Lecture 1
The Financial Environment, Understanding Interest Rates

- Why Study Finance?
- The Financial System: An Overview
  - Financial Instruments, markets and Institutions
- Understanding Interest Rates
  - Interest Rates
  - The Risk and Term Structures of Interest Rates

Why Study Finance?

- What is Finance?
  - The science of the management of money, investments, and other assets.
- Finance is important to
  - Individuals
  - Firms / corporations
  - The Economy

Personal Finance

- We all have to make financial decisions throughout our life, some big, some small
- Knowing how to make money is one thing, knowing how to manage money is sometime else.
  - Some celebrities and star athletes made hundreds of millions in their career but ended up flat broke.

Example: Credit Cards

- The finance charge on a typical credit card is about 24% APR (annual percentage rate).
- Do you know that the effective interest rate on any outstanding balance is actually 26.82%?
- Why? Because finance charges are computed on a monthly basis.

Example: Saving for a Down Payment

- You need $800,000 for a down payment on a house.
- Suppose your account pays 2.5% interest.
  - If you want to achieve that goal in 5 years, how much do you need to save every month for the next 60 months?
  - If you can only afford to save $5,000 a month, how long will it take for you to achieve your goal?

Example: Saving for Retirement

- Suppose you plan to retire in 30 years.
- Your goal is to have 20 million in your retirement account and live off the interest.
- How much do you need to save each month in order to achieve that goal (given some interest rate)?

Example: Mortgage Payments

- Suppose you take out a 20-year mortgage of, say, $3,000,000.
- Given some [fixed] mortgage rate, how does the bank figure out your monthly mortgage payment?
- Suppose mortgage rates drop 0.5% a few months after you took out the loan. Is it a good idea to refinance the mortgage?

Corporate Finance

Decisions Financial Managers Make

- The investment decision
  - What assets to acquire / projects to undertake?
- The financing decision
  - How to finance the assets / projects?
- The dividend decision
  - How much profit to distribute to shareholders?

Importance of Finance to the Economy

- A "good" financial system is essential for the growth and development of an economy.
- To understand the importance of finance to the economy, we need to know some basics about the financial system: how it is organized and how it functions.
- By financial system, we mean the
  - financial markets
  - financial institutions
  - financial instruments

Functions of The Financial System

Financial Markets and Institutions

- Allow society to transfer funds between those who have available funds (savers) to those who have a need for funds (borrowers).
- Allow individuals to shift funds
  - across time periods: inter-temporal transfer (e.g. mortgage, retirement plan)
  - across situations (e.g. insurance)
- Provide risk-sharing, liquidity, information

Three ways that capital is transferred between lenders and borrowers

- Direct financing
  lender ←→ borrower
  (e.g. corporations issue commercial papers to insurance company)
- Semi-direct financing
  lender ← broker / dealer → borrower
  (e.g. IPO, equity offering, or debt placement)
- Indirect financing
  lender ← financial intermediary → borrower
  (e.g. individuals deposit money in a bank, the bank makes loans to individuals or companies)

Common Financial Institutions

Financial transactions are facilitated by financial institutions:

- Commercial Banks
- Savings & Loan Associations
- Credit Unions
- Life Insurance Companies
- Mutual Funds
- Pension Funds
- Investment Banks

What are financial assets?

- A financial instrument or asset is essentially a contract that entitles the owner to some type of payoff.
  - Debt (e.g. loans, bonds)
  - Equity (e.g. stocks)
  - Derivatives (e.g. futures, options)
- In general, a financial asset involves two parties, a buyer (the provider of cash) and a seller (the user of cash).

Some Common Financial Instruments

Instrument	Return (as of Apr 2003)
U.S. T-bills (Treasury Bills)	1.14%
Commercial paper	1.21
Banker's acceptances	1.22
Eurodollar deposits	1.23
Negotiable CDs (Certificate of Deposit)	1.24
Commercial loans	Prime: 4.25%, LIBOR: 1.29%
U.S. T-notes and T-bonds	5.04%
Municipal bonds	4.84
Mortgages	5.57
Corporate (AAA) bonds	5.91
Preferred stocks	6 to 9%
Common stocks	9 to 15%

Classifying Financial Markets

By the type of financial assets being traded.

- Debt versus Equity Markets
  (bonds vs. stocks)
- Spot versus Futures markets
  (on-the-spot vs. future delivery)
- Money versus Capital markets
  (short-term vs. medium- and long-term)

Other:

- Primary versus Secondary markets

How are secondary markets organized?

