Lecture 6: The World of Finance: Interest Rates and the Fixed Income Markets

In a capitalist economy, the financial superstructure that facilitates economic activity is a dominant force. Marrying capital markets dynamics to real economy trajectories is the focus of the remainder of the course. This lecture begins with a qualitative description of real economy/capital market interplay. We then start to build a financial construct by establishing a theory of interest and sketching out the arithmetic of standard fixed income instruments. We review real interest rate concepts. We analyze duration and default issues as we explore the workings of the treasury yield curve and treasury/corporate credit spreads. We link yield curve/credit spread changes to changing expectations about the future path for interest rates and the mean expected levels of corporate default.

The World of Finance

In a modern capitalist economy, economic agents in all sectors are compelled to make both bricks and mortar and lending and borrowing decisions. As households, corporations, governments and central banks make investment and financing decisions, the sum of their transactions are visible real time on green screens.

The entire constellation of asset prices—stocks, bonds, currencies, commodities, futures, options—adjust, as opinions about economic prospects change. Indeed, if one embraces the efficient market hypothesis, the price of a capital asset is the embodiment of the present value of expected future incomes. Thus, every decision to buy or sell implies a judgment of what the future will be like. One can look at a blinking Bloomberg screen as a streaming, non-stop reassessment of the consensus forecast. Investors vote with dollars. And the majority not the chosen few, carry the day.

Thus the real time changes in asset prices, interest rates, currencies and the like, provide for the trained eye, an up to the second consensus opinion about what the future will bring. In the movie The Matrix, Cipher urges Neo to learn to see past the code streaming across the green screen and visualize the world that it implies. Professional economists, analysts, strategists, money managers and hedge fund speculators essentially do the same thing. As they contemplate their Bloomberg Screens, they see how opinions about the world ahead are changing.

Both the consensus opinion about the outlook for overall trends and the implied forecasts embedded in financial market asset prices are the product of the interplay of all players in the system. Corporate CEOs, government policy makers, Wall Street analysts and economists, T.V. commentators, consumers and print journalists all collaborate in its creation care and feeding (see Box I).
Emerging company, industry and sector developments inform opinion about the economic entities in question and also influence attitudes about overall economic prospects. Likewise, changing sentiments about aggregate trajectories, at times, weigh on opinion about company, industry and sector prospects. In Wall Street jargon, bottom-up developments can influence opinions about the overall outlook, just as barometers of economy-wide significance sometimes change opinions about the prospects for various sectors and companies.

Obviously company projections, macroeconomic forecasts and T.V. talking head commentaries are different animals. Nonetheless, most conjecture about the future shares a commonality of language and arithmetic. Talk almost always compares emerging news to previous expectations. Growth rates, not levels, are in focus. Moreover, the most captivating developments usually involve surprising changes in growth rates—not ascents to new levels or extensions of ongoing trends. As my Dad, a physicist, liked to put it, “It’s a second derivative world”.

**Pervasive Uncertainty, Alongside the Need to Decide**

Notwithstanding the powerfully democratic nature of the process that creates and updates the conventional wisdom, the underlying, inescapable real time truth remains:

> **NOBODY KNOWS!**
Thus the Green Screen is an excellent window on changing expectations about future prospects, but a mediocre forecaster. Efficient market theory, captivated by the notion that market prices benefit from all available information, celebrates the implied market forecast as “the best forecast that money can derive”. True enough, most of the time. The best forecast, unfortunately, remains a poor one. We need to remind ourselves of the pervasive uncertainty that attends all economic decisions. We need to infuse our calculating efforts with humility, even as we build a framework that relies on efficient market theory and produces very specific assertions about expected future outcomes. We can steal and massage a line from Hyman Minsky:

*Constructing a theory of finance without uncertainty is like casting Hamlet without the Prince.* (Minsky, John Maynard Keynes, 1975)

Pervasive uncertainty allows for a wide open evolution of expectations. As we progress, over the semester’s second half, we will come to see that a great deal of the *Art* part of economic forecasting involves selective use of the two competing schools of thought about expectations and financial markets. Belief in the wisdom of markets allows economic decision makers to accept most prices that they confront as reasonable. Moreover the EMH gives legitimacy to the ongoing forecast message embedded in global financial markets. As we have noted before, much of the time, the markets give us the best guess that money can buy. Conversely, our assertion is that expectations evolve, over the course of a business cycle. Behavioral finance, with its belief in systematic errors, explains much of what we witness, as cycles come to a close. More specifically, as worries about dastardly outcomes recede, risk appetites rise and a systemic rise in the use of credit comes into being. In some instances, in select sectors, irrational asset pricing takes charge. In all cases, the financial fragility that increased leverage puts into place sets the economy up for major reversal following only small disappointments. Ultimately, we see violent reversals of opinion, about the sustainability of previous expansion trajectories. These sentiment reversals are the earmarks of the onset of economic downturns. In sum, we need to understand both the workings of the efficient market hypothesis, and the dynamic that drives the behavioral finance model, to present our pragmatic approach to financial market/real economy interplay.

