WELCOME TO
Introduction to Finance
for
MSc Financial Technology and Innovation

Lecture 5

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Recap from last lecture
We did a lot today, most importantly

Financial markets; raising capital vial financial claims

- Bonds and terminology
  - Coupon rate: Issuer determines. Yield, aka rate of return: Market determines!
- Trading with bonds
  - Valuing bonds == PV of a bond
  - As an investor, I am constantly calculating the ***percentual*** difference between the face value and the actual price
- Term structure and yield curves
  - Date of issuance, time to maturity matters!

Your toolset so far:

- PV, FV
- Discount factor
- NPV, DCF
- Rate of Return rule
- Interest rates: simple or compounding

$$\text{PV} = \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \ldots + \frac{C_t}{(1+r)^T}$$

DCF

$$\text{NPV} = C_0 + \sum_{t-1}^{T} \frac{C_t}{(1+r)^t}$$

$$\text{NPV} = \text{PV} - \text{required investment}$$

$$\text{Return} = \frac{\text{profit}}{\text{investment}}$$

Annual Percentage Rate (APR)

$$\text{APR} = \text{rate per period} \times \text{periods per year}$$

Effective Annual Interest Rate (EAR)

$$\text{EAR} = (1 + \text{rate per period})^{\text{periods per year}} - 1$$

$EAR = [1 + \frac{r}{m}]^m - 1$, where

m = period; ***r*** = rate

Your toolset so far:

- Annuity

$$\text{PV of annuity}_t: \; C\times\left[\frac{1}{r}-\frac{1}{r\times(1+r)^t}\right]$$

$$\text{PV of annuity}_{due} = C_1\times\left[\frac{1}{r}-\frac{1}{r(1+r)^t}\right]\times(1+r)$$

$$\text{FV of annuity} = C\times\left[\frac{(1+r)^t-1}{r}\right]$$

- Perpetuity

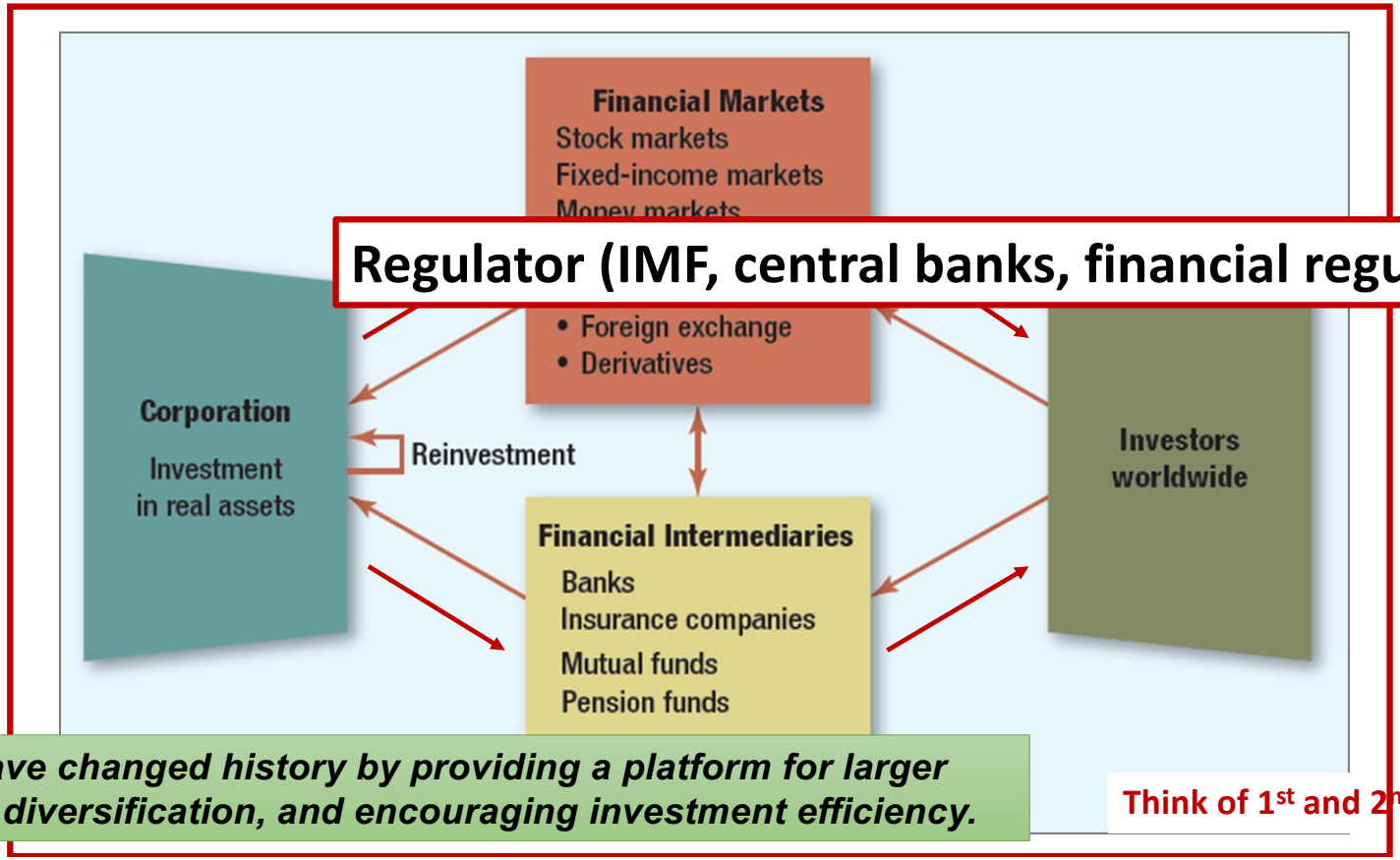
$$\text{PV of perpetuity} = \frac{C_1}{r}$$

$$\text{PV of perpetuity}_{due} = \frac{C_1}{r}\times(1+r)$$

Your toolset so far:

