

Robert Barbera Notes for Lecture 11:

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

Up until now, we have examined the economic system by looking at aggregate output, employment, and inflation barometers. In a capitalist economy, however, the financial superstructure that facilitates economic activity is a dominant force. Marrying capital markets dynamics to real economy trajectories is important. 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.

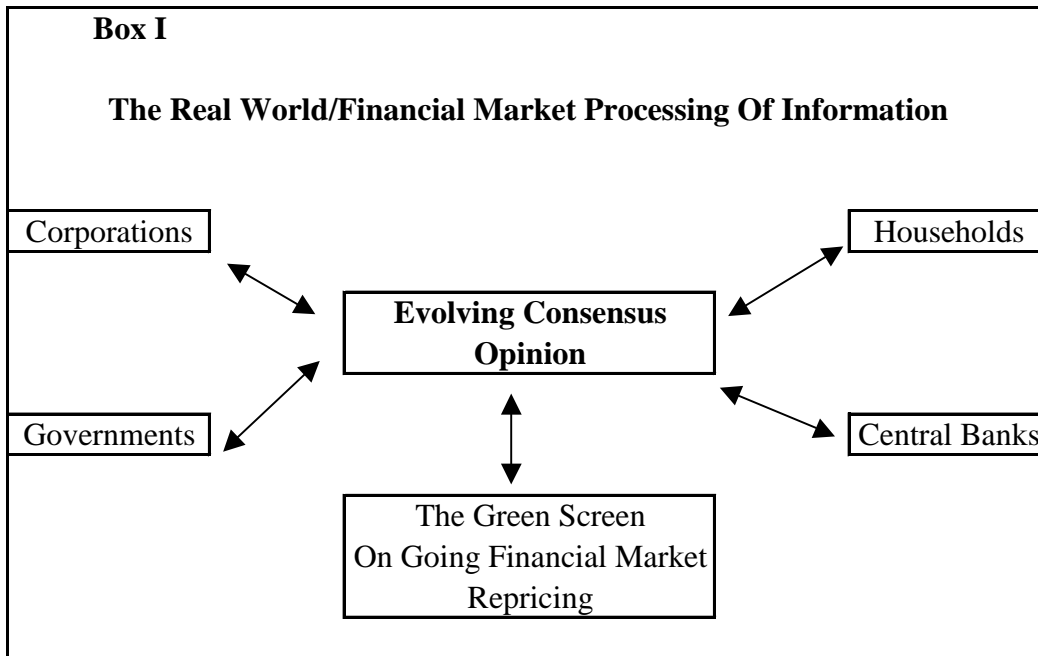
The World of Finance

In a modern capitalist economy, economic agents in all sectors are compelled to make both brick 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 income streams. Thus, every decision to buy or sell a stock or bond 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. 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*, Neo learns 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).



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 consensus, reflected in asset market prices, is a reasonable guess. The consensus forecast, unfortunately, at times can be terribly wrong.

We need to remind ourselves of the **pervasive uncertainty** that attends all economic decisions. In sum, 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.

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.

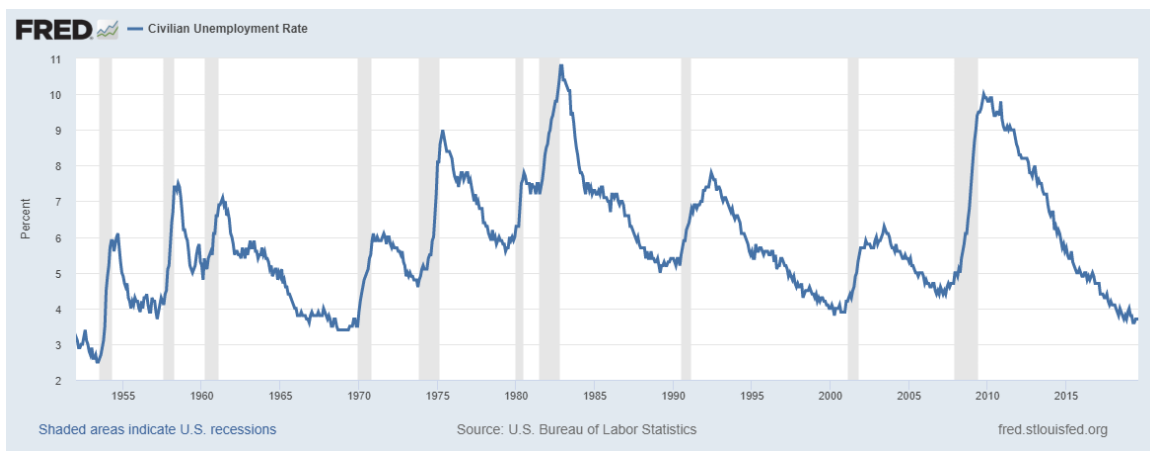
As we will see in the discussions that follow, much of our analysis of real interest rates, yield curves and credit spreads depends upon the EMH. Instantaneous, rational absorption of economic news is the process we assume is working when we talk about conventional expectations for inflation, Federal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