**The Efficient Market Hypothesis vs. Adaptive Expectations**

An efficient financial market is one in which security prices always fully reflect the available information. The EMH asserts that global financial markets, more or less, fit this definition. The EMH depends on three assertions:

1. Investors are assumed to be rational.
2. To the extent that some are irrational, their actions are random, and cancel.
3. To the extent that they are irrational in similar ways, rational speculators reverse their effects upon asset prices.

As we will see in the discussions that follow, much of our analysis of real interest rates, yield curves and credit spreads depends upon the EMH. Instantaneous, rational absorption of economic news is the process we assume is working when we talk about
conventional expectations for inflation, Fed tightening, or corporate bankruptcy rates. Thus, for much of our effort, we depend upon the wisdom of crowds.

In contrast, we also acknowledge that business cycles reveal a pronounced pattern pertaining to risk. Adaptive expectations in its simplest incarnation, concludes that for many investors, the persistence of a trend invites irrational conviction in its permanence. Rational calculations that prove the trend to be long term unsustainable, over the course of a business cycle are overwhelmed by the persistence of “surprisingly good news” over a multi-year period. At such moments all three assumptions designed to protect the conclusions of the EMH fall under the weight of the madness of crowds:

1. A large group of investors are not rational.
2. This group is irrational in a similar way, reinforcing, not canceling out the irrational bias.
3. The size of the many overwhelms the insights of rational speculators. The madness of crowds defeats the wisdom of arbitrageurs.

Armed with a basic understanding of the two competing schools of thought concerning the collective insights of the many, we now sketch out a barebones framework for thinking about how to value future flows of income in the fixed income marketplace, and how our collective assessments concerning such future flows provide insights about future economic trends.

**J.R. Hicks: A Theory of Interest**

Time is money. The lottery winner in the Bizarro world gets 1$/year for a million years. Why is she unhappy? In finance, we acknowledge that future dollars are less valuable than cash in hand today. If we can agree upon an interest rate, we can apply that rate to future earnings streams and add these discounted streams up. The result? We have a number that represents the present value of the future stream of dollars. Present value calculations allow rational economic agents to compare the relative worth of differing cash flows.

How do we frame our thoughts about interest rates? In *Value and Capital* Sir John Hicks gives us the essentials for a theory of interest:

> The essential characteristic of a loan transaction is that its execution is divided in time. The money rates of interest paid for different loans at the same date differ from one another for two main reasons: (1) because of differences in the length of time for which loans are to run, and in the way repayment is to be distributed over time; (2) because of differences in the risk of default by the borrower.

Hick’s definition leads to a two part analysis of interest rates. We consider the term structure of interest rates and the risk structure of interest rates as we evaluate the yield curve and credit spreads. Before we review these two concepts, however, we need to
sketch out the mechanics of a few credit market instruments. We also need to define and explore the concept of inflation adjusted or *real* interest rates.

**Simple Credit Market Instruments:**

Simple loan:
(e.g., one-period bank loan)

- **Principal:** the borrower receives a specific amount.
- **Interest:** Borrower repays the principal amount plus an interest payment.

<table>
<thead>
<tr>
<th>Period</th>
<th>1 Year</th>
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</table>

Receives $10,000

Discount loan:
(e.g., discount treasury-bill market)

- **Principal:** Lender provides borrower with amount of face value of the loan, minus the interest payment. Lender receives face value of the loan when loan is repaid.

<table>
<thead>
<tr>
<th>Treasury Bills</th>
<th>1 (borrower repays $10,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year</td>
</tr>
</tbody>
</table>

Borrower Receives $9091

\[
\begin{array}{c}
10,000 \\
9091 \\
\text{909 (10% Interest)}
\end{array}
\]

Face Value (par value)= at maturity payment
Maturity: Borrowers agrees to pay at a given date

Coupon bond:
(e.g., government corporate bond)

- **Principal:** borrower receives face value of the loan
- **Interest:** lender is paid interest each year, receives full value of loan back, at end of term of the loan.
Fixed Payment Loan:
(e.g., home mortgage, car loan)
Principal: borrower receives face value of the loan
Interest: lender is paid the same, each month. Both principal and interest are paid each month, until the loan is paid off.