- Price of a bond = PV of a bond $$\mathrm{PV} = \frac{\mathrm{cpn}}{(1+r)^1} + \frac{\mathrm{cpn}}{(1+r)^2} + \ldots + \frac{(\mathrm{cpn} + \mathrm{par})}{(1+r)^t}$$

Capital markets are part of the **Financial System** to channel funds from investors to companies in forms of equity or debt

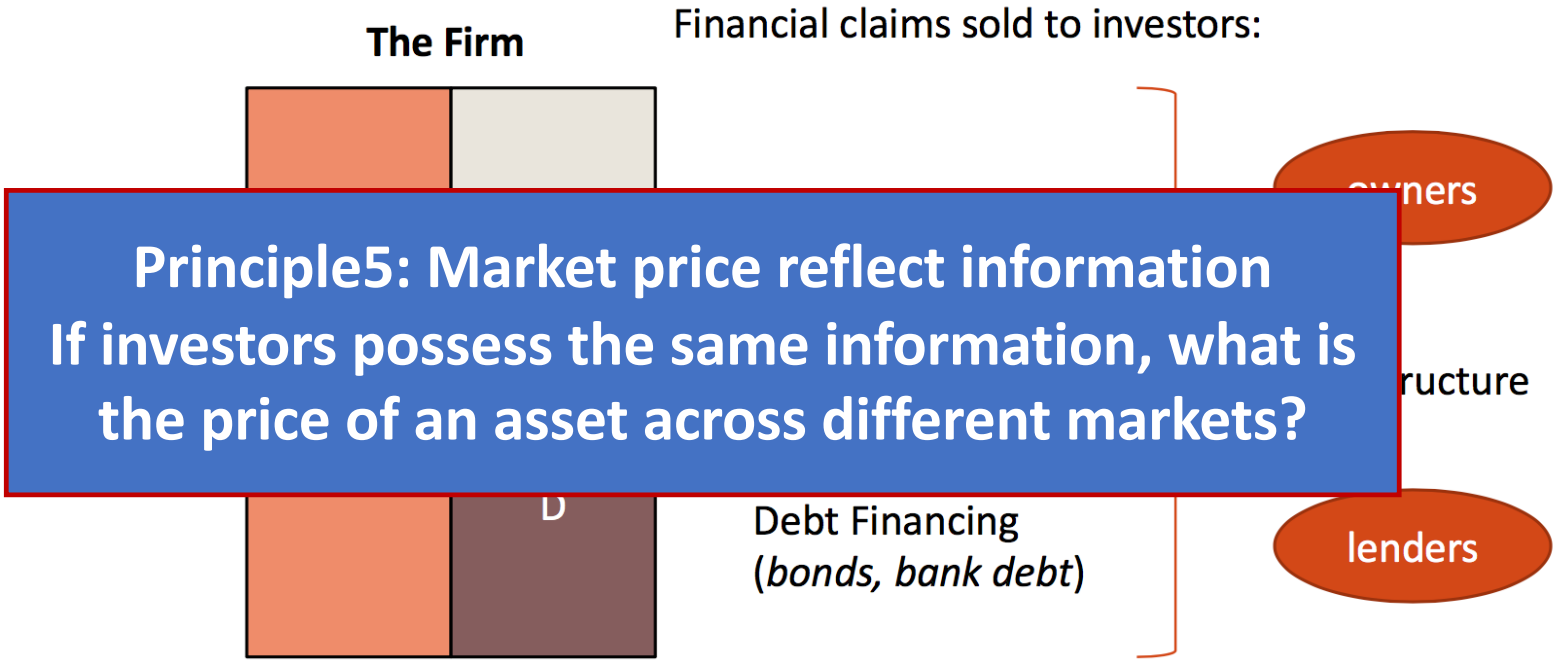


Markets have changed history by providing a platform for larger businesses, diversification, and encouraging investment efficiency.

Think of 1st and 2nd Axiom!

Markets as source of funding

Corporations raise money via financial claims



Law of One Price: In *frictionless* markets, two identical assets **must sell at the same price** at the **same time point** in competitive markets

However: Price is the function of market rates, and rates might change over time

- Thus, investors use **spot rates**, i.e. the interest rate of their observation unit (typically a year)

Rates might change, therefore:

- All interest-bearing instruments (in our case, bonds) are **priced to fit the observation unit**, i.e. the interest rate. ***Why is that?***
  - We want to pay a fair price for the risk we take!
  - This implies that asset price is ***adjusted***

$$\text{PV} = \underbrace{\frac{1}{1.03}}_{\text{1st timeframe yield = 3\%}} + \underbrace{\frac{1}{1.04^2}}_{\text{2nd timeframe yield = 4\%}} = 1.895$$