Adaptive Expectations

In contrast, we also acknowledge:

Business cycles reveal a pronounced pattern pertaining to risk.

What do we mean? Let's first define the phrase *business cycle*. Consider the chart, below, depicting the U.S. unemployment rate, 1950 to thru mid-2019. What jumps out from the graph? Periodically, U.S. gains for key economic barometers—employment, sales, production, income—simultaneously suffer violent interruptions. We label such events recessions [gray bars in the graph], and the U.S. has experienced 11 recessions since the end of World War II.



How can we observe attitudes toward taking risks? That is one important reason to learn about bond markets and stock markets. To make things super simple, at the outset, when people are willing to lend money to risky companies, at an interest rate that is only a bit higher than the interest rate they collect when lending to the government, we can conclude that investors are relaxed about risks. Conversely, when lenders demand a large premium to lend to risky companies, we say investors now appear risk averse. Consider the chart below, which shows us how much *extra* interest that individuals demand from risky companies, relative to what they accept from the government:



What does the graph reveal? During recessions, risk aversion spikes—more to the point, investors demand that risky companies pay a very high premium, to get access to funds.

Adaptive expectations, in contrast to the efficient market hypothesis, is a framework that focuses on this persistent pattern toward risk.

Adaptive expectations, in its simplest incarnation, concludes that for many investors, the persistence of a trend invites irrational conviction in its permanence. Why am I very confident that stocks will keep going up, after a long rise for stocks? Precisely because they have been going up for so long.

Behavioral finance economists argue that people form opinions in a fashion better characterized by adaptive expectations, not rational expectations.

They assert that analysts presenting investors with rational calculations, analyses that prove a trend to be unsustainable, cannot convince investors to embrace the idea that a trend in place for a long-time, is about to end.

At such moments, the three assumptions that buttress 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.

We now have two competing schools of thought concerning consensus market insights.

We now can think about how to value expected future income flows.
We start with income in the bond market.

J.R. Hicks: A Theory of Interest

Time is money. The lottery winner in the Bizarro world is awarded 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. You paint my house, and charge me \$1,000. I tell you I will send you the \$1,000, in one year. “No”, you respond, “If you don’t intend to pay me for one year, I demand \$1,100.

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.

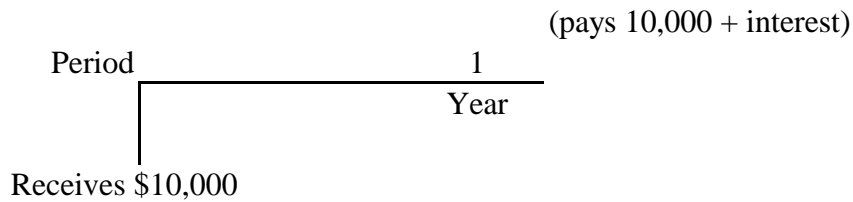
Simple Credit Market Instruments:

Simple loan:

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

Principal: the borrower receives a specific amount.

