The Low Interest Rate Environment: Measurement, Causes, Consequences

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Long-run trends in macroeconomics

**Trend inflation:** $\pi^*_t$
- Perceived inflation target of central bank
- Crucial for inflation forecasting

**Equilibrium real interest rate:** $r^*_t$
- Real interest rate after transitory shocks have dissipated
- Real interest rate where monetary policy is neutral
- Determined by fundamentals: productivity growth, demographics, price of capital goods, etc.
Secular decline in U.S. long-term interest rates

Graph showing the trend in ten-year yield and trend inflation over the years 1980 to 2010.
Secular decline in U.S. long-term interest rates
The low interest rate environment

Measurement

- How to define and estimate $r_t^*$?
  (equilibrium/natural/neutral/normal rate of interest)

Causes

- What forces have pushed $r_t^*$ lower?

Consequences

- What are the implications of persistent low rates?
Measurement

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Equilibrium real interest rate: $r_t^*$

Different definitions of equilibrium rate:

**Short-run $r_t^*$**

- Current value of real rate consistent with full employment and stable inflation. (Cúrdia et al., 2015, estimate counterfactual DSGE real rate with perfect competition, flexible prices, and no monopoly power.)

**Infinite-horizon $r_t^*$**

- Expected real short rate at an infinite horizon: $E_t[r_{t+\infty}]$ (Johannsen & Mertens, 2016, Lubick & Matthes, 2015)

**Intermediate-term or Longer-run $r_t^*$**

- “The level of the real interest rate expected to prevail, say, five to 10 years in the future, after the economy has emerged from any cyclical fluctuations and is expanding at its trend rate.” (Laubach & Williams, 2016)
Much recent research argues for a lower $r_t^*$

Interest rates have trended down globally since 1980. Longer-run inflation expectations fell early on, then steady.

Instead, persistent real-side factors may be pushing down steady-state real rate (e.g., slower productivity growth, aging population).

**Arguing for lower $r_t^*$:** Rachel and Smith (2015), Laubach and Williams (2016), Lubik and Matthes (2015), Gagnon, Johannsen, Lopez-Salido (2016), Pescatori and Turunen (2016), Carvalho, Ferrero, Nechio (2016), etc.

Three recent macro-based estimates of $r^*_t$

These $r^*_t$ estimates use macroeconomic *models* and *data*. 
Potential shortcomings of macro-based $r^*_t$ estimates

1. Requires a strong IS/Euler equation connection between real interest rate and output in order to identify $r^*_t$;

2. Uncertainty about correct macro specification:
   - Output and inflation dynamics must be stable and well specified (no structural shifts or regime changes)
   - Must be robust to nonlinearity at zero lower bound.

3. Difficulties in real-time estimation and monitoring:
   - Use of revised data to create estimates;
   - Backward-looking, one-sided filtering.
Christensen and Rudebusch (2017) estimate $r_t^*$ using a dynamic term structure model and prices of U.S. Treasury Inflation-Protected Securities (TIPS).

Advantages:

- No need for stable, correct macro specification;
- Sidesteps lower bound on nominal interest rates;
- Well-suited for real-time analysis.

Challenges:

- Short sample of available data (since 1997);
- Large and variable liquidity risk to take into account.
In 1980s and 1990s, macro-based $r_t^*$ is close to 2-1/2%, then falls—fortuitously with introduction of TIPS.

Both estimates exhibit similar trend: From 2+% to near zero.

Both estimates imply that $r_t^*$ is currently near its historical low.

Differences around the Great Recession:

- Macro-based $r_t^*$ shows only a modest decline until the financial crisis, then drops precipitously.
- Finance-based $r_t^*$ is similar pre and post Great Recession.
Range of seven existing $r_t^*$ estimates

Real-time estimates of finance-based $r_t^*$ can still be noisy.
Considerable uncertainty about $r_t^*$ estimates.