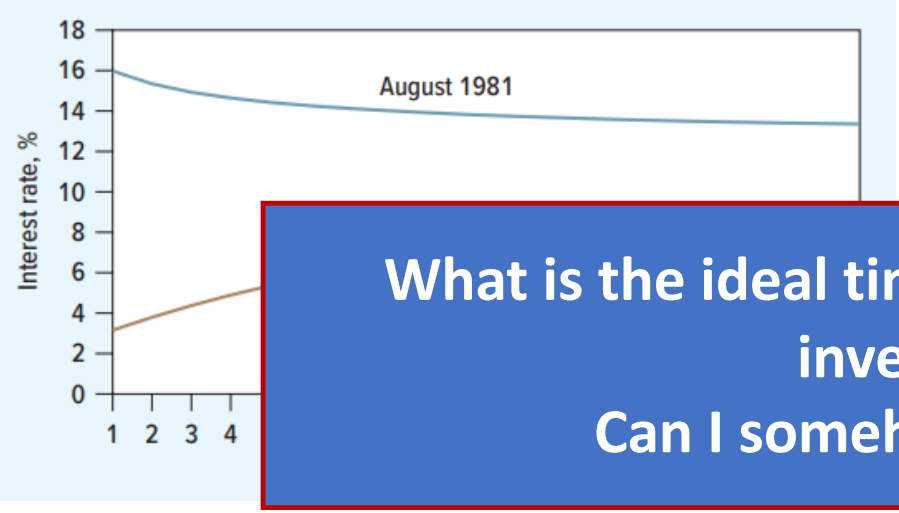
- And so, modified price creates a **new yield**, which fits the observation unit:

$$\text{PV} = 1.895 = \frac{1}{(1+y)} + \frac{1}{(1+y)^2}$$

If I was investing for 2 consecutive time periods, what is *y*?

A bit of a "chicken & egg" problem

As Law of One Price holds, everyone would seek for an investment that generates a higher expected return



Shall I invest into a 1Y-long or 2Y-long bond?

The ***difference*** *between* ***the expected***

f Law of

uch that

e 1-year

ecast of

What is the ideal time point to sell my bond investment?
Can I somehow calculate it?

This notion is coined as the **Expectations theory**:
In a frictionless, ideal market, where risk remains constant, the series of short-term bonds must offer the same benefit as a single long-term bond. Thus:

The main reason for an **upward** sloping term structure is the **expectations** that **short-term interest rates *rise***.

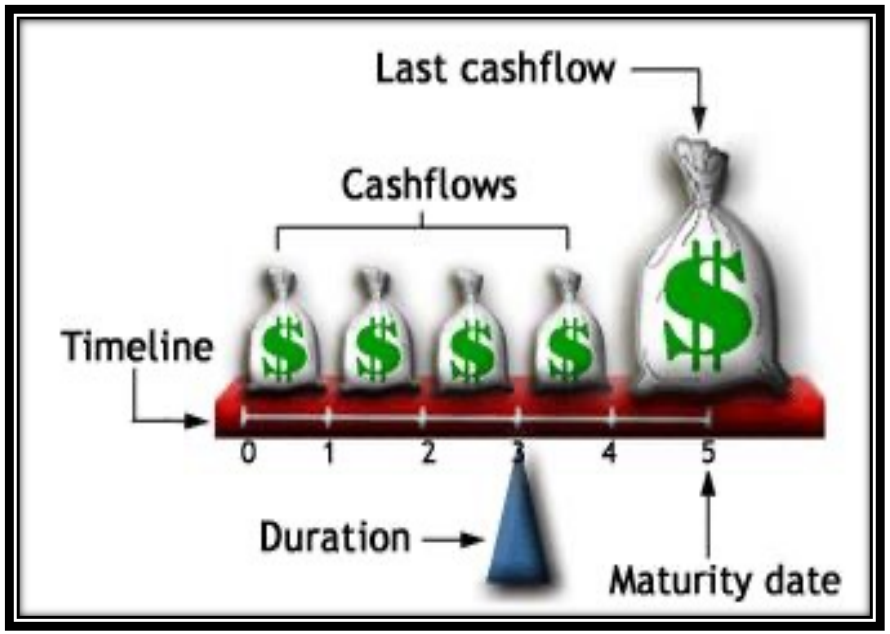
Source: https://www.federalreserve.gov/data/nominal-yield-curve.htm.

Generally speaking: Seek for FED (Federal Reserve) data if you are interested in understanding the US market

Digest the terminology: Bond duration

Duration = Weighted Average Life of Cash Flows

- Duration measures how long (in years) it takes for the price of a bond to be repaid by the bond's cash flows (payments)
- From an investor's point of view duration tells how quickly the investor is going to recover the investment



The moneybags represent the cash flows that you will receive each year over the next five years.

To balance the red lever (at the point where total cash flows equal the amount paid for the bond) the fulcrum must be further to the right, at a point before maturity.

Calculating bond duration: Weighted avg life of cash flows

Example:
We have a bond with an annual coupon of 10%, YTM = 5%, Maturity = 3 Y; Face value = 1,000

Year	Cash Flow	PV of Cash Flow at 5%	Percentage of Total PV received each period	Percentage of Total PV x Year
1	100	$\frac{100}{(1+0.05)^1} = 95.24$	$\frac{95.24}{1{,}136.16} = 0.084$	$0.084\ x\ 1 = 0.084$
2	100	$\frac{100}{(1+0.05)^2} = 90.7$	$\frac{90.7}{1{,}136.16} = 0.08$	$0.08\ x\ 2 = 0.16$
3	1000 + 100	$\frac{1000+100}{(1+0.05)^3} = 950.22$	$\frac{950.22}{1{,}136.16} = 0.836$	$0.836\ x\ 3 = 2.509$
		Total PV = 95.24 + 90.7 + 950.22 = 1,136.16		Duration = 0.084 + 0.16 + 2.509 = 2.753

