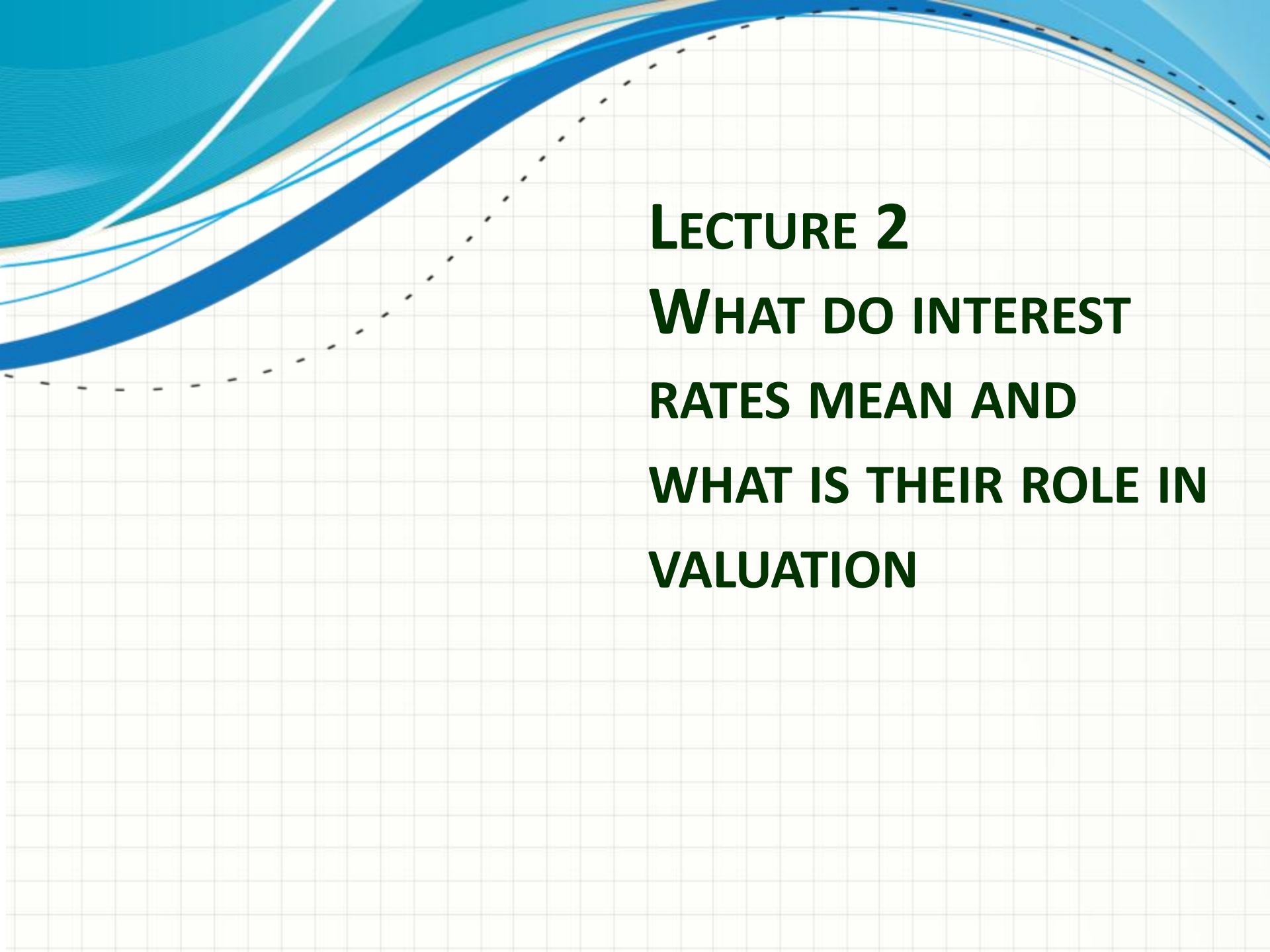




LECTURE 2

WHAT DO INTEREST RATES MEAN AND WHAT IS THEIR ROLE IN VALUATION

Lecture 2

- Chapter 3 of textbook by Frederic S. Mishkin and Stanley Eakins, Financial Markets and Institutions, Global Edition, 7th edition, Pearson

