The Decline in the Natural Rate of Interest[*]

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Since the onset of the global financial crisis, there has been a flurry of research and debate about what constitutes the "new normal" for the U.S. economy. Much of this analysis has focused on the supply side of the economy, such as labor force participation, unemployment, and productivity. With the Federal Reserve widely expected to begin the normalization process for monetary policy sometime this year, the spotlight has now turned to the question of what the new normal for interest rates may entail. This has important implications both for monetary policy and interest rates more generally. There has been a great deal of theoretical discussion of why real (inflation-adjusted) interest rates may be lower in the future than in recent decades, with the theory of secular stagnation at center stage (Summers 2014). In this essay, I focus instead on the empirical evidence regarding changes in the normal, or "natural," rate of interest over the past few decades with a particular focus on the period since the Great Recession.

By the natural rate of interest I mean the real federal funds rate consistent with the economy operating at its full potential once transitory shocks to aggregate supply or demand have abated (Williams 2003). This definition of the natural rate takes a "longer-run" perspective, in that it refers to the level expected to prevail, say, five to 10 years in the future, after the economy has fully recovered from the recent recession and is expanding at its trend rate. Importantly, there is no reason to expect the natural rate to be constant: highly persistent shifts in aggregate demand and supply will affect the natural rate. As discussed by Laubach and Williams (2003), Congressional Budget Office (2014), International Monetary Fund (2014), and Hamilton et al (2015), there are numerous potential influences on the natural rate of interest, including, but not limited to, fiscal policy, technological change, and demographics. Therefore, in trying to gauge the natural rate of interest, one needs to apply methods that allow for time variation in the natural rate, but at the same are not overall sensitive to cyclical influences on interest rates. In

the following, I focus on the model developed by Thomas Laubach and myself (2003) that is designed for exactly that purpose.

In the Laubach-Williams (LW) model, the natural rate of interest is assumed to change over time due to various unobservable influences. In principle, one would like to use data on the factors that influence the natural rate in order to quantify the effects. In practice, these are difficult to measure using available data and methods. In light of these data limitations, in the empirical implementation of the LW model, a parsimonious specification for the determinants of the natural rate is used. Specifically, the natural rate is assumed to depend on the (estimated) contemporaneous trend growth rate of potential output and a time-varying unobserved component that captures the effects of other unspecified influences on the natural rate. The model is estimated using the Kalman filter (see Laubach and Williams 2003).

In words, the Kalman filter works on the principle that one should partially adjust one's estimate of the natural rate of interest based on the distance between the model's prediction of GDP and actual GDP. If, for example, the model prediction for GDP proves to be too optimistic, the estimate of the natural rate is lowered accordingly. Estimation of the trend growth rate of potential output follows a similar logic. In this way, this procedure is designed to allow for the possibility of a changing natural rate, but guard against overreacting to short-term movements in real interest rates.

The LW estimates of the natural rate of interest display two periods of significant declines: a moderate secular decline over the two decades preceding the Great Recession, and a second, more substantial decline during the Great Recession. Figure 1 shows the Laubach-Williams estimates of the natural rate of interest from 1980 to 2014. These are the so-called one-

sided estimates, where the model parameters are estimated using the entire data sample through 2014, but the estimates of the natural rate are based on the past history of the data on GDP, interest rates, and other model variables only through the date indicated. As can be seen in the figure, the estimate of the natural rate was about 3-1/2 percent for 1990. It fluctuates over time but exhibits a downward trend, reaching about 2 percent in 2007, on the cusp of the Great Recession. Then, in the recession years of 2008 and 2009, the estimated natural rate plummets by nearly 2 percentage points. It has remained in the vicinity of zero for the subsequent 5 years. This represents an unprecedented decline and historical low level of the natural rate over the past half century for which we have estimates.

This pattern of declining natural rates of interest is also seen in estimates implied by economic forecasts and yields on Treasury inflation-protected securities (TIPS), reported in Table 1. The first row of the table reports natural rate estimates implied by the long-run forecasts from the Blue Chip survey of forecasters. The second row reports real interest rates five to 10 years in the future based on TIPS yields. Note that TIPS did not exist in 1990. The third row reports the LW estimates. Note that the LW model uses the personal consumption price index for the measure of inflation adjustment, while the Blue Chip and TIPS-based measures use the consumer price index, so these are not directly comparable in the levels. However, this does not materially affect comparisons of the different measures' changes over time, shown in the final two columns of the table. Interestingly, the pattern of decline in natural rates is consistent across the three measures, although the movements in the LW estimates are much larger than the other two measures.

What accounts for these periods of declining natural rates? While it is not possible to ascertain with any certainty the reasoning behind the changes in the Blue Chip and TIPS-based

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measures, the LW model estimates provide a partial accounting for these developments. In the LW model, a falling trend rate of growth of potential output, coupled with other factors, contribute to the decline in the estimated natural rate of interest in both periods. The final two rows of Table 1 report the contributions from changes in trend growth and the catch-all "other factors" to the decline in the estimated natural rate for the two periods, 1990-2007 and 2007-2014. Overall, the decline in trend growth accounts for nearly one half of the decline in natural rate growth and a little over one-half is accounted for by other unspecified factors. For reference, Figure 2 shows the LW model estimates of the trend growth rate of potential output over 1980-2014. Estimated trend potential output growth was about 3-1/2 percent in 1990, declining to 3 percent in 2007, then falling sharply to about 2 percent. Note that the model does not attribute these movements in trend potential output growth to specific sources, instead these are the values generated by the model estimation procedure that maximizes the fit to the data.