Generalizing the calculation of bond duration leads to

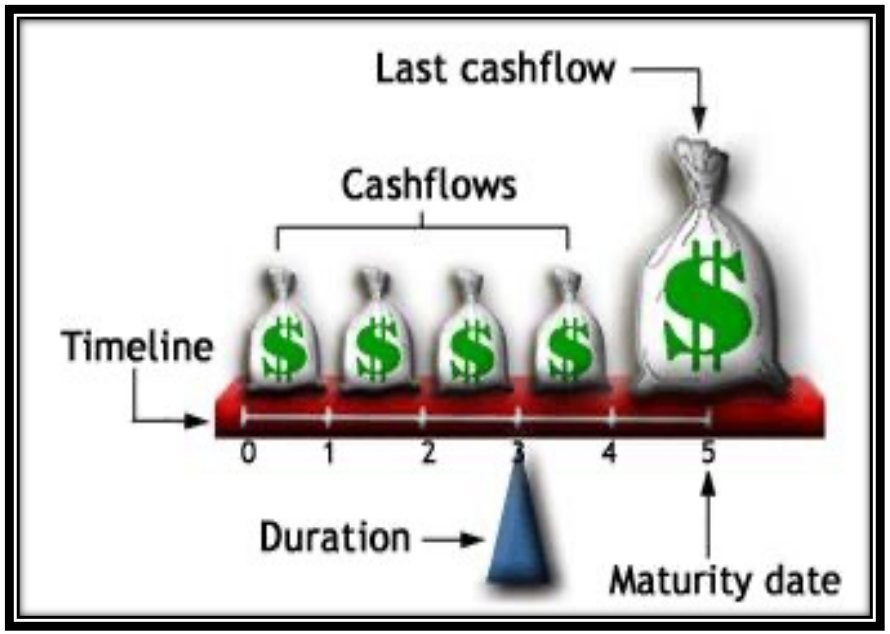
$$\text{Duration} = \frac{1 \times \text{PV}(C_1)}{\text{PV}} + \frac{2 \times \text{PV}(C_2)}{\text{PV}} + \frac{3 \times \text{PV}(C_3)}{\text{PV}} + \ldots + \frac{T \times \text{PV}(C_T)}{\text{PV}}$$

To calculate a duration makes perfect sense, since bond holders keep receiving coupons for their investment.

- What if there is no coupon payment?

For **zero-coupon** bonds:

- Only the last payment at maturity counts, and the duration is thus equal with the time to maturity



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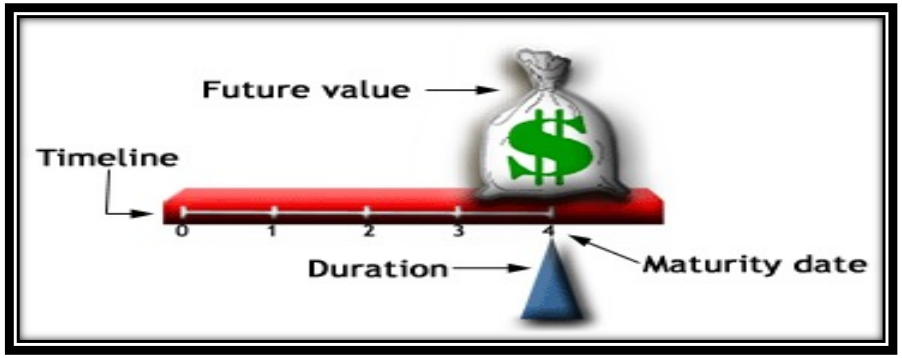

With **a zero-coupon** bond, we don't receive any cash flows throughout the life of the bond and therefore these bonds repay the full amount paid for the bond at maturity.

Digest the terminology: Bond duration

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- Duration measures how long (in years) it takes for the price of a bond to be repaid by the bond's cash flows (payments)
- From an investor's point of view duration tells how quickly the investor is going to recover the investment

$$\text{Duration} = \frac{1 \times \text{PV}(C_1)}{\text{PV}} + \frac{2 \times \text{PV}(C_2)}{\text{PV}} + \frac{3 \times \text{PV}(C_3)}{\text{PV}} + \ldots + \frac{T \times \text{PV}(C_T)}{\text{PV}}$$

Bond prices vary with interest rates

… and so, investors talk about **Modified Duration** to express price change dynamics

$$\text{Modified duration} = \text{volatility}(\%) = \frac{\text{duration}}{1+\text{yield}}$$

In our previous example, duration = 2.753; YTM = 5%

$$\text{Modified Duration} = \frac{Duration}{1+YTM} = \frac{2.753}{1+0.05} = 2.62$$

This means that a **1 percentage point change** in the Yield to Maturity will **change** the bond's **price by 2.62%**

If the **YTM increased** from 5% to 6% (i.e. by one percentage point), the bond's **price** will **decrease** by 2.62%(Vice versa)

How about risk in the context of expectations theory?

Interest rate risk: **Long-term** bond prices are more volatile; **liquidity premium** is therefore often incorporated

- In the normal state of the economy, the longer-term interest rates *lie above* short-term interest rates

Inflation risk: "Would you invest in a 20-Y bond or rather purchase shorter maturity bonds and reinvest?"

- To reduce exposure to inflation risk you **always shall invest short-term**, and roll over your investment; as expectations theory would imply that changing inflation rate would be incorporated to a higher interest rate

How about default risk?

