

July 12, 2017

LONG RUN VALUE FOR THE EQUILIBRIUM RATE OF INTEREST

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Introduction and summary of findings

This document provides an overview of recent evidence on the long run equilibrium real federal funds rate (r^*), including estimates from a selection of time-series econometric models and from a structural model featuring detailed modelling of demographic changes. We then complement the analysis with charts on the staff forecasts errors for the ten year treasury rate, which is driven in part by our assumptions about long run r^* .

Summarizing our main findings, we conclude that r^* remains at a low level, which the models put in the range of 0 to $\frac{3}{4}$ percent. These estimates are broadly unchanged since August 2016, when we last undertook a broad review of our long run assumption for r^* .¹ We argue that a case for revising down our long run r^* assumption can nevertheless be made given that (i) most estimates for r^* have been consistently below our assumed value for long run r^* for some time and (ii) there is no clear indication that r^* is starting to rise back towards our assumption in Tealbook.

Time-Series Evidence

- In the September 2016 Tealbook, our downward revision of the long run value of the equilibrium rate of interest from 1 percent to 0.75 percent was informed by estimates of econometric models and the low level of forward rates.
- Table 1 reports the one-sided estimates for r^* provided by the Laubach and Williams (2003) model for 2016:Q2 as of August 2016 and the current estimate for 2016:Q4. The second and third columns provide the one-sided estimate for 2016:Q2 and for 2016:Q4 in Holston, Laubach, and Williams (2017)² and in Johansson and Mertens (2016), respectively. All three models estimate a decline in r^* since August 2016, although the differences are small.
- The TIPS 5 year/5 year ahead monthly average in June 2017 is larger than the monthly average in August 2016. The 5 year/5 year forward rates have a term premium component, which varies

¹ Of course, we have changed r^* narrowly in the response to the fiscal assumptions in December of 2016.

² The one-sided estimate for 2016:Q2 reported in Table 1 is based on data until 2016:Q2. The estimates are available at

http://www.frbsf.org/economic-research/economists/Holston_Laubach_Williams_real_time_estimates.xlsx

over time. Only a modest term premium embodied in the forward rates is required to make the implied short rate roughly in line with the estimates of Holston, Laubach, and Williams.

Table 1

	Laubach and Williams (2003)	Holston, Laubach, and Williams (2017)	Johannsen and Mertens (2015)	TIPS 5 year/5 year ahead
August 2016	0.20	0.42	0.85	0.62
Current	0.02	0.36	0.75	0.91

Note: The August 2016 line shows the one-sided estimate for 2016:Q2 available in August 2016 for Laubach and Williams³. The one-sided estimate currently available on their website⁴ is 0.16. The current value TIPS 5 year/5 year ahead reports the average for June 2017.

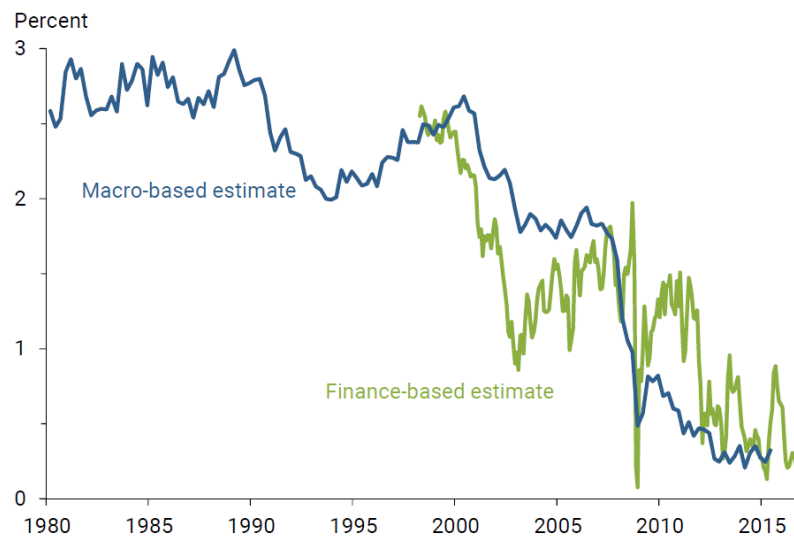
- Christensen and Rudebusch (2017)⁵ provide a comparison of a finance-based estimate of r^* and a macro-based estimate of r^* defined as the average of the estimated equilibrium real interest rates in Laubach and Williams (2016), Johansen and Mertens (2016), and Lubik and Matthes (2015). We report the comparison in Figure 1.
 - The finance-based estimate is based on an arbitrage-free model of real yields with liquidity risk, that is, a TIPS-only term structure model with liquidity adjustment. The model accounts for liquidity and term premiums to obtain expected real short rates and the associated measure of the equilibrium real rate. They use all TIPS issued since 1997 until 2016 but censor TIPS from their sample when they have less than one year to maturity.
 - Their market-based measure of the natural rate is the average expected real short rate over a five-year period starting five years ahead.
 - They conclude that both approaches to estimating the equilibrium rate imply that the equilibrium rate of interest is at historical lows. Moreover, the estimated model dynamics of fluctuations in the equilibrium rate of interest are very persistent in the finance-based setup, which brings them to conclude that the equilibrium rate of interest will most likely fluctuate around the current low levels for several years.