Valuing Cash Flows in the Credit Markets

Following the framework sketched out by J.R. Hicks, we now derive a set of formulae that allow us to determine the net present value of the cash flows of various types of credit market instruments. We begin by focusing on U.S. treasury instruments, bonds that offer up guaranteed cash flows, and as such require no default risk considerations. The interest rate earned on these riskless assets we identify as the risk free rate. The value of such assets is the present value of their cash flows, discounted to the present at the risk free rate.

Valuing a 10-Year Treasury Note

A U.S. treasury ten-year note provides the owner with a stream of coupon payments over the life of the instrument, followed by a return of the face value of the bond. When a ten-year note is issued, its coupon payments and the returned principal payment are discounted by the 10-year risk free rate. The result? By definition the 10-year risk free rate is the coupon interest rate offered on the bond, and using this rate to discount the value of the coupon payments and returned principal results, axiomatically, in a price of “par” or 100, for the bond.

Seasoned U.S. treasury bonds, however, have cash flows established in earlier periods. The coupon interest rate for these bonds and the guaranteed fixed coupon payments for these bonds must be valued using the contemporaneous risk free rate. The price of the bond—the value of this asset—adjusts to reflect the effect of changing interest rates on the value of the fixed and guaranteed cash flows. In formulaic terms we have the following:

<table>
<thead>
<tr>
<th>Maturity Date</th>
<th>Face Value</th>
<th>0</th>
<th>1000</th>
<th>1000</th>
<th>…</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coupon Rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borrower gets $10,000</td>
<td>1</td>
<td>2</td>
<td>19</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coupon Rate = Yearly Coupon Payment =</td>
<td>1,000</td>
<td>=</td>
<td>10%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Face Value =</td>
<td>10,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Coupon Bond (Government, Corporate, Bond Market)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maturity Date</td>
</tr>
<tr>
<td>Coupon Rate</td>
</tr>
<tr>
<td>Borrower gets $10,000</td>
</tr>
</tbody>
</table>
Value of Coupon bond = \[ \text{coupon(1)} + \frac{\text{coupon(2)}}{(1+r)} + \ldots + \frac{\text{coupon (20)}}{(1+r)^{20}} + \text{face value of bond} \]

Where \( r \) is the risk free rate.

The value of the bond, the bond’s price, therefore, will rise and fall, so as to ensure that the yield to maturity of the stream of payments is comparable to other treasury bonds of the same duration.

In fact, in the real world of fixed income finance, there is a multi-trillion dollar secondary market that trades government and corporate credit instruments. The secondary market for bonds is a prime example of a dynamic market that, without question operates according to EMH assumptions. Thousands of institutional investors squeeze out discontinuities ensuring that comparable instruments sport comparable yields.

Consider the table below. In February of 2007 the U.S. treasury issued 10-year bonds. They were offered with a 4 and 5/8s coupon rate. Twenty years earlier, in May of 1987 the treasury issued 30-year bonds, with a coupon rate of 8 and 3/4s. In early 2007, the 30 year bonds of 1987 had 10 years left, before maturity—in effect they now were instruments that would pay interest over the same 10 year period as the newly minted 10 year t-note. Clearly, the opportunity to collect 8 and ¾s for 10 years is wildly superior to collecting 4 and 5/8s. Market players, however, allow for no such windfall. As the table below informs us, the price of the 8 and ¾s of 1987, in mid: March of 2007 had climbed to 132, in contrast to the 100 par price for the newly minted bond. Thus the 8 and ¾s bond sported a 4.64% yield-to-maturity, all but identical to the yield-to-maturity of the most recently issued U.S. ten-year instrument. This arbitrage driven reconciliation of the yields’ of bonds of comparable risk and duration is the rule throughout the credit markets. The EMH in this case categorically rules the roost.