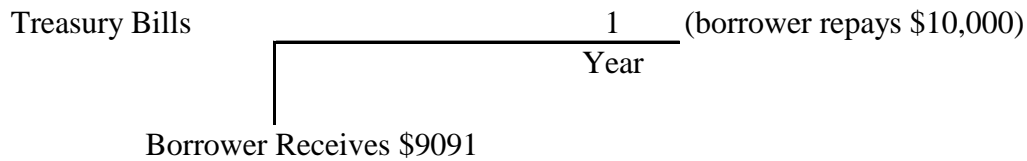
Interest: Borrower repays the principal amount plus an interest payment.



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.



$$\begin{array}{r}
 10,000 \\
 -9091 \\
 \hline
 909 \text{ (10 \% Interest)}
 \end{array}$$

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.

Coupon Bond (Government, Corporate, Bond Market)						
Maturity Date						
Face Value	0	1000	1000	...	1000	
Coupon Rate						
Borrower gets \$10,000	1	2	19		20	
Coupon Rate=	Yearly Coupon Payment		=	1,000	=	10%
	Face Value			10,000		

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.

The Efficient Market in Action

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 period as the newly minted 10-year t-note.

Imagine it is 2007. You own the bond that they issued in 1987. So you lent the government \$100 in 1987. The government is going to send you \$8.75, in each of the next 10 years. In 2017 they will send you your last interest payment of \$8.75, plus your \$100—the principle amount they borrowed from you.

From 1987 to 2007 inflation plunged, and so did most interest rates. Governments now can get money from individuals by offering much lower interest rates.

Your buddy, in 2007, decides to lend the government \$100 for 10 years. She is promised \$5.63 per year in interest, and she will get her \$100 back in 2017.

Clearly, your bond, with 10 years of interest payments of \$8.75 is a much better bond to own than the bond she is about to buy, which promises only \$4.64 per year.

Suppose you call your friend and say to her,

“Hey, I will sell you my government bond. It will pay you \$8.75 per year, and then you will get \$100 back from the government in 10 years.”

She says:

“Great, I will give you the \$100 today!”

You say:

“Are you kidding me! You get twice the monthly interest for 10 years. I want you to pay me a premium for my much higher guaranteed interest payments.”

Your friend agrees to pay you \$135 for your bond.

Now look at what happened. This bond, at a price of \$100, pays 8.75%.

But the new price is \$132. Clearly if you give someone \$135, and they pay you \$8.75 per year in interest, that is not 8.75%.

Let us do the division:

$$\frac{\$8.75}{\$132} = 6.6\%$$

So are we now getting 6.6%?

Remember that after the 10 years, the government will send you \$100, not \$132!!!

We need a more sophisticated formula to figure out what that does to the interest rate we are getting. It turns out that the interest rate equals roughly 4 and 5/8s.

Market bond traders, in fact, took that bond price to 132.

Thus the 8 and 3/4s 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 is called *arbitrage*.

Bonds of comparable default risk and duration will have the same effective yield

Key note:

**If the bond yield needs to fall, bond traders will bid the price up.
If the bond yield needs to rise, bond traders will bid the price down.**

The EMH in this case categorically rules the roost.

Efficient Markets In Action					
Statistics for 03/15/07					
Date Of Issuance	Years Remaining For Instrument	Coupon Rate	Date Of Maturity	Bond Price Secondary Market	Yield-to-Maturity
2/15/2007	10	4 5/8	2/15/2017	100	4.57
5/15/1987	10	8 3/4	5/15/2017	132	4.64

WHAT ABOUT RISK OF DEFAULT?

Lending to households or corporations introduces default risk in to the calculation. A corporate bond, like a U.S. treasury bond, promises a specific amount of cash payment over time. Nonetheless, the company may fail to deliver on its promises. We, therefore, must make a judgment about how risky the company is.

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 10-Year Treasury note

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:

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. Using the recent 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

TIPS Calc	10-YR Rate	10-YR TIPS	Breakeven Inflation
3-10	3.8	1.6	2.2
3-14	2.75	0.60	2.15
3-15	1.91	0.14	1.77
10-19	1.6	0.1	1.5

Recently, the U.S. treasury and a handful of other Nations' treasuries have begun issuing

	10-Year Yield	12-Month Core CPI	Actual CPI	Ex-Ante Real	Ex-Post Real
12-70	6.4	4.6	7.9	1.8	-1.5
12-80	12.8	9.6	4.8	3.2	8
10-19	1.60	2.4	??	-0.80	???

