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Notes on Interest Rates

1 The spectrum of interest rates

In macroeconomics we often talk of "the" interest rate, but literally there's no such thing: at any point in time there's a spectrum of rates. **Debt instruments** (bonds, bills) differ from each other in two main ways—by **default risk** and by **term to maturity**—and these differences are reflected in rates.

Default risk

Take the simpler question first, namely default risk. Greater default risk means a greater chance that the borrower will be unable to fulfill their part of the loan contract, that is, to pay interest and repay the principal sum when the loan matures. In the financial jargon we talk of a lender taking a "haircut" when they're obliged to accept less than what was promised. In the worst case the lender might get nothing at all back when the borrower defaults.

Now it stands to reason that if a given borrower is reckoned likely to default, in whole or in part, then that borrower will have to offer a relatively high interest rate to get people to buy their bonds. Conversely, a borrower whose creditworthiness is very high (minimal to no chance of default, as with the US government) will be able to borrow at a relatively low interest rate, other things equal.

In the US, three main agencies—Moody's, Standard and Poor's and Fitch—provide an assessment of the creditworthiness of major corporate and governmental borrowers. Their ratings are supposed to give potential lenders a well-informed measure of default risk. In practice these agencies fell down on the job quite spectacularly in the run-up to the financial crisis of 2007–2009, giving their top "AAA" rating to bonds based on sub-prime mortgages which turned out to be "junk," of little or no value.[1]

Term to maturity

A debt instrument is said to "mature" when the time comes for the borrower to repay the principal sum. Loans can differ greatly by term, running from overnight, to a few months, to a few years, to decades. In general, the presumption is that long-term loans will have to offer higher interest rates than short-term ones, to compensate lenders for the greater "commitment" they undertake. That's broadly correct, but there are some complications we need to consider.

2 Primary and secondary markets

The **primary market** in debt instruments is the market on which borrowers issue new bonds or bills. The **secondary market** is the market on which people, or institutions, buy and sell existing debt instruments. Unlike the markets for, say, cars or refrigerators, there's really no meaningful distinction between "new" and "used" bonds from the buyer's point of view. A bond is simply a promise to pay money in future. If we match by default risk and term, a bond that someone else has held for a while is just as good as a newly issued one.

We said above that longer-term lending is a greater "commitment." That's not so obvious if the debt in question is traded on an active secondary market. Suppose I'm holding some 10-year Treasury bonds which still have years to run till maturity, but I decide I want to get my money out now. I'm not stuck, I can sell them on the secondary market (which is very active for Treasury debt). Problem solved? Not necessarily. Yes, I can easily sell my bonds, but how much money will I get for them?

[1] We might suppose that the job of rating bonds should be performed by an independent, public agency along the lines of the Food and Drug Administration. In fact, Moody's and the others are private, profit-seeking companies who are paid by the very corporations whose debt they rate, giving rise to the possibility of a serious conflict of interest.

Here we need to go back to the idea that "new" and "used" bonds are essentially equivalent. That means that, in equilibrium, they have to offer the same rate of return to a prospective buyer. Suppose I bought my T-bonds at a time when the 10-year interest rate was 2 percent, but since then the rate on new issues has gone up (let's say, to 5 percent). How can the bonds I'm holding be made "just as good," from a buyer's point of view, as the new ones? They have to sell at a lower price. The less you pay for a given promise of future payments, the greater the return you're getting, so at some sufficiently low price my bonds will yield the required 5 percent.

This means that long-term lending *is* after all, in a sense, a greater commitment than short-term: you can get your money out OK, if there's an active secondary market, but you might not get as much as you were hoping for. On the other hand, if current interest rates have *fallen* since you bought your T-bonds you're in luck: you may be able to sell them for more than you paid for them originally. The idea is not that you're bound to lose money by selling your bonds before they mature, it's just that you're open to a certain kind of risk—not default risk but **capital risk**: the risk that when you come to sell, the price you get *may* not match your expectation, if meanwhile rates have risen.

3 The "term structure"

In this section we'll abstract from differences in default risk and concentrate entirely on term to maturity. We can do this mostly easily by considering a single borrower, say, the US government. If we take a snapshot of the interest rates currently available on debt of different maturities issued by a given borrower we get what's known as a **yield curve**, as shown in Figure 1.