<table>
<thead>
<tr>
<th>Date Of Issuance</th>
<th>Years Remaining For Instrument</th>
<th>Coupon Rate</th>
<th>Date Of Maturity</th>
<th>Bond Price Secondary Market</th>
<th>Yield-to-Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/15/2007</td>
<td>10</td>
<td>4 5/8</td>
<td>2/15/2017</td>
<td>100</td>
<td>4.57</td>
</tr>
<tr>
<td>5/15/1987</td>
<td>10</td>
<td>8 3/4</td>
<td>5/15/2017</td>
<td>132</td>
<td>4.64</td>
</tr>
</tbody>
</table>

Valuing a Coupon Bond with Default Risk

Lending to households or corporations introduces uncertainty into valuation calculations. A corporate bond, like a U.S. treasury bond, promises a specific set of cash flows over time. Nonetheless, the company may fail to deliver on its promises. We, therefore, no longer employ a risk free rate to value the stream of cash flows. Instead, we add a premium to the risk free rate—the corporate spread—to compensate for the risk of
default. Thus the rate used to discount the promised cash flows of a corporate bond is the corporate borrowing rate, sum of the risk free rate and the corporate spread. Corporate bond rates vary greatly, a function of the perceived riskiness of the company in question. Formulaically:

\[
\text{Value of Coupon bond} = \text{coupon(1)} + \frac{\text{coupon(2)}}{(1+\text{cr})} + \frac{\text{coupon}(20)}{(1+\text{cr})(2)} + \frac{\text{face value of bond}}{(1+\text{cr})(20)}
\]

Where cr is the corporate borrowing rate= risk free rate plus corporate spread

1. **Real Interest Rates**

A loan can be looked upon as willingness, by the lender, to postpone consumption today, in exchange for the opportunity to enjoy an increased level of consumption tomorrow. Interest paid on the loan represents the additional monies available for future consumption. But a generalized rise for the price level, over the course of the loan transaction, will reduce the purchasing power of future sums. Thus a focus on future purchasing power requires that both lenders and borrowers engage in a transaction that attempts to include the effects of inflation. A real interest rate is the interest rate paid, adjusted for the inflation rate that is expected to prevail over the course of the loan.

**Real Fed Funds Rate**

The real overnight interest rate, the real fed funds rate, is a critical barometer for U.S. monetary policy. The fed funds rate, the overnight borrowing rate amongst banks, is quoted on an annualized basis. By subtracting the latest year-on-year inflation rate from the fed funds rate, we have a measure of real, or inflation adjusted overnight borrowing costs:

- 0.13%-2.21% = -2.1% using CPI (year-on-year, through Feb 10)
- 0.13%-1.33% = -1.2% using core CPI (year-on-year, through Feb 10)

**Real 10-Year Treasury note**

Similarly, a conventional measure of the real ten-year borrowing rate is the difference between the prevailing ten-year treasury rate and the past year’s inflation rate:

- 3.8%-.2.2% = 1.6% using CPI (year-on-year, through Feb 10)
- 3.8%-1.3%=2.5% using core CPI (year-on-year, through Feb 10)

But is the trailing 12-Month inflation rate, or core rate, a good indicator of the next ten years’ overall inflation rate performance? History says no (see above). Using the past inflation performance for calculating the real overnight rate is reasonable— inflation is
quite unlikely to change in a day. But inflation has the potential to surprise mightily, when we are contemplating long periods.

Thus the ex-ante naïve calculation about the real yield of a given ten-year instrument may well deviate greatly from the ex-post real yield that the borrower ultimately collected. As the table above details, a lender in 1970, depending upon the recent performance of the core CPI as a guide, expected to receive a 1.8% per year real yield—in reality the return, adjusted for inflation, was negative! In sharp contrast, a lender in 1980, again focusing upon recent core inflation, expected a return of 3.2%--life turned out much better, with an 8% real return over the period.

**Alternative Is TIPS**

<table>
<thead>
<tr>
<th>TIPS</th>
<th>10-YR Calc Rate</th>
<th>10-YR TIPS Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-26/18</td>
<td>2.8%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

Recently, the U.S. treasury and a handful of other Nations’ treasuries have begun issuing inflation protected bonds. These government bonds promise to pay an interest plus the year-to-year change in the inflation rate. The bonds therefore, explicitly compensate the lender for inflation changes. These Treasury Inflation Protected Securities, or TIPS bonds, provide useful information about market expectations for inflation.

Again we start by asserting that in this arena, we will assume that EMH holds. If the treasury bond market and the TIPS market are priced efficiently, relative to one another, then the expected total return to a holder of the a 10-year bond of either kind, should be the same.

