FINA 1303

INTRODUCTION TO FINANCIAL MARKETS

Veronique Lafon-Vinais

Associate Professor of Business Education - Department of Finance

Course Objective

Knowledge is nothing without understanding

- Understanding
  - Fundamentals of DCF and interest rates
  - Basic asset pricing and stock valuations
  - What are the major types of financial institutions
  - What they do in practice
  - How they overlap with each other
  - How they are regulated (if time allows)
- Special focus on the **Asian markets** as much as possible
- The approach will be very **practical**
  - Drawn from real life experience
  - Exposure to market practice

Grading

- **Assessment:**
  The final grading will be determined as follows:

Participation	10%
4 Online Quizzes	20%
Group Assignment	20%
Exam I	25%
Exam II	25%

Participation

- Despite the large class size I intend to make this course as **interactive** as possible
- I expect students to engage actively in class and online with each other and with me and our TA.
- Participation represents **10%** of the grade
- Points will be awarded based on active involvement in class, and participation in class through iPRS, raise hands (unmute yourself to speak out for online lecture) and Canvas discussion board.

Personal Response System (PRS)

- We will be using iPRS in every class so you can participate in class exercises and earn participation credit
- You must use iPRS app on your smartphone.
- Make sure you login to iPRS apps (HKUST I learn) every time, as participation counts!

Online Quizzes

- Are designed to check that you have mastered the key concepts from the class
- Will help prepare you for the exams
- Will be spaced out through the course
- Will be taken online in a limited time
- Will cover materials covered in class
- Will take the form of MCQ and T/F questions
- Represent **20%** of the grade (5% each)

Group assignment

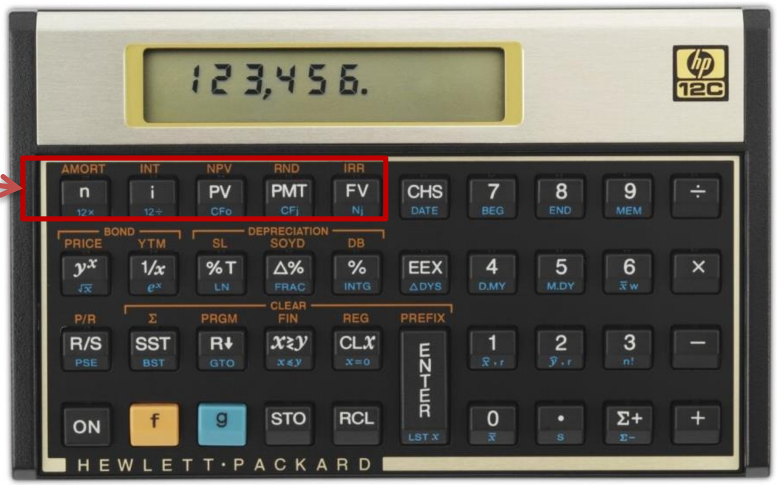
- You will be formed into groups of 6-7 students (final number TBC)
- Assignment 1:
  - Each group will be assigned a topic from the course content by lucky draw
    - Each group has to submit one (short) video and one (short) article that I can use for this course and will be called upon to present their topic
  - Your submission for assignment 1 is due in Week 4.
- Assignment 2:
  - Each group will be called upon to give a digest of significant financial news in the week assigned to them by lucky draw, and submit a PowerPoint presentation with voice over ppt.
- These submissions accounts for **20%** of the grade (10% each)
- Grading will be based on the relevance of the submissions to the course and maximum points will be obtained for videos and articles that will be integrated in the course.
- You will be asked to do peer evaluation at the end of the course.

Exams

- There will be 2 exams, one roughly half-way through the course and one at the end during the final exam period.
- Midterm will be **during class time.** Time for Final exams will be scheduled by the school. Both Exams will be **face to face/ online (TBC)** . Please do not plan to travel during the exam periods as there will be **no make ups**
- **You MUST report to TA any time conflict for the Midterm no later than the add-drop period**
- Make yourself familiar with the exam rules of the school and HKUST. Be reminded that academic integrity is taken extremely seriously at HKUST.
- The mid-term will represent 25% of the grade and the final 25%. Exams will include mostly MCQ and T/F questions but may also include some open questions.

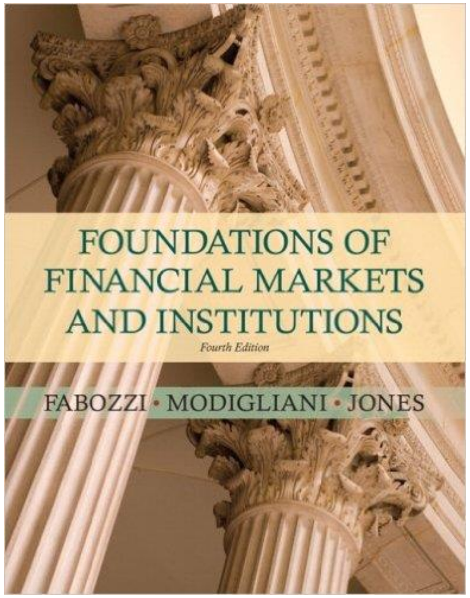
Financial Calculator

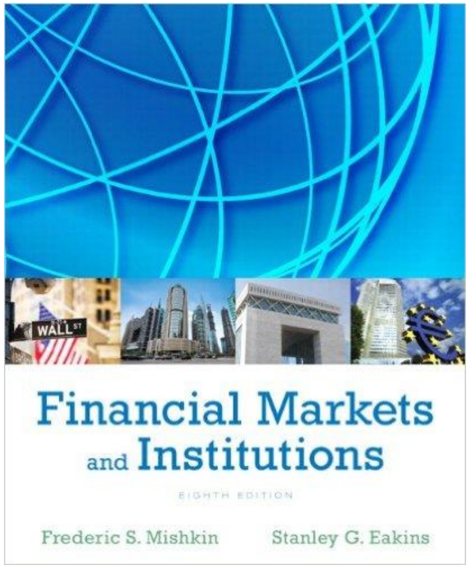
- Financial calculators have built-in functions that save time in solving time value of money problems, and their use is permitted in examinations. We will also work on examples in lectures.
- It is suggested that you procure a financial calculator and become proficient in using its time value of money functions. You should refer to the user manual for instructions.
- Financial calculator: recommended models – **TI BA II Plus** or **HP 12C**
- NOTE: Programmable calculators and calculators with text display functions are NOT allowed during examinations. All HKEAA approved calculators are allowed during examinations.



Textbook

- There are two **suggested** textbooks:
  - Fabozzi/Modigliani/Jones
  - Mishkin/Eakins
- Both are available in the library and the bookstore
- **Neither are required**, and the course does not strictly follow either
- However the textbooks may be useful for your own study, for example end of chapter questions

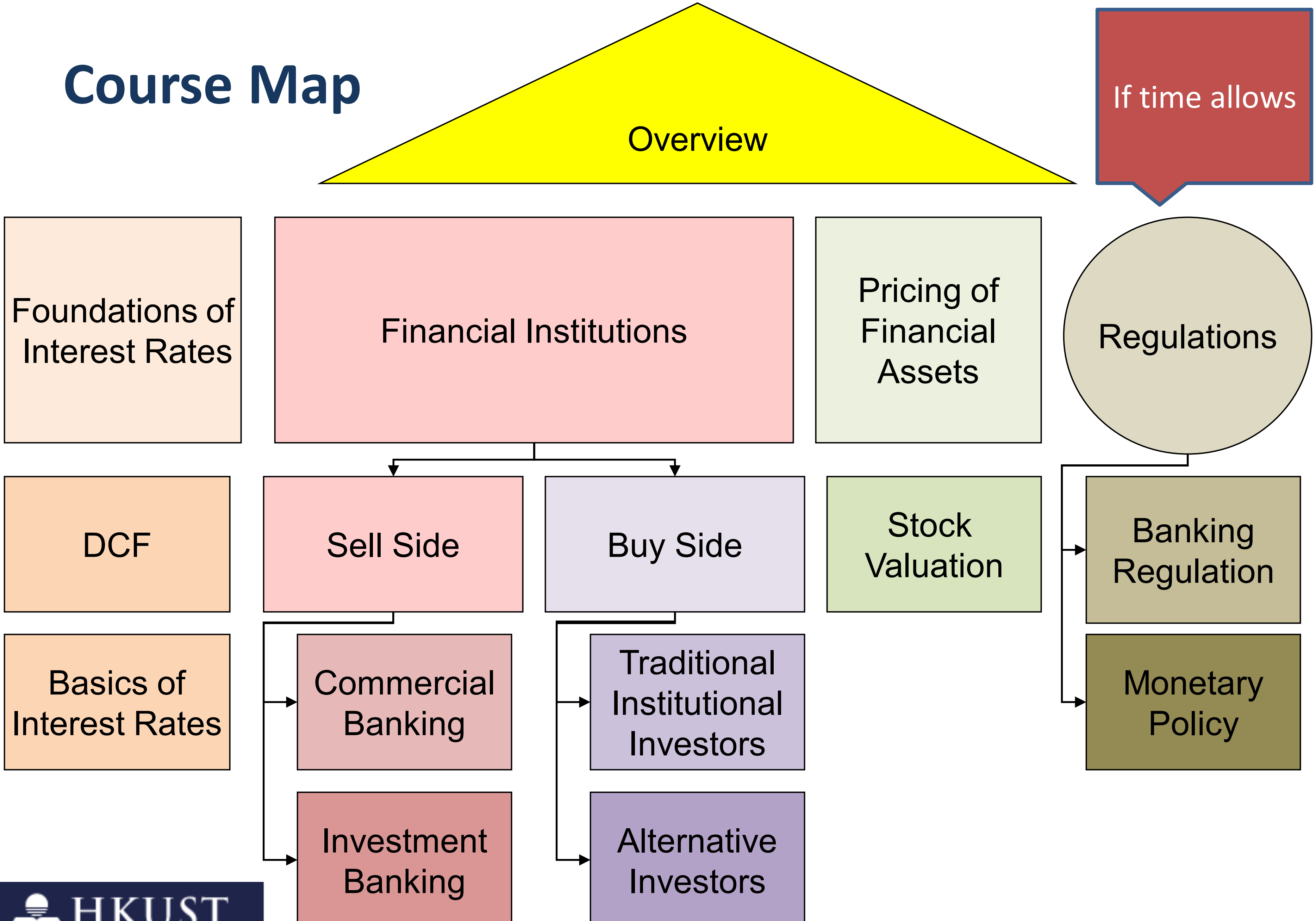




How to study for this class

- All parts of the grade count: prepare all assignments on time
- **Attend all classes**, and review the video if you have missed it. Not everything is on the slides!
- Review the slides and your notes carefully before the exams
- PRS questions and quizzes are designed to help you prepare for the exams, which will follow a similar format (MCQ and T/F). Review those carefully before the exams.
- **Ask questions** if you don't understand! Raise your hand in class. Catch me or Benson after class, make an appointment, email….
- **Participate**

Course Map


Overview
If time allows
Foundations of Interest Rates
Financial Institutions
Pricing of Financial Assets
Regulations
DCF
Sell Side
Buy Side
Stock Valuation
Banking Regulation
Basics of Interest Rates
Commercial Banking
Traditional Institutional Investors
Monetary Policy
Investment Banking
Alternative Investors

Course Tentative Agenda First Half: Overview, Rates, Financial Intermediation, Sell-side

- Week 1,2(Feb 4,7,11,14) : Introduction; overview of financial markets
  - *End of Add/Drop period: 17 Feb*
  - *Group formed due: 17 Feb*
- Week 2, 3(Feb 18, 21) : Discounted Cash Flows and Interest Rates basics (Part I), (part II)
- Week 3, 4 (Feb 25,28 Mar 4): Financial intermediation; types of Fis
  - *Group Submissions due (28 Feb)*
  - *Online Quiz I (4 Mar)*
- Week 5 (Mar 7, 11): The sell-side: commercial banks
- Week 6 (Mar 14, 18): The sell-side: investment banking
  - *Online Quiz II (Mar 22)*
  - ***Mid-term Exam(Mar 25)***

Course Tentative Agenda
Second Half: Buy-side, Pricing Basics, Regulation, Monetary Policy

- Week 7 (Mar 21): Fundamentals of pricing : stock valuation and asset pricing basics
- Week 8 (Mar 28, Apr 1) : The buy-side: insurance
- Week 9 (Apr 4,8) : The buy-side: pensions and retirement
- Online Quiz III (Apr 12)
- Week 10 (Apr 11, Apr 22) : The buy-side: asset management
- Week 11 (Apr 25,29): The buy-side: alternatives
- Week 12,13 (May 2, 6, 9) : Central banking & monetary policy, bank regulation
  - Online Quiz IV (May 10)
- ***Final Exam Period: Exam II***

Copyright Issues

- The lectures **will be recorded** by UST
- Videos will be made available on CANVAS and are subject to copyright; students are **not** allowed to copy, duplicate or disseminate the videos without prior written consent
- **No other recording or taping is allowed**
- The lectures notes are provided to you for single use. You may not copy or distribute all or any part of the notes without the written consent of the Lecturer.
- Please be aware of intellectual property issues in all your work and presentations. Take care to indicate the source of your quotes and include a reference list at the end of your presentations.
- **Plagiarism is not tolerated at HKUST**. Plagiarism software may be used in evaluating homework and clear cases of plagiarism will impact your grade significantly.

Contact Info

Instructor: Prof. Veronique Lafon-Vinais

- Email HKUST: vlafon@ust.hk
- Telephone: office: 2358-7686 (please do NOT leave voice mail)
- Mail to: Department of Finance, HKUST
- Meeting **by appointment only**

TA: Benson Leung

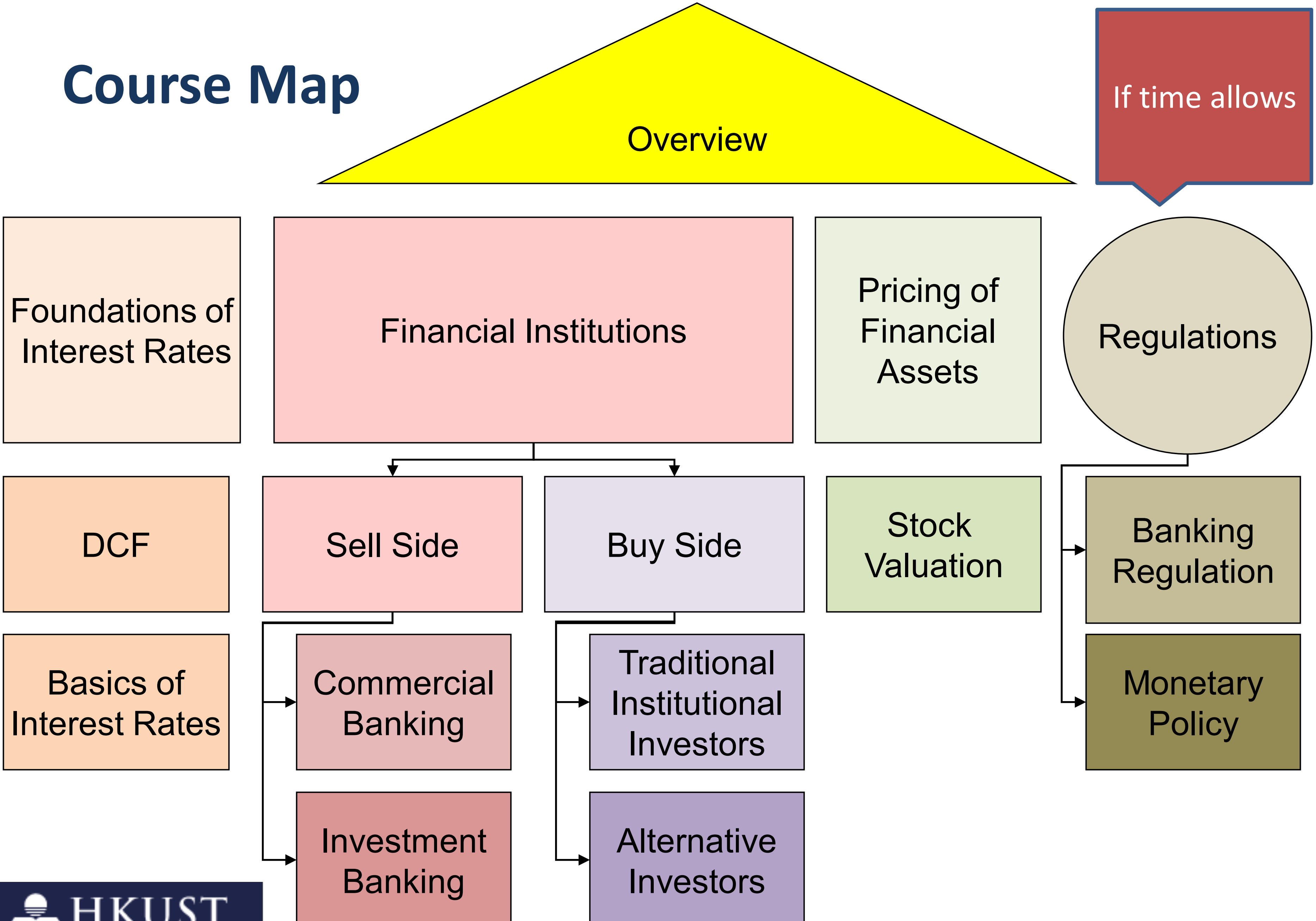
- E-mail: bbsleung@ust.hk
- Meeting by appointment only

Ask Questions

- Definitions, terminology & jargon
- Never take anything for granted
- Nothing new under the sun
- No stupid questions
- No one has all the answers

…not even me!

Course Map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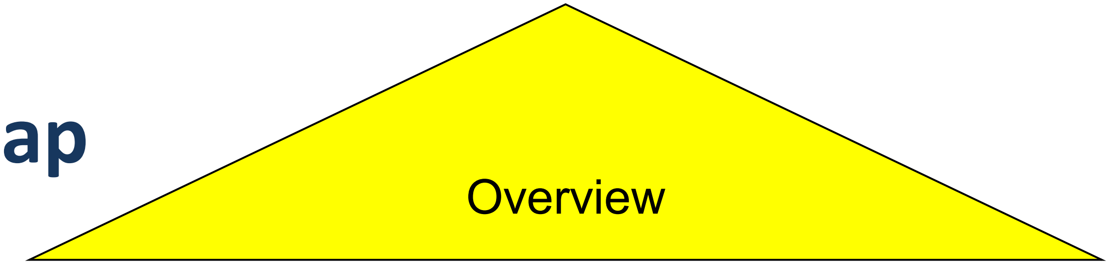


- **The Language of Business**
- What is finance? Why do we need a financial system?
- Who are the players?
- How does it work?