One criticism of the Laubach-Williams natural rate estimates are that they can be subject to revision as additional and revised data become available (Clark and Kozicki 2005). Although this can be an issue with any model estimates, it is striking that in the recent episode, the LW estimates of the natural rate have been remarkably consistent. Figure 3 compares the ex post (one-sided) LW estimates of the natural rate to the corresponding real-time estimates over 2007-2014. The real-time estimates represent the estimate of the natural rate based solely on data available a few months after the end of the quarter for which the estimate is reported. By construction, the real-time and ex post estimates are identical for the final data point in our sample (fourth quarter of 2014).

The real-time LW estimates fell sharply during the recession and remain low through the end of the sample. Thus, these estimates provided a strong early signal of a lower natural rate. In addition, the estimates have sent a consistent signal of a low natural rate over time. Indeed, the real-time and ex post estimates are close to the same from 2011 to 2014. In this episode at least, revised estimates do not tell a different story than real-time estimates.

A second criticism of the LW model is that the assumed relationship between the trend growth rate and the natural rate of interest, although justified by economic theory, does not have strong empirical support (Hamilton et al 2015). In this regard, it's worth noting that the decline in factors besides trend growth explains more than half of the decline in the estimated natural rate of interest since 1990, as shown in Table 1. Therefore, even if one discounts the role of trend growth in affecting the natural rate, the implied decline in the natural rate over the past few decades, and especially in the aftermath of the Great Recession, has been remarkably large.

What are the implications of the sizable decline in the natural rate of interest for monetary policy and interest rates more generally? First, if sustained, it implies that real short-term interest rates will be lower on average in the future than was typical in the postwar period. By implication, longer-term interest rates will also be corresponding lower on average. Second, a lower average real interest rate implies that episodes of monetary policy being constrained at the zero lower bound are likely to be more frequent and longer (Reifschneider and Williams 2000). Third, it is a powerful reminder that one should not treat the natural rate of interest as fixed, as is often done in discussions of monetary policy rules such as the Taylor rule.

Finally, it is important to remember that estimates of the natural rate are subject to a great deal of uncertainty (Orphanides and Williams, 2002; Laubach and Williams, 2003). As seen in

table 1, the three measures of the natural rate differ by as much as 1-1/2 percentage point, an atypically large deviation in estimates compared to the period before the Great Recession. As emphasized by Orphanides and Williams (2002, 2007) and Hamilton et al (2015), uncertainty about the natural rate of interest has implications for the design of robust monetary policy strategies. In particular, strategies that do not rely as much on the estimates of the natural rate tend to be more robust to this type of uncertainty.

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Table 1: Estimates of the natural rate of interest

	Estimate			Change in estimate[*]	
	1990	2007	2014	1990-2007	2007-14
Blue Chip survey	3.1	2.4	1.4	-0.7	-1.0
TIPS yields (5-10 years ahead)	n/a	2.5	1.3		-1.2
Laubach-Williams (one-sided)	3.4	2.1	-0.2	-1.3	-2.3
contribution from trend growth				-0.5	-1.1
contribution from other factors				-0.8	-1.1

[*]Numbers may not sum to total due to rounding.

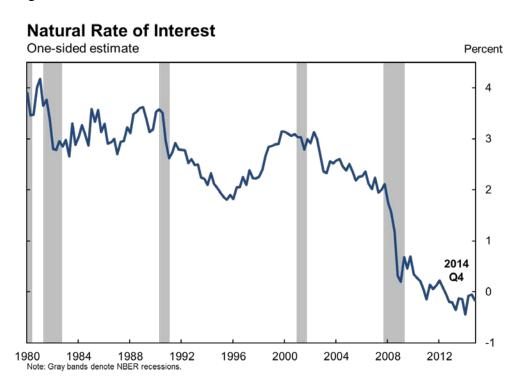Figure 1: Laubach-Williams Estimates of the Natural Rate of Interest

Natural Rate of Interest
One-sided estimate

Note: Gray bands denote NBER recessions.

Figure 2: Laubach-Williams Estimates of the Trend Growth Rate of Potential Output

Potential output growth
One-sided etimate

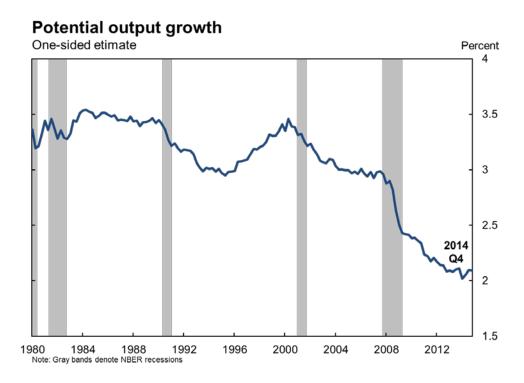Note: Gray bands denote NBER recessions

Figure 3: Real-time Laubach-Williams Estimates of the Natural Rate of Interest

Estimates of the Natural Rate of Interest
One-sided estimates

Note: Gray bands denote NBER recessions.