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.

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 2.8% and the TIPS bond yields 0.7% , the implied inflation rate over the next ten years is 2.1%.

More simply, the spread between the treasury rate and the TIPS rate is the market expectation for inflation.

Interest Rate spreads and Expectations for Federal Reserve Board Policy

As we learned in our previous lecture, treasury bonds, are bought and sold in secondary markets. The government, periodically, sells bonds, to raise funds. The bonds, however, can be resold. In fact, millions of treasury bond transactions occur each day. That means we get up-to-the-minute changes in consensus opinion about interest rates, as bond prices rise and fall, and as bond yields fall and rise.

Suppose you have \$1,000 that you want to invest safely, for two years. Lending to a company, or buying stock in a company, invites the possibility of bankruptcy—default risk. If a company goes bankrupt, you likely lose all your money if you bought their stock and you may lose much of your money if you bought one of their bonds.

You choose to lend to the U.S. government, a safe bet. You look at two possible ways to invest:

Buy a 1-year treasury bond, 10/22, when you get your money back in one year, buy a t-bond issued in 10/23.

Buy a 2-year treasury bond, 10/22.

Suppose it is 10/3/22. Treasury yields are as follows:

1-year treasury: 3% yield

2-year treasury: 1% yield

You see that you will get 3% per year, for two years, if you buy the 2-year treasury.

You see that you will only get 1% in the first year, if you buy the 1-year treasury.

What interest rate will you be paid, when buying the 1-year, in one year? Nobody knows!

But we do know something! We know that the world of investors, as they are buying and selling millions of bonds, by their actions, have said that they think they are *indifferent* to lending to the government for two years at 3% per year, and lending at 1% per year, and then again, at an unspecified rate.

A simple question: What must the rate be, for the 1-year treasury, 1 year forward, for the interest they collect to be roughly the same?

$$3\% = \frac{1\% + X\%}{2} \quad X\% = 5\%$$

Aha! The 2-year yield, so much higher than the 1-year yield, tells us that the consensus expectation is that interest rates will rise dramatically over the next year.

[Note: The equation above is shorthand, and is not quite right. The actual equation?

$$(1.03)^2 = (1.01) \cdot (1.0X) \quad \frac{1.0609}{1.01} = 1.0X = 1.05039 \quad X = 5.039\%]$$

Do we believe that the consensus view of where 1-year treasury rates will be in one year is a bit more than 5%? No. we need to add one other consideration. Finance theory, and a great deal of historical evidence tells us that, even if people think interest rates will be stable for a year, they want to be paid a premium, to lend over a longer term.

We call this the term premium. We will ignore the term premium, however, for home works and exams.

Where are we, in early October of 2019?

The annualized 3-month treasury interest rate? 1.7%

The 2-year treasury interest rate? 1.3%

If we ignore term premium, what is the consensus expectation for the 1-year treasury rate, in one years' time?

$$1.3\% = \frac{1.7\% + X\%}{2} \quad X\% = 0.9\%$$

In Wall Street parlance, "The markets are pricing in move down for interest rates, over the next year."

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:

	Principal	Interest rate	lump-sum payment	# of Defaults
T-Note	\$1,000,000	3%	\$1,030,000	zero
Corp loans	\$1,000,000	8%	\$1,030,000	X

We now solve for X:

$$\begin{aligned}
 1.08(10,000)(100-X) - X(5,000) &= 1.03(1,000,000) \\
 1.08(10,000)(100) - ((1.08)(10,000)X + X(5000)) &= 1,030,000 \\
 1,087,000 - 1,030,000 &= 15,800X \\
 X &= 3.1
 \end{aligned}$$

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 average 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.

**...Junk/Treasury Yields Lead
Business Cycle Downturns.**

KDP High Yield Index