<table>
<thead>
<tr>
<th></th>
<th>10-Year Yield</th>
<th>12-Month Core CPI</th>
<th>Actual CPI</th>
<th>Ex-Ante Real</th>
<th>Ex-Post Real</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-70</td>
<td>6.4</td>
<td>4.6</td>
<td>7.9</td>
<td>1.8</td>
<td>-1.5</td>
</tr>
<tr>
<td>12-80</td>
<td>12.8</td>
<td>9.6</td>
<td>4.8</td>
<td>3.2</td>
<td>8</td>
</tr>
<tr>
<td>3-26</td>
<td>2.8</td>
<td>1.7</td>
<td>???</td>
<td>1.1</td>
<td>???</td>
</tr>
</tbody>
</table>

The buyer of a newly issued 10-year treasury will receive the coupon rate of interest. The buyer of a newly issued 10-year TIPS bond will receive the TIPS yield plus the subsequent inflation rate over the next ten years. Thus if the treasury yields 4.7% and the TIPS bond yields 2.2% , the implied inflation rate over the next ten years is 2.5%.

More simply, the spread between the treasury rate and the TIPS rate is the market expectation for inflation.
The Federal Reserve Board’s Preferred Long Run Inflation Expectation Indicator

The FRB recognizes that spikes for volatile prices like food and energy can drive measured inflation sharply higher/lower over short run periods. For instance, a surge in oil prices, everyone recognizes, will drive up the energy component of the CPI over a multi-month period. TIPS bonds will immediately reflect this change. But the arithmetic rise of a few months for the CPI, reflecting a spike for a few prices, may not change underlying opinion about long run inflation prospects. So the Fed attempts to strip away short run developments, by imputing *out year* inflation expectations.

The Fed computes the inflation expectation embedded in the 5-year treasuries/TIPS spread. They then calculate inflation expectations found in the 10-year treasury/TIPS spread. These two inputs allow them to impute expected inflation over years 6 through 10:

10-Year inflation expectation = 2.1%
5 year inflation expectation = 2.0%
Year 6 through 10 inflation expectation = “X”

\[
2.1\% = \frac{(2.0\% + X)}{2} \quad X = 2.2\%
\]

Compounding and Geometric Averages
The calculation used above to calculate expected inflation is not quite right, as it fails to account for compounding. We need to use a geometric average. Let’s consider a two-year zero coupon note, a one-year zero coupon note and infer the one-year zero coupon note, in one year’s time [the one-year, one-year forward]. The formula we will use:

\[
(1 + y_2)^2 = [(1 + r_1) \times (1 + r_2)]
\]

Rather than: 2 × (y₂) = r₁ + r₂

Suppose the 2-Year zero is 6% and the 1-Year zero is 4%. Our oversimplified equation states: 2 × (6%) = 4% + r₂ *thus* r₂ = 8%

If we account for compounding, however, we get a different result,

\[
(1 + y_2)^2 = [(1 + r_1) \times (1 + r_2)]
\]

\[
(1.06)^2 = (1.04) \times (1 + r_2)
\]

\[
1.1235 / 1.04 = 1 + r_2
\]

\[
1.0803 = 1 + r_2 \quad r_2 = 8.03\%
\]
A Crude Imputation of Fed Funds Rates from the Treasury Curve

Accepting the implications of compounding on calculations of forward interest rates, we can rely on bond calculators to “make things right” and we can impute forward interest rates from existent rates. Let’s suspend that subtlety for the moment and consider expectations for the Fed Funds rate, based upon term structure of interest rates in the treasury market. We confront a picture in early 2005 that has the Fed Funds Rate at 2.75%, the two year treasury at 3.88% and the 5-year treasury at 4.4%. Let’s assume for the moment, that the Fed Funds rate averages over the two year will equal the two year-yield. If we assume further a steady rise for the Fed Funds rate how might we calculate the Fed Funds rate over the period?

We want the Fed Funds rate to average 3.88% over the two years. We want quarterly increases to all be of the same magnitude. We start with a Fed Funds rate of 2.75%. Let’s posit that Q2:2005 the Fed Funds rate will rise by $\alpha$, so that the Fed Funds rate will average 2.75% + $\alpha$. In Q3:2005 it will rise by 2$\alpha$ and the funds rate will average 2.75% + 2$\alpha$ and so on.

\[ \sum 1 \times \alpha + 2 \times \alpha + \ldots + 8 \times \alpha = 36 \times \alpha \]

\[ 8 \times (2.75) + 36 \times (\alpha) = 3.88 \]

We solve for $\alpha$.