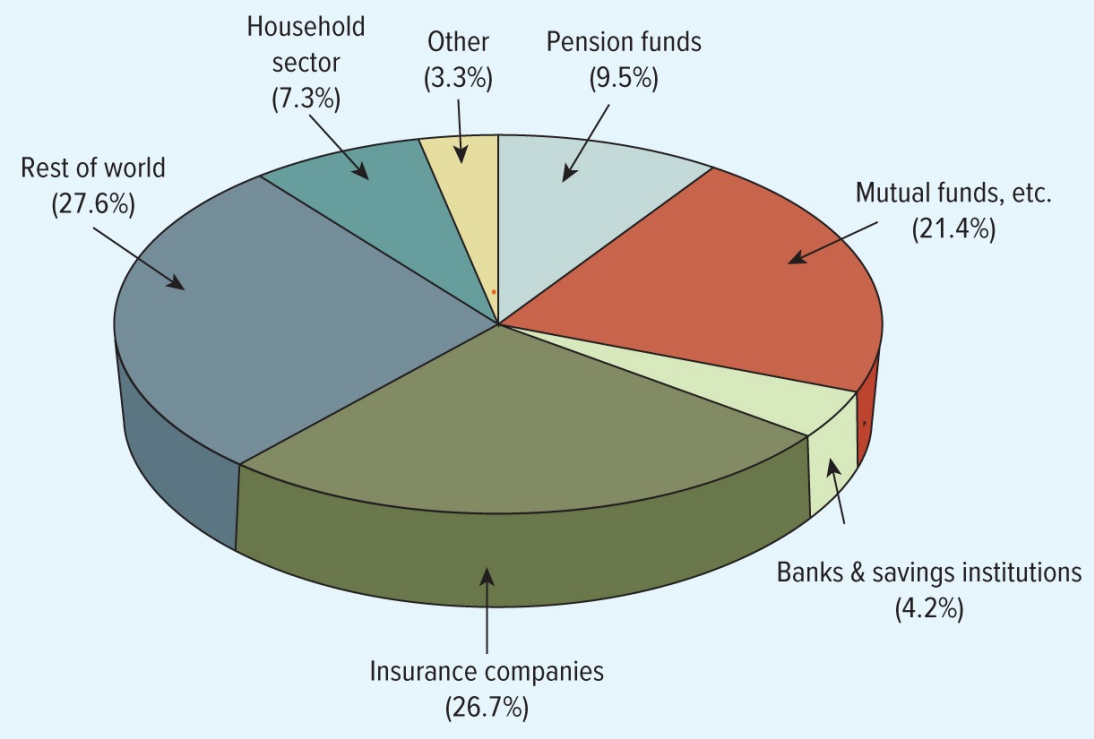
Investors in bonds face the risk that they will not receive their payments back (i.e. the risk that the issuer of the bond will default on their payments)

- **Government bonds** are typically perceived as very safe investments because governments rarely fail to repay their debt obligations
- **Corporate bonds** are typically higher risk bonds because the risk of default is higher relative to government bonds

Because of this higher risk of default, the yields on corporate bonds tend to be higher too

- **Bond rating agencies** evaluate the risk of default of bond issuers
- The three main bond rating agencies are **Moody's**, **Standard & Poor's** (S&P) and **Fitch**

Financial intermediaries are the biggest **debtholders** in the United States, i.e., ***lenders*** of corporations (December 2020)



Debt is a **prior claim** on cash-flows

- **Bonds** (or notes) are traded on financial markets
- **Loans** are issued by banks directly

As a company, you decide:

1: Borrowing short-term or long-term?

- Bank loan versus bond issuance

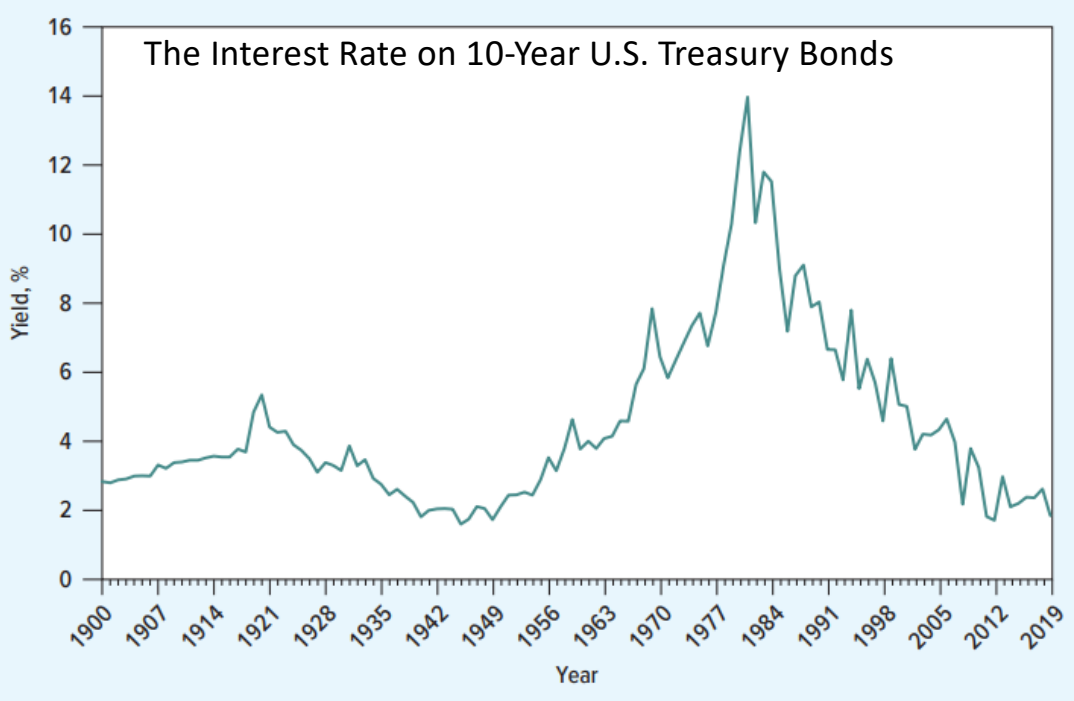
2: Fixed or *floating* (variable) interest rate?

