Monetary Policy and the Term Structure of Interest Rates

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Long-term interest rates have trended lower in recent months even as the Federal Reserve has raised the level of the target federal funds rate by 150 basis points. Historically, even distant forward rates have tended to rise in association with monetary policy tightening. ... For the moment, the broadly unanticipated behavior of world bond markets remains a conundrum.

–Alan Greenspan, February 2005
Yields on U.S. Treasury 10-year notes are at their highest level of the year, albeit still in a remarkably low neighborhood around 2.11%.
To get a better picture of the effects of news on interest rates at different time horizons, I look at forward interest rates. Forward rates are rates contracted today for a loan made or security issued at a specified future date. A forward rate with, say, two years maturity is the interest rate that would be contracted for today on an overnight loan to be extended in two years. Conceptually, the forward interest rate is determined by expectations about the real short-term interest rate and the rate of inflation two years in the future. The rate also includes compensation for the interest rate risk of a two-year commitment. Changes in forward rates with different maturities reflect expectations of inflation and monetary policy at specific time horizons.

For example, consider the employment report released on July 8, 2011, in which the U.S. Bureau of Labor Statistics (BLS) reported that total nonfarm payroll employment increased by 18,000 in June. This fell well short of the consensus forecast for a 105,000 increase in payroll positions and was interpreted as bad news regarding the pace of economic recovery. Figure 1 shows the daily changes between July 7 and July 8, 2011, in hundredths of a percentage point for one- to ten-year Treasury yields and forward rates one to ten years ahead. All yields decreased, but by different magnitudes.

To get a better idea of the interest rate movements across horizons, I consider forward rates instead of yields. A forward rate is about one specific future point in time whereas yields are averages of forward rates. Thus forward rates offer clearer information about different horizons. On July 8, following the BLS employment report, the largest movements occurred in forward rates two to four years ahead. Changes at the longer end of the term structure eight to ten years out were much smaller. To the extent that these yield changes reflect shifting expectations for future short-term interest rates, the June employment report caused market participants to lower their anticipated path for the Federal Reserve’s policy rate, the federal funds rate, most dramatically at the two- to four-year horizon.

Macro surprises and the response of the term structure

Non-Farm Payroll released, lower than forecasts: Bauer, 2011
How does Fed Policy determine the Term Structure of Rates?

What is Fed policy?

Setting current rates?

Setting a Fed Funds Rate Policy: The Taylor Rule?

QE?
The Taylor Rule

\[ i_t = \tau_x \text{Output Gap} + \tau_p \pi \text{ Gap} + \text{policy shock} \]
But rates depend on inflation

\[ r_{\text{nominal}} = r_{\text{real}} + \text{Expected Inflation} + \text{Inflation Risk} \]

Setting short term rates should help determine inflation and nominal bond returns
Bond returns depend on rate changes

Expected future rates should determine today’s term structure

But that is going to depend on future inflation, future gaps, and future policy shocks

What about risk?
How does changes in the Taylor rule change the term structure?

How does it change inflation risk?

How does it change real rates?

How do changes in the Taylor rule can change the dynamics of inflation, the dynamics of inflation risks, the dynamics of bond returns, yields, and yield volatility?

What do policy shocks do?
Our approach

No-arbitrage factor model for real rates depending on output and economic environment

Policy rule for short-term rates, simultaneously determines inflation and nominal rate process and so determines the entire term structure
The effect of policy

The ratio of the volatility of the 10-year rate to the short-term rate is 78% in the data as well as the endogenous inflation model, but only 19% in the exogenous inflation model. This failure of the exogenous inflation model is driven by the lack of persistence in the consumption growth and inflation processes. The time-varying prices of risk \( \gamma \) give rise to parameters \( \gamma_c \) and \( \gamma_\nu \) as a result.

In contrast, the endogenous inflation model is able to capture short-term rate and long-term rate volatility simultaneously since the policy rule allows us to describe inflation, and thus, interest rates, in terms of a very persistent process, the policy shock. That is, the volatility of interest rates does not die out quickly with bond maturity because the non-systematic component of the Taylor rule exhibits significant persistence.

One way to increase the volatility of long-term rates relative to the short-term rate in the exogenous inflation model is to increase the autoregressive parameter for the latent preference variable \( \gamma_\nu \). However, increasing this parameter leads to counterfactual implications. When the 10-year rate volatility is matched, a hump-shaped pattern for volatility across maturities is obtained: the volatility of interest rates for some intermediate maturities is significantly higher than the volatility of short and long term rates. Therefore, the exogenous model is not strong enough to increase the volatility of long rates when inflation is an exogenous process.

Figure 3: Nominal Interest Rate Properties - Exogenous and Endogenous Inflation. The \( \gamma \) denotes data.
Bond returns are sensitive to the policy rule

The more policy rates respond to output, the better long term bonds are at hedging risk, and the lower the risk compensation in long-term bonds

Credibility is key: a short term change in the rule is much less effective than an long term change
More aggressive inflation response

- Inflation drops
- Reduces short term nominal rates
- Reduces inflation volatility
- Makes long-term bonds worse inflation hedges: makes the curve steeper
- Smoothes out rates
A change in policy rules

Panel A: Interest Rates – Avg. Level

Panel B: Interest Rates – Volatility

Panel C: Avg. Term Premia

Figure 4: Nominal Interest Rate Properties - Policy Experiment. The ($\pi$) denotes 1971–2005 data and the (\Delta) denotes 1987–2005 data.

Inflation therefore increases the riskiness of longer bonds. In contrast, a stronger reaction of short-term interest rates to consumption growth increases the hedging benefits of longer bonds.

Panel B of Figure 4 shows the implications of the experiments on the volatility of interest rates. The $\Delta \pi$ experiment implies a higher volatility for short-term rates than implied in the Greenspan period and a quick decline in volatility with maturity. The ratio of 10-year rate volatility to short-rate volatility decreases to 55% from 78%. This ratio is low in comparison to the 73% ratio observed on average during the Greenspan era. Therefore, policy shocks lose some of their ability to generate long-term rate volatility. The reason is a reduced response in inflation to policy shocks that is also reflected in the reduced persistence in inflation observed during the period. The $\Delta i_c$ experiment reduces the volatility of short-term rates, but long-term rate volatility is unaffected.

Other implications of the $\Delta \pi$ that are consistent with interest rate developments during the Greenspan era are the increase in the correlation between consumption growth and the short-term interest rate, and a decrease in the correlation between inflation and the interest rate. The autocorrelation of the short-term rate decreases in the policy experiment while it increased during the Greenspan era.

A change in policy rules
Hedging inflation with long term bonds

Even if the Fed is not changing real rates, it has an impact on inflation risk and the correlation of real and nominal rates.

Less feedback from inflation to rates means more inflation risk, but longer bonds become better hedges: flattens the curve.

Credibility: there is a difference between committing to a policy and a short term deviation.