Lecture 6: The Risk and Term Structures of Interest Rates

ECON 43370: Financial Crises

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Nominal vs. Real

An interest rate is the intertemporal price of borrowing (equivalently, the return to lending)

- Nominal: how many dollars one gives up in the future to borrow a dollar today

- Real: how many goods one gives up in the future to borrow a good today:

Fisher relationship:

$$1 + r_t = (1 + i_t)\frac{P_t}{P_{t+1}} = (1 + i_t)\Pi_{t+1}^{-1}$$

$$r_t \approx i_t - \pi_{t+1}$$

Interest Rates (Continued)

In most macro models, we talk about “the” interest rate

In reality, there are <u>tons</u> of interest rates

Interest rates principally vary according to:

1. Cash flow risk (i.e., default risk)
2. Time to maturity (i.e., interest rate risk)

Monetary Policy 101

Economically relevant interest rates are typically (i) risky and (ii) long-term

- e.g., 15-year mortgage, 10-year corporate bond yield, 5-year auto loan

The interest rate that policy focuses on (e.g., Federal Funds rate) is (i) essentially riskless and (ii) short-term

These are all connected because interest rates on debt instruments with different risk and maturity characteristics are more or less substitutable

Monetary Policy 101 (Cont.)

Let:

- i_t^{er}: economically relevant rate (e.g., 30-year mortgage)
- i_t^{gov}: long-term government bond yield
- i_t^{sgov}: short-term riskless rate
- rp_t: risk premium
- tp_t: term premium
- EH_t: expectations hypothesis (average of current and expected future short-term rates)

$$i_t^{er} = i_t^{gov} + rp_t$$

$$i_t^{gov} = EH_t + tp_t$$

Monetary Policy 101 (Cont.)

In "normal" times, we can think of rp_t and tp_t as being roughly constant (or, at least policy-invariant)

Monetary policy affects the real economy via changes in current and anticipated short-term rates, which alters the expectations hypothesis component of long-term bond yields, impacting economically relevant rates

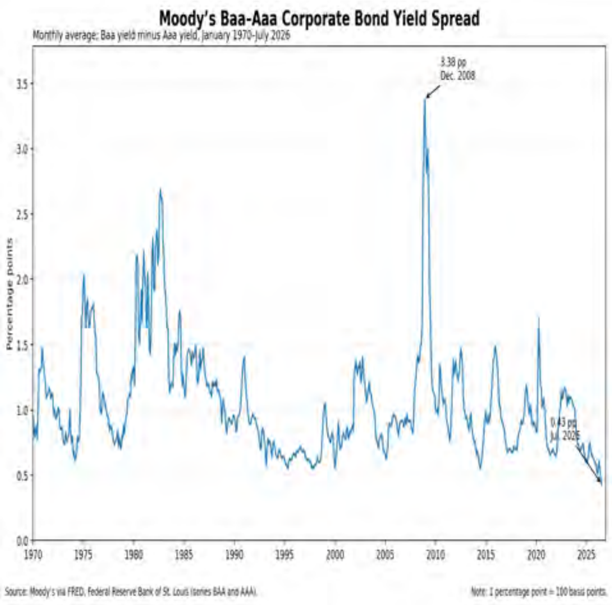
During financial crises, weird things happen with rp_t: flight to safety, so these premia go up significantly

Because of the zero lower bound (ZLB), monetary policy might have to try to impact the economy via other channels (i.e., forward guidance and quantitative easing)

Risk Premium: Baa Spread

Risk Premium: Aaa Spread

Baa-Aaa Spread



The Risk Structure of Interest Rates

We've essentially already covered this with asset pricing

Bonds with more perceived default risk (failure to pay promised cash flows in whole or in part) are going to trade at higher yields (lower prices)

"Pricing" a risky bond is not unlike pricing a risky stock – investors demand compensation for bearing risk, and really don't like default risk if default is likely when consumption is low (so marginal value of additional consumption is high)

This is where the rp_t term above comes from

Demand-Supply Analysis

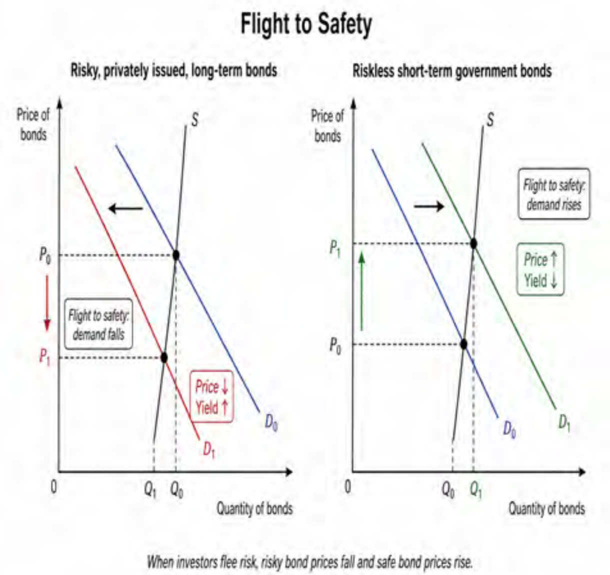
Can get a long way in thinking about bond prices / interest rates with demand-supply graphs