- Risk-apetite? Hurdle rate you offer?

Coupon rate is fix, determined ex-ante, however, market demand regarding return, thus the yield of a bond vary!

… bonds are financial assets, tradable, exposed to market dynamics.

As opportunity costs, so return expectations change, yield changes, thus the PV of the bond!



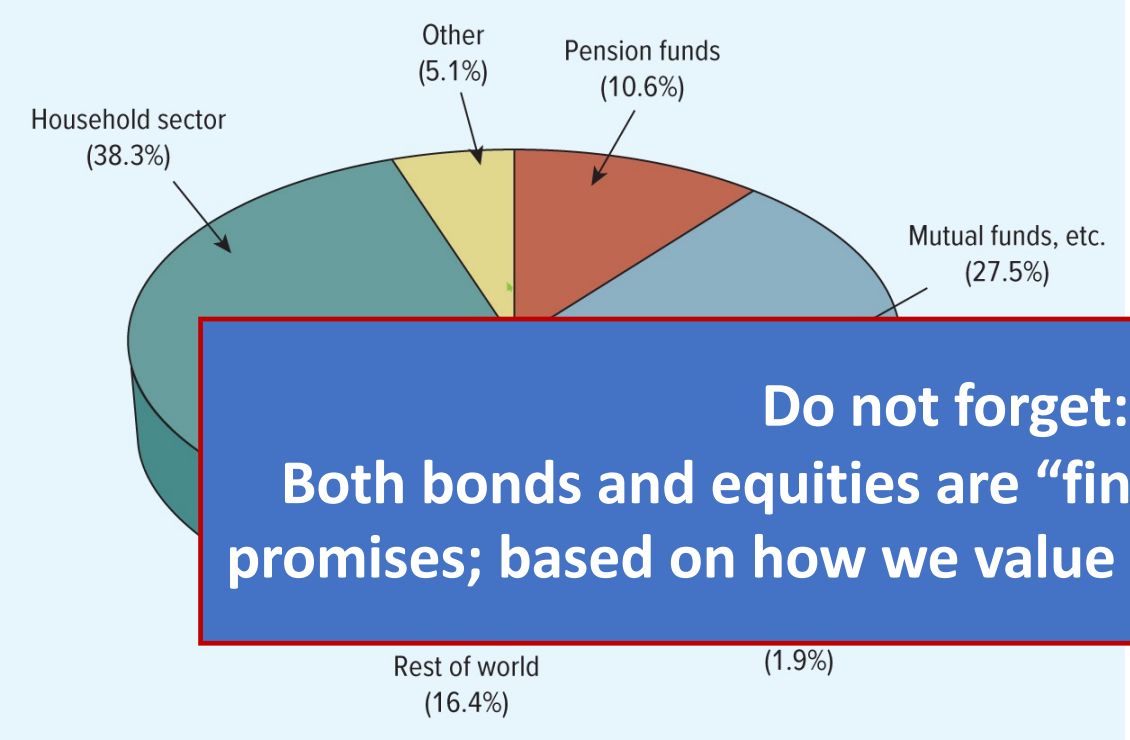
How would the bond price dynamics correspond?

$$PV = \frac{cpn}{(1+r)^1} + \frac{cpn}{(1+r)^2} + \ldots + \frac{(cpn + par)}{(1+r)^t}$$

$P_A > P_B \longleftrightarrow YTM_A < YTM_B$

Bond prices and yields **must** move to the opposite direction

Financial intermediaries are the biggest **stockholders** in the United States, i.e., ***owners*** of corporations (December 2020)



Ownership: Cash-flow rights and control rights are concentrated

- As soon as company borrows money, cash-flow and control rights get separatred

Do not forget:
Both bonds and equities are "financial claims", aka promises; based on how we value the underlying asset

Digest the terminology: Equity

Ownership?- have a claim on the fraction of the profits. The more shares you own, the larger your "share" of the company

Equity is the value attributable to the owners of a business

Control?- BOD, CEO&CFO are the **key decision-makers!**

Pay out priority: equity holders are at the bottom of the list; debt holders do have the priority!

Equity (or the ownership of equity securities) provides the rights to all assets of the corporation after all other 'claimants' have received their 'stakes'. In finance language, **equity is the 'residual claimant'.**

Consider this statement. True or false?

"*If a company uses more debt to finance a project, it needs less equity.*

Therefore, the required rate of return on equity, that investors would ask for, is lower."

- Is this statement true or false?

No, the statement is incorrect.

More debt means financial stress, i.e. fixed cost to calculate with (Principle 3: cash flows are the source of value), increasing therefore the risk for investors. Higher risk asks for higher return, as Principle 2 would dictate.