Quick reminder on types of firms

- When setting up a business, you have to decide which type of **legal structure** to use
  - There are many different types of legal structures ranging from sole proprietorship to listed limited liabilities corporations.
- The choices available to you depend on the country of incorporation's **legal system**.
  - For example, Hong Kong's legal system is based on English law and is quite different from the US which has both federal law and different state laws
  - New York law is different from Delaware law, for example

Some examples of corporate organization in the financial industry

- Mutual funds: **mutual organization**: the investors are also the shareholders (in a mutual organization, customers are the shareholders)
- Banks: typically listed corporations (**limited liability companies**) but some are cooperatives or credit unions (a form of mutual organization)
- Insurance: can be limited liability companies or mutual organizations
- Hedge Funds and Private Equity Funds: **limited partnerships**, with General Partners and Limited Partners
- In the economy there are all forms of organizations, including many **sole proprietorships**, but the organizations we discuss in class are mainly limited liability companies (generally publicly listed)

The corporation

- In business and finance classes, we generally focus on **publicly listed corporations**, which are limited liability companies.
- A corporation is a **legal entity** in its own right. It has rights and obligations under the relevant legal system.
- In such entities, the owners are the **shareholders**, but their liability is limited to the amount they have invested to buy the shares.
- The corporation has a **governance structure**, whereby the shareholders appoint a board of directors to represent their interests, and the board appoints a management team headed by a CEO.

Why does it matter?

- The choice of legal structure has important implications:
  - Risk for the different parties
  - Tax
  - Conflicts of interest
  - Possibility to raise capital
  - Survival of business

Pop Quiz!

- What makes mutual organizations different?
- If my friend and I are lawyers and we want to set up our own law firm, what legal structure should we use?
- If you are a shareholder in a publicly listed corporation, are you responsible for the debt of the company?

Financial Statements

- **Financial statements** are accounting reports issued periodically to present past performance and a snapshot of the firm's assets and the financing of those assets
- Regulations generally require publicly listed companies to file their annual financial statements with listing authorities; they must send an **annual report** together with their financial statements to their shareholders. The annual report is a yearly summary of the business. It must generally be verified by an **auditor.**
  - Example: CX annual report https://www.cathaypacific.com/content/dam/cx/about-us/investor-relations/interim-annual-reports/en/annual_report_2019_eng.pdf
- Investors, financial analysts, managers, and other interested parties such as creditors rely on financial statements to obtain reliable information about a corporation

Accounting standards

- Accounting standards provide the "language" of financial statements.
- There are different types of standards, like there are many languages – in the old days, each country had its own set of Generally Accepted Accounting Principles "**GAAP**".
- Two main global standards nowadays, which are broadly converging:
  - **IFRS** (International Financial Reporting Standards) which are increasingly adopted worldwide (currently > 100 countries)
  - **US GAAP** in the US only, but companies who want to issue securities in the US market have to convert their statements to US GAAP (unless they use IFRS)

Quick Search!

- Find out which accounting standards are used in your country

Role of the auditor

- Financial statements generally must be reviewed and certified by an auditor.
- The auditor must check that the financial statements present a true picture of the financial health of the company, and must sign off on the statements by providing a statement to the shareholders
- Problem: conflicts of interest.

Pop Quiz!

- Why do firms have to publish financial reports?
- Why does it matter that there are different accounting standards?
- What is the role of auditors?

Types of Financial Statements

- The main types of financial statements are:
  - Balance sheet (statement of financial position)
  - Income statement (profits and loss account)
  - Cash flow statement
  - Statement of changes in shareholders equity

The Balance Sheet

- Also called "Statement of Financial Position"
- Lists the firm's assets and liabilities, as well as shareholders' equity
- Provides a snapshot of the firm's financial position at a given point in time

In simple terms, a balance sheet presents a picture of what the firm OWNS (assets) and OWES (liabilities) at a specific point of time.

Illustration: Global Corporation Balance Sheet for 2012 and 2013

ASSETS

Uses of Capital - What we OWN

Assets	2013	2012	Liabilities and Stockholders' Equity	2013	2012
Current Assets			Current Liabilities		
Cash	23.2	20.5	Accounts payable	29.2	26.5
Accounts receivable	18.5	13.2	Notes payable/short-term debt	5.5	3.2
Inventories	15.3	14.3			
Total current assets	57.0	48.0	Total current liabilities	34.7	29.7
Long-Term Assets			Long-Term Liabilities		
Net property, plant, and equipment	113.1	80.9	Long-term debt	113.2	78.0
Total long-term assets	113.1	80.9	Total long-term liabilities	113.2	78.0
			Total Liabilities	**147.9**	**107.7**
			Stockholders' Equity		
			Common stock and paid-in surplus	8.0	8.0
			Retained earnings	14.2	13.2
			Total Stockholders' Equity	22.2	21.2
Total Assets	170.1	128.9	Total Liabilities and Stockholders' Equity	170.1	128.9

The difference between assets and liabilities is the shareholders' equity

LIABILITIES

Sources of Capital – What we OWE

The firm's net worth

The Balance Sheet

- The Balance Sheet Identity
  - The two sides of the balance sheet must balance

The Balance Sheet Identity

Assets = Liabilities + Stockholders' Equity

  - If we OWE more than we OWN we have negative equity
  - It should not be possible and is generally not desirable but we will see that the book value and the market value may be different, allowing successful firms to borrow more than the book value of their assets

Shareholder's Equity (Capital)

- Shareholders' (Stockholders') Equity
  - The difference between Assets and Liabilities constitutes the shareholders' equity – also called **book value** of equity
  - An accounting measure of the **net worth** of the firm
  - Main components:
    - Share (equity) capital (money invested directly by shareholders in exchange for **shares** of the company)
    - Retained earnings (reinvestment of profits)

Market v. Book Value

- Market Value v. Book Value
  - **Book value** of equity
    - Net worth from an accounting perspective
    - Assets – Liabilities = Equity
    - True value of assets may be different from book value because (i) the true value of an asset may be different from its book value and (ii) many valuable assets are not captured on the balance sheet: ex: reputation, quality….
  - **Market capitalization** (also called market value of equity)
    - Market price per share times number of shares
    - Does not depend on historical cost of assets

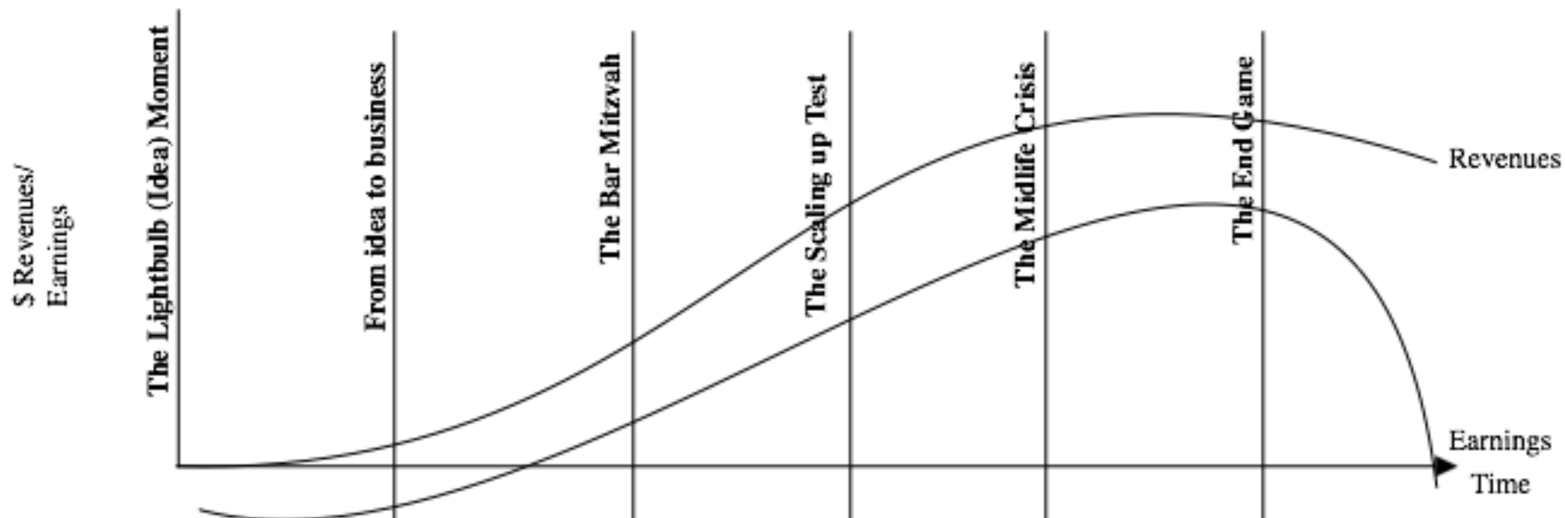
Quick Search!

- Find out what is the book value (annual report 2019) and the market value (market cap) of Cathay Pacific (today)

Funding the business

- Funds come from 2 main sources (as evidenced by the balance sheet):
- Equity (Capital) => shares/stocks
  - To start a business we source money from the **3Fs** (friends, family & fools) by issuing **shares** (stock)
  - Later on, we can raise more money from **financial investors** (generally angel investors, venture capital, private equity)
  - As we become a larger business, we typically get listed (IPO) and raise money from the general **public (retail investors)**
- Debt (Liabilities) => loans, bonds, notes, leases…
  - We can borrow money from : suppliers (payables & trade credit); banks (loans) finance companies (leases) and investors (bonds, notes, private placements)

Life Cycle of Firms

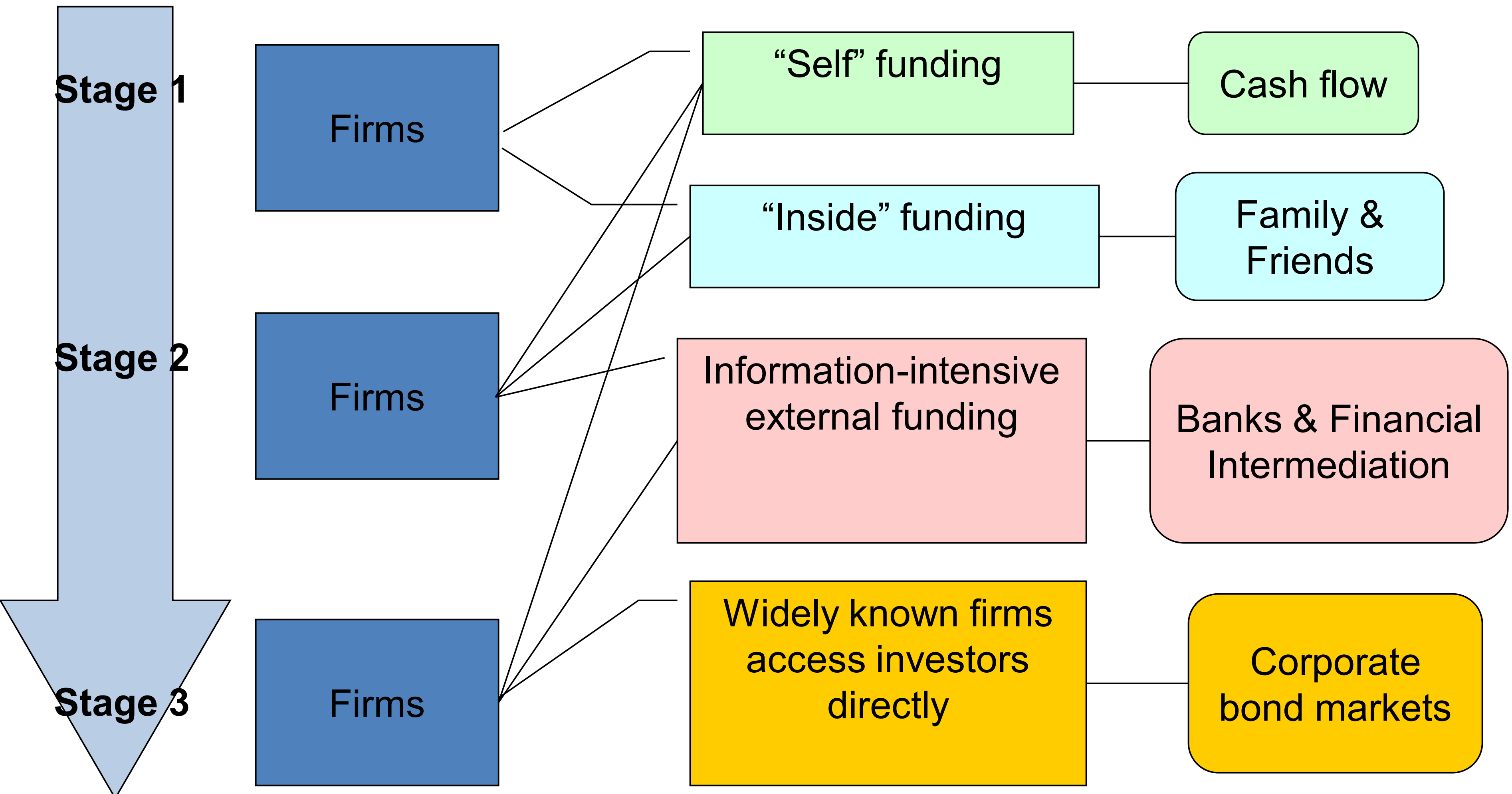


Growth stage	Stage 1 Start-up	Stage 2 Young Growth	Stage 3: High Growth	Stage 4 Mature Growth	Stage 5 Mature Stable	Stage 6 Decline
Description	Have an idea for a business that meets an unmet need in the market.	Create a business model that converts ideas into potential revenues & earnings	Build the business, converting potential into revenues.	Grow your business, shifting from losses to profits	Defend your business from new competitors & find new markets	Scale down your business as market shrinks.

Life Cycle of Businesses

Source: Prof. Damodaran, NYU Stern

Life cycle and funding



The Income Statement

- The income statement lists the firm's revenues and expenses over a period of time
  - Sometimes called the **profit and loss statement**, or "P&L"
- The last or "bottom" line of the income statement shows net income (also called "profits" or "earnings")
  - A measure of its profitability during the period
  - Also referred to as the firm's **earnings**

In simple terms, the income statements shows what the company earns and how profitable it is!

Illustration: Global Corporation's Income Statement Sheet for 2013 and 2012

Profit & Loss Account

Revenues

Cost of Goods Sold

Operating Expenses

Net Profit, Earnings

GLOBAL CORPORATION
Income Statement
Year ended December 31 (in $ millions)

	2013	2012
Net sales	186.7	176.1
Cost of sales	−153.4	−147.3
Gross Profit	33.3	28.8
Selling, general, and administrative expenses S, G & A	−13.5	−13
Research and development R & D	−8.2	−7.6
Depreciation and amortization	−1.2	−1.1
Operating Income	10.4	7.1
Other income	—	—
Earnings Before Interest and Taxes (EBIT)	10.4	7.1
Interest income (expense)	−7.7	−4.6
Pretax Income	2.7	2.5
Taxes	−0.7	−0.6
Net Income	2.0	1.9
Earnings per share: EPS	$0.56	$0.53
Diluted earnings per share:	$0.53	$0.50

The Statement of Cash Flows

- The firm's statement of cash flows uses the information from the income statement and balance sheet to determine:
  - How much cash the firm has generated
  - How that cash has been allocated during a set period
- Cash is important because it is needed to pay bills and maintain operations and is the source of any return of investment for investors

Illustration

Global Corporation's Statement of Cash Flows for 2013 and 2012

The statement of cash flows is divided into **three sections** which roughly correspond to the three major jobs of the financial manager:
Operating activities
Investment activities
Financing activities

GLOBAL CORPORATION
Statement of Cash Flows
Year ended December 31 (in $ millions)

	2013	2012
Operating activities		
Net income	2.0	1.9
Depreciation and amortization	1.2	1.1
Cash effect of changes in		
Accounts receivable	−5.3	−0.3
Accounts payable	2.7	−0.5
Inventory	−1.0	−1.0
Cash from operating activities	**−0.4**	**1.2**
Investment activities		
Capital expenditures	−33.4	−4.0
Acquisitions and other investing activity	—	—
Cash from investing activities	**−33.4**	**−4.0**
Financing activities		
Dividends paid	−1.0	−1.0
Sale or purchase of stock	—	—
Increase in short-term borrowing	2.3	3.0
Increase in long-term borrowing	35.2	2.5
Cash from financing activities	**36.5**	**4.5**
Change in cash and cash equivalents	**2.7**	**1.7**

Pop Quiz!

- When a start-up raises equity capital from investors, does it issue shares or bonds?
- When a company needs to finance a new project with debt, will it issue shares or bonds?
- If a company is losing money, are its earnings positive or negative?
- As a retail investor, how can you invest in a company to make money from its growth?

Some important ratios and terms you should know about

- EBIT and EBITDA
- EPS

EBITDA

- EBITDA
  - Financial analysts often compute a firm's **earnings before interest, taxes, depreciation, and amortization**, or EBITDA
  - Because depreciation and amortization are not cash flows (non-cash expense), this subtotal reflects **the cash** a firm has earned from operations
  - This is a measure frequently used in debt covenants

EPS

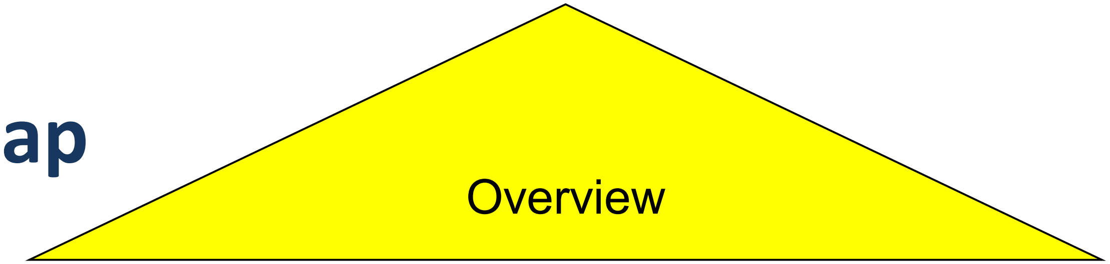
- Earnings Per Share EPS
  - Net income reported on a per-share basis

- $$\text{EPS} = \frac{\text{Net Income}}{\text{Shares Outstanding}}$$

Quick Search!

