



# Economic Letter

## Navigating by the Stars: The Natural Rate as Economic Forecasting Tool

by Evan F. Koenig and Alan Armen

**ABSTRACT:** Fed policymakers must assess the stance of monetary policy each time they decide whether the target federal funds rate should be changed. Several different benchmark, or “natural,” interest rates have been suggested for this purpose. The gap between the target funds rate and the natural rate should, in principle, help forecast real economic activity and inflation.

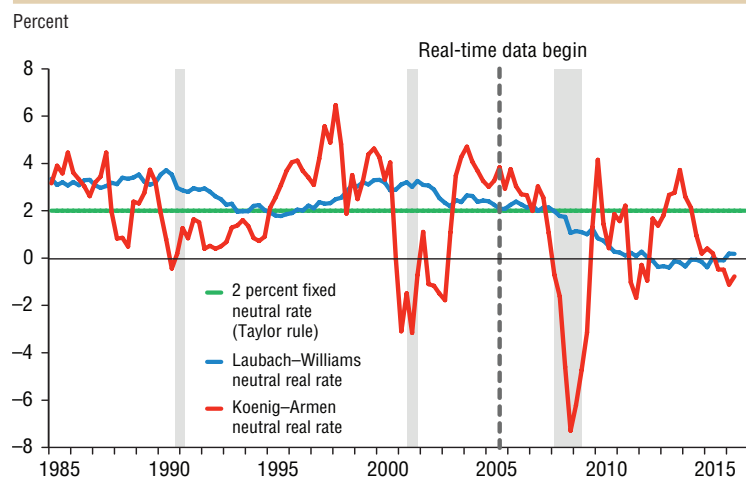
Federal Reserve policymakers adjust the overnight interbank lending rate—the federal funds rate—in an effort to satisfy the Fed’s mandate to promote full employment and price stability. So it is important that they understand how the funds rate affects unemployment and inflation. One approach is to compare the level of the real (inflation-adjusted) funds rate to a “natural,” “neutral” or “equilibrium” rate of interest. This reference interest rate is often called “r star” and is labeled  $r^*$ .

A real funds rate above  $r^*$  indicates

that monetary policy is restrictive, tending to drive the unemployment rate up and inflation down. A real funds rate below  $r^*$  indicates that policy is accommodative, tending to drive the unemployment rate down and inflation up.

We examine three alternative empirical estimates of  $r^*$  to see which is most useful for assessing the Federal Reserve’s policy stance. The measure that seems to perform best is a simple combination of a long-term interest rate and growth in household net worth. It suggests that recent policy has been accommodative, which means that