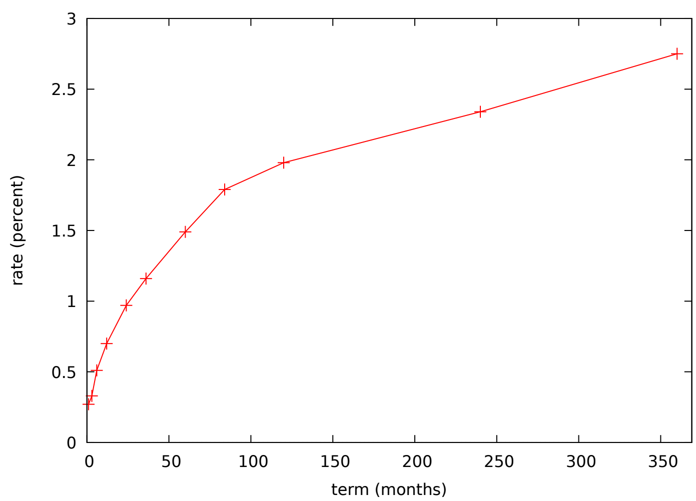

Figure 1: US Treasury debt, 03/11/2016

The yield curve shown in Figure 1 is "normal," in that greater term to maturity is associated with greater yield. That's not always the case. Sometimes the long-term interest rate lies below the short-term rate. Why should that be?

Welcome to the **expectations theory of the term structure**. Let's suppose you have a sum of money that you want to put aside, to earn interest, over the next five years. You have (at least) two options, one being to buy a 5-year Treasury bond and another being to buy a series of 1-year Treasury bonds (when the first one matures you buy another, and so on).

We'll write a subscript on the interest rate to indicate its term, so r_1 will be the one-year rate and r_5 the five-year rate. And we'll append a second subscript to indicate the period in which the loan starts (t means today, $t+1$ means a year from today, and so on). In addition we'll write a superscript e on an interest rate to indicate that it's a value you *expect*, as of today, but which is not yet known. And for this discussion we'll express the nominal interest rate, r, as a decimal fraction (so a 5 percent interest rate corresponds to $r = 0.05$).

So, suppose you know the current five-year rate, $r_{5,t}$. In that case if you lend a present sum of money, P, in the form of buying a 5-year bond and holding it to maturity, your future sum F after 5 years will be

$$F_5 = (1 + r_{5,t})^5 \times P$$

This reflects the compounding of interest: each year your money will grow by the factor $(1 + r_5)$.

On the other hand, if you go for the sequence of 1-year bonds, then after 5 years you can expect to have

$$F_1^e = (1 + r_{1,t})(1 + r_{1,t+1}^e)(1 + r_{1,t+2}^e) \cdots (1 + r_{1,t+4}^e) \times P$$

Your money will grow by a factor equal to 1 plus the 1-year rate for each of the 5 years, but as the e superscripts remind us, you do not actually know the *future* 1-year rates; rather, you're having to form an expectation of what they will be.

Now, if we temporarily ignore the matter of capital risk (discussed in section 2 above), the two future sums F_5 and F_1^e ought to be *equal* in financial-market equilibrium. (If they were unequal, bond traders would be buying or selling the short or long bonds in the hope of making a profit on the deal.) That means that the current 10-year rate ought to be some sort of average (a *geometric average*, to be precise) of the current 1-year rate and the series of expected future 1-year rates.

This gives us a clue as to why the yield curve may sometimes be **inverted** (meaning that the long-term interest rate lies below the current short-term rate). This will happen if the current short-term interest is considered to be exceptionally high, so that bond-holders in general reckon it cannot remain that high for much longer. In that case the average of current and expected future short rates will be below the current short rate, and so the current long rate should also be below the current short rate.

Conversely, if the short-term interest rate is expected to rise in future (and stay high) this will raise the current long-term rate relative to the current short rate. This will exaggerate the "normal" upward slope of the yield curve.

Exercise

Here are percentage yields on US Treasury securities of three different maturities in four different months (along with the unemployment rate, for reference):

	3-month	5-year	10-year	unemployment
March 1980	15.2	13.47	12.75	6.3
December 1996	4.91	6.07	6.30	5.4
February 2007	5.03	4.71	4.72	4.5
November 2016	0.45	1.60	2.14	4.6

For each date, what if anything can you infer about expectations at the time, regarding the future course of short-term interest rates?