$\alpha = 25$ basis points

So we can assert that the Fed Funds Rate Pattern implied is:

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</tr>
</thead>
<tbody>
<tr>
<td>Fed Funds Rate</td>
<td>2.75</td>
<td>3.00</td>
<td>3.25</td>
<td>3.5</td>
<td>3.75</td>
<td>4.00</td>
<td>4.25</td>
<td>4.5</td>
<td>4.75</td>
</tr>
<tr>
<td>2-year note</td>
<td>3.88</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-year note</td>
<td>4.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-yr 2 yrs fwd</td>
<td>4.75</td>
<td></td>
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What about fed funds, over the next 3 years (years 3, 4 and 5)? We can use the 5-year yield and the 2-year yield to impute the three-year yield 2-years forward:

\[ 4.3 = \frac{2}{5} \times (2 \text{ Year Yield}) + \frac{3}{5} \times (3\text{-Year, 2 years Forward}) \]

\[ 4.3 = \frac{2}{5} \times (3.85) + \frac{3}{5} \times (3\text{-Year, 2 years Forward}) \]

3-Year, 2-years Forward = 4.75%
The 3-year yield, two years hence, yields 4.75%. That is the yield in place for the fed funds rate at the outset of the three year period. Thus since the Fed Funds rate needs to average 4.75%, over the period Q1:07 through Q1:10, we can assert:

The fed funds rate will rise to 4.75% from 2.75% over the next two years
The fed funds rate will be steady, at 4.75%, over the subsequent three years.

What do forward curves look like today? Type ‘FWCM’ on Bloomberg and then type ‘treasury actives curves’. You will get implied forward interest rates across the maturity spectrum.

Forward Rates Future Expectations, In an Uncertain World

Now we need to insert one additional complication. We need to remind ourselves of Minsky’s notion of “pervasive uncertainty”. In a world that is ever and always uncertain, investors demand compensation for committing funds over long time periods. They want to be paid a premium for extending loans for lengthening periods. This “term premium” is embedded in forward curves and it is separate from expectations of future interest rates.

Let’s return to our simplified model. Suppose the ten-year yield to maturity is 8% and the 5-year is 6%. Suppose further that investors demand 1% in term premiums, to be compensated for lending over the final 5-years of the 10-year note’s existence.

We label F= expected future rate
We label α = term premium
We then have:

\[
\begin{align*}
8\% &= \frac{6\% + F + \alpha}{2} \\
16\% &= 6\% + (F + \alpha) \\
10\% &= F + \alpha \\
\alpha, \text{ we assert} &= 1\% \\
\text{So, } F &= 9\%
\end{align*}
\]

In other words, the forward rate = 10%, but the expected future rate is 9%.

Can we estimate α? One way to try to do this is to measure forward rates and contrast them, to the actual rates that develop. The table below does this in short dated euro markets for the twenty years ending in 2007. The table reveals that the term premium is positive for all the terms and that it rises as the term lengthens. In the U.S.A. the term premium for 12-month euro dollars averaged 0.64%. In other words, on average the forward market looked for a rise for the 3-month Eurodollar interest rate, over the subsequent 12-months, that was 64 basis points more than actually transpired. So when we use the term structure to talk about the future interest rate expectations, we need to
beware a “term premium” exists and it renders forward rates consistently biased above actual interest rates that come to pass.
Thanks for help from Kent Huang of Mt. Lucas Management. He states, “please also note that for all the quarterly data, I was able to use the implied rate based on the various futures contracts [U.S. – Eurodollar (ED), Canada – Bankers Acceptances (BA), Great Britain – Short Sterling (L), and Europe – Euribor (ER)]. For the monthly data, when the necessary futures contract was not available, which mainly occurred during the 9 month and 12 month rates for intra quarter reference dates, I used the respective FRA prices (i.e. 9 x 12 FRA for the 9 mth rate and 12 x 15 FRA for the 12 mth rate). In these instances, I have provided the difference between the quarterly futures contract and the FRA price as reference to the applicability of using the FRA implied rates. In Canada, there wasn’t a 12 x 15 FRA available which as a result I simply replicated the quarterly data.