Simulated confidence interval for finance-based $r_t^*$. 
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Underlying theoretical framework for lower $r_t^*$

Supply of saving: Intertemporal AD/IS/Euler Equation with heterogeneous life-cycle considerations

Demand for investment: Profit maximizing demand for capital

Potential drivers of $r_t^*$:
- Consumption growth, output growth
- TFP growth
- Demographic shifts: dependency ratio, life expectancy, ...
- Global saving glut
- Inequality
- Demand for safe assets
- Relative price of capital goods
Evidence from over a century of data

Hamilton, Harris, Hatzius, and West, 2016:
“Both our U.S. and our international data yield a sign for the correlation between average GDP growth and the average real interest rate that is sensitive to sample, with correlations that are numerically small in almost all samples.”

Lunsford and West, 2017:
“... safe real interest rates are correlated as expected with demographic measures [labor force growth, dependency ratio]. ... We do not find productivity to be positively correlated with real rates.”
FOMC projections of longer-run growth and real rate

Median forecasts from FOMC Economic Projections
CBO projections of longer-run growth and real rate

CBO: Assumes connection between growth and real rates
Private-sector forecasts have a weak growth-$r_t^*$ connection.
Demographic contribution to lower $r_t^*$

Finance-based $r_t^*$ is projected to remain low.

Estimate of demographic contribution from Gagnon, Johannsen, Lopez-Salido (2016)
Projections for life expectancy and population growth

Note: OECD average, weighted by population in 2000.
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Level of $r_t^*$ is crucial for policymakers, investors, etc.

**Monetary Policy:**

- Neutral benchmark for monetary policy, e.g., Taylor rule (However, Rudebusch, 2001, shows that uncertainty about $r_t^*$ has modest effects on the optimal rule coefficients):
  
  \[ i_t = r_t^* + \pi_t^* + \beta_Y(Y_t - Y_t^*) + \beta_\pi(\pi_t - \pi_t^*). \]

- Probability of ZLB episode depends on $r_t^*$, $\pi_t^*$, $\sigma$

**Fiscal policy:** Important input for deficit projections.

**Financial analysis:** Anchors projections of discount rates used for valuing assets.
What are the underlying drivers of long-term interest rates?

Long-term yields have two components: expectations and term premium:

\[ y_t^{(n)} = \frac{1}{n} \sum_{j=0}^{n-1} E_t y_{t+j}^{(1)} + TP_t^{(n)} \]

Accounting for movements in \( i_t^* \) matters for this decomposition.

Consider two models of the yield curve:

- Model 1: VAR(1) for PCs of yields (conventional model)

- Model 2: VAR(1) for PCs of detrended yields, \( y_t^{(n)} - i_t^* \)
Term premium based on VAR with constant $i_t^{*}$

![Chart showing the 5-to-10y forward rate, Expectations, and Forward term premium from 1980 to 2000.](image)
Term premium based on VAR with time-varying $i_t^*$

![Graph showing term premium based on VAR with time-varying $i_t^*$](image-url)
Predicting bond returns with $r_t^*$

Investors care about excess bond returns:

$$rx_{t+h}^{(n)} = p_{t+h}^{(n-h)} - p_t^{(n)} - y_t^{(h)}$$

Predictive regression for (annual) excess returns:

$$rx_{t,t+h} = \beta_0 + \beta_1' PC_t + \beta_2' X_t + u_{t+h}$$

Result: Both $\pi_t^*$ and $r_t^*$ have strong incremental predictive power beyond what’s in the yield curve at time $t$. 
## Predictive regressions for excess returns

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<td>(0.38)</td>
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<td>PC3</td>
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<td>$\pi_t^*$</td>
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<td>$R^2$</td>
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Newey-West SEs in parentheses, bootstrap $p$-values in squared brackets, annual excess returns, sample: 1971-2017
Conclusion

**Measurement:** Much uncertainty, especially in real time. Finance-based $r_t^*$ complements earlier macro estimates.

**Causes:** Demographic trends appear to be important and persistent drivers of decline in $r_t^*$.

**Consequences:** Time variation in $\pi_t^*$ (historically) and $r_t^*$ (recently) and the current low interest rate environment are important considerations in many areas.