The vast majority of financial assets are traded in the secondary markets which can be classified by

- the way trading is done
  - Physical location exchanges
  - Computer / telephone networks
- the way that orders from buyers and sellers are matched through
  - Open outcry auction (e.g. CBOT)
  - Dealers (i.e., market makers)
  - Electronic communications networks (ECNs)

Physical Location vs. Computer/telephone Networks

- Physical location ("floor") exchanges: e.g., NYSE, AMEX, CBOT, Tokyo Stock Exchange
  - Traders meet face to face and trade on the trading floor.
- Computer / telephone networks: e.g., Nasdaq, government bonds markets, foreign exchange markets
  - Trading is done through a network of linked computers.

Auction Markets

- NYSE (New York Stock Exchange) and AMEX (American Stock Exchange) are the two largest auction markets for stocks in the U.S.
- Participants have a seat on the exchange, meet face-to-face, and place orders for themselves or for their clients.
- CBOT (Chicago Board of Trade) is one of the largest auction markets for futures and options contracts.

Dealer Markets

- Dealers are "market makers" who keep an inventory of the financial asset and list *bid* and *ask* quotes which are prices at which they are willing to buy and sell.
- Computerized quotation system keeps track of bid and ask prices, but does not automatically match buyers and sellers.
- Example: Nasdaq (U.S. stocks), SEAQ (U.K. stocks), Neuer Market (German small-cap stocks).

Electronic Communications Networks (ECNs)

- Participants (traders) post their orders to buy or sell in the ECN and the computerized system automatically matches orders from buyers and sellers and executes the trade.
- Examples: Instinet (U.S. stocks), Eurex (Swiss-German futures contracts), SETS (U.K. stocks).

Over the Counter (OTC) Markets

- In the old days, securities were kept in a safe behind the counter, and passed "over the counter" when they were sold.
- Now the OTC market is the equivalent of a computer bulletin board, which allows potential buyers and sellers to post an offer.
- e.g. Nasqad operates an OTC Bulletin Board which lists quotes of stocks NOT listed on any exchange.

INTEREST RATES

- Interest is the "price" (or rental fee) of the amount of money borrowed (principal).
- Interest RATE is the *percentage* return earned by a financial instrument.
- By convention, interest rates are expressed in *percent per annum*

Annual Rate of interest =

(annual fee / principal) x 100

Interest Rate

- Annual Percentage Rate (APR)
  - For financial instruments with terms shorter than 1 year, interest rates are typically expressed in *annualized percents*, commonly known as APR
- A Basis Point = 1/100th of a percentage point.
  - It is frequently used to measure interest rate changes of less than 1 percentage point.
  - Example: 25 basis points = 0.25%

Examples of Interest rates

Rate of return ("yield") on different instruments:

	9/20/07	1/15/10
3 mth. T-bill	3.69%	0.06%
3 mth. Com. Paper	4.72%	0.13%
10 yr. T-note	4.64%	3.70%
10 yr. AAA Corp. Bonds	5.81%	5.12%
10 yr. BAA Corp. Bonds	6.73%	6.18%
30 yr. Mortgage	6.34%	5.06%

Why are there so many Interest Rates?

- In general, the nominal (quoted) interest rate on a debt security is composed of two parts:

  $r = r^*$ + risk premiums

  where r^* is the *real risk-free rate of interest*.

  Note: "real" means inflation adjusted.
- Risk premium = additional return necessary to compensate investors for taking more risk.
- The short answer to our question is: *Different securities have different risk premiums.*

$$r = r^* + IP + DRP + LP + MRP$$

Here:

r = Required rate of return on a debt security

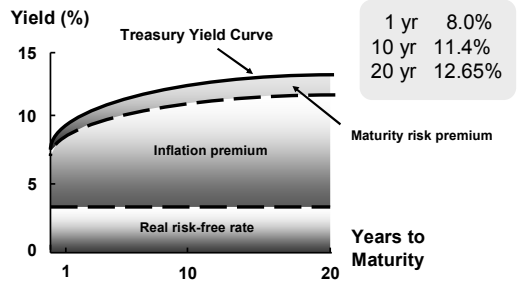
r^* = Real risk-free rate
IP = Inflation premium
r_{RF} = Nominal risk-free rate = r* + IP
DRP = Default risk premium
LP = Liquidity premium
MRP = Maturity risk premium
(also called interest rate risk or term premium)

Premiums Added to *r** for Different Types of Debt

S-T = Short-term, L-T = Long-term

- S-T Treasury: r^* + IP
- L-T Treasury: r^* + IP + MRP
- S-T Corporate: r^* + IP + DRP + LP
- L-T Corporate: r^* + IP + DRP + LP + MRP

Hypothetical Treasury Yield Curve



What factors can explain the shape of this yield curve?