Digest the terminology: Stocks and stock market

- Common Stock - Ownership shares in a publicly held corporation
- Primary Market - **the first time the security is issued,** obtain funding; this is when the company raises new capital
- Secondary Market - market in which **already issued securities (existing)are traded** by investors, exchange of ownership
- Dividend - Periodic cash distribution from the firm to the shareholders- discretionary decision
- P/E Ratio - Price per share divided by earnings per share; The most common measure of share value; investors compare against similar companies in the same industry

Digest the terminology: Stocks and stock market

Equity Book Value

- Net worth of the firm according to the balance sheet
- backward-looking/ historical measure

Liquidation Value

- Net proceeds that would be realized by selling the firm's assets and paying off all outstanding obligations(failed firms; bankrupt; stop operation).

Market Value

- share (current)price when traded on the stock exchange
- PV of all the future cash flows, indicates the market expectations on the firm

Three fundamental facts to value a common stock

- **Cash-flow assessment**: Estimate the *amount* and *timing* of future cash flows of the *stock* is expected to provide

- **Risk assessment**: Evaluate the riskiness of future dividends, and determine the rate of return an investor would expect to receive from a comparable investment (recall: opportunity cost vs hurdle rate)

- **Present value equals price**: Calculate the PV of expected future cash-flows (recall DCF) using the stock's rate of return

Recall from Lecture 2:
How do we “price in” risk related to foreseen profit? RoR!

If costs = $700k and income = $800k then profit = money received – money spent = $100k

Rate of return rule: Accept investments that offer rates of return ***in excess*** of their opportunity cost of capital

$$\text{Return} = \frac{\text{profit}}{\text{investment}} = \frac{\$800,000 - \$700,000}{\$700,000} = 0.143 \text{ or } 14.3\%$$

Digest the terminology: Valuing common stocks

Expected Return is then the percentage yield or difference that an investor forecasts from a specific investment over a set period of time. Sometimes called the **market capitalization rate**.

$$\text{Expected return} = r = \frac{\text{DIV}_1 + P_1 - P_0}{P_0} \quad \longleftarrow \quad \textit{Recall:}\ \text{Return} = \frac{\text{profit}}{\text{investment}}$$

If Fledgling Electronics is selling for $100 per share today and is *expected* to sell for $110 in a year, what is the expected return if the dividend 1 year from now is *forecasted* to be $5.00?

$$\text{Expected return} = \frac{\$5 + 110 - 100}{\$100} = 0.15$$

Important: Pay attention to the rates!

- Remember that there are always two sides to every transaction
- Just like in the case of bonds the yield to maturity is the return to the bondholder (investor) and it is also the cost of debt financing to the firm that is issuing the bond
- The ***Expected Return of Equity Investors*** *is also known as* **THE COST OF (Equity) CAPITAL** *to the firm raising funds*

Valuing common stocks: Looking closer

- The Expected Return formula can be broken into two parts
- The first part is the Dividend Yield, that is the part of the total return that we expect to get in the form of dividends
- The second part is the Capital Appreciation, that is the percentage return that we will make from selling the stock at the end of the investment period. It is given by the percentage change between the purchase price (initial price of the stock, P_0) and the selling price (price of the stock at the end of the investment period, P_1).

$$\text{Expected Return} = r = \underbrace{\frac{Div_1}{P_0}}_{\text{Dividend Yield}} + \underbrace{\frac{P_1 - P_0}{P_0}}_{\text{Capital Appreciation}}$$

What does stock pricing have to do with dividends?

The *price* of any stock is the **present value** of its future cash flows

- PV (Share of stock) = PV (Expected future dividends per share)

For a stock, the future cash flows are **dividends** and the **ultimate sales price** of the stock

$$\text{Price} = P_0 = \frac{\text{DIV}_1 + P_1}{1 + r}$$

$$\text{Expected return} = r = \frac{\text{DIV}_1 + P_1 - P_0}{P_0}$$

$$\text{PV}_0 = \frac{\text{C}_1}{1 + r}$$

This reflects the Discounted Cash Flow (DCF) formula, as dividends represent the future cash flows of the firm

Fledgling Electronics is forecasted to pay a $5.00 dividend at the end of Year 1 and a $5.50 dividend at the end of Year 2.

At the end of the second year, the stock will be sold for $121. If the discount rate is 15%.

What is the price of the stock **today**?

List what you know: 2 different cash-flow periods

List what you have: PV **aka** P_0 $\quad \text{Price} = P_0 = \frac{\text{DIV}_1 + P_1}{1+r}$, as of $\text{PV} = \frac{\text{C}_1}{1+r}$

$$\text{PV} = \frac{\$5.00}{(1+0.15)^1} + \frac{\$5.50 + 121.00}{(1+0.15)^2} = \$100$$

Some words on dividends

A distribution of a company's earnings to its shareholders and is determined by the company's board of directors.

It is cash-flow dependent

- Negative net income: No basis for dividend!
- Companies might not pay dividends; they retain earnings to be reinvested

Even if positive net income is reached, no guarantee for dividend

- Firms often decide to re-invest

Dividends thus help us **approximating** the value of a firm (recall Principle 3!)

- Direct (dividends observable)
- Supporting tool for valuation models (Dividend-discount model)

Digest the term: Dividend Discount Model (DDM)

Computation of today's stock, price which states that share value equals the present value of ***all expected future dividends*** and the expected selling price (recall DCF).