Chart 1 Natural-Rate Estimates Differ Greatly in Trend, Variability

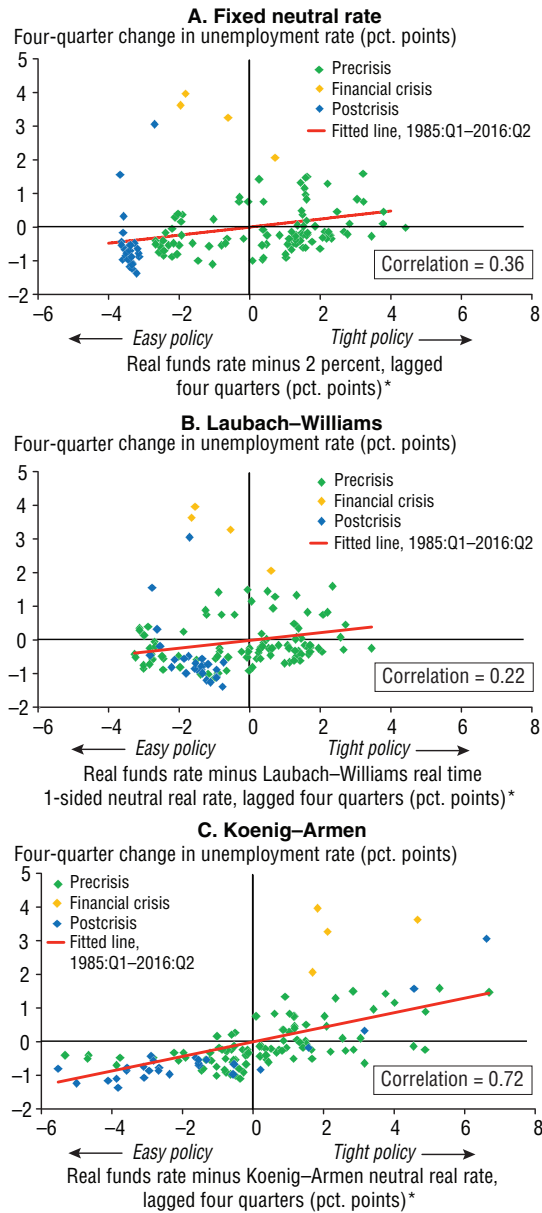


NOTE: Shaded bars indicate U.S. recessions.

SOURCES: Laubach and Williams (2003); Koenig and Armen (2015); National Bureau of Economic Research.

## Chart 2

### Koenig–Armen Funds-Rate Gap Has Strongest Relationship with Unemployment Rate



\*Real rates are computed with the projected four-quarter-ahead, four-quarter percent change in the first-revision core personal consumption expenditures price index, as described in Laubach and Williams (2003).

NOTES: Yellow diamonds correspond to the four quarters immediately following the collapse of Lehman Brothers. Correlation statistic and regression for fitted line exclude 2008:Q4–2009:Q3.

SOURCES: Bureau of Economic Analysis; Bureau of Labor Statistics; Koenig and Armen (2015); Laubach and Williams (2003); authors' calculations.

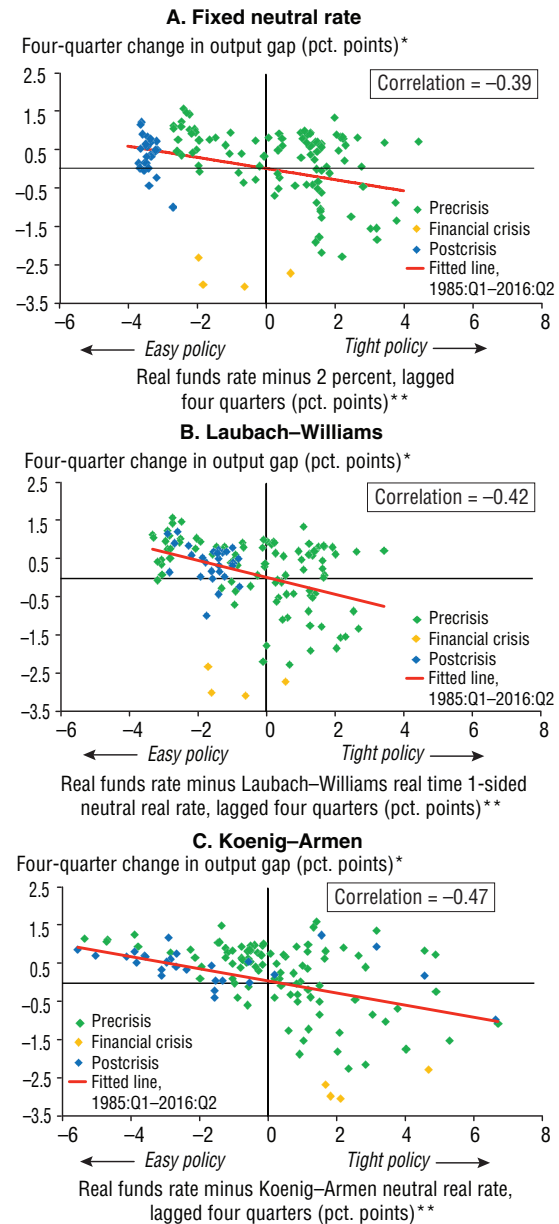
the unemployment rate is likely to fall in coming quarters and inflation is likely to rise.