- Find out Cathay Pacific's EPS as of 2019

Course Map



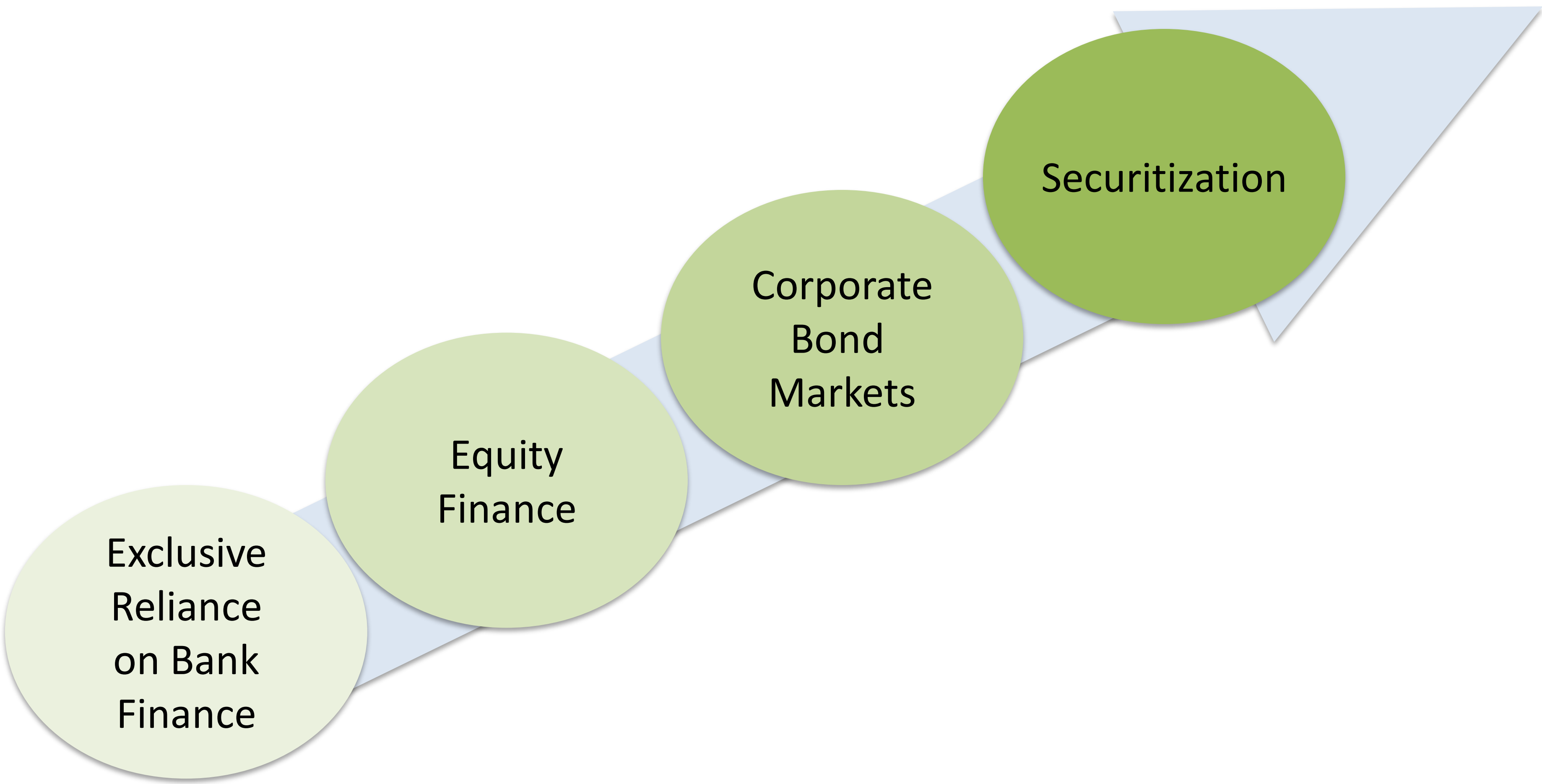
- The Language of Business
- **What is finance? Why do we need a financial system?**
- Who are the players?
- How does it work?

Imagine…

- A region without money…
- A country with no banking system…
- A world with no global capital flows…

Why was Muhammad Yunus the 2006 Nobel Peace Prize winner?

Evolution of Financial System



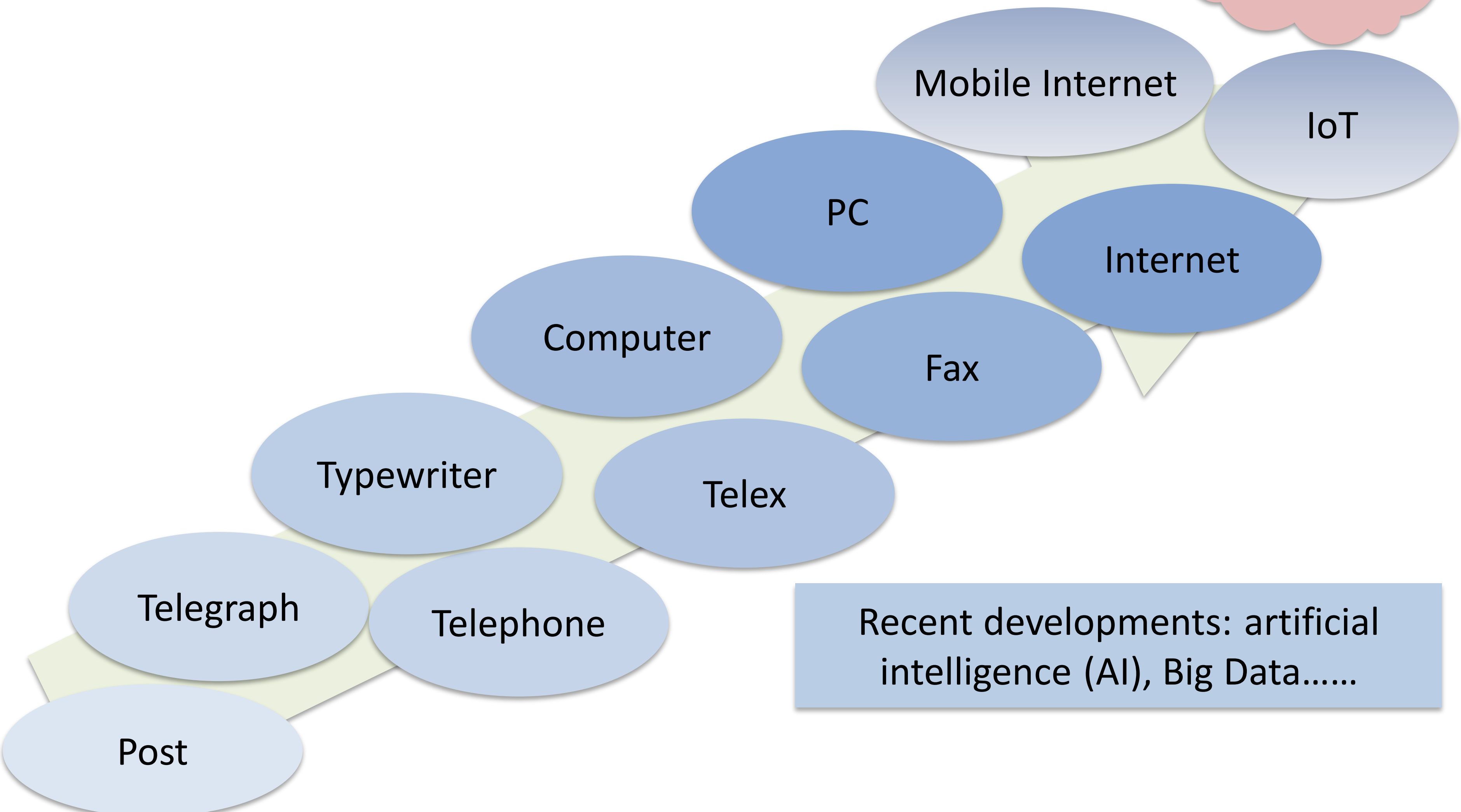
Tech, tech, FinTech

- When I started working, this is the technology we had:
  - Mainframe computer
  - Telephone
  - Telex
  - Typewriter
  - Post

Quick Search!

- What is a telex?

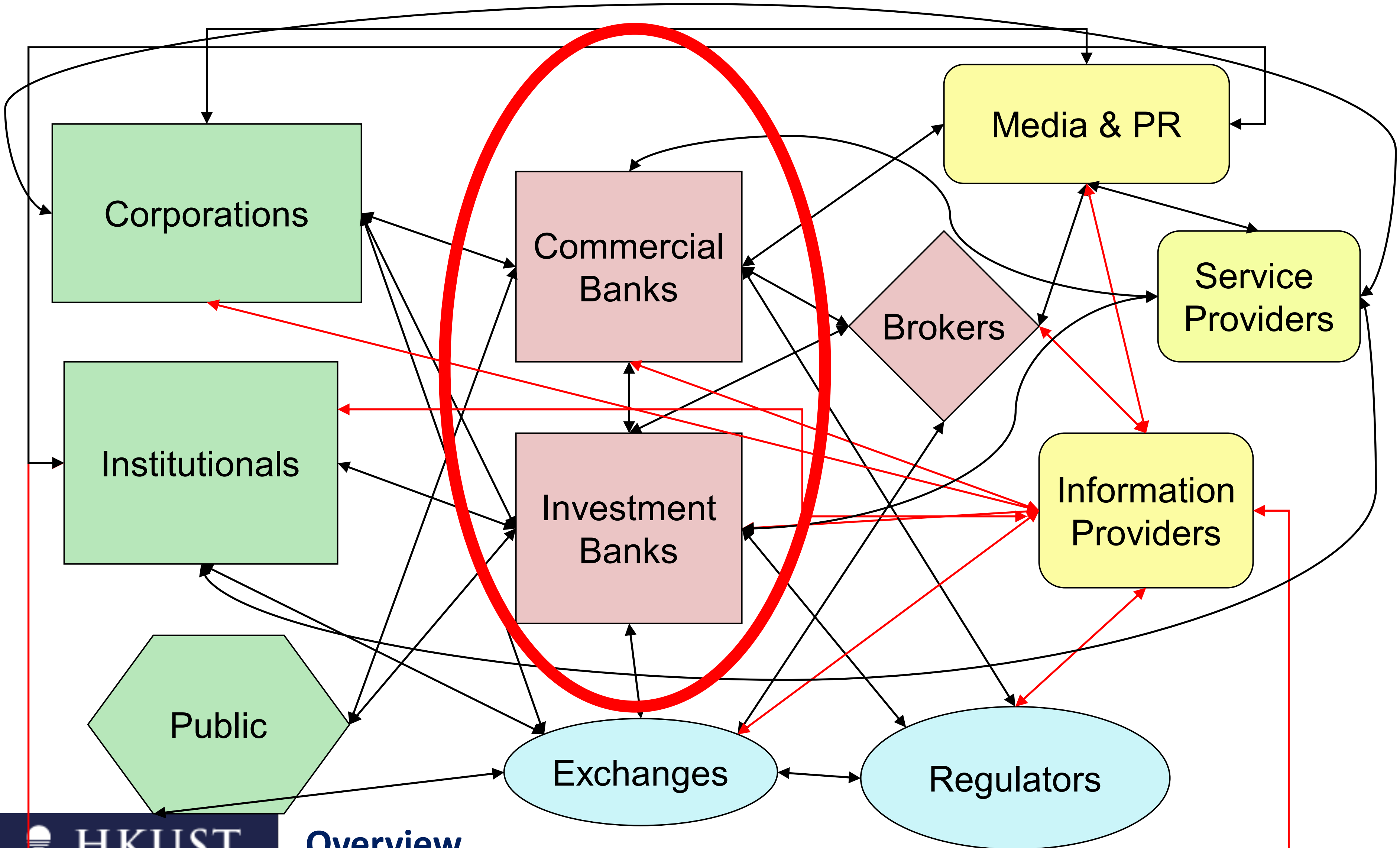
Disruptive Technologies



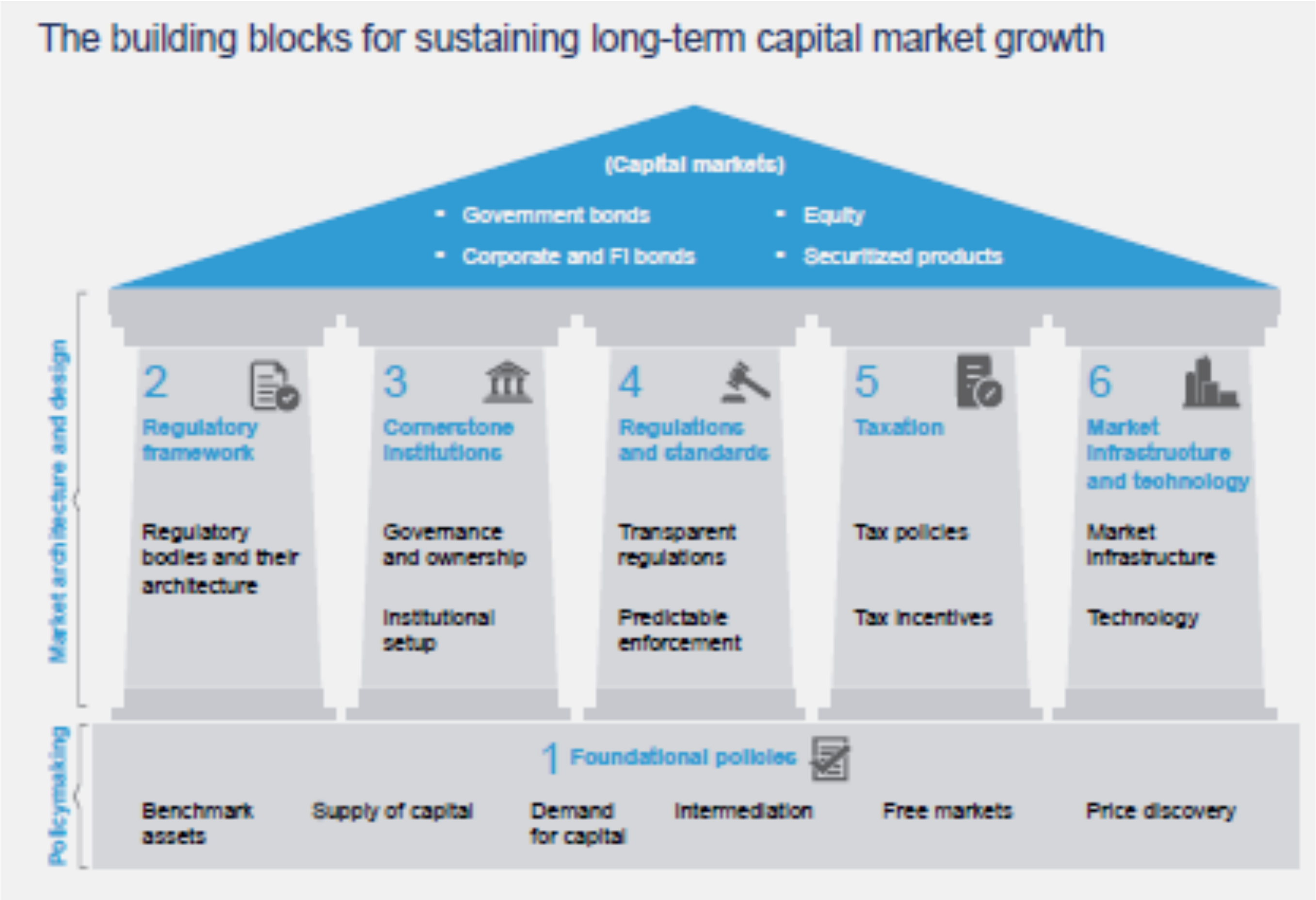
Recent developments: artificial intelligence (AI), Big Data……


the world before social media...
LinkedIn
Pinterest
YouTube
foursquare
Instagram
Imgur
ADDRESS
reddit
WordPress
Skype
Twitter
Facebook
Tumblr

Financial Markets



Key building blocks for capital markets



Source McKinsey April 2017

Functions of Financial Markets

- Channeling funds
- Efficiency
- Price determination
- Risk sharing
- Liquidity
- Financial stability
- Information aggregation and coordination

Asia's Financial Markets

- Fragmented markets
- Lack of information
- Reliability of information
- Timeliness and accuracy of information
- Legal (un)certainty
- Weak regulators

No transaction efficiency

Information asymmetry

Affects price efficiency

McKinsey Asian Capital Markets Development Index

Source McKinsey April 2017

Constituents of the McKinsey ACMD Index

Constituents of McKinsey Asian Capital Markets Development Index

Theme	Sub-theme	Metric	Description
Funding at scale	Availability	1 Financial depth of primary market	3-year average issuances of equity, government bonds (>1 year), corporate and FI bonds, and securitized products, as percent of GDP
		2 Availability of long-term debt	Ratio of long-term (>10 years) to short-term (1 to 3 years) debt issuances, vis-à-vis overall size of the debt market
	Diversity of sources	3 Availability and stability of foreign investment	Stock of Foreign Portfolio Investment (FPI) as percent of GDP, vis-à-vis 5-year standard deviation of FPI flows
	Affordability	4 Competitiveness of cost of capital	Cost of equity and debt adjusted for inflation
Investment opportunities	Availability	5 Availability of investment opportunities across asset classes	Stock of all capital market assets (comprising outstanding equity, corporate and FI bonds, government bonds, and securitized products) as a percentage of GDP
	Return	6 Appropriate risk-adjusted returns	7-Year Sharpe ratio, 2008–2015, for investments in cash equity products
Market efficiency	Pricing efficiency	7 Quality of pricing information	Efficiency index comprising:[1] • Long-term memory/Hurst Exponent, measuring correlation in the long-term series • Fractal dimension, measuring correlation in shorter fractions of the earlier long-term series • Approximate entropy, measuring the availability of information which can be used to predict market trends

1 FINMAP Financial Distortions and Macroeconomic Performance, Kristoufek and Vosvrda (2014)

Source McKinsey April 2017

Course Map

Overview

- The Language of Business
- What is finance? Why do we need a financial system?
- **Who are the players?**
- How does it work?