³ As reported in the September 2016 FOMC memo “Adjustments to some long-term parameters of the staff judgmental forecast”.

⁴ http://www.frbsf.org/economic-research/economists/john-williams/Laubach_Williams_updated_estimates.xlsx.

⁵ Jens H. E. Christensen and Glenn D. Rudebusch, “New Evidence for a Lower New Normal in Interest Rates”, FRBSF Economic Letter 2017-17.

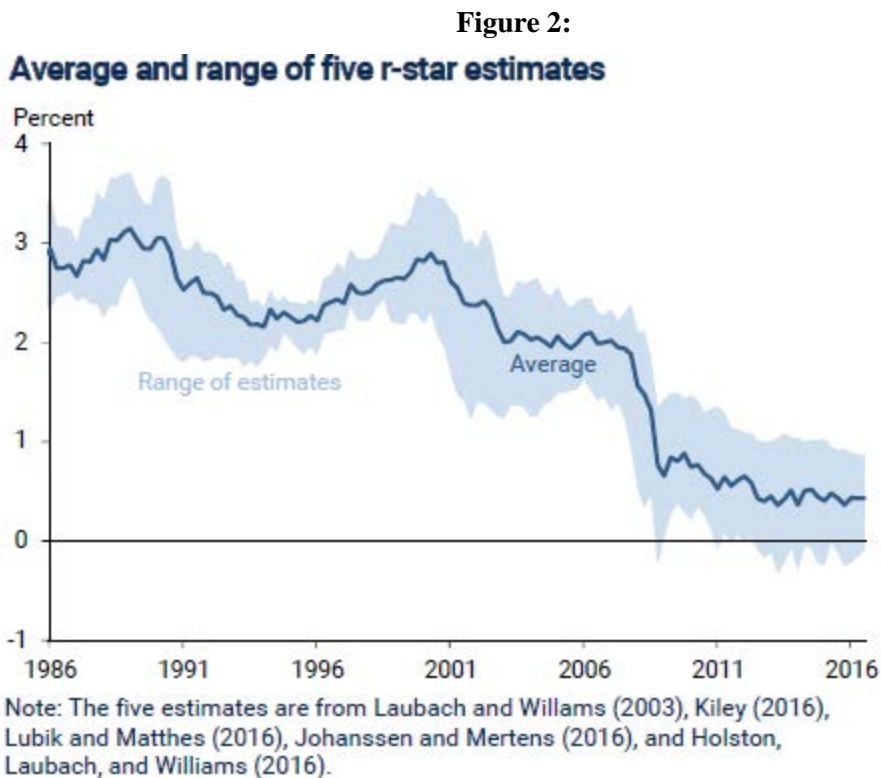
Figure 1:
Estimates of the equilibrium real interest rate



Note: Figure reported in Jens H. E. Christensen and Glenn D. Rudebusch, “New Evidence for a Lower New Normal in Interest Rates”, FRBSF Economic Letter 2017-17.

- Estimates of the equilibrium rate of interest are surrounded by sizable uncertainty. In order to have a sense of the possible range of variation of macro-based estimates of r^* , Williams, in a recent FRBSF Economic Letter article⁶, provides the following figure—Figure 2—with the average and range of the estimates in Laubach and Williams (2003, updated), Kiley (2016), Lubik and Matthes (2016), Johansen and Mertens (2016), and Holston, Laubach, and Williams (2016).

⁶ John C. Williams, “Three Questions on R-Star”, FRBSF Economic Letter 2017-05.



Note: Figure reported in John C. Williams, “Three Questions on R-Star”, FRBSF Economic Letter 2017-05.

Structural Model Results

- Gagnon, Johanssen and Lopez-Salido (2016) argue that demographic factors will continue to put downward pressure on the equilibrium interest rate and conclude that r^* will fall below $\frac{1}{2}$ at the end of this decade and beyond.

Staff Forecast Errors for Long-term Yields

- While long-term bond yields are not directly informative about r^* , we have taken some signal from their evolution in the past when considering the revision of long run values of r^* and the term premium, as long run assumptions for the equilibrium rate of interest and the term premium have a sizable effect on the staff projection for long term rates.
- Figure 3 reports staff nowcasts and up to two-year ahead forecasts for the 10-year Treasury bond rate (RG10). The black line is the actual path of RG10.⁷

⁷ The value for RG10 in 2017:Q2 is an estimate based on the data available for the last two months, instead of the realized average for the entire quarter.

- As shown in the figure, over the last few years, there has been a persistent upward bias in the RG10 forecast. Since the downward revision of the long run values for the natural rate of interest and the term premium in the September 2016 Tealbook, one- to two-quarter-ahead forecast errors have not shown persistent bias, although longer horizon forecasts have tended to be too high.

Figure 3: RG10 forecast