- The hypothetical yield curve in this example is **upward sloping** because we assume
  - an increasing expected inflation premium (which can also be constant or decreasing)
  - an increasing maturity risk premium (which must be increasing)
- The risk-free interest rate is assumed constant, but it can be increasing or decreasing.

Week of 10/24/09: Non-Callable, Credit Quality Corporate Bond Yields vs. Years to Maturity

YTM	US Treasury	AAA	AA	A	BBB	BB	B
6 mo	0.18	1.53	4.35	4.53	8.20	13.39	8.61
1 yr	0.40	1.60	4.34	4.51	8.19	13.32	8.57
2 yr	1.04	1.76	4.33	4.47	8.17	13.16	8.53
3 yr	1.57	1.91	4.31	4.43	8.15	13.00	8.23
5 yr	2.46	2.23	4.28	4.35	8.10	12.67	7.78
10 yr	3.51	3.10	4.20	4.18	7.96	11.81	13.41
20 yr	4.27	5.13	4.03	3.86	7.48	9.87	9.64
30 yr	4.29	7.71	3.85	3.54	6.18	7.56	9.57

Source: BondVillage

Explanatory Notes

- The "yield to maturity" (YTM) is the average annual return (interest plus capital gain) that you would receive if you held the bond to maturity.
- “AAA”, “AA”, “A”, “BBB”, “BB”, and “B” are Standard & Poor's credit ratings for corporate bonds.
- We will talk more about YTM and credit ratings in lecture 3.

The Risk and Term Structure of Interest Rates

We will examine the interest rate differences between various debt instruments in two dimensions:

- Risk Structure: interest rates on securities with the same maturity but different characteristics, like risk, liquidity, and tax considerations.
- Term Structure: interest rates on securities with similar risk, liquidity, and tax considerations but different maturities.

The Risk Structure of Interest Rates

- The risk structure of interest rates is the relationship among the different interest rates of securities with the same term to maturity.
- Securities with higher risks have to pay higher interest rates – a risk premium.
- Determinants of Risk Structure
  - Default risk
  - Liquidity risk

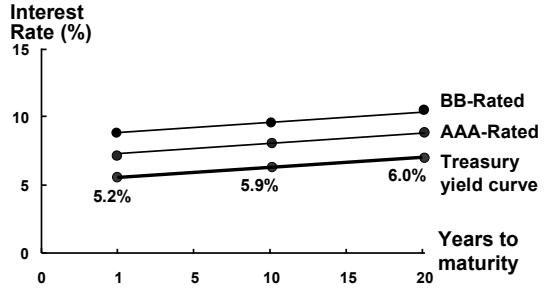
Risk Structure: Default Risks

- Default risk is the risk that the issuer of a bond may fail to meet its obligation to make interest payments and/or redeem the bond at face value when it matures.
- U.S. Treasury securities have no default risk because the government can always raise taxes or print money to meet its payment obligations.
- The default risk premium on a bond is the difference between the yield on that bond and the yield on a default-free bond of comparable maturity.

Risk Structure: Liquidity Risks

- Liquidity risk is the risk of not being able to sell a security quickly (because it is not actively traded in the market for various reasons).
- Investors care about liquidity and are willing to accept a lower rate of interest on a security that is more liquid.
- So differences in the liquidity of different types of bonds also help explain the different interest rates of bonds with the same maturity.

Hypothetical Treasury and Corporate Yield Curves



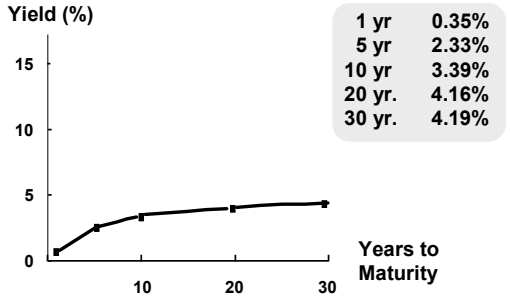
Relationship between the Treasury yield curve and the yield curves for corporate issues

- Corporate yield curves are higher than that of the Treasury bond (but not necessarily parallel to it) because corporate bonds carry more risks.
- The spread between a corporate yield curve and the Treasury yield curve will widen if the credit rating of the corporate bond decreases, i.e. if its default or liquidity risk increases.
- Credit ratings are given by rating agencies like Moody's and S&P.