The Players

- Sources of funds (Investors)
  - Institutionals
  - Sovereigns and quasi-sovereigns
  - Banks & FIs
  - Corporations
  - HNWI
  - Public (households)

- Users of funds (Issuers)
  - SSAs:
    - Supras
    - Sovereigns
    - Agencies
  - Banks
  - Corporations
  - SPVs

The Players

Warning! We will explain the difference between "intermediaries" and "financial intermediaries" later

- Intermediaries
  - Investment bankers
  - Primary dealers/traders
  - Brokers
  - Credit and liquidity enhancers
- Other actors
  - Regulators
  - Service providers
  - Rating agencies

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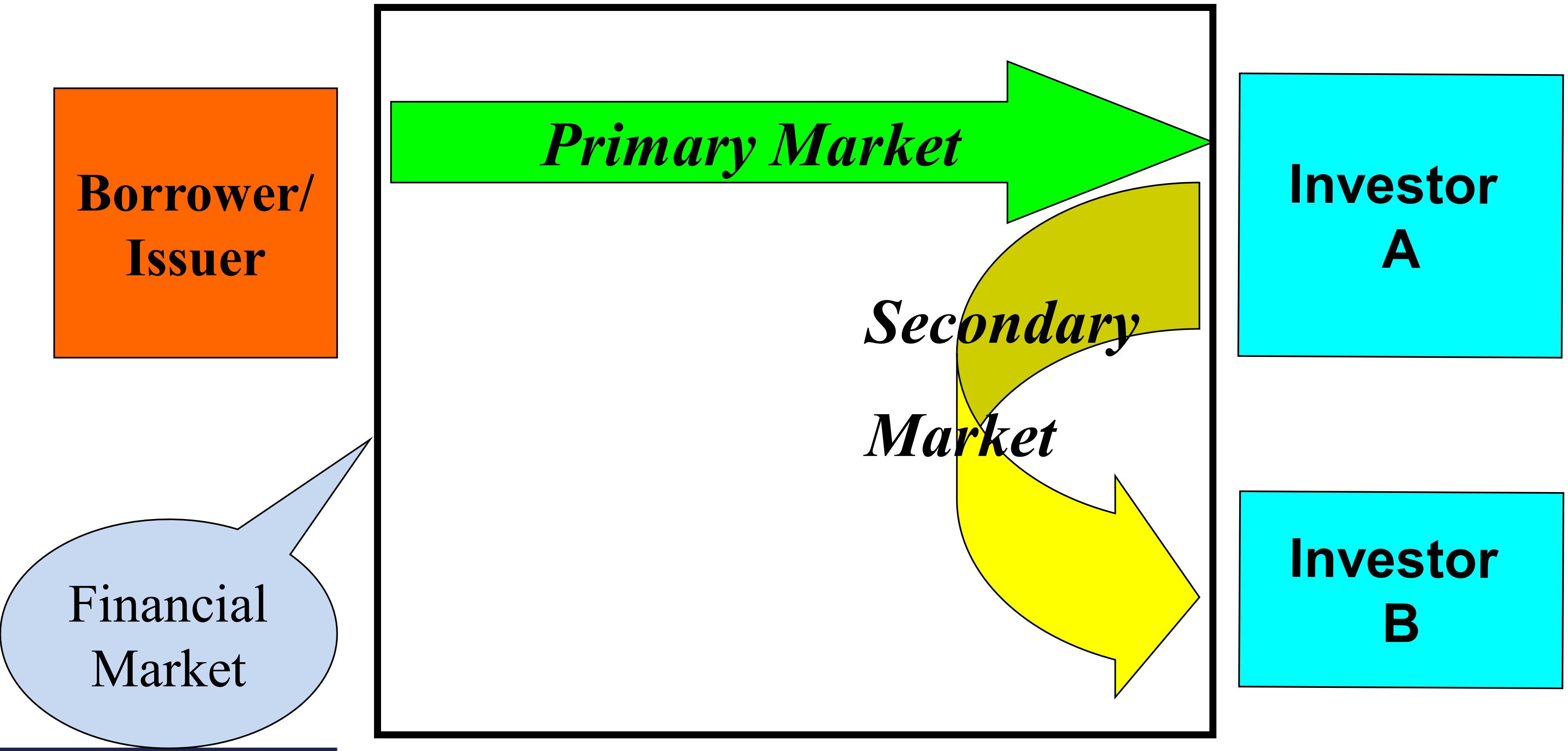
Classification of Financial Markets

- Primary v. Secondary
- Debt v. Equity
- Exchanges v. OTC
- Domestic v. International
- Public v. Private
- ……

Primary & Secondary Markets

- Primary market = raising money/capital for the first time
- Secondary market = selling securities onto another investor

Primary v. Secondary Markets



Test Your Understanding/PRS time!

- Is an IPO (initial public offering) a **primary** market or **secondary** market transaction?
  - Primary
  - Secondary
- If you buy shares from another investor, is it **primary** market or **secondary** market transaction?
  - Primary
  - Secondary

Debt v. Equity

- Debt
  - Legally binding obligation
  - No voting rights
  - Requires repayment of principal and interest
  - Interest is tax-deductible (some countries inc. US, but not always)
  - Covenants can be restrictive

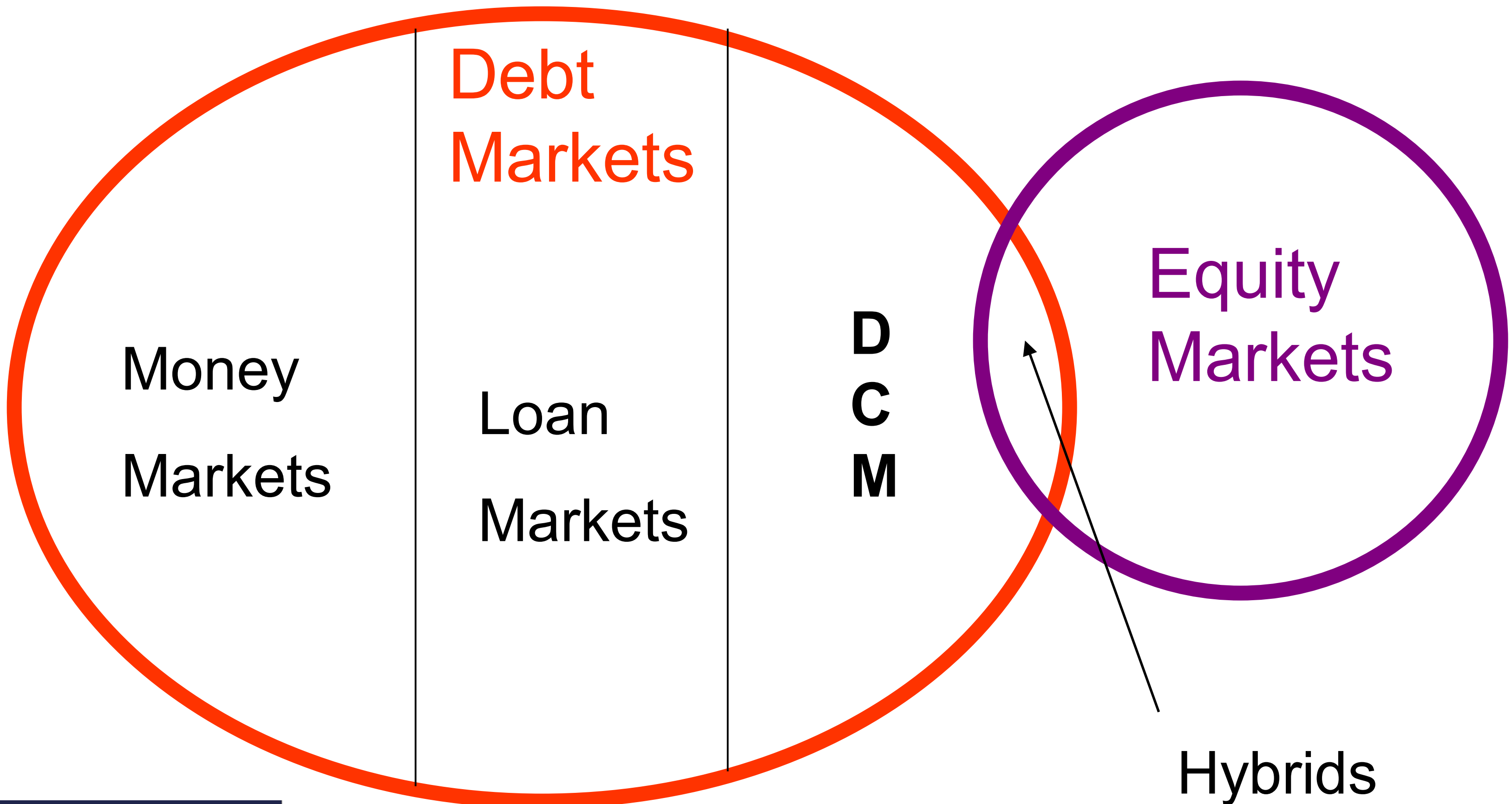
The conditions in the contract

- Equity
  - Ownership
  - Voting rights on common stock
  - Dividends on common stock are optional
  - Dividends are paid from after-tax profits
  - All cumulative preferred dividends must be paid before dividends paid on common stock

Securities & Capital Markets

- Securities = negotiable, tradable financial instruments
  - Include equity securities (stocks/shares) and debt securities (bonds/notes)
- Capital markets = markets where securities are traded and where firms can raise capital (either equity capital or debt capital)
  - Include Equity Capital Markets (ECM) and Debt Capital Markets (DCM)
- Financial markets include but are not limited to, capital markets. For example:
  - Foreign Exchange (FX) market (market for trading currencies) – the largest and most liquid of all financial markets, is not a "capital market" since participants don't raise capital
  - Commodities market
  - Loan market
  - Money market (interbank, commercial paper, CDs…)
  - Derivatives market

Debt v. Equity Markets



Test Your Understanding/PRS time!

- If a company issues bonds, which type of market does it use?
  - ECM
  - DCM
- The FX market is a
  - Capital market
  - Financial market

Market Organization

4 main types of market organization:

- Direct search
- Brokered market
- Dealer market
- Auction market

Methods of Price Determination

- **Dealer markets:** Price determined by market makers (traders/dealers) based on supply/demand; their existing position; their view of the market
- **Broker markets:** Price determined by supply/demand
- **Auction markets:** All bids and offers entered into system; price determined at equilibrium point (Dutch auction) or highest price bid

Some exchanges are auction markets while others are dealer markets

Exchanges vs. Over-the-Counter (OTC)

Exchanges

- One centralized "location"
- 2 types: stock exchanges and derivatives exchanges
- Can be auction markets or dealer markets

Over-the-counter (OTC)

- Not localized
- Dealer markets
- Examples: bond market

Some misunderstandings

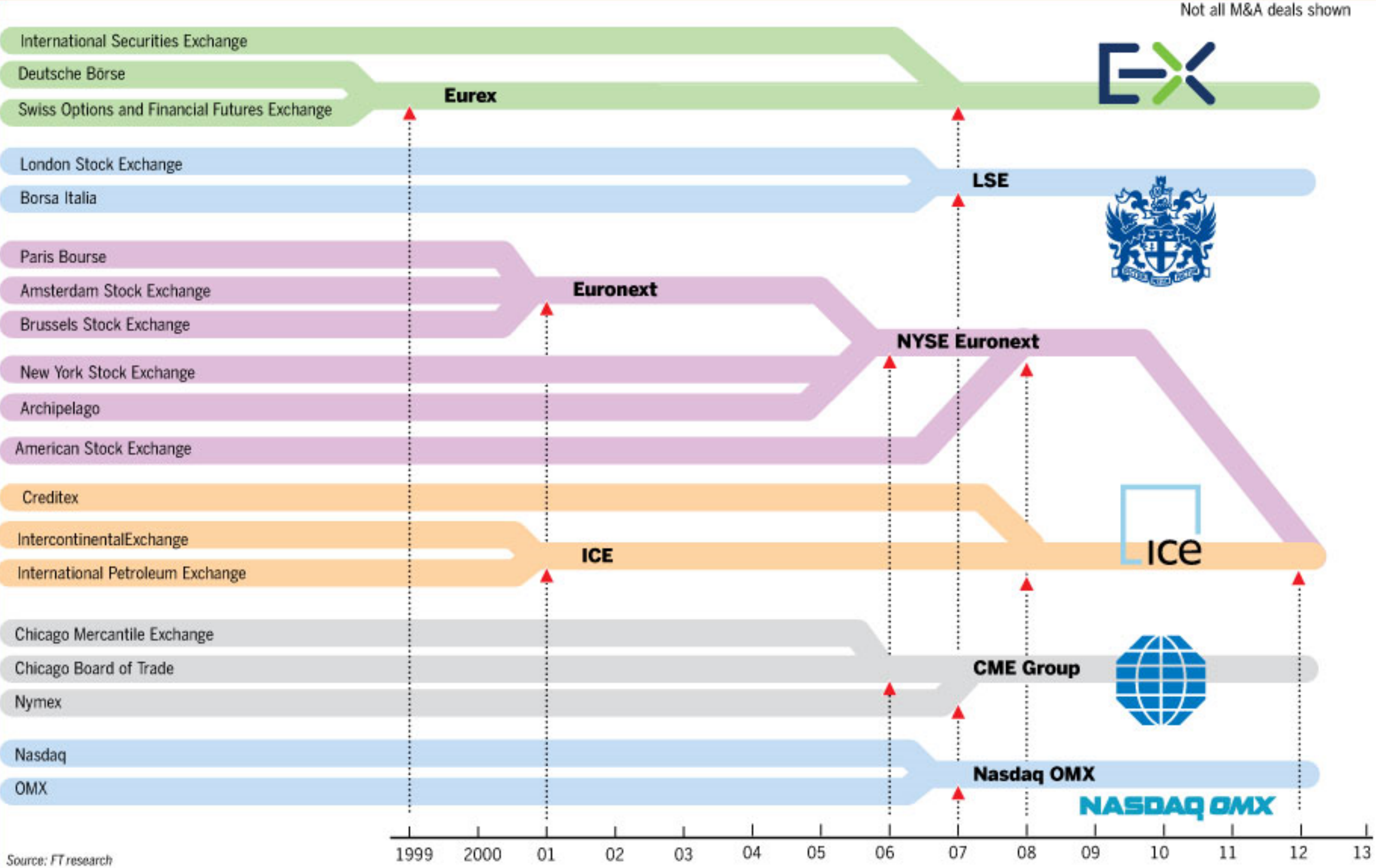
- Trading v. listing: financial instruments can be **listed** on an exchange …
  - to **list** a security or a financial instrument on an exchange, the firm needs to meet the listing requirements and rules of that particular exchange
- … But don't necessarily **trade** on that exchange
  - Trading has to do with supply and demand for that particular instrument
  - A stock can be listed on an exchange but very rarely trade on it if there is no or limited liquidity
- Some financial instruments ONLY trade on exchanges
  - for example **futures** are exchange specific financial instruments
- Others can be traded on exchanges or OTC
  - for example bonds are often listed on exchanges but generally trade OTC.
  - Spot FX only trades OTC

Current issues related to market organization

- The advent of electronic trading
- Will open outcry disappear?
- Demutualization and listing of exchanges
- Mergers and consolidation
- Dark pools and private exchanges
- Advent of High Frequency Trading (HFT)
- Regulators push to move OTC onto exchanges

Impact?

Bourse buyouts Who is next?



Source: FT research

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Source: FT"ICE and NYSE Euronext go where other exchanges have struggled" 3 October 2013

Test Your Understanding

- Futures are traded on
  - Exchange markets
  - OTC markets
- FX is traded on
  - Exchange markets
  - OTC markets

Domestic, Euro and Foreign markets

- To determine if a securities issue is domestic, foreign or "Euro" we need to check three key variables:
  - what currency is the security issued in?
  - Where is the security placed? (where are the investors)
  - Where is the issuer?
- Domestic issues: placed with investors in the country of the currency and the issuer is also from the country of the currency
  - Example: HK Land issues a HKD bond placed to HK investors

Domestic, Euro and Foreign markets

- Foreign issues: placed with investors in the country of the currency but the issuer is from a different country
  - Example: HK Land issues USD bond to US investors
- "Euro" issues: placed with investors <u>outside</u> the country of the currency. It doesn't matter where the issuer is from.
- WARNING!! Very confusing as "Euro" here is NOT the Euro currency. "Euro" here means the currency is used OUTSIDE its country.
  - Example 1: HK Land issues a EUR denominated bond to HK investors
  - Example 2: HK Land issues a USD denominated bond to EU investors

BIS Classification of Bond Markets

For the BIS, securities issues are classified as domestic or international. The international category includes foreign and "euro" issues.

Classification of BIS securities statistics

	Issues by residents	Issues by non-residents
In domestic currency		
Targeted at resident investors	Domestic	International (foreign: yankee, samurai, bulldog)
Targeted at non-resident investors	International (offshore or euromarket)	International (offshore or euromarket)
In foreign currency	International	International

Source: BIS (2003a), p 14.

Internal v. External classification

Internal (national) **Market**

- **Domestic Market**: Issuers domiciled in the country
- **Foreign Market**: Issuers not domiciled in the country, e.g. *Yankee* market in the US

External (international, offshore, Euromarket) **Market**

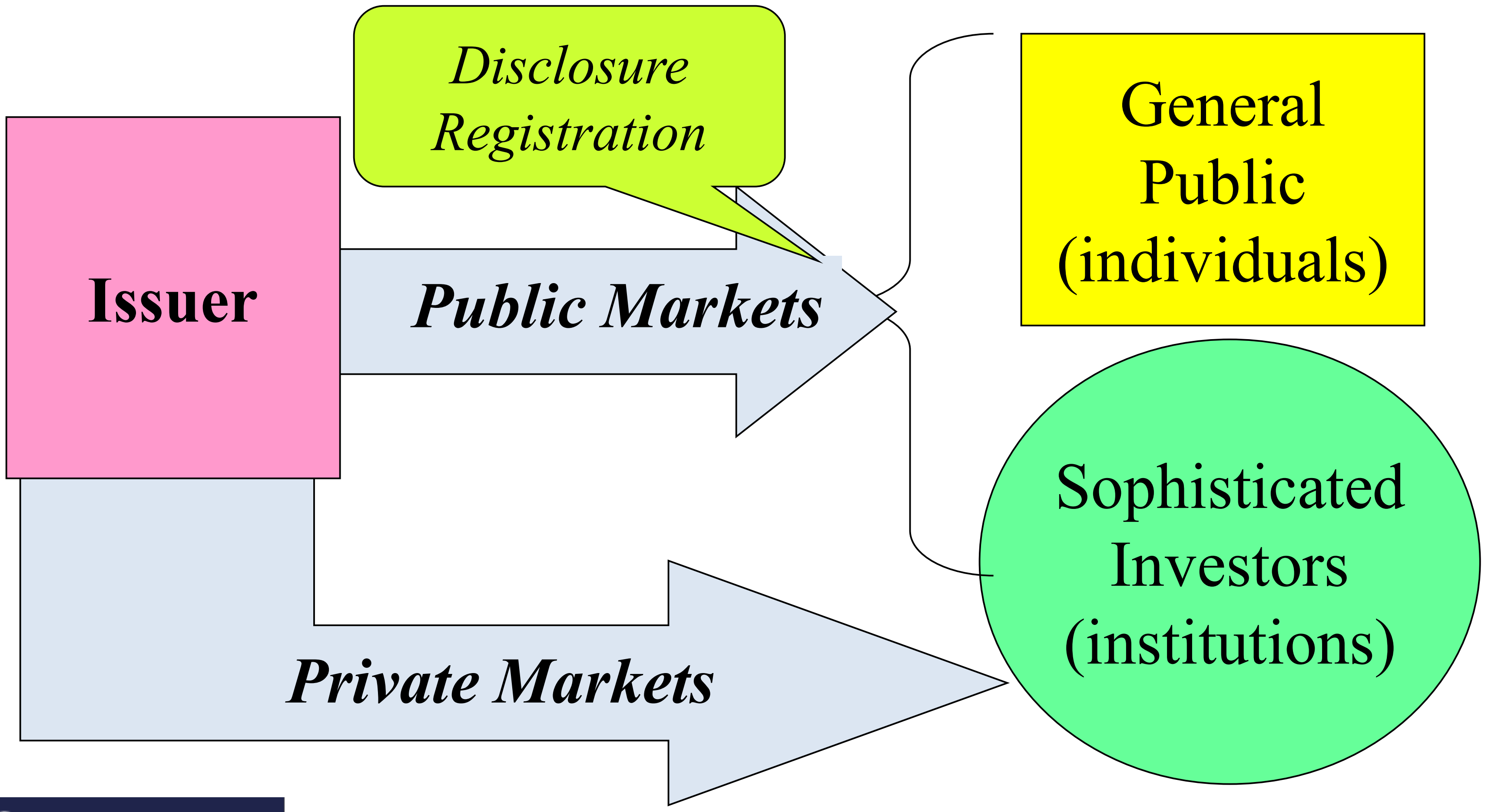
Securities offered simultaneously to investors in a number of countries and issued outside the jurisdiction of a single country

Source: Fabozzi/Modigliani "Capital Markets: Institutions and Instruments" 1996

Test Your Understanding

- HK Land issues a HKD bond to HK investors. This is a:
  - Domestic issue
  - Euro issue
  - Foreign issue
- BIS records the issue as a:
  - domestic securities issue
  - International securities issue
- This issue was done in an
  - Internal market
  - External market

Private v. Public



Public Issues

- Targeted at the general public (also called “retail” issues)
- Subject to regulatory control
- Typically underwritten by an investment bank
- Typically require
  - Registration/filing
  - Disclosure (prospectus) + due diligence
  - Rating (in some countries)
  - In some countries there may be a need for prior approval from regulator (e.g. PRC) and a queuing system

Private Issues (Private Placements)

- Targeted at “sophisticated investors” or QIBs
- Typically exempted from registration requirements (in the US various exemptions may apply depending on the nature of the issue e.g. rule 144A)
- Lower standards of disclosure and due diligence as investors are deemed “sophisticated”
- Generally no need for underwriting

Test Your Understanding

- HK Land issues a HKD bond to HK investors. The placing banks are targeting individual investors in HK. This is a:
  - Public issue
  - Private issue
- The MTRC places a USD bond with sophisticated investors in the US under rule 144A. This is a:
  - Public issue
  - Private issue

FINA 1303

FOUNDATIONS OF INTEREST RATES
Part I

Veronique Lafon-Vinais

Associate Professor of Business Education - Department of Finance

HKUST BUSINESS SCHOOL 香港科大商學院

Agenda

- Part 1: Time Value of Money
  - Present Value
  - Future Value
- Part 2: Valuing a Stream of Cash Flows
- Part 3: Applications
  - IRR
  - Mortgages

Interest in History & Islamic Finance

- Throughout history, money lenders have been unpopular because they charge interest
- Shakespeare's famous play "The Merchant of Venice" is an illustration of this
  - Christianity banned the charging of interest (usury) for centuries, and only Jews were involved in providing credit
- Today, Islamic Finance prohibits the payment and charging of interest (*riba*) which is contrary to Islamic laws (*sharia*). Yet, the Islamic Finance market is growing fast including in Hong Kong, where the HKSAR Government has issued two *sukuks* (Islamic bonds)

Important things to know before we start!