<table>
<thead>
<tr>
<th>MONTHLY DATA</th>
<th>QUARTERLY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CANADA</strong></td>
<td><strong>CANADA</strong></td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td>3 MTH</td>
</tr>
<tr>
<td>0.061</td>
<td>0.198</td>
</tr>
<tr>
<td><strong>STANDARD DEV</strong></td>
<td>0.313</td>
</tr>
<tr>
<td><strong>UNITED STATES</strong></td>
<td>3 MTH</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td>0.094</td>
</tr>
<tr>
<td><strong>STANDARD DEV</strong></td>
<td>0.423</td>
</tr>
<tr>
<td><strong>GREAT BRITAIN</strong></td>
<td>3 MTH</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td>0.073</td>
</tr>
<tr>
<td><strong>STANDARD DEV</strong></td>
<td>0.482</td>
</tr>
<tr>
<td><strong>EUROPE</strong></td>
<td>3 MTH</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td>0.070</td>
</tr>
<tr>
<td><strong>STANDARD DEV</strong></td>
<td>0.348</td>
</tr>
</tbody>
</table>

1 Thanks for help from Kent Huang of Mt. Lucas Management. He states, “please also note that for all the quarterly data, I was able to use the implied rate based on the various futures contracts [U.S. – Eurodollar (ED), Canada – Bankers Acceptances (BA), Great Britain – Short Sterling (L), and Europe – Euribor (ER)]. For the monthly data, when the necessary futures contract was not available, which mainly occurred during the 9 month and 12 month rates for intra quarter reference dates, I used the respective FRA prices (i.e. 9 x 12 FRA for the 9 mth rate and 12 x 15 FRA for the 12 mth rate). In these instances, I have provided the difference between the quarterly futures contract and the FRA price as reference to the applicability of using the FRA implied rates. In Canada, there wasn’t a 12 x 15 FRA available which as a result I simply replicated the quarterly data.
Monetary Policy, the Collapse and Partial Return of the Term Premium.

We noted above, that estimating $\alpha$, the term premium, was important, when concerned with inferring market expectations of future rates from forward rates. In the aftermath of the Great Recession, a wide body of evidence suggests that the term premium collapsed, as a combination of central bank forward guidance and bond buying apparently removed market participants demands for compensation for making longer duration loans.

The Yield Curve, Nonetheless, a Good Forecaster

Look at the yield curve below, we see “neutral” is modestly positively sloped, not flat due to the time premium. But very steep or inverted yield curves have important messages embedded in them.

![A Neutral Yield Curve: A Fed Funds/10-Year Spread Of 40 Basis Points.](image)

![Inverted Yield Curve: Tight Money, Temporary To Curtail Growth, Lower Inflation.](image)
<table>
<thead>
<tr>
<th>Spread (%)</th>
<th>YOY % Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

**Inverted Yield Curves Are A Harbinger Of A Substantially Weaker Economy.**

10-Year Treasury Note Yield Minus 2-Year Treasury Note Yield

---

### Spread (%)

<table>
<thead>
<tr>
<th>Spread (%)</th>
<th>YOY % Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

**Neutral 100 to 150 BPS**
- Goldilocks economy
- Acceptable Inflation
- "Neutral Short Rates"

**Steep**
- Low inflation
- Struggling Economy
- "Negative Real Short Rates"

**Great Recession Aftermath**
- Low inflation
- Little Change
- Little Change

**Neutral due to Zero Bound**
- "Negative Real Short Rates"
Credit Spreads and Default Expectations

Just as we did with yield curve analysis, we begin by embracing the EMH, as we investigate the implications of treasury market, corporate bond market credit spreads. We assert that lending to the U.S. government is risk free. Lending to individuals and corporations introduces the potential for default. Lenders, therefore, will demand a higher interest rate, as compensation for this risk. How much more will lenders demand? Again, in a many trillion dollar market, we assume that investors in these debt instruments arbitrage away any significant advantage for lenders contemplating the choice between lending to the government or a private borrower.

A more precise way to think about this? Creditors will lend to private borrowers at rates that are just enough above treasury rates to compensate them for the amount of bankruptcies that they think are most likely over the period in question. In other words, embedded in the spread between treasury and corporate borrowing rates is a forecast of future default rates for corporate borrowers.

Let’s simplify. We will compare a bank’s choice between lending $1,000,000 to the government versus lending $1,000,000 to a collection of small businesses. In our super simplified example, the bank has 100 businesses that each would like to borrow $10,000 for one year. Alternatively, the bank can buy a 1 year treasury note. The coupon rate for the treasury is 3%. The bank has determined that, in the current marketplace, it can secure 8% from the business borrowers. The EMH asserts that the two interest rates will leave the bank almost indifferent to the two loan choices. For that to be true the default risk inherent in the corporate loans will equal the extra interest that the borrowers, in aggregate pay.