The Term Structure of Interest Rates and Yield Curves

- The term structure of interest rates is the relationship between the rates of returns (yields) and the maturity (or term) of different instruments with similar risk, liquidity, and tax considerations.
- A graph that depicts the relationship between **yield** and **maturity** of a security is called a *yield curve*, with yield to maturity (YTM) on the vertical axis and term (number of years) to maturity on the horizontal axis.

Treasury Yield Curve (Oct 2009)



1 yr	0.35%
5 yr	2.33%
10 yr	3.39%
20 yr.	4.16%
30 yr.	4.19%

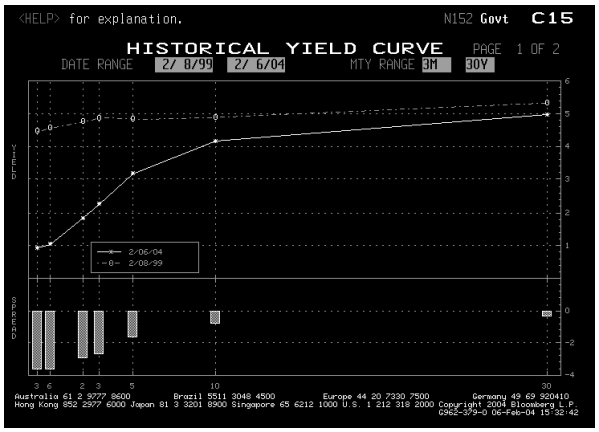
Empirical Facts of Term Structure

- **Fact 1:** Interest rates on securities of different maturities tend to move together overtime.

  i.e. long-term rates tend to follow short-term rates
- **Fact 2:** Yield curves are *typically* upward sloping.

  i.e. long-term rates are higher than short-term rates → longer term loans and securities carry higher interest rates than shorter term financial assets.

Figure 7.5 The Term Structure of Treasury Interest Rates



Two Theories of Term Structure

Two popular explanations on the shape of yield curves:

- Pure Expectations Theory
- Liquidity Premium Theory

These theories have difference assumptions about investor preferences, hence different implications for what the yield curves tell us about interest rates.

Pure Expectations Theory

- **Main Idea:** The slope of the yield curve is determined by market expectations about changes in *future short-term rates*.
- **Key Assumption:** Investors only care about the expected returns and not the maturity of securities (i.e. MRP=0).
- **Implication:** Securities of different maturities are perfect substitutes, so their expected returns must be equal.

Pure Expectations Theory

- **Expectations Theory:** Long-term rates are the average of *current* and *expected future* short-term rates.
- i.e. Interest rate on a long-term bond is equal to the weighted average of short-term rates expected to occur over the life of that bond.

Some Notations

Let i = today's 1-year rate ("short" rate)

i_2 = today's 2-year rate ("long" rate)

${}_1\hat{i}_1$ = expected 1-year rate one year from now

${}_1\hat{i}_2$ = expected 2-year rate one year from now

${}_2\hat{i}_2$ = expected 2-year rate two years from now

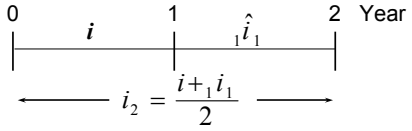
Note: The "^" denotes expected value.

Pure Expectations Theory

- According to the Pure Expectations Theory

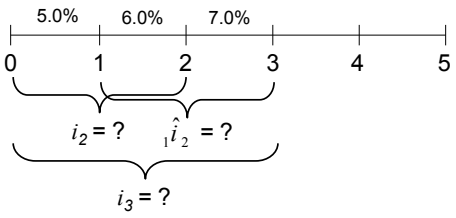
$$i_n = \frac{i + {}_1\hat{i}_1 + {}_2\hat{i}_1 + \cdots + {}_n\hat{i}_1}{n}$$

- For two periods (n = 2)



Example

- Suppose the current one-year interest rates is 5% and the expected one-year rates of the next two years are 6% and 7%.



Example

- According to the Expectations Theory, the long-term interest rate on
  - a two-year bond is
    i_2 = (5% + 6%)/2 = 5.5%
  - a three-year bond is
    i_3 = (5% + 6% + 7%)/3 = 6%
  - a two-year bond one year from now is
    ${}_1\hat{i}_2$ = (6% + 7%)/2 = 6.5%

The Slope of Yield Curves

Why yield curves can have different slopes?

- When short-term rates are expected to rise in the future, the average of future short rates is above current short rate → the yield curve will be upward sloping.
- When short-term rates are expected to stay the same, the average of future short rates will be the same as today's → the yield curve will be flat.
- When future short-term rates are expected to fall, the yield curve will be downward sloping.

Using Term Structure to Forecast Interest Rate

- While current short-term rate and long-term rates are observable, expected future short-term rates are not.
- The slope of the yield curves provides some general information about the market's expectations of future interest rates
- Using the Expectations Theory, we can impute *expected future short-term rates* from the observed long-term rates.

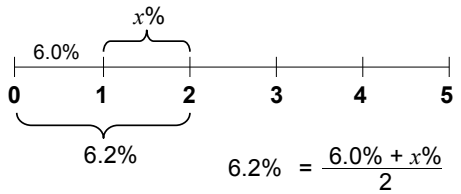
Observed Treasury Rates

Maturity	Yield
1 year	6.0%
2 years	6.2%
3 years	6.4%
4 years	6.5%
5 years	6.5%

Given the observed rates above, what will be the expected market interest rate on

1) one-year securities one year from now?
2) three-year securities two years from now?

1 - 53



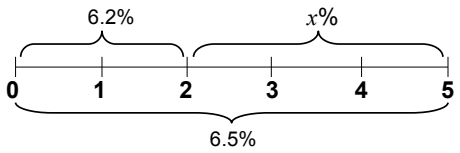
$$6.2\% = \frac{6.0\% + x\%}{2}$$

$$12.4\% = 6.0 + x\%$$

$$6.4\% = x\%.$$

The Expectations Theory tells us that the expected yield of one-year securities one year from now should be 6.4%.

1 - 54



$$6.5\% = \frac{2(6.2\%) + 3(x\%)}{5}$$

$$32.5\% = 12.4\% + 3(x\%)$$

$$20.1\% = 3(x\%)$$

$$6.7\% = x\%.$$

The Expectations Theory tells us that the expected yield of three-year securities two years from now should be 6.7%.

1 - 55

Explanation of Term Structure Facts

Pure Expectations Theory

- Explains Fact 1: all rates move together over time.
- Does not fully explain Fact 2: Short-term rates as likely to fall in the future as they are to rise, so there is no reason to expect that the average of future short-term rates will usually be higher than the current short-term rate.

1 - 56

Liquidity Premium Theory

- **Main idea**: the interest rate on a long-term bond is equal to the average of short-term interest rates expected to occur over the life of the long-term bond plus a term or liquidity premium.
- **Key assumption**: bonds of different maturities are substitutes but not perfectly so, and investors prefer shorter maturity.

Example

- Suppose the current one-year rate is 5% and the expected one-year interest rate over the next four years are: 6%, 7%, 8% and 9%.
- Investors prefer to hold short-term bonds, and the term premiums for one to five-year bonds are: 0%, 0.25%, 0.5%, 0.75% and 1%.
- Then the interest rate on
  - a two-year bond:
    (5% + 6%)/2 + 0.25% = 5.75%
  - a five-year bond:
    (5% + 6% + 7% + 8% + 9%)/5 + 1% = 8%

Liquidity Premium Theory

- According to the Liquidity Premium Theory

$$i_n = \frac{i + {}_1\hat{i}_1 + {}_2\hat{i}_1 + \cdots + {}_n\hat{i}_1}{n} + l_n$$

  where l_n is the liquidity premium for holding the *n*-period bond.
- According the to liquidity premium theory, the term premium is always positive and varies directly with the term to maturity of the bond.

Explanation of Term Structure Facts

The Liquidity Premium Theory explains

- Fact 1: all rates move together over time.
- Fact 2: yield curves are generally upward sloping.
  - Investors prefer short-term bonds and demand a premium (additional rate of return) for the risk of holding long-term bonds.

Why Study the Shape of Yield Curves?

- The Pure Expectations Theory and The Liquidity Premium Theory help explain the shape(s) of the yield curves -- that is, *how maturity affect yield.*
- What does the shape of the yield curves tell us, if anything, about the capital market and the state of the economy?

What does the yield curve tell us?

The slope of the yield curve is useful in predicting economic conditions:

- Slightly upward sloping: normal GDP growth
- Steep upward sloping: either recovering from a recession or higher expected inflation
- Flat: uncertain; could mean recession or slow growth
- Inverted (downward sloping): economic slowdown or recession