- In this section, unless otherwise indicated, interest rates are **yearly** (annual) interest rates (in the markets we use the term "per annum" or "p.a.")
- Financial institutions are generally required to indicate the interest rates they charge on an *annual percentage rate* (**APR**) basis so that consumers can compare prices
- The way we calculate interest payments differs depending on the financial instrument we use. You need to verify the applicable conditions in the contract!
- In particular, debt contracts of less than one year and money market securities use simpler formulas (we will discuss this later)

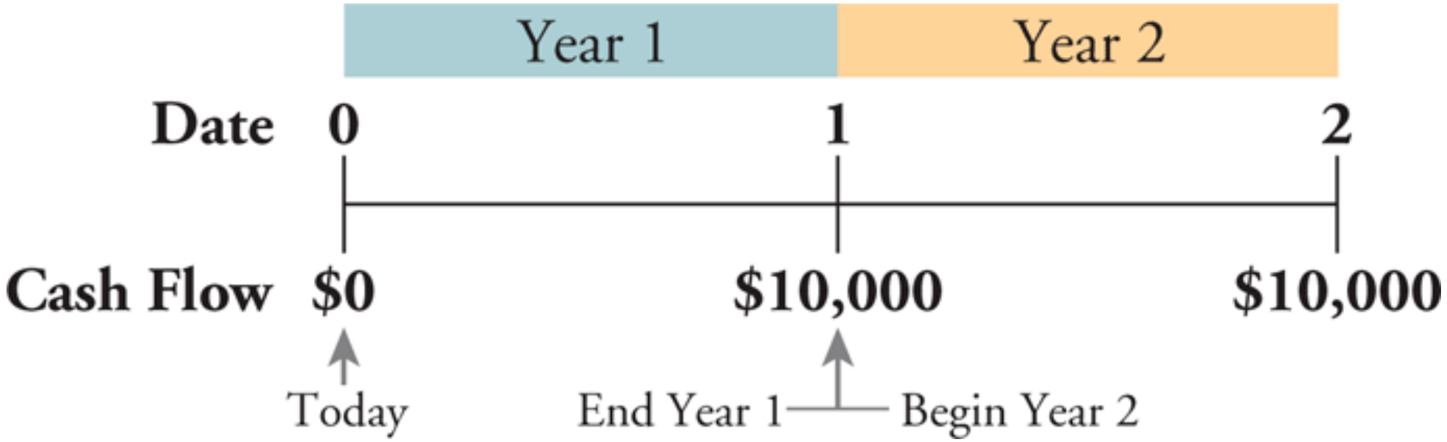
Part 1: Time Value of Money

Valuing Monetary Payments now and in the Future: Introducing DCF (“Discounted Cash Flows”)

- How do we compare the return on different financial instruments?
  - Different debt instruments have different streams of cash payments to the holder (known as **Cash Flows**), with different **timing**.
- How and why is the promise to pay $X on T1 more or less valuable than the promise to pay $Y on T2?
- To find out, we use **DCF calculations**

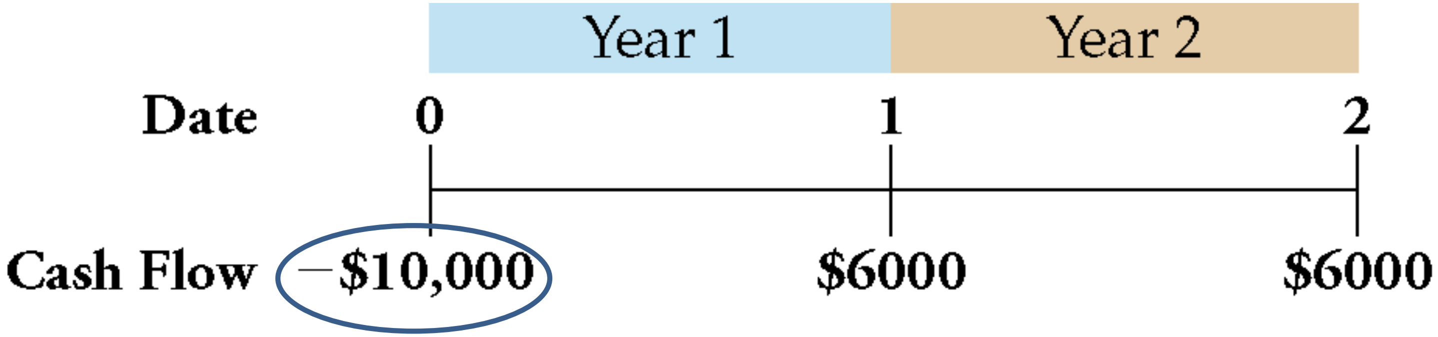
Timelines

- Constructing a Timeline
  - Identifying Dates on a Timeline
    - Date 0 is today, the beginning of the first year
    - Date 1 is the end of the first year



Timelines

– Distinguishing Cash Inflows from Outflows (negative signs indicate outflows)



– Representing Various Time Periods
  - Indicate the label :"Year" or "Month" or .....

DCF Introduction

- The concept of discounted value is based on the notion (assumption) that a dollar of cash flow paid to you some time from now is less valuable to you than a dollar paid to you today: "a dollar is worth more today than tomorrow" or the **time value of money**
  - Why? This notion has been GENERALLY true because you could invest the dollar in a savings account that earns interest
  - BUT in an era of NEGATIVE interest rates this is no longer true everywhere
- We will learn basic pricing of financial instruments **under the assumption of positive interest rates**. Negative interest rates change significantly our allocation of resources and distort financial markets.

Class Discussion

- What do you think will happen to interest rates and why?

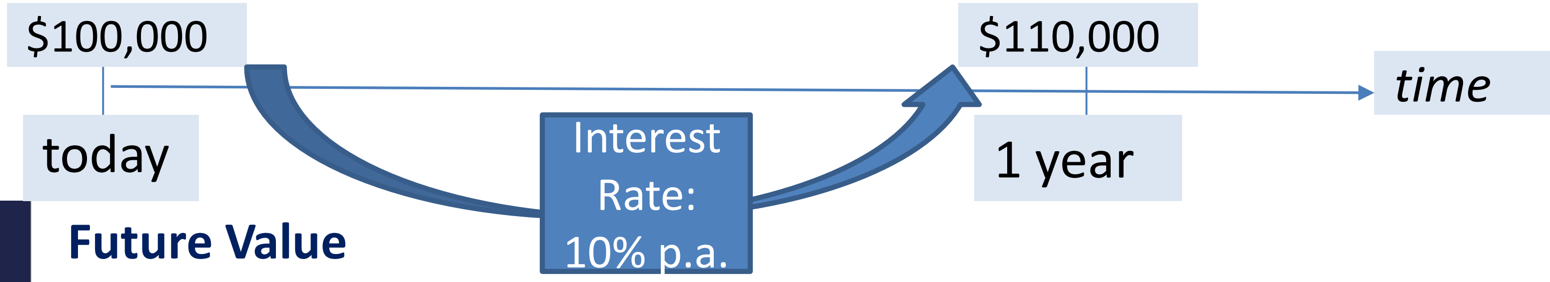
The Time Value of Money and Interest Rates

- The Interest Rate: Converting Cash Across Time
  - Present Value PV
    - The value of a cost or benefit computed in terms of cash **today**
  - Future Value FV
    - The value of a cash flow that is moved forward **in time**

Future Value and Interest

- **Future value** is the value on a later date of an investment today.
  - $100,000 invested today at 10% interest gives $110,000 in a year.

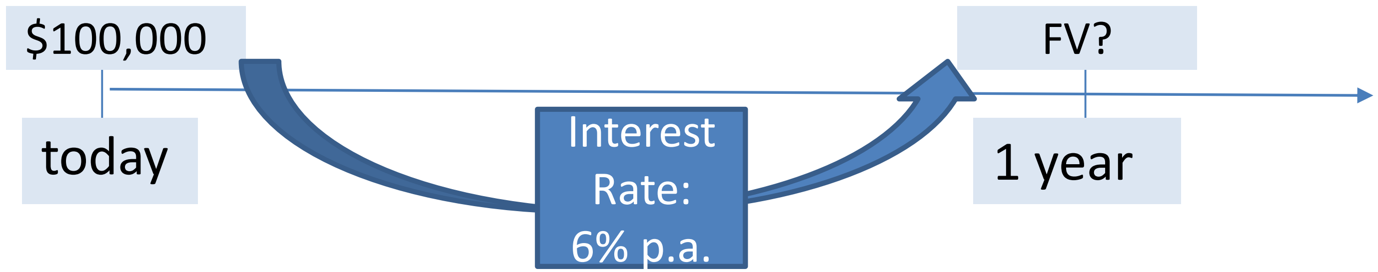
    => the **future value** of $100,000 today at 10% interest is $110,000 **one year from now**.
  - The $100,000 *yields* $10,000, which is why interest rates are sometimes called **yield** or yield to maturity.



Future Value

Future Value example (single period)

- Calculate the value of $100,000 Investment in 1 year at a rate of 6% (p.a.)



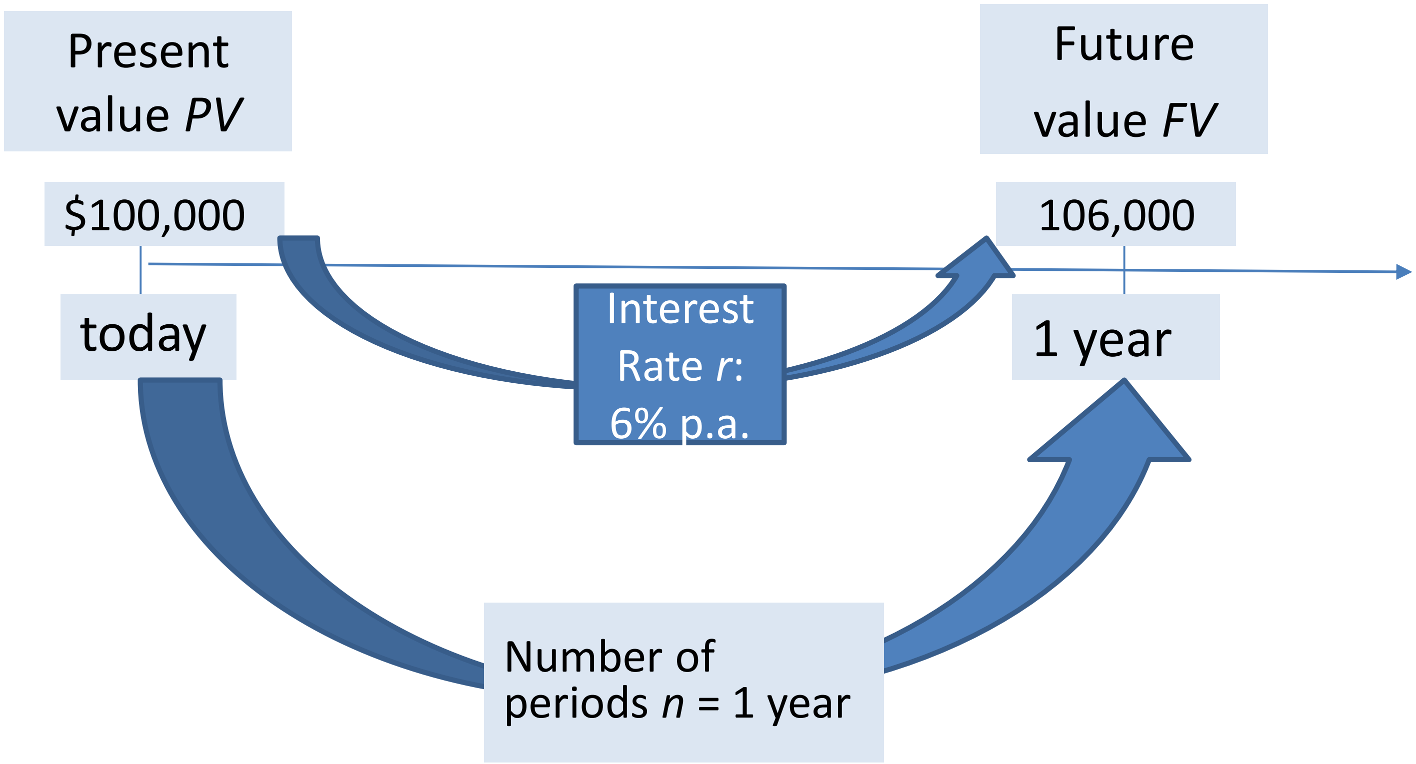
Time Value of Money

Future Value example (single period)

- the cost of the investment is:
  - ($100,000 today) + ($100,000 x 6% p.a.) = $106,000 in one year
  - We can also express it as:
  - ($100,000 today) × (1.06 $ in one year/$ today) = $106,000 in one year
- $106,000 is the **opportunity cost** of spending $100,000 today
  - The firm gives up the $106,000 it would have had in one year if it had left the money in the bank
  - Alternatively, by borrowing the $100,000 from the same bank, the firm would owe $106,000 in one year.

Future Value example (single period)

- Calculate the value of $100,000 Investment in 1 year at a rate of 6% (p.a.)



Future Value and Interest (single period)

- Notice that
  - If the interest rate **r** is **10%**, the future value **FV** in one year is:
    - $100,000 + ($100,000 x 0.10) = $110,000
  - If the interest rate **r** is **6%**, the future value **FV** in one year is:
    - $100,000 + ($100,000 x 0.06) = $106,000
- **The higher the interest rate, the higher the future value**.
- $\boxed{FV = PV + PV \times r = PV \times (1 + r)}$

Future Value and Compound Interest

- The higher the interest rate, the higher the future value.
- The higher the amount invested, the higher the future value.
- Most financial instruments are not so simple, so what happens when time to repayment varies?
- When using one-year interest rates to compute the value repaid **more** than one year from now, we must consider compound interest.

Compound interest is the interest on the interest.

Future Value and Compound Interest

- What if you leave your $100 in the bank for two years at 6% yearly interest rate?
  - Yearly: Calculated and credited at the end of each year!
- The future value is:

$$\$100 + (\$100 \times 0.06) + (\$100 \times 0.06) + (\$6 \times 0.06) = \$112.36$$

$$\$100 \times 1.06 \times 1.06 = \$100 \times (1.06)^2$$

- In general

$$\boxed{FV_n = PV \times (1 + r)^n}$$

Future Value and Compound Interest

Today		**Year 1**		**Year 2**
$100	Principal	$100	Principal	$100
			Interests from Y2 on Principal	$100 x 6% = $6
	Interests from Y1 on Principal	$100 x 6% = $6	Interests from Y1	$6
			Interests on Interests	$6 x 6% = $0.26
$100	Year 0 Principal + 6% =>	$106	Year 1 Principal + 6% =>	$ 112.36

Future Value and Compound Interest

Future Value of \$100 at 6.00% annual interest

Nbr Years	Calculations	Future Value
1	$\$100 \times (1+6\%)$	\$ 106.00
2	$\$100 \times (1+6\%)^2$	\$ 112.36
3	$\$100 \times (1+6\%)^3$	\$ 119.10
4	$\$100 \times (1+6\%)^4$	\$ 126.25
5	$\$100 \times (1+6\%)^5$	\$ 133.82
6	$\$100 \times (1+6\%)^6$	\$ 141.85
7	$\$100 \times (1+6\%)^7$	\$ 150.36
8	$\$100 \times (1+6\%)^8$	\$ 159.38
9	$\$100 \times (1+6\%)^9$	\$ 168.95
10	$\$100 \times (1+6\%)^{10}$	\$ 179.08

Pop Quiz!

- The time value of money: “a dollar is worth _____today than tomorrow”
- The higher the interest rate, the ______ the future value.
- The higher the amount invested, the ______ the future value.
- Present Value = The value of a cost or benefit computed in terms of cash _____
- Compound interest is _________________

Compounding Frequency

- If the *annual* interest rate is 6%, what is the equivalent *monthly* rate if interests are calculated and credited on a monthly basis?
- Assume ***j*** is a one-month interest rate and ***n*** is the number of months, then a one year (***n*** = 12) deposit of \$100 will have a future value of: \$100 x $(1 + j)^{12}$.

Compounding Frequency

- In one year the future value is \$100 x 1.06 so we can find j:

$$(1 + j)^{12} = 1.06$$

$$(1 + j) = (1.06)^{1/12} = 1.0049$$

$$j = \mathbf{0.49\%} = 49\text{bp}$$

- A **basis point** **(bp)** is one one-hundredth of a percentage point, 0.01 percent.

Changing Compounding Frequency

- The frequency of the compounding (calculating and crediting interest) changes substantially the future value

- What if compounding is:
  - 12% annual,
  - 6% semi-annual,
  - 3% quarterly,
  - 1% monthly?