Key Terms

- Measuring Interest Rates
 - Present Value
 - Yield To Maturity
- Real vs. Nominal Interest Rates
- Interest Rates vs. Returns
- Interest Rate Risk
- Duration

Present Value

- Present (discounted) value: future amount of money discounted to reflect its current value, as if existed today
- The Present Value (PV) is less than the Future Value (FV) because money has interest-earning potential (time value of money)
- A £1 received n years from now is worth only $\frac{£1}{(1+i)^n}$ today, where i =interest rate

Present Value & Future Value

- The operation of evaluating the FV is called “capitalization”
 - how much will 100 today be worth in 5 years?
- The reverse operation—evaluating the PV of a future amount of money is called “discounting”
 - how much will 100 received in 5 years be worth today?

Interest Rate

- Interest represents the time value of money
- “Rent” that is required of a borrower to use money from a lender
- Interest is the money gained between the beginning and the end of a time period
- Simple interest is additive.
- **Simple interest is earned only on principal amount, there is no interest earned on interest already accrued**

Interest Rate

- To compare the change in purchasing power, the real interest rate (nominal interest rate minus expected inflation rate) should be used
- Real interest rates are a better indicator than nominal interest rates to be used amongst other things for:
 - Borrowing & lending purposes
 - Evaluating credit market conditions

Compound interest

- Compound interest is multiplicative
- A compounding period is the length of time that must transpire before interest is added to the total
- Interest compounded annually is credited once a year, compounding period is one year
- Interest compounded quarterly is credited 4 times a year, compounding period is three months
- A compounding period can be any length of time, annually, semi-annually, quarterly, monthly, daily, and continuously
- Continuous compounding is nominal interest that is compounded infinitely throughout the year

PV

- PV of a single cash payment, for example a loan
- $PV = \frac{CF}{(1+i)^n}$
- PV=Present value
- CF=single cash payment in the future
- i=annual interest rate
- n=number of years

Yield To Maturity

- Yield To Maturity (YTM): interest rate that equals the present value of cash flows received from a debt instrument with its value today
- In the previous example (single cash payment/e.g., loan) the interest rate equals YTM
- YTM of a bond is the Internal Rate of Return (IRR) earned by an investor who buys the bond today at the market price, with the bond held until maturity, and all coupon & principal payments made on schedule

Price of a coupon bond & YTM

- Price of a coupon bond

- $$P = \frac{C}{(1+i)^1} + \frac{C}{(1+i)^2} + \frac{C}{(1+i)^3} + \dots + \frac{C}{(1+i)^n} + \frac{F}{(1+i)^n}$$

- P=Price of coupon bond
- C=Coupon payment each year
- i=annual interest rate (YTM)
- n=number of years
- F=Face value of the bond

YTM

- YTM is the discount rate at which the sum of all future cash flows from the bond (coupons and principal) is equal to the price of the bond
- The yield is usually quoted without making any allowance for tax paid by the investor on the return
- It also does not make any allowance for the dealing costs incurred by the purchaser (or seller)

YTM

- The price of a bond and the YTM **are negatively** correlated
- If a bond's coupon rate is less than its YTM, then the bond is selling at a discount
- If a bond's coupon rate is more than its YTM, then the bond is selling at a premium
- If a bond's coupon rate is equal to its YTM, then the bond is selling at par
- The price of the zero coupon bond is always quoted at a discount

Rate Of Return

- Rate of return (ROR), is the ratio of money gained or lost on an investment relative to the amount of money invested
- ROR on a bond **will not** necessarily equal the interest rate of the bond
- ROR on a bond held from t to time t+1 is:
- $$R = \frac{C}{P_t} + \frac{P_{t+1} - P_t}{P_t}$$
- R=return holding the bond from t to t+1
- P_t =price of bond at time t
- P_{t+1} =price of bond at time t+1
- C=coupon payment

ROR

- $R = \frac{C}{P_t} + \frac{P_{t+1} - P_t}{P_t}$ can be rewritten in 2 parts:
- 1) $i_c = \frac{C}{P_t}$, is the current yield (coupon payment over purchase price)
- 2) $g = \frac{P_{t+1} - P_t}{P_t}$, is the rate of capital gain/loss (change in the bond's price relative to the initial price)
- $R = i_c + g$
- Return on a bond = current yield + rate of capital gain/loss