### What Is $r^*$ ?

In most macroeconomic models, there is a negative relationship—called the IS curve—between the real interest rate and the short-run level of output.<sup>1</sup> In these models,  $r^*$  is the real interest rate

## Chart 3

### All Three Policy Measures Lead the Output Gap



\*Percentage-point deviations of real GDP from two-sided Laubach and Williams (2003) estimates of potential real GDP.

\*\*Real rates are computed with the projected four-quarter-ahead, four-quarter percent change in the first-revision core personal consumption expenditures price index, as described in Laubach and Williams (2003).

SOURCES: Bureau of Economic Analysis; Koenig and Armen (2015); Laubach and Williams (2003); authors' calculations.

that is consistent with the economy operating at the full-employment level of output,  $y^*$ .

The Federal Reserve, by adjusting the real funds rate, moves the economy along the IS curve, increasing or decreasing output,  $y$ , relative to  $y^*$ . A real funds rate that is low relative to  $r^*$  stimulates output and employment by encouraging households to consume now rather than later, and by encouraging

businesses to expand investment. A real funds rate that is high relative to  $r^*$  restrains output and employment by discouraging consumption and investment.

Increases (decreases) in output relative to  $y^*$ , in turn, put upward (downward) pressure on inflation relative to recent past inflation or longer-run inflation expectations.

This discussion overly simplifies the conduct of policy. For one thing, the economy does not typically respond contemporaneously to policy shifts.<sup>2</sup> Also,  $r^*$  isn't directly observed: Its value must be inferred from the behaviors of output, unemployment, inflation and other macroeconomic variables. This inference could go wrong in many ways.

Presumably, though, the better the estimate of  $r^*$ , the tighter will be the links between the stance of policy, as measured by the deviation of the real funds rate from  $r^*$ , and the strength of the economy. One should observe weaker real activity and lower inflation in response to restrictive policy, and stronger real activity and higher inflation in response to accommodative policy.

## Alternative $r^*$ Measures

The first neutral rate that we consider is a simple, fixed value. This approach isn't without precedent. The celebrated Taylor rule—Stanford University economist John B. Taylor's guide for setting the funds rate—assumes that policy is, on average, restrictive when the real funds rate is above 2 percent and is, on average, accommodative when the real funds rate is below 2 percent.<sup>3</sup> We find that 2 percent is a reasonable estimate of the neutral rate in the pre-financial-crisis period, if the neutral rate is assumed fixed.<sup>4</sup>

A time-varying neutral-rate estimate was developed by Thomas Laubach and John C. Williams (LW). They infer values for both  $r^*$  and potential output using a dynamic IS-curve framework that relates the output gap,  $y - y^*$ , to past output gaps and past policy gaps,  $r - r^*$ .<sup>5</sup> Additionally, LW assume that the best forecast of future trend output growth is current trend growth and that  $r^*$  is positively related to trend growth. Thus, in contrast with Taylor, who assumes that  $r^*$  is well approximated by a constant, LW assume that  $r^*$  shows no tendency to revert to any particular value over time.

Like Laubach and Williams, Koenig and Armen (KA) estimate  $r^*$  within a dynamic IS-curve framework.<sup>6</sup> However, rather than define the IS curve as a relationship between the output and policy gaps, KA define it as a relationship between unemployment and policy gaps.

