period of the late 1960s and 1970s, but instead recognized it as one of excessive growth and inflationary pressures resulting from real rates that lay well below the true natural rate of interest. Similarly, it was not fooled by the early 1980s into thinking that the natural rate had increased sharply because policy had tightened; instead, it recognized that real rates well above the natural rate had contributed to the slowing of economic activity and, in fact, had little longer-term implications for real interest rates.

Conclusion

Economists have made progress in estimating the natural rate of interest in recent years. But they have not yet hit a "home run." For example, although the Kalman filter has proven its usefulness in this effort, it is important to note that the resulting estimates are not very precise; that is, from a statistical viewpoint, we cannot be confident that these estimates are correct. Furthermore, as Orphanides and Williams (2002) point out, these estimates are sensitive to the choice of statistical methods, which further obscures our ability to measure the natural rate of interest accurately.

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