Changing Compounding Frequency

Final Value	Annual	Semi-Annual	Quarterly	Monthly
Months	12%	6%	3%	1%
0	$100.00	$100.00	$100.00	$100.00
1				$ 101.00
2				$ 102.01
3			$ 103.00	$ 103.03
4				$ 104.06
5				$ 105.10
6		$ 106.00	$ 106.09	$ 106.15
7				$ 107.21
8				$ 108.29
9			$ 109.27	$ 109.37
10				$ 110.46
11				$ 111.57
12	$ 112.00	$ 112.36	$ 112.55	$ 112.68
Difference		$ 0.36	$ 0.55	$ 0.68

Changing Compounding Frequency

Final Value	Annual	Semi-Annual	Quarterly	Monthly
Months	24%	12%	6%	2%
0	$100.00	$100.00	$100.00	$100.00
1				$102.00
2				$104.04
3			$106.00	$106.12
4				$108.24
5				$110.41
6		$ 112.00	$112.36	$112.62
7				$114.87
8				$117.17
9			$119.10	$119.51
10				$121.90
11				$124.34
12	$124.00	$ 125.44	$126.25	$126.82
Difference		$ 1.44	$ 2.25	$ 2.82

With higher interest rates, the difference from a higher compounding frequency is even larger

Present Value

- Financial instruments promise future cash payments. Valuing those payments under the same or consistent assumptions enables us to compare several alternatives.
- **Present value** is the value **today** of a payment to be made in **the future**.
- Present value is the equivalent amount to invest today in order to be equal to a specific amount on a given future date.

Present Value for 1 Period

- Knowing the Future Value, we can find easily the Present Value:

$$FV = PV \times (1+r), \text{ so}$$

$$\boxed{PV = \frac{FV}{(1+r)}}$$

- This is just the future value calculation inverted.

Present Value for *n* Periods

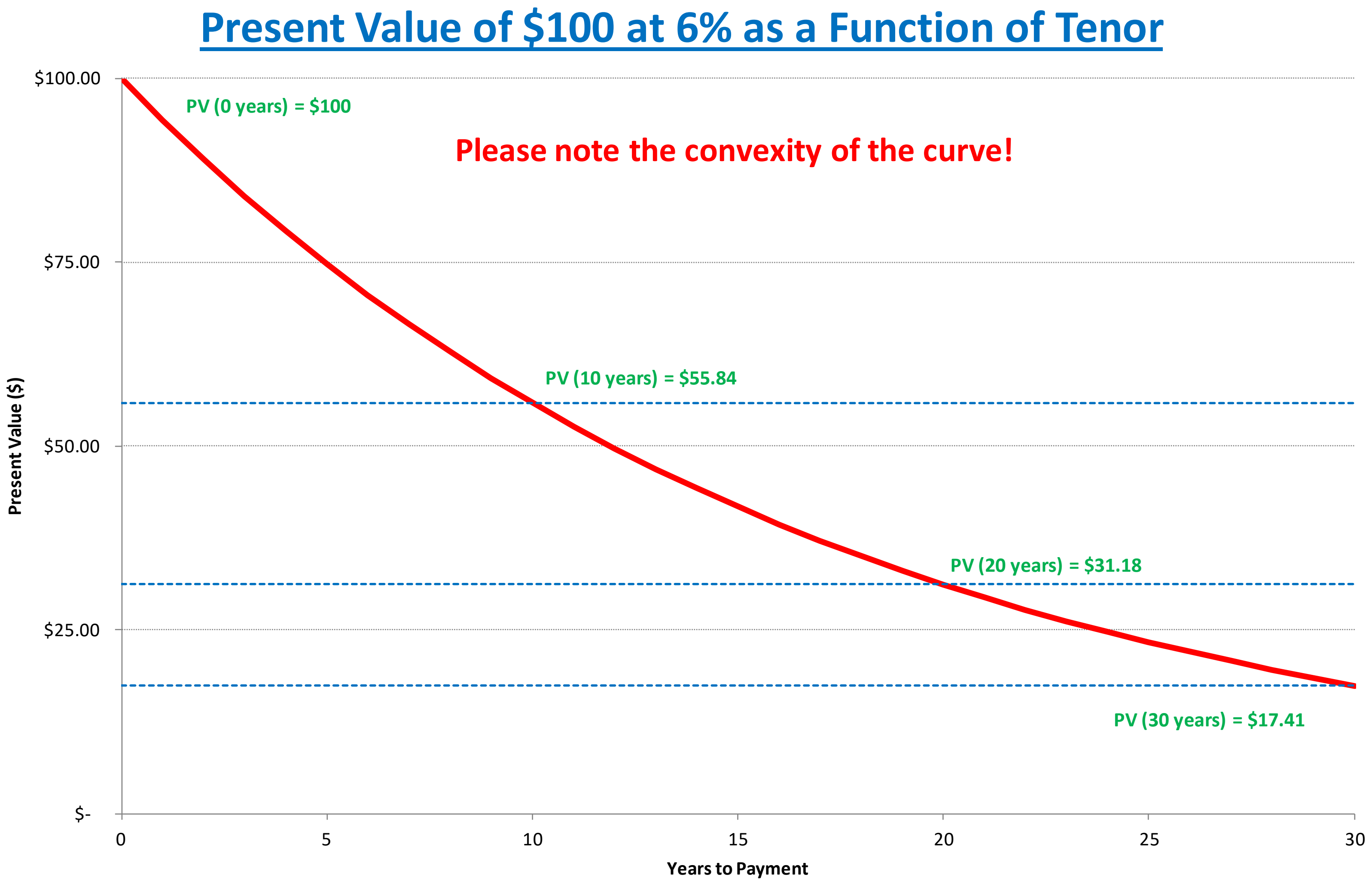
- We can generalize the process as we did for future value.
- Present Value of one payment credited ***n*** years in the future, but calculated at the end of each year:

$$\boxed{\text{PV} = \frac{FV}{(1+r)^n}}$$

Present Value: THE Basis for DCF

- The present value is higher:
  - The higher future value of the payment, FVn.
  - The shorter time period until payment, ***n***.
  - The lower the interest rate, *r*.
- **Present value is the single most important relationship in our study of financial instruments**. **It is THE basis for Discounted Cash Flows analysis.**

Present Value as a Function of Tenor



Present Value of $100 Payment

	PV		PV		PV	
Rate/Tenor (Yr)	1		5		10	
1.00%	$99.01		$95.15		$90.53	
2.00%	$98.04	$ (0.97)	$90.57	$ (4.57)	$82.03	$ (8.49)
3.00%	$97.09		$86.26		$74.41	
4.00%	$96.15		$82.19		$67.56	
5.00%	$95.24		$78.35		$61.39	
6.00%	$94.34	$ (0.90)	$74.73	$ (3.63)	$55.84	$ (5.55)
7.00%	$93.46		$71.30		$50.83	
8.00%	$92.59		$68.06		$46.32	
9.00%	$91.74		$64.99		$42.24	
10.00%	$90.91	$ (0.83)	$62.09	$ (2.90)	$38.55	$ (3.69)
11.00%	$90.09		$59.35		$35.22	
12.00%	$89.29		$56.74		$32.20	
13.00%	$88.50		$54.28		$29.46	
14.00%	$87.72		$51.94		$26.97	
15.00%	$86.96	$ (0.76)	$49.72	$ (2.22)	$24.72	$ (2.26)
		Difference		Difference		Difference

- Higher interest rates are associated with lower PV no matter the timing of the payment.
- At any interest rate, a longer tenor reduces PV.
- For 1% interest rate variation, the difference in PV varies with rate and tenor: Convexity

Example 1: Comparing Revenues at Different Points in Time

Problem:

- The launch of Sony's PlayStation 3 was delayed until November 2006, giving Microsoft's Xbox 360 a full year on the market without competition. Sony did not repeat this mistake in 2013 when the PS4 launched at the same time as the Xbox One.
- It is November 2005 and you are the marketing manager for the PlayStation. You estimate that if the PlayStation 3 were ready to be launched immediately, you could sell **$2 billion** worth of the console in its first year.
- However, if your launch is delayed a year, you believe that Microsoft's head start will reduce your first-year sales by **20%** to **$1.6 billion**.
- If the interest rate is **8%**, what is the cost of a delay in terms of dollars in 2005?

Example 1: Comparing Revenues at Different Points in Time

Solution:

Plan:

- Revenues if released today: $2 billion
- Revenue if delayed: $1.6 billion
- Interest rate: 8%
- We need to compute the revenues if the launch is delayed and compare them to the revenues from launching today.
- However, in order to make a fair comparison, we need to convert the future revenues of the PlayStation if delayed into an equivalent present value of those revenues today.

Example 1: Comparing Revenues at Different Points in Time

Execute:

- If the launch is delayed to 2006, revenues will drop by 20% of $2 billion, or $400 million, to $1.6 billion.
- To compare this amount to revenues of $2 billion if launched in 2005, we must convert it using the interest rate of 8% (this is calculating the present value of the $1.6Bn):

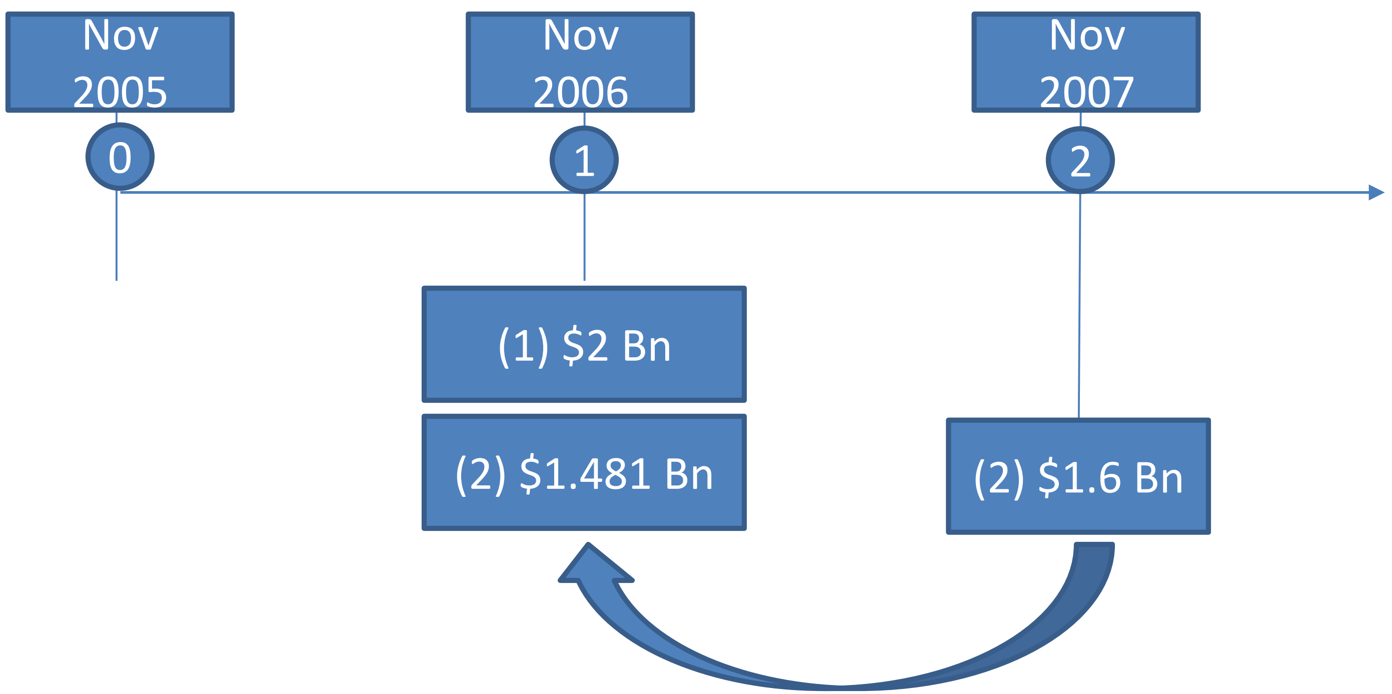
  $1.6 billion/1.08 = $1.481 billion in 2005
- Therefore, the cost of a delay of one year is

  $2 billion - $1.481 billion = **$0.519 billion ($519 million).**

$$\text{PV} = \frac{FV}{(1+r)^n}$$

In other words, we multiply the future value ($1.6Bn) by the discount factor (1/1+r) to get the present value

Example 1: Comparing Revenues at Different Points in Time



Example 1: Comparing Revenues at Different Points in Time

Evaluate:

- Delaying the project for one year was equivalent to giving up $519 million in cash.
- In this example, we focused only on the effect on the first year's revenues. However, delaying the launch delays the entire revenue stream by one year, so the total cost would be calculated in the same way by summing the cost of delay for each year of revenues.

Your Turn!

Problem:

- The launch of Sony's PlayStation 3 was delayed until November 2006, giving Microsoft's Xbox 360 a full year on the market without competition.
- It is November 2005 and you are the marketing manager for the PlayStation. You estimate that if the PlayStation 3 were ready to be launched immediately, you could sell **$3 billion** worth of the console in its first year.
- However, if your launch is delayed a year, you believe that Microsoft's head start will reduce your first-year sales by **35%**.
- If the interest rate is **6%**, what is the cost of a delay in terms of dollars in 2005?

Your Turn! (PRS, please)

- The cost of delay is
  - $519 million
  - $1.160 billion
  - $2 billion
  - I don’t care I don’t like video games

Solution to Example: Comparing Revenues at Different Points in Time

Solution:

Plan:

- Revenues if released today: $3 billion,
- Revenue decrease if delayed: 35% ,
- Interest rate: 6%
- We need to compute the revenues if the launch is delayed and compare them to the revenues from launching today.
- However, in order to make a fair comparison, we need to convert the future revenues of the PlayStation if delayed into an equivalent present value of those revenues today.

Solution to Example: Comparing Revenues at Different Points in Time

Execute:

- If the launch is delayed to 2006, revenues will drop by 35% of $3 billion, or $1.05 billion, to $1.95 billion.
- To compare this amount to revenues of $3 billion if launched in 2005, we must convert it using the interest rate of 6%:

  $1.95 billion/1.06 = $1.840 billion in 2005

$$PV = \frac{FV}{(1+r)^n}$$

- Therefore, the cost of a delay of one year is

  $3 billion - $1.840 billion = $1.160 billion

Solution to Example: Comparing Revenues at Different Points in Time

Evaluate:

- Delaying the project for one year was equivalent to giving up $1.16 billion in cash.
- In this example, we focused only on the effect on the first year's revenues.
- However, delaying the launch delays the entire revenue stream by one year, so the total cost would be calculated in the same way by summing the cost of delay for each year of revenues.

The Three Rules of Valuing Cash Flows

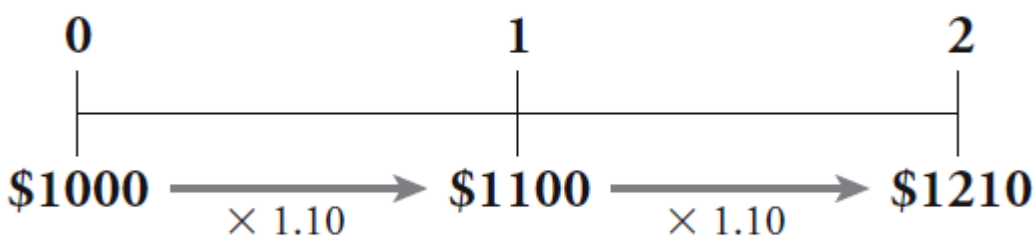
Rule	Formula
1: Only values at the same point in time can be compared or combined.	None
2: To calculate a cash flow's future value, we must compound it.	Future value of a cash flow: $FV_n = C \times (1 + r)^n$
3: To calculate the present value of a future cash flow, we must discount it.	Present value of a cash flow: $PV = C \div (1 + r)^n = \dfrac{C}{(1 + r)^n}$

Valuing Cash Flows at Different Points in Time

- **Rule 1**: Comparing and Combining Values
  - It is only possible to compare or combine values **at the same point in time**

Valuing Cash Flows at Different Points in Time

- **Rule 2**: Compounding
  - To calculate a cash flow's **future value**, you must **compound** it



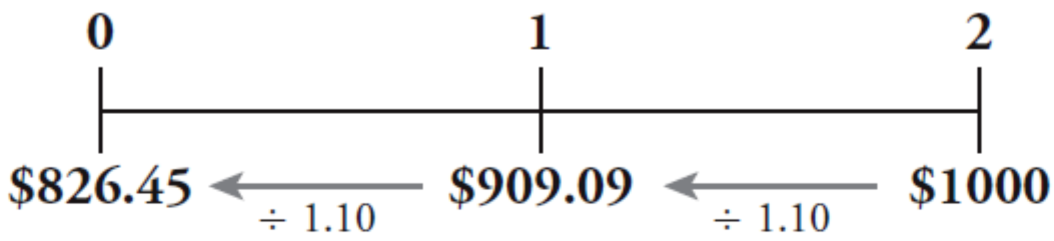
  - **Compound Interest = The effect of earning "interest on interest"**

Future Value of a Cash Flow

$$FV_n = C \times \underbrace{(1 + r) \times (1 + r) \times \cdots \times (1 + r)}_{n \text{ times}} = C \times (1 + r)^n \qquad (3.1)$$

Valuing Cash Flows at Different Points in Time

- **Rule 3**: Discounting
  - To calculate the value of a future cash flow at an earlier point in time, we must **discount** it.