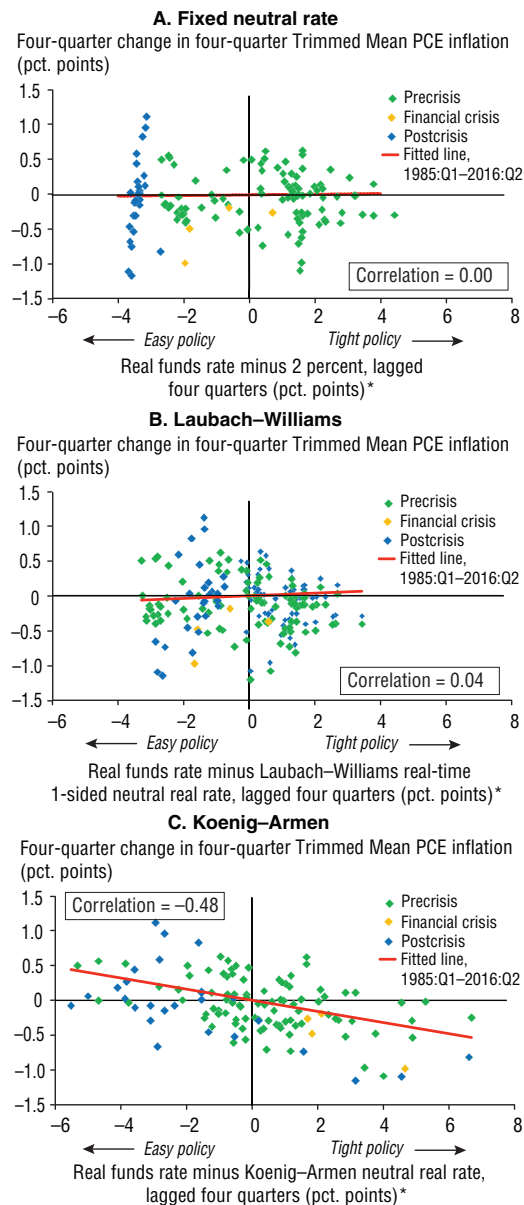
The unemployment gap, which is the difference between the equilibrium ("natural") rate of unemployment,  $u^*$ , and the actual rate of unemployment,  $u$ , has several advantages over the output gap. First, the unemployment gap is more directly related to the Fed's mandate to promote full employment. Second, unemployment data are released earlier and are subject to less revision than output data. Finally, while neither potential output nor the natural rate of unemployment is directly observed,  $u^*$  is reasonably approximated by a constant, whereas  $y^*$  is not.

Another difference between LW and KA is that while LW posit a relationship between the neutral real interest rate and trend growth in potential output, KA posit a relationship between the neutral nominal interest rate and two financial variables: a long-forward interest rate and growth in household net worth.

Intuitively, banks find it profitable to accept new deposits and

## Chart 4

### Only the Koenig–Armen Funds-Rate Gap Leads Inflation



\*Real rates are computed with the projected four-quarter-ahead, four-quarter percent change in the first-revision core personal consumption expenditures (PCE) price index, as described in Laubach and Williams (2003).

SOURCES: Bureau of Economic Analysis; Federal Reserve Bank of Dallas; Koenig and Armen (2015); Laubach and Williams (2003); authors' calculations.

expand lending when long-term interest rates are high relative to short-term rates. Increases in net worth expand households' borrowing capacity. The notion that increases in wealth encourage consumption, shifting the IS curve upward (or to the right), has long been recognized.<sup>7</sup>

The LW and KA neutral rates appear to share a common long-run trend—a conclusion confirmed by statistical analysis (Chart 1). However, the KA measure is much more volatile, and deviations of the KA neutral rate away from the LW neutral rate are strongly procyclical. This raises the question of whether the

longer-term variation shared by the KA and LW  $r^*$  estimates and the shorter-term swings unique to the KA measure contain useful information about future real activity and/or future inflation.

### Forecasting Unemployment

All three policy measures have predictive power for four-quarter changes in the unemployment rate, with restrictive policy ( $r > r^*$ ) tending to precede increases in the unemployment rate, and accommodative policy ( $r < r^*$ ) tending to precede decreases in the unemployment rate (*Chart 2*). The strength of the relationship between policy and future movements in the unemployment rate varies considerably, though, depending on which neutral-rate estimate is used. The weakest link is with the LW measure of monetary policy; the strongest link is with the KA measure. The measure of policy restrictiveness implicit in the Taylor rule is between the two.

Follow-up regression analysis using all three policy-gap measures shows that the KA interest rate gap dominates the alternatives in real-time forecasting of the unemployment rate.