Indeed, in this simple one period loan situation, we can calculate the market expectation of default. We need only specify one additional assumption. We assert that when a loan defaults, in this circumstance, no interest is collected and half of the principal is lost. We now simply need to figure out how many businesses will default, in order to erase the extra interest paid by those borrowers who make good on their loans:

<table>
<thead>
<tr>
<th></th>
<th>Principal</th>
<th>Interest rate</th>
<th>lump-sum payment</th>
<th># of Defaults</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-Note</td>
<td>$1,000,000</td>
<td>3%</td>
<td>$1,030,000</td>
<td>zero</td>
</tr>
<tr>
<td>Corp loans</td>
<td>$1,000,000</td>
<td>8%</td>
<td>$1,030,000</td>
<td>X</td>
</tr>
</tbody>
</table>

We now solve for X:

\[
\begin{align*}
1.08(10,000)(100-X) - X(5,000) & = 1.03(1,000,000) \\
1.08(10,000)(100) - ((1.08)(10,000)X + X(5000)) & = 1,030,000 \\
1,0870,000 - 1,030,000 & = 15,800X \\
X & = 3.1
\end{align*}
\]
Thus the implied market expectation for corporate bankruptcies, in the example above is a bit more than 3%, or roughly 3 of the 100 firms.
EXCEPT! We now should add one more level of detail. Investors, as lenders or equity owners, are demonstrably risk averse. Put more simply, when offered two investment alternatives, sporting the same mean rates of return but different variability of returns, investors prefer the lower volatility investments. Therefore, some of the extra interest payment in the example provided above would be compensation for the lender, given the more volatile nature of lending to corporations. The extra compensation we call the risk premium.

We conclude, then, in a similar fashion to our discussion of the yield curve. Assume EMH and we can infer a bankruptcy rate for corporate borrowers. That calculation, however, will overstate bankruptcy expectations, given the fact that risky assets receive a premium. Thus yield curve analysis overstates the implicit rise for short rates, as it fails to account for the inherent bias to lend over shorter time periods. Implied default rates embedded in credit spreads overstate the case, due to the risk premium demanded by lenders to risky borrowers.

**Credit Spreads and Rating Agencies**

Banks lend to corporate borrowers, depending to a great degree on the expertise of their loan officers. An enormous amount of corporate borrowing, however, is done in the corporate bond market. Individual lenders, equipped with limited information and analytic skills, are able to sort through corporate bonds with the aid of Bond rating agencies. Moody’s, Standard and Poors and Fitch all employ credit analysts. These analysts, unlike their equity market counterparts, are not charged with assessing the overall success of given companies. Instead, they have one challenge. They analyze companies in an effort to assess company ability to make good on its debt. These agencies have developed ratings, depicted below. As the rating declines, the risk of default rises. As EMH would predict, the lower the credit rating, the higher the borrowing costs for the companies in question.
Credit Spreads and the Business Cycle

Like the yield curve, credit spreads shift violently, at business cycle turning points. Consider the table below. Junk bonds, very risky corporate bonds, during “normal” times over the past twenty years, yield 250-270 basis points more than comparable duration treasuries. But at business cycle turning points, the spread soars. The 700 basis point spread, demanded by lenders in 2002, at the end of the last recession, was testimony to two things. Lenders feared substantial bankruptcies. In addition, risk appetites had been crushed by the collapse for the equity market and the surge in bankruptcies in 2001. As a consequence the risk premium demanded also rose dramatically.

<table>
<thead>
<tr>
<th>Bond Ratings</th>
<th>Moody's</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment Grade</td>
<td>Ever Junkier</td>
</tr>
<tr>
<td>Aaa</td>
<td>Ba</td>
</tr>
<tr>
<td>Aa</td>
<td>Ba</td>
</tr>
<tr>
<td>A</td>
<td>Caa</td>
</tr>
<tr>
<td>Baa</td>
<td>Ca</td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

Credit Spreads and the Business Cycle

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>2002</th>
<th>06</th>
<th>09</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Year Treasury</td>
<td>5.5</td>
<td>5.0</td>
<td>4.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Junk Bond</td>
<td>8.0</td>
<td>12.0</td>
<td>7.2</td>
<td>17.5</td>
</tr>
<tr>
<td>Spread (10-Year-Junk)</td>
<td>2.5</td>
<td>7.0</td>
<td>2.7</td>
<td>15.0</td>
</tr>
</tbody>
</table>
Junk Bond Yields Are Violently Pro-Cyclical...

KDP High Yield Index

Baa/10-year Spreads Are Violently Pro-Cyclical: