FIXED INCOME ANALYSIS
LECTURE 3

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TABLE OF CONTENTS

1. INTRODUCTION

- The fixed-income market is a key source of financing for business and governments.
- Similarly, the fixed-income market represents a significant investing opportunity for institutions and individuals.
- Understanding how to value fixed-income securities is important to investors, issuers, and financial analysts.

2. BOND PRICES AND THE TIME VALUE OF MONEY

- Bond pricing is an application of discounted cash flow analysis.

  Bond price should be equal to the value of all discounted future cash flows.

- On an option-free fixed-rate bond, the promised future cash flows are a series of coupon interest payments and repayment of the full principal at maturity.
- The market discount rate is used to obtain the present value.

  The **market discount rate** is the rate of return required by investors given the risk of the investment in the bond.

Formula for calculating the bond price given the market discount rate:

$$\mathrm{PV} = \frac{\mathrm{PMT}}{(1+r)^1} + \frac{\mathrm{PMT}}{(1+r)^2} + \cdots + \frac{\mathrm{PMT} + \mathrm{FV}}{(1+r)^N}$$

where

- **PV** is the present value (price) of the bond
- **PMT** is the coupon payment per period
- **FV** is the future value paid at maturity, or the bond's par value
- ***r*** is the required rate of return per period
- ***N*** is the number of evenly spaced periods to maturity

Examples. Calculate the value of **a) an annual 4% coupon paying bond** and **b) a semiannual 8% coupon paying bond**. Both have five years to maturity and a market discount rate of 6%:

a) $$\mathrm{PV} = \frac{4}{(1.06)^1} + \frac{4}{(1.06)^2} + \frac{4}{(1.06)^3} + \frac{4}{(1.06)^4} + \frac{104}{(1.06)^5} =$$

$$= 3.774 + 3.560 + 3.358 + 3.168 + 77.715 = \mathbf{91.575}$$

The bond price is 91.575 per 100 of par value.

b) $$\mathrm{PV} = \frac{4}{(1.03)^1} + \frac{4}{(1.03)^2} + \frac{4}{(1.03)^3} + \frac{4}{(1.03)^4} + \frac{4}{(1.03)^5} +$$

$$+ \frac{4}{(1.03)^6} + \frac{4}{(1.03)^7} + \frac{4}{(1.03)^8} + \frac{4}{(1.03)^9} + \frac{104}{(1.03)^{10}} = \mathbf{108.530}$$

The bond price is 108.530 per 100 of par value.

- The price of a fixed-rate bond, relative to par value, depends on the relationship of the coupon rate to the market discount rate.

If the bond price is higher than par value, the bond is said to be traded **at a premium.**	• This happens when the coupon rate is greater than the market discount rate.
If the bond price is lower than par value, the bond is said to be traded **at a discount.**	• This happens when the coupon rate is less than the market discount rate.
If the bond price is equal to par value, the bond is said to be traded **at par.**	• This happens when the coupon rate is equal to the market discount rate.

MINI-QUIZ #1

- Identify whether each of the following bonds is trading at a discount, at par value, or at a premium. Calculate the prices of the bonds per 100 in par value. If the coupon rate is deficiency or excessive compared with the market discount rate, calculate the amount of the deficiency or excess per 100 of par value.

94.58
107.26
100.0
82.03

Bond	Coupon Payment per Period	Number of Periods to Maturity	Market Discount Rate per Period
A	2	6	3%
B	6	4	4%
C	5	5	5%
D	0	10	2%

- If the market price of a bond is known, the equation on slide 5 can be used to calculate its **yield-to-maturity**.

The **yield-to-maturity** is the internal rate of return on a bond's cash flows. It is the implied market discount rate.

The **yield-to-maturity (YTM)** is the rate of return on the bond to an investor provided three conditions are met:

- The investor holds the bond to maturity.
- The issuer does not default on coupon or principal payments.
- The investor is able to reinvest coupon payments at that same yield.

Therefore, the yield-to-maturity is the promised yield.

Example. Suppose that a four-year, 5% annual coupon paying bond is priced at 105 per 100 of par value. The yield-to-maturity is the solution for the rate, *r*, in this equation:

$$105 = \frac{5}{(1+r)^1} + \frac{5}{(1+r)^2} + \frac{5}{(1+r)^3} + \frac{105}{(1+r)^4}$$

where r = 0.03634, or 3.634%.

The bond is traded at a premium because its coupon rate is greater than the yield required by investors.

duration & convex

- The price of a fixed-rate bond will change whenever the market discount rate changes.

The bond price is inversely related to the market discount rate. When the market discount rate increases, the bond price decreases (the inverse effect).

For the same coupon rate and time-to-maturity, the percentage price change is greater when the market discount rate goes down than when it goes up (the convexity effect).

For the same time-to-maturity, a lower-coupon bond has a greater percentage price change than a higher-coupon bond when their market discount rates change by the same amount (the coupon effect).

For the same coupon rate, a longer-term bond has a greater percentage price change than a shorter-term bond when their market discount rates change by the same amount (the maturity effect).

Relationships between Bond Prices and Bond Characteristics

Bond	Coupon Rate	Maturity	Price at 20%	Discount Rates Go Down		Discount Rates Go Up	
				Price at 19%	% Change	Price at 21%	% Change
A	10%	10	58.075	60.950	4.95%	55.405	–4.60%
B	20%	10	100.000	104.339	4.34%	95.946	–4.05%
C	30%	10	141.925	147.728	4.09%	136.487	–3.83%
D	10%	20	51.304	54.092	5.43%	48.776	–4.93%
E	20%	20	100.000	105.101	5.10%	95.343	–4.66%
F	30%	20	148.696	156.109	4.99%	141.910	–4.56%

MINI-QUIZ #2

- An investor is considering the following six annual coupon payment government bonds:

Bond	Coupon Rate	Time-to-Maturity	Yield-to-Maturity
A	0%	2 years	5.00%
B	5%	2 years	5.00%
C	8%	2 years	5.00%
D	0%	4 years	5.00%
E	5%	4 years	5.00%
F	8%	4 years	5.00%

1. Based on the relationships between bond prices and bond characteristics, which bond will go up in price the *most* on a percentage basis if all yields go down from 5.00% to 4.90%?

   D, long maturity , low coupon

2. Based on the relationships between the bond prices and bond characteristics, which bond will go down in price the *least* on a percentage basis if all yields go up from 5.00% to 5.10%?

   C, short maturity, high coupon

- Because the market discount rates for the cash flows with different maturities are rarely the same, it is fundamentally better to calculate the price of a bond by using a sequence of market discount rates that correspond to the cash flow dates.

These market discount rates are called "spot rates."

Spot rates are yields-to-maturity on zero-coupon bonds maturing at the date of each cash flow.

General formula for calculating a bond price given the sequence of spot rates:

$$\mathrm{PV} = \frac{\mathrm{PMT}}{(1+Z_1)^1} + \frac{\mathrm{PMT}}{(1+Z_2)^2} + \cdots + \frac{\mathrm{PMT}+\mathrm{FV}}{(1+Z_N)^N}$$

where Z_1, Z_2, *and* Z_N are spot rates for period 1, 2, and N, respectively.

Example. Suppose that the one-year spot rate is 2%, the two-year spot rate is 3%, and the three-year spot rate is 4%. Calculate the price of a three-year 5% annual coupon paying bond:

$$\frac{5}{(1.02)^1} + \frac{5}{(1.03)^2} + \frac{105}{(1.04)^3} =$$

$$4.902 + 4.713 + 93.345 = \mathbf{102.960}$$

The bond price is 102.960.

- The present values of the individual cash flows discounted using spot rates differ from those using yield-to-maturity, but the sum of the present values is the same. Thus, the same price is obtained using either approach.

3. PRICES AND YIELDS: CONVENTIONS FOR QUOTES AND CALCULATIONS

Bond price consists of two components

Flat (clean) price (P_c) + Accrued interest (AI)

The sum of flat price and accrued interest is the full (dirty) price (P_f).

$$P_f = P_c + \mathrm{AI}$$

Bond dealers usually quote the flat price.

Buyers pay the full price for the bond on the settlement date.

- Accrued interest is the proportional share of the next coupon payment:

$$\text{AI} = \frac{t}{T} \times \text{PMT}$$

where ***t*** is the number of days from the last coupon payment to the settlement date; ***T*** is the number of days in the coupon period; ***t*/*T*** is the fraction of the coupon period that has gone by since the last payment; and **PMT** is the coupon payment per period.

30/360 is common for corporate bonds.

The two most common conventions to count days in bond markets:

(*Days in the month/Days in a year*)

Actual/actual is common for government bonds.

- The full price of a fixed-rate bond between coupon payments given the market discount rate per period (*r*) can be calculated as:

$$P_f = \frac{\mathrm{PMT}}{(1+r)^{1-t/T}} + \frac{\mathrm{PMT}}{(1+r)^{2-t/T}} + \cdots + \frac{\mathrm{PMT}+\mathrm{FV}}{(1+r)^{N-t/T}}$$

where ***N* – *t*/*T*** represents the time before the appropriate payment is made and **FV** is the face value of the bond.

- The above formula can be simplified to:

$$P_f = \mathrm{PV} \times (1+r)^{t/T}$$

where **PV** is the value of the bond on the most recent coupon payment date and can be calculated using the standard bond price formula (slide 5).

Example. A 6% German corporate bond is priced for settlement on 18 June 2015. The bond makes semiannual coupon payments on 19 March and 19 September of each year and matures on 19 September 2026. Using the 30/360 day-count convention, calculate the **full price**, the **accrued interest**, and the **flat price** per EUR100 of par value if the YTM is 5.80% (2.90% per six months):

- The value of the bond after the latest coupon (19 March) is

$$\mathrm{PV} = \frac{3}{(1.0290)^1} + \frac{3}{(1.0290)^2} + \cdots + \frac{103}{(1.0290)^{23}} = 101.6616$$

The present value of the bond is EUR101.6616.

Example (continued):

- The **full price** on 18 June 2015 is

$$P_f = 101.66 \times (1.0290)^{89/180} = \mathbf{EUR103.1088}$$

- The **accrued interest** is

$$\mathrm{AI} = \frac{89}{180} \times 3 = \mathbf{EUR1.4833}$$

- The **clean/flat price** is

$$P_c = 103.1088 - 1.4833 = \mathbf{EUR101.6254}$$

MINI-QUIZ #3

Bond	Price	Coupon Rate	Time-to-Maturity
A	101.886	5%	2 years
B	100.000	6%	2 years
C	97.327	5%	3 years

1. Which bond offers the lowest yield-to-maturity?

   A,a小于5，b等于6，c大于5

2. Which bond will *most likely* experience the smallest percent change in price if the market discount rates for all three bonds increase by 100 bps?

   B

3. A rabbit wants to jump to a 10-step tower. It can either jump 1 step or 2 steps. How many ways this rabbit can reach the top?

   87

Matrix pricing is an estimation process used for bonds that are not actively traded.

In matrix pricing, market discount rates are extracted from comparable bonds (i.e., bonds with similar time-to-maturity, coupon rate, and credit quality).

Example. An analyst is pricing a three-year, 4% semiannual coupon corporate bond with no active market to derive the appropriate YTM. He finds two bonds with a similar credit quality: A two-year bond is traded at a YTM of 3.8035%, and a five-year bond is traded at a YTM of 4.1885%. Using linear interpolation, the estimated YTM of a three-year bond will be 3.9318%:

$$0.038035 + \left(\frac{3-2}{5-2}\right) \times (0.041885 - 0.038035) = 0.039318$$

Matrix pricing is also used in underwriting new bonds to get an estimate of the **required yield spread** over the **benchmark rate**.

- The benchmark rate is typically the yield-to-maturity on a government bond having the same, or close to the same, time-to-maturity.

The **spread** is the difference between the yield-to-maturity on the new bond and the benchmark rate.

- The yield spread is the additional compensation required by investors for the difference in the credit risk, liquidity risk, and tax status of the bond relative to the government bond. This spread is sometimes called the "**spread over the benchmark**."

Yield Measures for Fixed-Rate Bonds

- Investors use standardized yield measures to allow for comparison between bonds with varying maturities.

For bonds maturing in more than one year:

- An **annualized and compounded** yield-to-maturity is used.

For money market instruments of less than one year to maturity:

- These are **annualized but not compounded**.

- An annualized and compounded yield on a fixed-rate bond depends on the **periodicity** of the annual rate.
  - The periodicity of the annual market discount rate for a zero-coupon bond is arbitrary because there are no coupon payments.
  - The **effective annual rate** helps to overcome the problem of varying periodicity. It assumes there is just one compounding period per year.

- Another way to overcome a problem of varying periodicities is to calculate a **semiannual bond equivalent yield** (i.e., a YTM based on a periodicity of two).

General formula to convert yields based on different periodicities:

$$\left(1+\frac{\mathrm{APR}_m}{m}\right)^m=\left(1+\frac{\mathrm{APR}_n}{n}\right)^n$$

where **APR** is the annual percentage rate and ***m*** and ***n*** are the number of payments/compounding periods per year, respectively.

- For example, converting a YTM of 4.96% from a semiannual periodicity to a quarterly periodicity gives a YTM of 4.93%:

$$\left(1+\frac{0.0496}{2}\right)^2=\left(1+\frac{APR_4}{4}\right)^4, APR_4=0.0493$$

OTHER YIELD MEASURES

Street convention yield-to-maturity:	True yield-to-maturity:	Government equivalent yield:	Current yield:	Simple yield:
The internal rate of return on the cash flows, assuming the payments are made on the scheduled dates (no weekends or holidays)	The internal rate of return on the cash flows using the actual calendar of weekends and bank holidays	Restatement of a yield-to-maturity based on a 30/360 day-count to one based on actual/actual	The sum of coupon payments received over the year divided by the flat price	The sum of coupon payments plus the straight-line amortized share of the gain or loss, divided by the flat price

YIELD MEASURES FOR FLOATING-RATE NOTES

The interest payments on a floating-rate note vary from period to period depending on the current level of a reference interest rate.

The principal on the floater is typically non-amortizing and is redeemed in full at maturity.

The reference rate is determined at the beginning of the period, and the interest payment is made at the end of the period.

The most common day-count conventions for calculating accrued interest on floaters are actual/360 and actual/365.

The specified yield spread over the reference rate is called the "**quoted margin**" on the FRN.

The **required margin** (i.e., discount margin) is the yield spread over, or under, the reference rate such that the FRN is priced at par value on a rate reset date.

Simplified FRN pricing model:

☆

$$PV = \frac{\frac{(\text{Index}+QM)\times \text{FV}}{m}}{\left(1+\frac{\text{Index}+\text{DM}}{m}\right)^{1}} + \frac{\frac{(\text{Index}+\text{QM})\times \text{FV}}{m}}{\left(1+\frac{\text{Index}+\text{DM}}{m}\right)^{2}} + \ldots \frac{\frac{(\text{Index}+\text{QM})\times \text{FV}}{m}+\text{FV}}{\left(1+\frac{\text{Index}+\text{DM}}{m}\right)^{N}}$$

where **PV** is the present value/price of the FRN, **Index** is the annual reference rate, **QM** is the quoted margin (annualized), **FV** is the value at maturity, ***m*** is the periodicity of the FRN, **DM** is the annualized discount margin, and ***N*** is the number of evenly spaced periods to maturity.

Example. Suppose that a five-year FRN pays three-month Libor plus 0.75% on a quarterly basis. Currently, three-month Libor is 1.10%. The price of the floater is 95.50 per 100 of par value. Calculate the discount margin:

$$95.50 = \frac{\frac{(0.011+0.0075)\times 100}{4}}{\left(1+\frac{0.011+DM}{4}\right)^{1}} + \frac{\frac{(0.011+0.0075)\times 100}{4}}{\left(1+\frac{0.011+DM}{4}\right)^{2}} + \dots + \frac{\frac{(0.011+0.0075)\times 100}{4}+100}{\left(1+\frac{0.011+DM}{4}\right)^{20}}$$

Solving for DM, DM = 1.718%, or 171.8 bps

- There are several important differences in yield measures between the money market and the bond market:

The rate of return on a money market instrument is stated on a simple interest basis.

Money market instruments often are quoted using nonstandard interest rates and require different pricing equations than those used for bonds.

Money market instruments having different times-to-maturity have different periodicities for the annual rate.

- Quoted money market rates are either **discount rates** or **add-on rates**.
  - “Discount rate” has a unique meaning in the money market. It is a specific type of quoted rate.

Pricing formula for money market instruments quoted on a discount rate basis:

- $PV = FV \times \left(1 - \frac{\text{Days}}{\text{Year}} \times DR\right)$

Pricing formula for money market instruments quoted on an add-on rate basis:

- $PV = \frac{FV}{\left(1 + \frac{\text{Days}}{\text{Year}} \times AOR\right)}$

where **Days** is the number of days between settlement and maturity; **Year** is the number of days in a year (365 or 360); **DR** is the discount rate, stated as an annual percentage rate; and **AOR** is the add-on rate, stated as an annual percentage rate.

Examples: Suppose that a 91-day US Treasury bill (T-bill) with a face value of USD10 million is quoted at a discount rate of 2.25% for an assumed 360-day year. Enter FV = 10,000,000, Days = 91, Year = 360, and *DR* = 0.0225. Find the price of the T-bill:

$$PV = 10{,}000{,}000 \times \left(1 - \frac{91}{360} \times 0.0225\right) = \mathbf{USD9,943,125}$$

- Suppose that a Canadian pension fund buys an 180-day banker's acceptance (BA) with a quoted add-on rate of 4.38% for a 365-day year. If the initial principal amount is CAD10 million, calculate the redemption amount due at maturity:

$$FV = 10{,}000{,}000 \times \left(1 + \frac{180}{365} \times 0.0438\right) = \mathbf{CAD10,216,000}$$

The discount rate is calculated using the formula:

- $\mathrm{DR} = \left(\frac{\text{Year}}{\text{Days}}\right) \times \left(\frac{\mathrm{FV}-\mathrm{PV}}{\mathrm{FV}}\right)$

The add-on rate is calculated using the formula:

- $\mathrm{AOR} = \left(\frac{\text{Year}}{\text{Days}}\right) \times \left(\frac{\mathrm{FV}-PV}{\mathrm{PV}}\right)$

The first term for both formulas, **Year/Days**, is the periodicity of the annual rate.

The second term for the add-on rate is the interest earned, **FV** – **PV**, divided by **PV**, the amount invested.

However, for the discount rate, the denominator in the second term is **FV**, not **PV**. Therefore, by design, a money market discount rate understates the rate of return to the investor.

Examples. Suppose that an investor is considering an investment in 90-day commercial paper quoted at a discount rate of 5.76% for a 360-day year. Its *FV* = 100 and *PV* = 98.560. Find the paper's AOR based on a 365-day year:

$$\text{AOR} = \left(\frac{365}{90}\right) \times \left(\frac{100-98.56}{98.56}\right) = 0.05925, \text{ or } 5.925\%$$

This converted rate is called a "**bond equivalent yield**."

Now suppose that an analyst prefers to convert money market rates to a semiannual bond basis. The quoted rate for a 90-day money market instrument is 10%, quoted as a bond equivalent yield (its periodicity is 365/90):

$$\left(1 + \frac{0.1}{365/90}\right)^{365/90} = \left(1 + \frac{\text{APR}_2}{2}\right)^2, \text{APR}_2 = 0.10127, \text{ or } 10.127\%$$

MINI-QUIZ #4

- Matrix pricing allows investors to estimate market discount rates and prices for bonds:
  A . with different coupon rates.
  B . that are not actively traded.
  C . with different credit quality.
- When underwriting new corporate bonds, matrix pricing is used to get an estimate of the:
  A . required yield spread over the benchmark rate.
  B . market discount rate of other comparable corporate bonds.
  C . yield-to-maturity on a government bond having a similar time-to-maturity

4. THE MATURITY STRUCTURE OF INTEREST RATES

The difference between yields on two bonds might be due to various reasons, such as:

- currency denomination
- liquidity
- periodicity
- credit risk
- tax status
- varying time-to maturity

The **term structure** of interest rates is the factor that explains the differences between yields. It involves the analysis of yield curves, which are relationships between yields-to-maturity and times-to-maturity.

Examples of yield curves

The (government bond) **spot curve** is a sequence of yields-to-maturity on zero-coupon (government) bonds.	The **yield curve on coupon bonds** is a sequence of yields-to-maturity on coupon paying (government) bonds.

A **par curve** is a sequence of yields-to-maturity such that each bond is priced at par value.

The par curve is obtained from a spot curve using the following formula and solving for PMT (*z* is the spot rate for the period):

$$100 = \frac{PMT}{(1+z_1)^1} + \frac{\text{PMT}}{(1+z_2)^2} + \cdots + \frac{\text{PMT} + 100}{(1+z_N)^N}$$

A **forward curve** is a series of forward rates, each having the same time frame. These forward rates might be observed on transactions in the derivatives market.

A forward rate	• is the interest rate on a bond or money market instrument traded in a forward market (future delivery).
An implied forward rate (also known as a forward yield)	• is calculated from spot rates and is a break-even reinvestment rate • links the return on an investment in a shorter-term zero-coupon bond to the return on an investment in a longer-term zero-coupon bond.

- Although finance textbook authors use varying notation, the most common market practice is to name forward rates as in this example: "2y5y" — pronounced "the two-year into five-year rate." The first number (two) refers to the length of the forward period in years from today, and the second number (five) refers to the tenor (time-to-maturity) of the underlying bond.

- A general formula for the relationship between the two spot rates and the implied forward rate is

$$(1 + z_A)^A \times (1 + \mathrm{IFR}_{A,B-A})^{B-A} = (1 + z_B)^B$$

where *A* is the years from today when the security starts and *B* – *A* is the tenor.

Example. Calculate the 2y2y if the two-year spot rate is 4.5% and the four-year spot rate is 5%, assuming annual compounding:

$$(1 + \mathrm{IFR}_{2,2})^2 = \frac{(1 + 0.05)^4}{(1 + 0.045)^2} \quad \mathrm{IFR}_{2,2} = 5.50\%$$

•Because spot rates can be derived using forward rates, bonds can be valued using the forward curve:

$$\mathbf{PV} = \frac{\mathbf{PMT}}{\mathbf{1} + \boldsymbol{Z}_{\mathbf{1}}} + \frac{\mathbf{PMT}}{(\mathbf{1} + \boldsymbol{Z}_{\mathbf{1}})\times(\mathbf{1} + \mathbf{IFR}_{\mathbf{1},\mathbf{1}})} + \cdots + \frac{\mathbf{PMT} + \mathbf{FV}}{(\mathbf{1} + \boldsymbol{Z}_{\mathbf{1}})\times\left(\mathbf{1} + \mathbf{IFR}_{\mathbf{1},\mathbf{1}}\right)\times\cdots\times(\mathbf{1} + \mathbf{IFR}_{\boldsymbol{N},\mathbf{1}})}$$

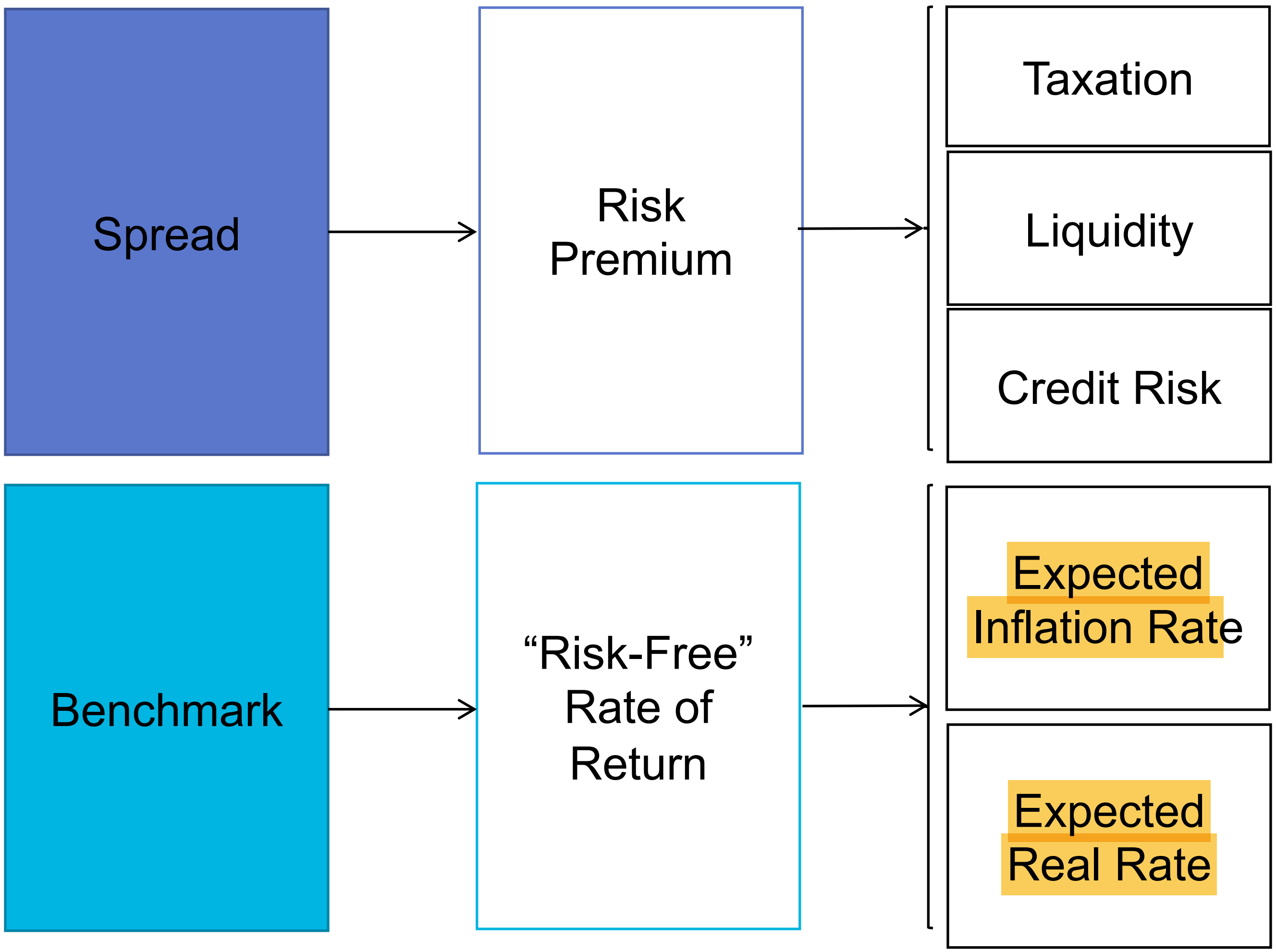
5. YIELD SPREADS

The **spread** is the difference between the yield-to-maturity and the benchmark.

The **benchmark** is often called the "risk-free rate of return." Fixed-rate bonds often use a government benchmark (**on-the-run**) security with the same time-to-maturity as, or the closest time-to-maturity to, the specified bond.

A frequently used benchmark for floating-rate notes is **Libor**. As a composite interbank rate, it is not a risk-free rate.

Yield-to-Maturity Building Blocks



G-spread

- The yield spread in basis points over an actual or interpolated government bond

I-spread or **interpolated spread** to the swap curve

- The yield spread of a specific bond over the standard swap rate in that currency of the same tenor

A **zero volatility spread** (Z-spread) of a bond

- Calculated as a constant yield spread over a government (or interest rate swap) spot curve — as opposed to the G-spread and I-spread, which use the same discount rate for each cash flow
- $\mathbf{PV} = \frac{\mathbf{PMT}}{(1+z_1+Z)^1} + \frac{\mathbf{PMT}}{(1+z_2+Z)^2} + \cdots + \frac{\mathbf{PMT+FV}}{(1+z_N+Z)^N}$
- The Z-spread is also used to calculate the **option-adjusted spread** (OAS) on a callable bond.

6. SUMMARY

Bond's price given a market discount rate

- The market discount rate is the rate of return required by investors given the risk of the investment in the bond.
- A bond is priced at a premium above par value when the coupon rate is greater than the market discount rate.
- A bond is priced at a discount below par value when the coupon rate is less than the market discount rate.

Relationships among a bond's price, coupon rate, maturity, and market discount rate

- A bond price moves inversely with its market discount rate.
- The price of a lower-coupon bond is more volatile than the price of a higher-coupon bond, other things being equal.
- Generally, the price of a longer-term bond is more volatile than the price of a shorter-term bond, other things being equal.

SUMMARY

Spot rate

- A spot rate is the yield-to-maturity on a zero-coupon bond.

Flat price, accrued interest, and the full bond price

- Between coupon dates, the full (or invoice, or "dirty") price of a bond is split between the flat (or quoted, or "clean") price and the accrued interest.
- Accrued interest is calculated as a proportional share of the next [illegible] actual/actual or 30/360 method to count days.

Matrix pricing

- Matrix pricing is used to value illiquid bonds by using prices and yields on comparable securities having the same or similar credit risk, coupon rate, and maturity.

SUMMARY

Yield measures for fixed-rate bonds, floating-rate notes, and money market instruments

- A yield quoted on a semiannual bond basis is an annual rate for a periodicity of two. It is the yield per semiannual period times two.
- The current yield is the annual coupon payment divided by the flat price.
- The simple yield is like the current yield but includes the straight-line amortization of the discount or premium.
- The quoted margin on a floater is typically the specified yield spread over or under the reference rate, which often is LIBOR.
- Money market instruments, having one year or less time-to-maturity, are quoted on a discount rate or add-on rate basis.

SUMMARY

Spot curve, yield curve on coupon bonds, par curve, and forward curve

- A spot curve is a series of yields-to-maturity on zero-coupon bonds.
- A frequently used yield curve is a series of yields-to-maturity on coupon bonds.
- A par curve is a series of yields-

are priced at par value.

Forward rates and spot rates

- A forward rate is the interest rate on a bond or money market instrument traded in a forward market.
- An implied forward curve can be calculated from the spot curve.

SUMMARY

Forward rates and spot rates (continued)

- An implied forward rate is the breakeven reinvestment rate linking the return on an investment in a shorter-term zero-coupon bond to the return on an investment in a longer-term zero-coupon bond.
- A fixed-income bond can be
  rate, a series of spot rates, or a series of forward rates.

Yield spread measures

- A bond yield-to-maturity can be separated into a benchmark and a spread.
- Changes in spreads typically capture microeconomic factors that affect the particular bond—credit risk, liquidity, and tax effects.
- Benchmark rates are usually yields-to-maturity on government bonds or fixed rates on interest rate swaps.

HOMEWORK

1. Game: you are asked to write down a number (between 0-100). The number is only kept to yourself. The one who is closet the half of the class average (1/2 of all the numbers of classmates) wins the game. Think carefully what number you want to write down. Special prize will be given to the winner.
2. A portfolio manager is considering the purchase of a bond with a 5.5% coupon rate that pays interest annually and matures in three years. If the required rate of return on the bond is 5%, the price of the bond per 100 of par value is *closest* to:
   A . 98.65.
   B . 101.36.
   C . 106.43
3. Suppose a bond's price is expected to increase by 5% if its market discount rate decreases by 100 bps. If the bond's market discount rate increases by 100 bps, the bond price is *most likely* to change by:
   A . 5%.
   B . less than 5%.
   C . more than 5%.
4. A bond with 20 years remaining until maturity is currently trading for 111 per 100 of par value. The bond offers a 5% coupon rate with interest paid semiannually. The bond's annual yield-to-maturity is *closest* to:
   A . 2.09%.
   B .4.18%.
   C .4.50%

HOMEWORK

A bond with 5 years remaining until maturity is currently trading for 101 per 100 of par value. The bond offers a 6% coupon rate with interest paid semiannually. The bond is first callable in 3 years, and is callable after that date on coupon dates according to the following schedule:

End of Year	Call Price
3	102
4	101
5	100

5. The bond's annual yield-to-maturity is *closest* to:
   A . 2.88%.
   B . 5.77%.
   C . 5.94%.
6. The bond's annual yield-to-first-call is *closest* to:
   A . 3.12%.
   B . 6.11%.
   C . 6.25%.
7. The bond's annual yield-to-second-call is *closest* to:
   A . 2.97%.
   B . 5.72%.
   C .5.94%.
8. The bond's yield-to-worst is *closest* to:
   A . 2.88%.
   B .5.77%.
   C . 6.25%.