When perceived risk is high (or risk aversion is high), demand for risky bonds falls

This causes prices to fall (yields to rise)

Flight to safety: everyone wants out of risky stuff (low prices, high yields) and wants safe stuff (high prices, low yields)

Flight to Safety



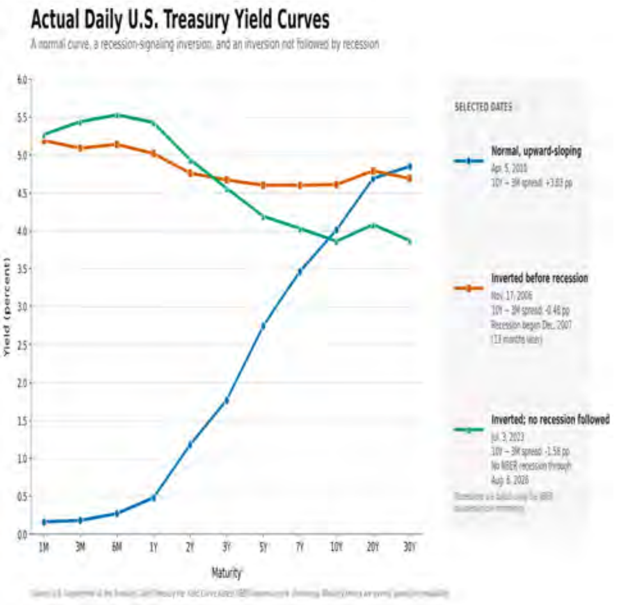
The Term Structure of Interest Rates

How do rates on securities with identical default risk (e.g., government bonds) vary according to time to maturity?

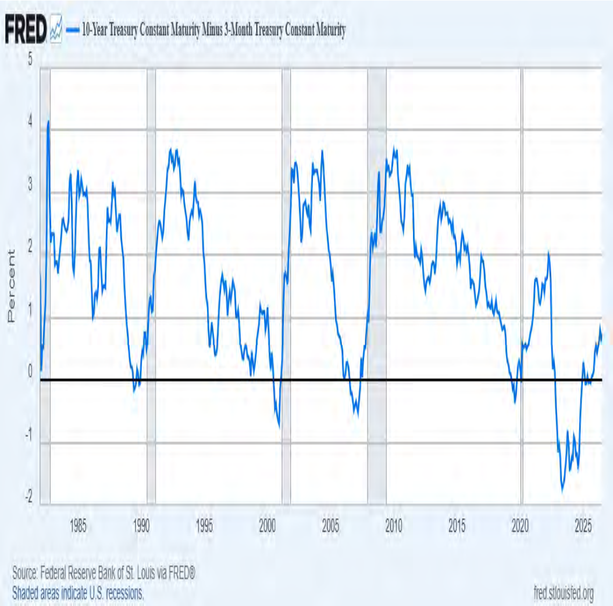
Yield curve: a plot of interest rates (at a given point in time) on securities according to time to maturity

- Yield curves are usually upward-sloping
- Changes in yield curve slope may contain economically interesting information
  - Inverted yield curves often predict recessions

Yield Curves



Slope of Yield Curve



The Expectations Hypothesis

The expectations hypothesis of the term structure states that the yield on a long-term bond is approximately equal to the average of the expected sequence of short-term yields

$$i_{t,t+h} = \frac{1}{h}\left[i_{t,t+1} + i^e_{t+1,t+2} + i^e_{t+2,t+3} + \ldots i^e_{t+h-1,t+h}\right]$$

Extremely useful for thinking about:

- Why inverted yield curves often predict recessions
  - During recessions, the Fed typically cuts short-term rates. Lower future short-term rates, lower long-term rates in present
- Why forward guidance might work
  - Forward guidance involves promising lower short-term rates in the future

Micro Foundation

Suppose a household lives for three periods: t, $t+1$, $t+2$

No income or repayment uncertainty

Can save/borrow in t through two risk-free bonds:

- One-period discount bond with face value of one, $B_{t,t,t+1}$ at price $P_{t,t,t+1}$
- Two-period discount bond with face value of one, $B_{t,t,t+2}$, at price $P_{t,t,t+2}$