### Output Gap, Inflation

The Taylor policy measure, which assumes  $r^* = 2$ , does about as well predicting four-quarter changes in the output gap as it does predicting four-quarter changes in the unemployment rate (*Chart 3*). The LW policy gap, in contrast, does notably better. Although the performance of the KA policy gap deteriorates, it still outperforms the other two policy measures.

A regression analysis that includes all three policy measures finds that the LW

and KA measures both have predictive power, with neither dominating the other. In contrast, the policy gap that assumes a fixed, 2 percent neutral rate lacks significant predictive power.

Contrary to expectations, neither the fixed  $r^*$  measure of policy nor the LW measure has any correlation with future changes in Trimmed Mean PCE (personal consumption expenditures) inflation (*Chart 4*). In contrast, policy that is restrictive according to the KA measure tends to be followed by a reduction in inflation, while policy that is accommodative tends to be followed by an inflation increase.

In a regression that includes all three policy measures, only the KA interest rate gap is statistically significant.

### Current Policy

The nominal federal funds rate stood at 0.4 percent and projected core PCE inflation at 1.6 percent in third quarter 2016; thus, the real funds rate was  $0.4 - 1.6 = -1.2$  percent. Against a fixed 2 percent neutral rate, policy was highly accommodative:  $r - r^* = -1.2 - 2.0 = -3.2$  percentage points.

The LW and KA neutral-rate estimates were 0.2 percent and  $-0.1$  percent, respectively, in the third quarter of 2016. The corresponding policy gaps were  $-1.2 - 0.2 = -1.4$  and  $-1.2 + 0.1 = -1.1$  percentage points. By either measure, policy was accommodative but not nearly so much as in the fixed- $r^*$  framework.

Charts 2C and 4C indicate that a KA rate gap of  $-1.1$  percentage points has typically been associated with a 0.2-percentage-point decline in the unemployment rate over four quarters (which would lower the jobless rate to 4.7 percent in

third quarter 2017) and a 0.1-percentage-point increase in inflation (which would raise inflation to 1.8 percent per year). The uncertainty around these estimates is large.

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### Notes

<sup>1</sup> See *Macroeconomics* by N. Gregory Mankiw, New York: Worth Publishers, 1992, and "Rethinking the IS in IS-LM: Adapting Keynesian Tools to Non-Keynesian Economies," by Evan F. Koenig, Federal Reserve Bank of Dallas *Economic Review*, Third Quarter, 1993, and Fourth Quarter, 1993.

<sup>2</sup> Modern theory suggests that the economy may respond with a lag to unexpected shifts in policy and may move in advance of anticipated policy changes.

<sup>3</sup> See "Discretion Versus Policy Rules in Practice," by John B. Taylor, Carnegie Rochester Conference Series on Public Policy, vol. 39, no. 1, 1993, pp. 195–214.

<sup>4</sup> When we estimate an IS-style equation over the precrisis period and assume a fixed  $r^*$ , the point estimate of  $r^*$  is within one standard error of 2 percent.

<sup>5</sup> See "Measuring the Natural Rate of Interest," by Thomas Laubach and John C. Williams, *Review of Economics and Statistics*, vol. 85, no. 4, 2003, pp. 1,063–70.

<sup>6</sup> See "Assessing Monetary Accommodation: A Simple Empirical Model of Monetary Policy and Its Implications for Unemployment and Inflation," by Evan F. Koenig and Alan Armen, Federal Reserve Bank of Dallas *Staff Papers*, no. 23, December 2015.

<sup>7</sup> See "The Classical Stationary State," by Arthur C. Pigou, *Economic Journal*, vol. 53, 1943, pp. 343–51. Some researchers recognize that changing credit conditions cause IS-curve shifts but define  $r^*$  to exclude the effects of those shifts. See "What Can the Data Tell Us About the Equilibrium Real Interest Rate?" by Michael T. Kiley, Finance and Economics Discussion Series, no. 2015-077, Federal Reserve Board, 2015.



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