ROR

- ROR on a bond shows how good the investment has been over the holding period
- It is equal to the YTM in only one special case, when the holding period and the maturity of the bond are the same
- Changes in interest lead to capital gains or losses that produce differences between ROR and YTM at the time the bond is purchased

ROR

- Interest (i) $\uparrow \Rightarrow$ bonds $\downarrow$, $\Rightarrow$ capital loss for bonds with maturity $>$ holding period
- The longer bond's maturity, the greater the price change with i change
- The longer bond's maturity, the lower the ROR, with $i \uparrow$

Interest Rate Risk

- Prices of longer-maturity bonds are more sensitive to changes in interest rates
- Prices and ROR are more volatile for longer-term bonds than short-term

Reinvestment Risk

- When the investor's holding period is longer than the term to maturity of the bond there is Reinvestment Risk (RR)
- RR exists because the proceeds from the short-term bond have to be reinvested at future uncertain rate

Duration

- **Macaulay duration** is the name given to the weighted average time until cash flows are received, and is **measured in years**

- $$DUR = \frac{\sum_{t=1}^n t \frac{CP_t}{(1+i)^t}}{\sum_{t=1}^n \frac{CP_t}{(1+i)^t}}$$

- DUR=Macaulay duration
- t=years until cash payment is made
- CPt=cash payment (i+principal (p)) at time t
- i=interest rate
- n=years to maturity of the security

Duration

- **Macaulay duration** is the name given to the weighted average time until cash flows are received, and is measured in **years**
- **Modified duration** is the name given to the price sensitivity and is the **% change in price** for a unit change in yield

Duration

- **Modified duration** is the name given to the price sensitivity and is the **% change in price** for a unit change in yield
- $\% \Delta P \approx -\text{DUR} \times \frac{\Delta i}{1+i}$
- $\% \Delta P$ = %change in the price of the security
- Δi = change in interest rate
- DUR = Macaulay duration (years)
- i = interest rate

Duration

- Duration is a good approximation, when interest rates changes are small, of the security's price change for a given change in interest rates
- The modified duration is a measure of the price sensitivity to yields and provides a linear approximation
- For large yield changes convexity can be added to provide a quadratic or second-order approximation
- Convexity can be used to measure how the modified n changes as yields change

Duration

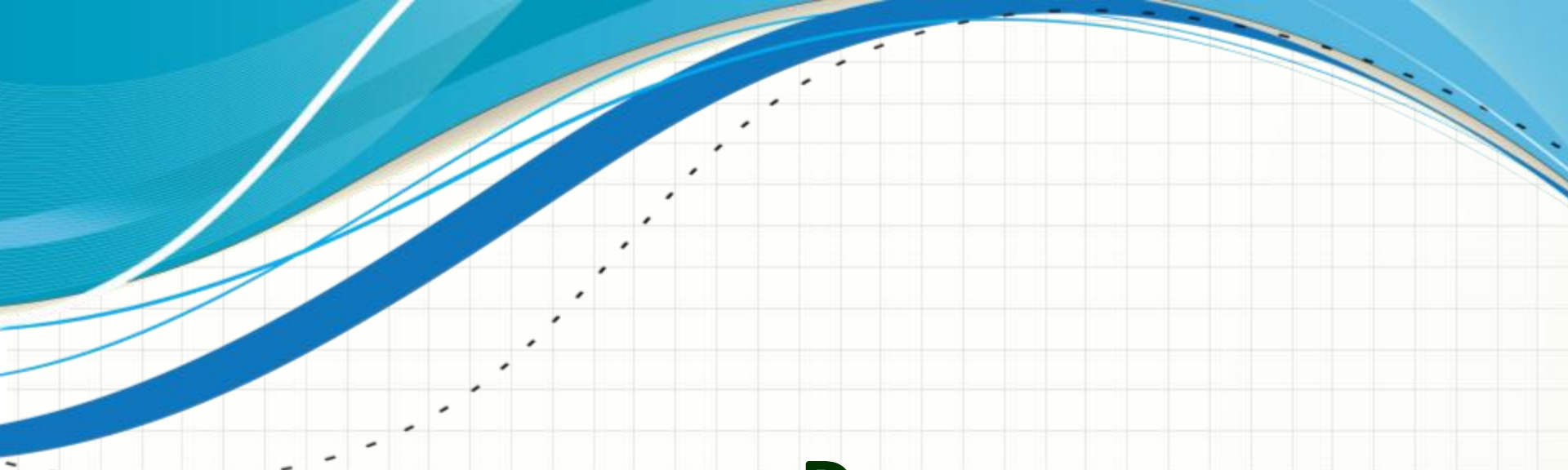
- Macaulay duration is a time measure with units in years
- It makes sense only for an instrument with fixed cash flows
- For a standard bond the Macaulay duration will be between 0 and the maturity of the bond
- It is equal to the maturity if and only if the bond is a zero-coupon bond