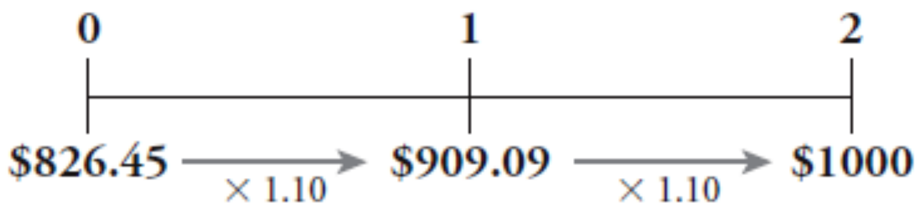


Present Value of a Cash Flow

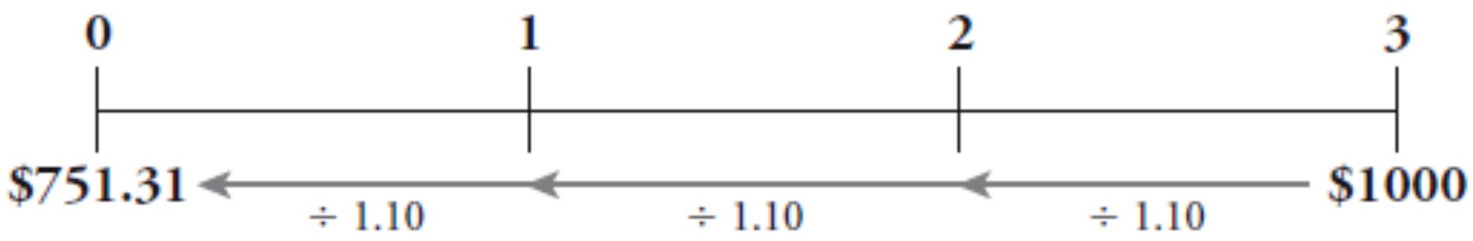
$$PV = C \div (1+r)^n = \frac{C}{(1+r)^n} \tag{3.2}$$

Valuing Cash Flows at Different Points in Time

- Rule 3: Discounting & Compounding **- Example**
  - If $826.45 is invested today for **two** years at 10% interest, the **future value** will be $1,000-



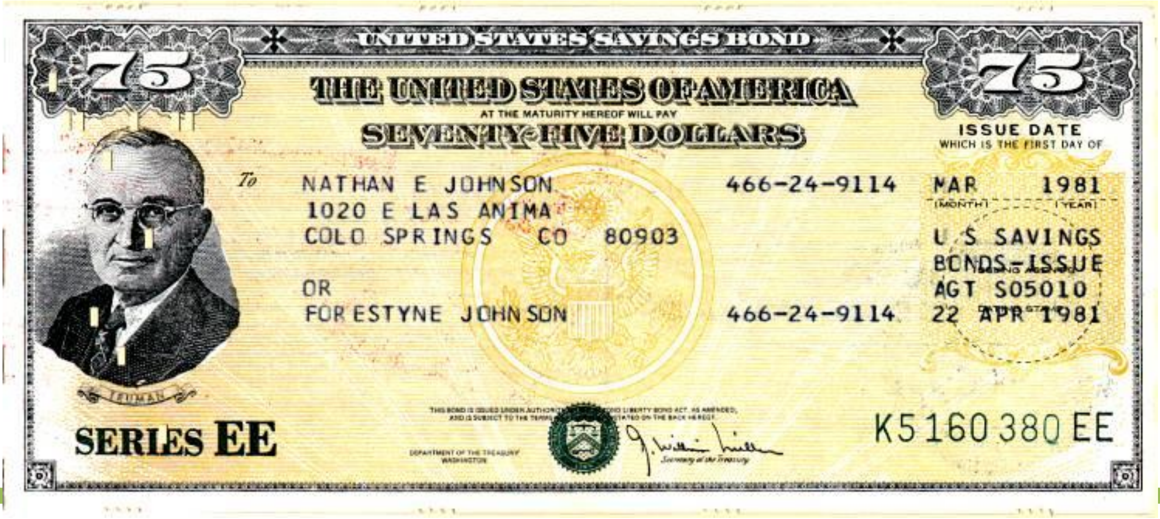
  - If $1,000- were **three** years away, the **present value**, if the interest rate is 10%, would be $751.31



Example: Present Value of a Single Future Cash Flow

Problem:

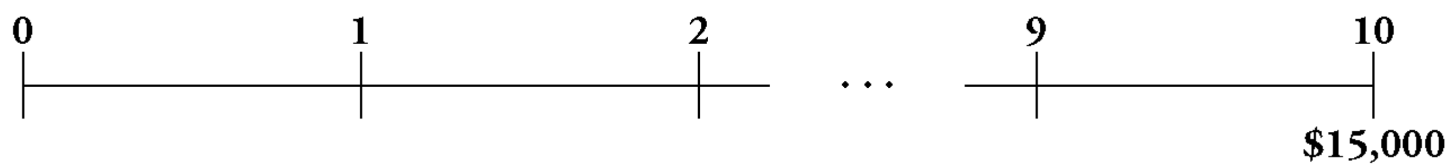
- You are considering investing in a savings bond that will pay **$15,000** in **10 years**.
- If the competitive market interest rate is fixed at **6%** per year, **what is the bond worth today?**



Example: Present Value of a Single Future Cash Flow

Solution:

- First set up your timeline. The cash flows for this bond are represented by the following timeline:



- Thus, the bond is worth $15,000 in 10 years. To determine the value today, we compute the present value using the PV equation and our interest rate of 6%.

Present Value of a Cash Flow

$$PV = C \div (1+r)^n = \frac{C}{(1+r)^n}$$

Where C is the single cash flow – in this case, it's also the Future Value

Example: Present Value of a Single Future Cash Flow

Execute:

$$PV = \frac{15,000}{1.06^{10}} = \$8,375.92 \text{ today}$$

Using the financial calculator we can input the relevant variables

	N	I/Y	PV	PMT	FV
Given:	10	6		0	15,000
Solve for:			**-8,375.92**		
Excel Formula: =PV(RATE,NPER, PMT, FV) = PV(0.06,10,0,15000)					

Example: Present Value of a Single Future Cash Flow

Evaluate:

- The bond is worth much less today than its final payoff because of the time value of money.

Food for thought:
What if interest rates were lower?

Your Turn!

Problem:

- XYZ Company expects to receive a cash flow of **$2 million** in **five** years.
- If the competitive market interest rate is fixed at **4%** per year, how much can they borrow **today** in order to be able to repay the loan in its entirety with that cash flow?

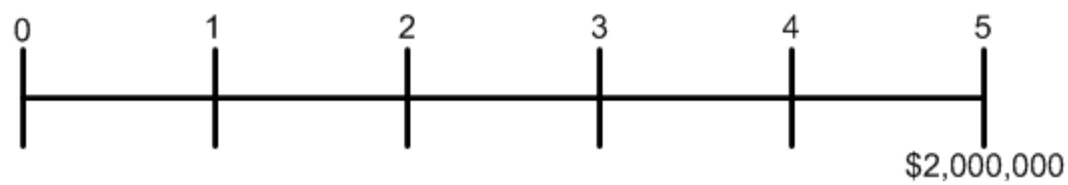
Your Turn! (PRS, please)

- We can borrow
  - $1.5 million
  - $1.6 million
  - $2 million
- Borrowing is bad, it leads to trouble!

Solution to Example: Present Value of a Single Future Cash Flow

Solution:

- First set up your timeline. The cash flows for the loan are represented by the following timeline:



- Thus, XYZ Company will be able to repay the loan with its expected $2 million cash flow in five years. To determine the value today, we compute the present value using our interest rate of 4%.

Present Value of a Cash Flow

$$PV = C \div (1+r)^n = \frac{C}{(1+r)^n}$$

Where C is the single cash flow – in this case, it's also the Future Value

Solution to Example: Present Value of a Single Future Cash Flow

Execute:

$$PV = \frac{\$2,000,000}{(1.04)^5} = \$1,643,854.21$$

Using the financial calculator we can input the relevant variables

	N	I/Y	PV	PMT	FV
Given:	5	4		0	2,000,000
Solve for:			**-1,643,854.21**		
Excel Formula: =PV(RATE,NPER, PMT, FV) = PV(0.04,5,0,2000000)					

Solution to Example: Present Value of a Single Future Cash Flow

Evaluate:

- The loan is much less than the $2 million the company will pay back because of the time value of money.

Part 2: Valuing a Stream of Cash Flows

Valuing a Stream of Cash Flows

Applying the Rules of Valuing Cash Flows

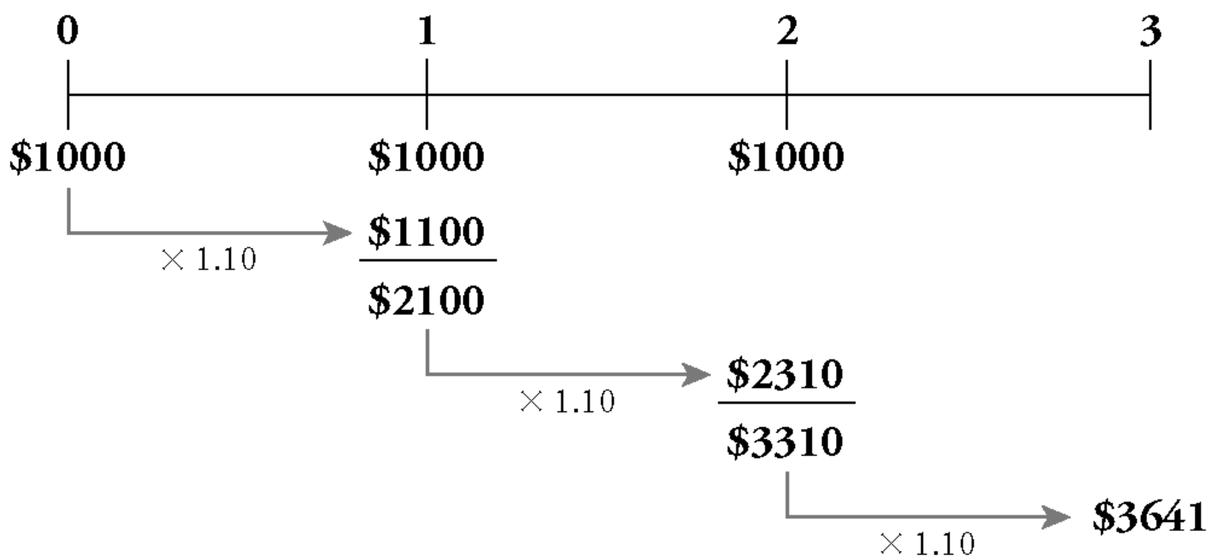
- Suppose we plan to save $1,000 today, and $1,000 at the end of each of the next two years
- If we earn a fixed 10% interest rate on our savings, how much will we have three years from today (future value)?

We can do this in several ways

- First, take the deposit at date 0 and move it forward to date 1
- Combine those two amounts and move the combined total forward to date 2

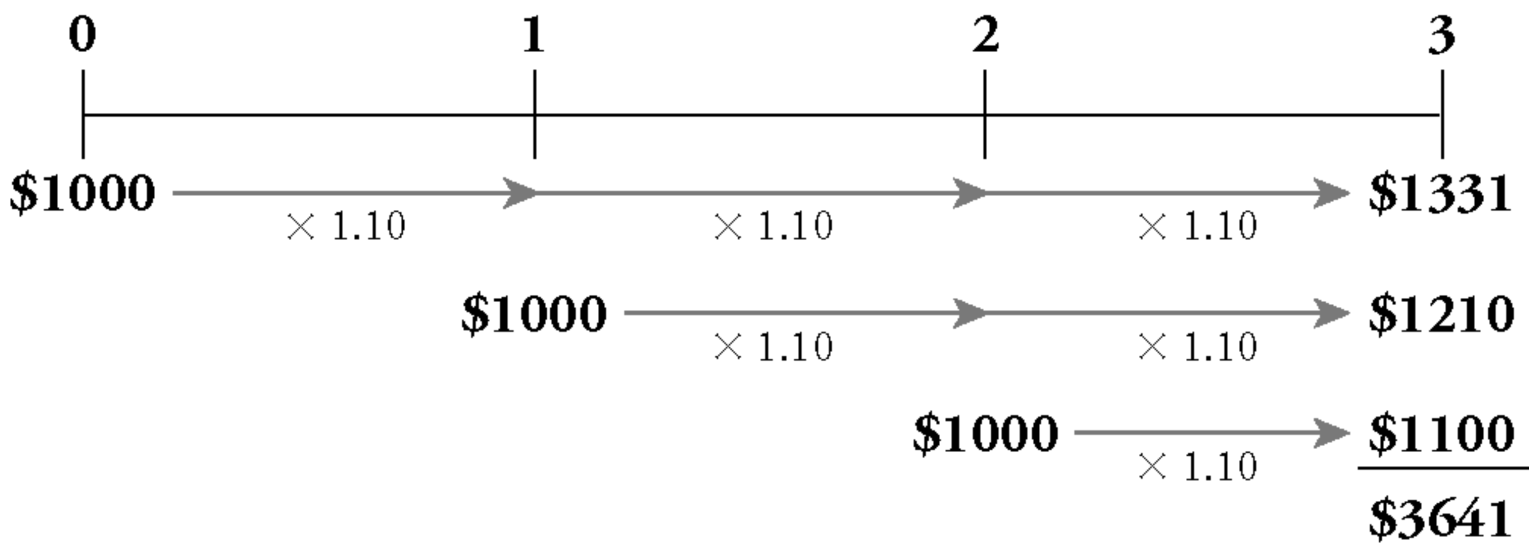
Valuing a Stream of Cash Flows

- Continuing in the same fashion, we can solve the problem as follows:



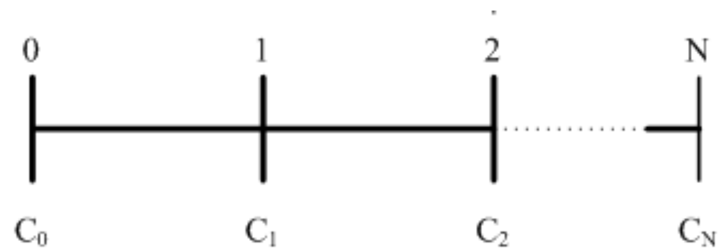
Valuing a Stream of Cash Flows

- Another approach is to compute the **future value** in year 3 of **each cash flow** separately
- Once all amounts are in year 3 dollars, combine them



Valuing a Stream of Cash Flows

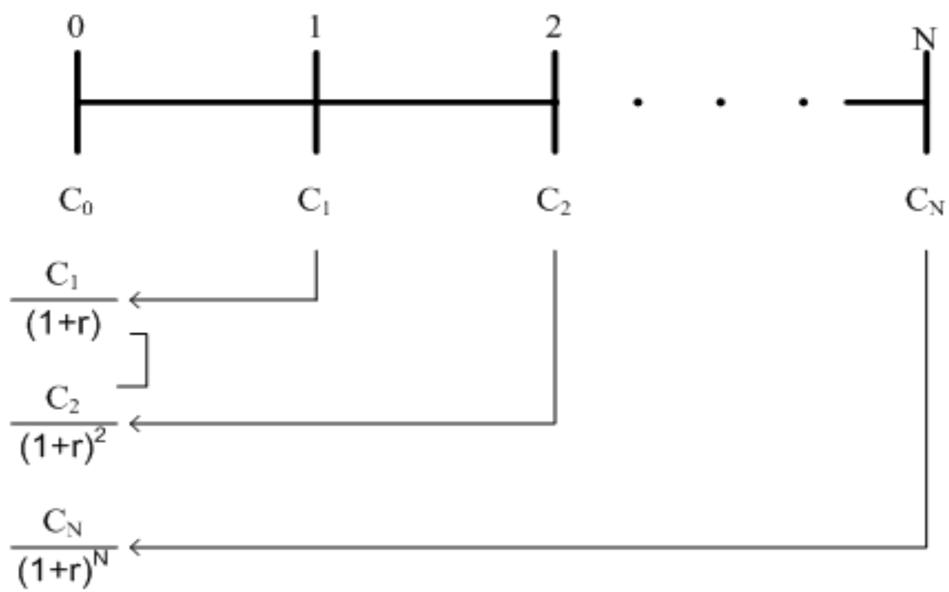
- Consider a stream of cash flows: C_0 at date 0, C_1 at date 1, and so on, up to C_N at date N



- We compute the **present value** of this cash flow stream in two steps

Valuing a Stream of Cash Flows

- First, compute the present value of each cash flow
- Then combine the present values: the PV of a stream of cash flows is the sum of the present values of each cash flow



Valuing a Stream of Cash Flows

- **The present value of a cash flow stream is the sum of the present values of each cash flow**

$$PV = C_0 + \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \cdots + \frac{C_N}{(1+r)^N}$$

Your Turn!

Problem:

- You have just graduated and need money to buy a laptop
- Your aunt will lend you the money so long as you agree to pay her back **within six years**.
- You offer to pay her the rate of interest that she would otherwise get by putting her money in a savings account.
- Based on your earnings and living expenses, you think you will be able to pay her **$70** next year, **$85** in each of the next two years, and then **$90** each year for years 4 through 6.
- If your aunt would otherwise earn **0.5%** per year on her savings, **how much can you borrow from her?**

Your Turn! (PRS, please)

- We can borrow
  - $600.7
  - $500.9
  - $400.5
- Borrowing is bad, it leads to trouble!

Solution : Present Value of a Stream of Cash Flows

Plan:

- The cash flows you can promise your aunt are as follows:

- She should be willing to give you an amount equal to these payments in **present value** terms.

Solution : Present Value of a Stream of Cash Flows (cont'd)

Plan:

- We will:
  - Solve the problem using the equation

$$PV = C_0 + \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \cdots + \frac{C_N}{(1+r)^N}$$

  - the present value of a series of cash flows is the sum of the present values of each of the cash flows; so we calculate the present value of each cash flow and add up all the present values
  - Verify our answer by calculating the **future value** of this amount.

Solution : Present Value of a Stream of Cash Flows (cont'd)

Execute:

- We can calculate the PV as follows:

$$PV = \frac{70}{1.005} + \frac{85}{1.005^2} + \frac{85}{1.005^3} + \frac{90}{1.005^4} + \frac{90}{1.005^5} + \frac{90}{1.005^6}$$

$$= \$69.65 + \$84.16 + \$83.74 + \$88.22 + \$87.78 + \$87.35$$

$$\boxed{= \$500.90}$$

Solution : Present Value of a Stream of Cash Flows (cont'd)

Part 2

- Now, suppose that your aunt gives you the money, and then deposits your payments in the bank each year.
- How much will she have six years from now?

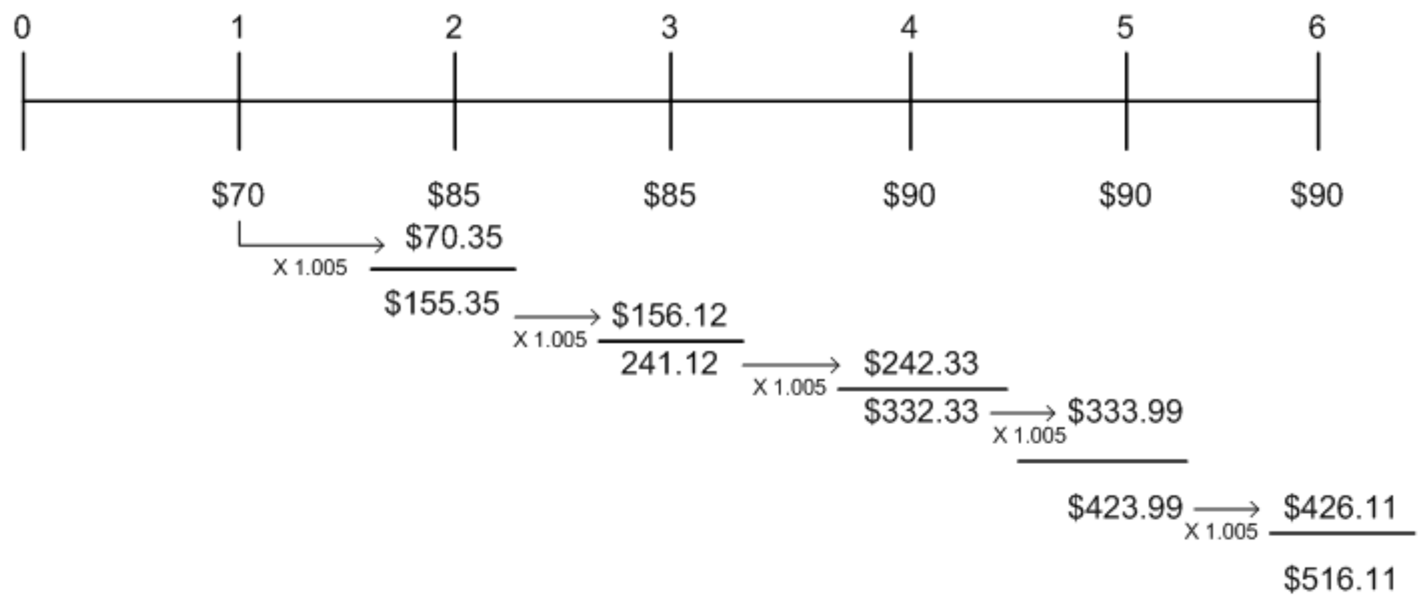
Your Turn! (PRS, please)

- She will have
  - $600
  - $516
  - $475

Solution : Present Value of a Stream of Cash Flows (cont'd)

Execute:

- We need to compute the **future value** of the yearly deposits.
- One way is to compute the bank balance each year.