Generalizing $\text{PV} = \frac{\$5.00}{(1+0.15)^1} + \frac{\$5.50 + 121.00}{(1+0.15)^2}$ would lead to

$$P_0 = \frac{\text{DIV}_1}{(1+r)^1} + \frac{\text{DIV}_2}{(1+r)^2} + \ldots + \frac{\text{DIV}_H + P_H}{(1+r)^H}$$

$$= \sum_{t=1}^{H} \frac{\text{DIV}_t}{(1+r)^t} + \frac{P_H}{(1+r)^H}$$

Where:

$\boldsymbol{P_H}$ *is the eventual selling price, the pice at which we expect to be able to sell the share*

r is the expected (or required) rate of return for this kind of investment, we can think of r as the rate of return required by investors for the given level of risk

H is time period of the investment, also called investment horizon, or time horizon

Valuing common stocks: If dividends grow with constant rate?

If we forecast a constant growth in dividends, and plan to hold our stock indefinitely, we will then value the stock as a **GROWING PERPETUITY** using Constant Growth Dividend Discount Model ***(also called the Gordon Growth Model)***

$$PV_0 = \frac{C_1}{r - g}$$

$$Price\ of\ Stock_0 = PV_0 = \frac{\boldsymbol{Div_1}}{\boldsymbol{r - g}}$$

Where:

Div_1 = the dividend expected at the end of the ***first time-period; c***ash flows start growing at a constant rate after that

g = the annual growth rate of the dividends (from second payment period, i.e. period 2 onward)

r = the discount rate (opportunity cost of capital), expected rate of return from stock

From this model we can derive the expected return of the stock

..... Given a minor algebraic manipulation, we could get g as well

$$P_0 = \frac{Div_1}{r - g}$$

Apply Step 1: Multiply both sides by (r-g)

$$P_0 x (r - g) = Div_1$$

Apply Step 2: Divide both sides by P_0

$$r - g = \frac{Div_1}{P_0}$$

Apply Step 3: Add g to both sides

$$r = \frac{Div_1}{P_0} + g$$

We get an expression for the expected return from the stock!

As stated earlier:
Three fundamental steps to value a common stock

- **Cash-flow assessment**: Estimate the *amount* and *timing* of future cash flows of the *stock* is expected to provide (see e.g. DDM)

- **Risk assessment**: Evaluate the riskiness of future dividends, and determine the rate of return an investor would expect to receive from a comparable investment (recall: opportunity cost vs hurdle rate) (see e.g. price derived from expected return)

- **Present value equals price**: Calculate the PV of expected future cash-flows (recall DCF) using the stock's rate of return (see e.g. Gordon Growth Model)

We have two different measurements for return

Thus, to address as well the riskiness of a stock, depending on the growth potential:

$$\text{Dividend Yield} = \frac{\text{Div}_1}{\text{P}_0}$$

is useful if dividends are constant, thus company is not growing

$$r = \frac{Div_1}{P_0} + g$$

is useful if dividends (thus company) are growing

Valuing common stock using cash-flow assessment cont'd

$$\text{Return on Equity} = ROE$$

$$ROE = \frac{\text{EPS}}{\text{Book Equity Per Share}}$$

- EPS stands for **Earnings per Share**, it is how much income the company generated per one share of stock
- Book Equity per Share is how much capital **was** invested per one share of stock
- The ROE tells me how much income the company made based on how much capital they invested, the return generated given the amount invested, backward looking measure.

Valuing common stocks: If dividends remain the same?

If we forecast *no growth*, and plan to hold our stock indefinitely, we will then value the stock as a **PERPETUITY**

$$Perpetuity = P_0 = \frac{Div_1}{r} \; or \; \frac{EPS_1}{r}$$

The second version of the formula is a special case where we assume that all earnings are paid to shareholders.

If the company is paying out all its earnings to the shareholders, it means that it is **not reinvesting** any funds back into the business, hence Div_1 = Earning Per $Share_1$; the company is also not growing in this case since there is no reinvestment

… might not work with private companies, startups. We need another strategy: Valuation by **comparables**

Identify similar firms per industry as potential comparables and then examine

- Ratios and market performance
- How much investors in these comparable companies pay “in”

Price / *Earnings* (P/E) Ratio, what investors pay per dollar of earnings

- Price per share divided by earnings per share.

Price / *Book* (P/B) Ratio, what investors pay per dollar of book value

- Price per share divided by book value per share

Valuation by comparables – visit the textbook example, too:

	Stock Price	P/E	P/B	Comparable	P/E	P/B
Coca-Cola (beverages)	$ 55	24.0	12.4	PepsiCo	23.1	12.8
Union Pacific (railroad)	$ 157	17.2	6.1	Canadian Pacific	18.0	6.5
				CSX	15.2	4.5
				Kansas City Southern	18.5	3.0
				Norfolk Southern	16.5	3.1
				Average	17.1	4.3
Bank of America (bank)	$28.50	9.6	1.1	JPMorgan Chase	11.1	1.6
				Wells Fargo	10.6	1.1
				Citigroup	7.6	0.8
				Capital One	7.5	0.7
				Key Corp	9.1	1.2
				US Bancorp	10.8	1.6
				Average	9.5	1.2

Get familiar with Yahoo Finance, we will work with data

Let us fly back in time to June 28, 2010
What would be Tesla's comparable?

What is common in Apple and in Tesla?

We did a lot in this lecture, most importantly:

- Finishing up the valuation principles of bonds: Duration, modified duration matters!

- Financial markets continued: Equities
- Valuing common stocks
- Valuation strategies: Cash-flow, riskiness, PV equals price