Duration

- Duration (years) is the average lifetime of a debt security's stream of payments
- The greater the duration (% change), the greater the % change in the market value for a given change in interest rates
- The greater the duration, the greater the interest rate risk

Duration

- All else equal, the longer the term to maturity, the greater the duration
- All else equal, when interest rates rise, the duration of a coupon bond falls
- All else equal, the higher the coupon rate on the bond, the shorter the duration of the bond
- Duration is additive: the duration of a portfolio of securities is the weighted-average of the durations of the individual securities, with the weights reflecting the proportion of the portfolio invested in each



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World Bond Markets

<HELP> for explanation.

Regional		97) Settings		99) Feedback		World Bond Markets							
91) Bonds		92) Spreads		93) Curves									
Maturity		10 Year		Data Range								3 Months	
Country	CMI	Security		Price	Chg	Yield	Chg	Yield	Low	Range	High	3M Chg	
1) Americas													
10) United States		T 2 1/2 08/23		98-31	+ 10	2.619	-3.6		2,469		2,994	+1.1	
11) Canada		CAN1 1/2 06/23		90.970	+0.279	2.560	-3.4		2,351		2,812	+2.6	
12) Brazil (USD)		BRAZIL 8 7/8 24		138.675	+0.050	4.278	-7		3,954		4,801	-18.4	
13) Colombia (USD)		COLOM 8 1/8 24		131.820	+0.255	4.356	-2.7		3,875		4,901	-13.2	
14) Mexico (USD)		MEX8 09/24/22		134.200	-0.400	3.525	+4.1		3,428		4,061	-63.4	
2) EMEA													
20) United Kingdom		UKT2 1/4 09/23		95.670 c	+0.340	2.750	-4.0		2,254		3,016	+21.6	
21) France		FRTR 1 3/4 23		94.915 c	+0.075	2.344	-9		2,165		2,624	-10.2	
22) Germany		DBR2 08/15/23		101.600 c	+0.205	1.821	-2.3		1,514		2,044	+1.8	
23) Italy		BTPS 4 1/2 23		102.410 c	+0.045	4.234	-6		4,155		4,574	-61.4	
24) Spain		SPGB4.4 10/23		101.020 c	-0.085	4.274	+1.0		4,256		4,802	-78.1	
25) Portugal		PGB4.95 10/23		86.220 c	+0.145	6.891	-2.1		6,199		7,260	+12.5	
26) Sweden		SGB1 1/2 11/23		91.692 c	+0.368	2.436	-4.3		2,043		2,723	+18.5	
27) Netherlands		NETHER1 3/4 23		96.055 c	+0.105	2.202	-1.2		1,940		2,460	-5.0	
28) Switzerland		SWISS 4 02/23		126.580 c	+0.080	1.010	-1.0		,917		1,133	-4.1	
29) Greece		GGB2 02/24/23		61.365 c	+0.775	9.406	-16.5		9,356		11,223	-175.0	
3) Asia/Pacific													
30) Japan		JGB 0.8 09/23		101.282 c	--	0.663	--		,663		,884	-18.0	
31) Australia		ACGB 5 1/2 23		112.891 c	+0.204	3.873	-2.5		3,588		4,162	+8.1	
32) New Zealand		NZGB 5 1/2 23		106.887	+0.325	4.600	-4.1		4,077		4,789	+40.6	
33) South Korea		NDFB 3 3/8 23		100.007 c	-0.061	3.392	+8		3,375		3,727	-20.4	

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