First subscript: date of choice/observation. Second subscript: date of issuance. Third subscript: date of maturity

Household Problem

$$\max \quad U = u(C_t) + \beta u(C_{t+1}) + \beta^2 u(C_{t+2})$$

s.t.

$$C_t + P_{t,t,t+1}B_{t,t,t+1} + P_{t,t,t+2}B_{t,t,t+2} = Y_t$$

$$C_{t+1} + P_{t+1,t+1,t+2}B_{t+1,t+1,t+2} + P_{t+1,t,t+2}\left(B_{t+1,t,t+2} - B_{t,t,t+2}\right) = Y_{t+1} + B_{t,t,t+1}$$

$$C_{t+2} = Y_{t+2} + B_{t+1,t+1,t+2} + B_{t+1,t,t+2}$$

Optimality Conditions

$$P_{t,t,t+1}u'(C_t) = \beta u'(C_{t+1})$$

$$P_{t,t,t+2}u'(C_t) = P_{t+1,t,t+2}\beta u'(C_{t+1})$$

$$P_{t+1,t+1,t+2}u'(C_{t+1}) = \beta u'(C_{t+2})$$

$$P_{t+1,t,t+2}u'(C_{t+1}) = \beta u'(C_{t+2})$$

Implications

$P_{t+1,t,t+2} = P_{t+1,t+1,t+2}$: price of bond depends on time to maturity, <u>not</u> date of issuance

$$P_{t,t,t+2} = P_{t,t,t+1} \times P_{t+1,t+1,t+2}$$

In terms of yields:

$$\frac{1}{(1+i_{t,t+2})^2} = \frac{1}{1+i_{t,t+1}} \frac{1}{1+i_{t+1,t+2}}$$

Or, approximately:

$$i_{t,t+2} \approx \frac{1}{2}\left(i_{t,t+1} + i_{t+1,t+2}\right)$$

The Term Premium

The problem with the EH: yield curves are typically upward-sloping

If short-term rates are stationary (mean-reverting), typical yield curve should be flat

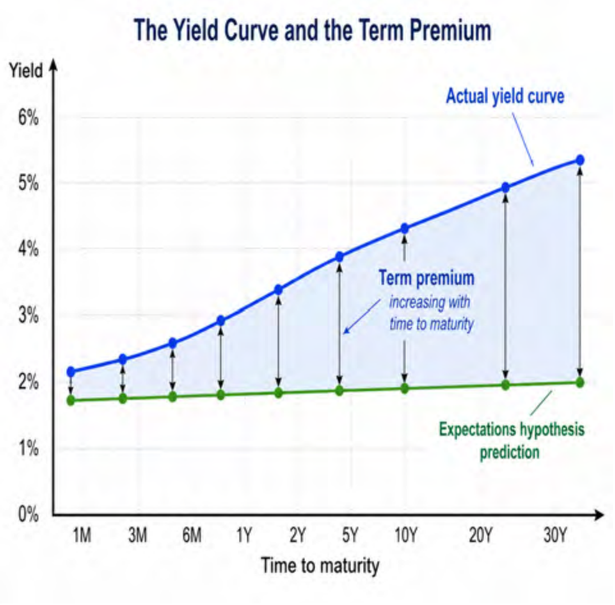
Term premium: long-term bonds are riskier than short-term bonds

If short-term rates change in unexpected ways, the priced of long-term bonds change. Prices react more the longer the remaining time to maturity (duration risk)

Bondholders demand compensation for this risk

$$i_{t,t+h} = \frac{1}{h}\left[i_{t,t+1} + i^e_{t+1,t+2} + i^e_{t+2,t+3} + \ldots i^e_{t+h-1,t+h}\right] + tp_t(h)$$

Yield Curves



Unconventional Monetary Policy

Conventional monetary policy: impact economically relevant rates via manipulation of short-term, riskless rates

Zero lower bound (ZLB): interest rate on bonds cannot go (very far) below zero because money offers no interest and is a competing asset

What to do if short-term rates are at or near zero?

- Forward guidance: promise low short-term rates in the <u>future</u>
  - Works through the logic of the expectations hypothesis.
- Quantitative easing (QE): directly buy (via reserve creation) long-term and/or risky bonds
  - Logic is simple: push up demand for long-term, risky stuff (raise price, lower yield)

QE

Ben Bernanke: "The problem with QE is that it works in practice but not in theory"

Why? Demand-supply logic seems simple enough

But it ignores substitution across different types of assets

For a given term premium, long-term bond yields are pinned down by the Expectations Hypothesis (expected sequence of short-term rates)

Perhaps QE impacts term or risk premia, but not really clear how without some kind of frictions

- Ideally, articulate the frictions