Solution : Present Value of a Stream of Cash Flows (cont'd)

Execute:

- To verify our answer, suppose your aunt kept her **$500.90** in the bank today earning 0.5% interest.
- In six years she would have:

$$FV = \$500.90 \times (1.005)^6 = \mathbf{\$516.11} \text{ in 6 years}$$

Your Turn!

Problem:

- We plan to save $1,000 today and at the end of each of the next **two** years.
- At a fixed **6%** interest rate, **how much will we have in the bank three years from today?**

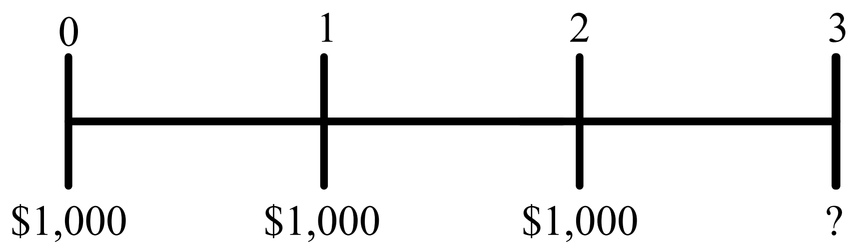
Your Turn! (PRS, please)

- We will have
  - $3,505.5
  - $2,833.4
  - $3,374.6

Solution : Computing the Future Value (cont'd)

Plan:

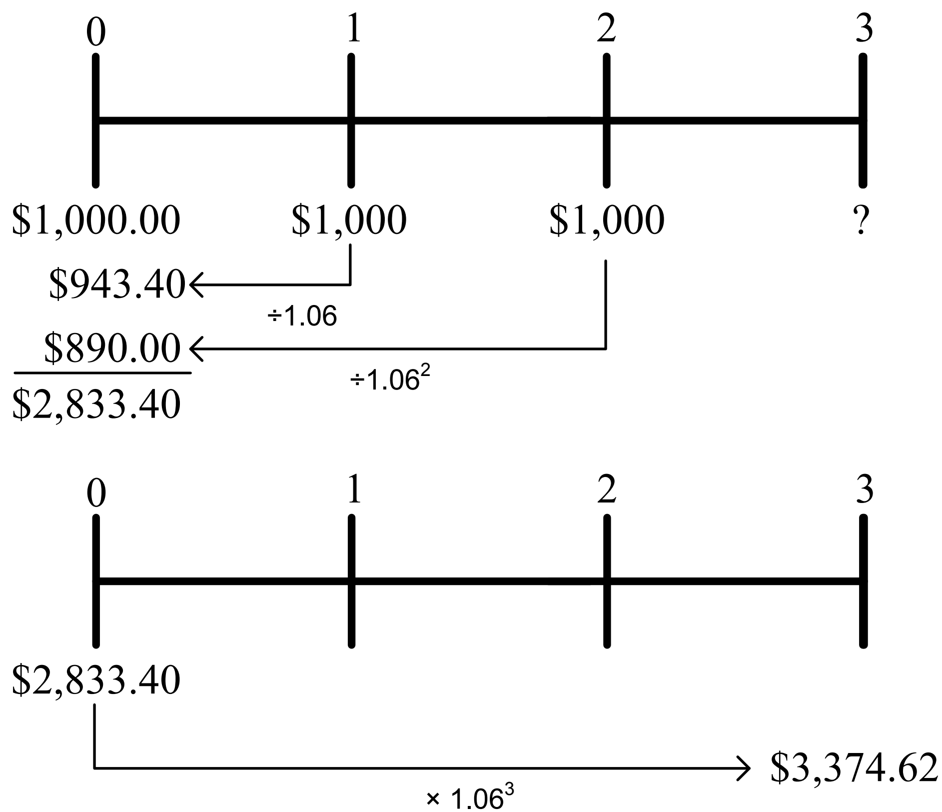
- We'll start with the timeline for this savings plan:



  – First we'll compute the present value of the cash flows.
  – Then we'll compute its value three years later (its future value).

Solution : Computing the Future Value (cont'd)

Execute:



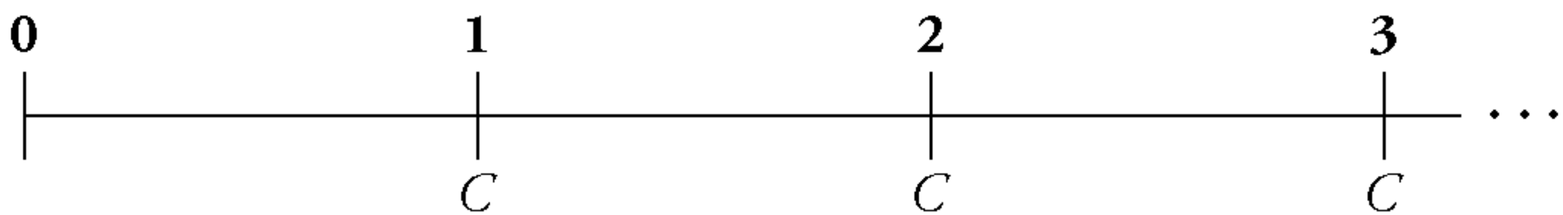
This is how we've done it so far – this works no matter the cash flows

Perpetuities

Examples?

Perpetuities (also called consols)

- A perpetuity is a stream of **equal** cash flows that occur at regular intervals and last **forever**
- Here is the timeline for a perpetuity:



- the first cash flow does not occur immediately; it arrives at the **end of the first period**

Perpetuities

- Using the formula for present value, the present value of a perpetuity with payment C and interest rate r is given by:

$$\boxed{PV = \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \ldots\ldots}$$

- Notice that **all the cash flows are the same**
- Also, the first cash flow starts at time 1 (not 0)

Perpetuities/Consols

- Present Value of a Perpetuity

$$\boxed{PV(C \text{ in Perpetuity}) = \frac{C}{r}}$$

- This formula **only** works when ***r*** is **positive**!

Example of consol

Your Turn!

Problem:

- You just won the lottery, and you want to endow a professorship at your *alma mater*.
- You are willing to donate **$4 million** of your winnings for this purpose.
- If the university earns **5%** per year on its investments, and the professor will be receiving her first payment **in one year**, how much will the endowment pay her each year?

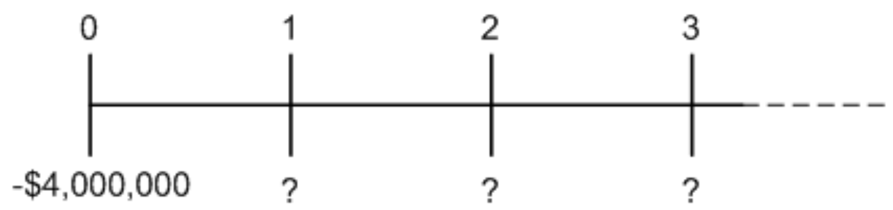
Your Turn! (PRS, please)

- The endowment will pay
  - $200,000
  - $283,334
  - $337,456

Solution : Endowing a Perpetuity

Plan:

- The timeline of the cash flows you want to provide is:



- This is a standard perpetuity. The amount she can withdraw each year while keeping the principal intact is the cash flow *C* when solving the equation:

$$PV(C \text{ in Perpetuity}) = \frac{C}{r}$$

Solution : Endowing a Perpetuity (cont'd)

Execute:

- From the formula for a perpetuity,

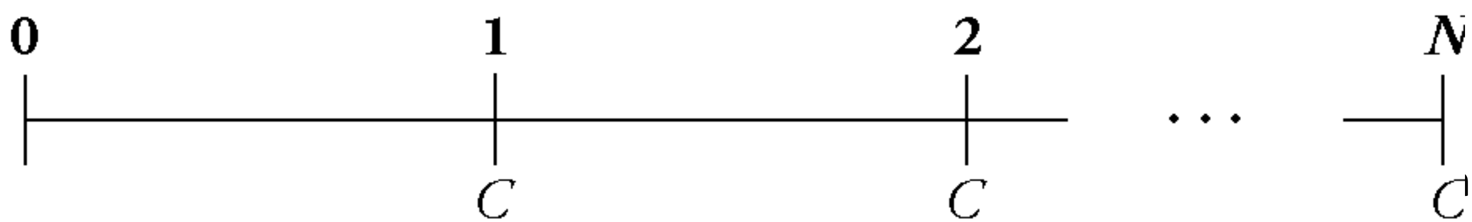
$$\boxed{PV = \frac{C}{r}, so\ C = PV\ X\ r}$$

$$C = \$4{,}000{,}000\ X\ .05$$
$$= \$200{,}000$$

Annuities

Examples?

- Annuities (also called fixed payment loans)
  - An **annuity** is a stream of *N* **equal** cash flows *C* paid at regular intervals



  - **ds** after some fixed number of payments (*N*)

Annuities

Present Value of An Annuity

- Note that, just as with the perpetuity, we assume the first payment takes place one period from today (time 1)

$$PV = \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \ldots\ldots \frac{C}{(1+r)^N}$$

$$PV(\text{Annuity of } C \text{ for } N \text{ Periods with Interest Rate } r) = C \times \frac{1}{r}\left(1 - \frac{1}{(1+r)^N}\right)$$

Annuities

Future Value of an Annuity

$$
\begin{aligned}
FV(\text{Annuity}) &= PV \times (1+r)^N \\
&= \frac{C}{r}\left(1 - \frac{1}{(1+r)^N}\right) \times (1+r)^N \\
&= C \times \frac{1}{r}\left((1+r)^N - 1\right)
\end{aligned}
$$

Your Turn!

Problem:

- Your parents have made you an offer you can't refuse.
- They're planning to give you part of your inheritance early (!).
- They've given you a choice.
  - Option a: They'll pay you **$10,000** per year for each of the next **seven** years (beginning **today,** last payment at the end of the 7th year)
  - Option b: they'll give you their BMW Convertible, which you can sell for **$61,000** (guaranteed) **today**.
- If you can earn **7%** annually on your investments, which should you choose?

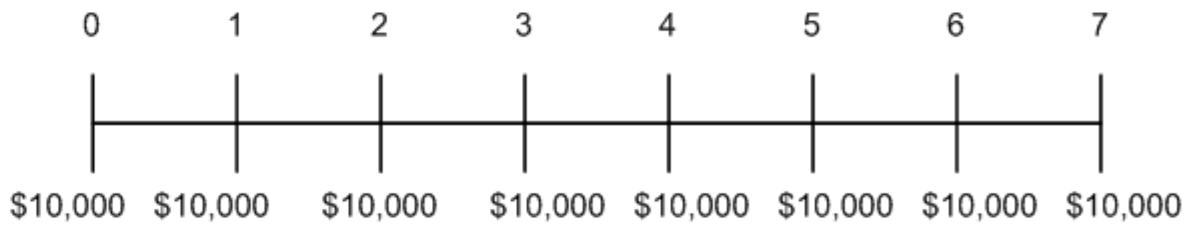
Your Turn! (PRS, please)

- We should choose
  - A
  - B

Solution : Present Value of an Annuity

Plan:

- Option (a) provides $10,000 paid over time. To evaluate it correctly, we must convert it to a **present value**. Here is the timeline:



- The $10,000 at date 0 is already stated in present value terms, but we need to compute the present value of the remaining payments.
- Fortunately, this case looks like a 7-year annuity of $10,000 per year, so we can use the annuity formula.

Solution : Present Value of an Annuity (cont'd)

Execute:

$$\boxed{PV(\text{Annuity of } C \text{ for } N \text{ Periods with Interest Rate } r) = C \times \frac{1}{r}\left(1 - \frac{1}{(1+r)^N}\right)}$$

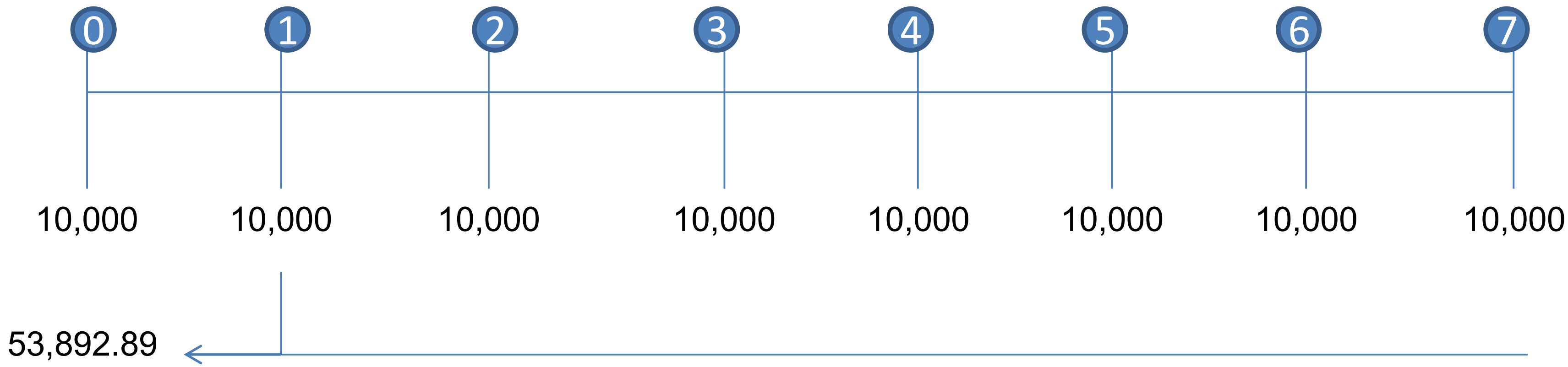
$$PV = 10{,}000 \times \frac{1}{0.07} \times \left(1 - \frac{1}{1.07^7}\right)$$

- PV = 53,892.89

Solution : Present Value of an Annuity (cont'd)

Execute (cont'd):

- Thus, the total present value of the cash flows is $10,000 + 53,892.89 = **$63,892.89** which is **more** than the value of the car. In timeline form:



63,892.89

Solution : Present Value of an Annuity (cont'd)

Execute (cont'd):

- Financial calculators or Excel can handle annuities easily—just enter the cash flow in the annuity as the PMT:

	N	I/Y	PV	PMT	FV
Given:	7	7		10000	0
Solve for:			**-53,892.89**		
Excel Formula: =PV(RATE,NPER, PMT, FV) = PV(0.07,7,10000,0)					

Your Turn!

Problem:

- Adam is **25** years old, and he has decided it is time to plan seriously for his retirement.
- He will save **$10,000** in a retirement account at the end of each year until he is **45**.
- At that time, he will **stop** paying into the account, though he does not plan to retire until he is **65**.
- If the account earns **10%** per year, **how much will Adam have saved at age 65?**

Your Turn! (PRS, please)

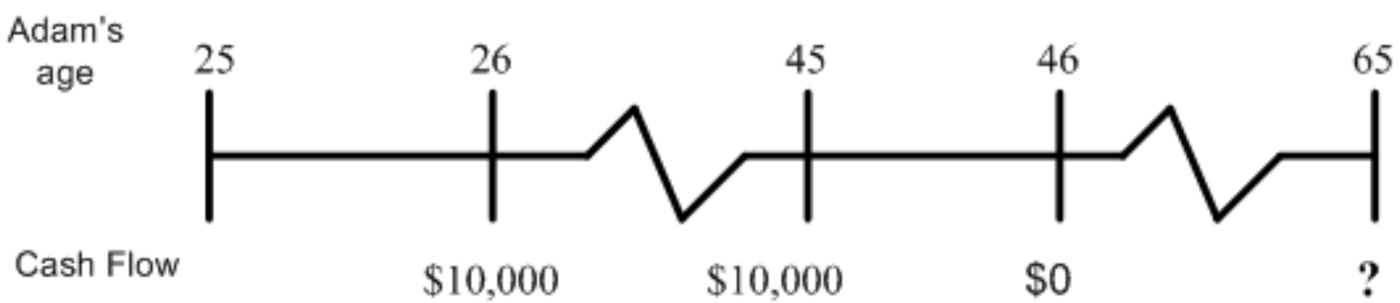
- Adam will have saved
  - $572,750
  - $1,545,250
  - $3,853,175

Solution : Retirement Savings Plan Annuity

Solution:

Plan:

- As always, we begin with a timeline. In this case, it is helpful to keep track of both the dates and Adam's age:



Solution : Retirement Savings Plan Annuity

Execute:

$$FV(at\ age\ 45)$$
$$= \$10,000 \times (1.10^{20} - 1) \text{ X } 1/0.10$$
$$= \$572,750$$

Using Financial calculators or Excel:

	N	I/Y	PV	PMT	FV
Given:	20	10.0	0	-10,000	
Solve for:					$572,750
Excel Formula: =FV(RATE,NPER, PMT, PV) = FV(0.10,20,-10000,0)					

Solution : Retirement Savings Plan Annuity

Execute:

$$\begin{aligned} FV(at\ age\ 65) \\ &= \$572,750 \times (1.10)^{20} \\ &= \$3,853,175 \end{aligned}$$

Using Financial calculators or Excel:

	N	I/Y	PV	PMT	FV
Given:	20	10.0	-$572,750	0	
Solve for:					$3,853,175
Excel Formula: =FV(RATE,NPER, PMT, PV) = FV(0.10,20,0,-572750)					

Part 3: Applications

HKUST BUSINESS SCHOOL 香港科大商學院

Application 1: Your Credit Card in Hong Kong

- Check out your credit card statement
- What does it show at the end of the statement?
- Why do you think the financial regulators are forcing the credit card issuers to include this information?

Credit Cards "Easy Money": Pay Fast!

- Credit cards are useful, but sometimes too easy.

<u>Number of months to pay off a HK$20,000 credit card debt</u>

	Monthly Paiements		
Annual Rate	HK$500	HK$600	HK$700
10.00%	**48.4**	**38.9**	**32.6**
12.50%	**51.1**	**40.6**	**33.7**
15.00%	**54.3**	**42.5**	**35.0**
17.50%	**58.0**	**44.6**	**36.4**
20.00%	**62.4**	**47.0**	**37.9**

Applying PV : Example - calculating the Internal Rate of Return

- Imagine that you run a toy manufacturing company and that you are considering purchasing a new machine.
  - Machine costs $4 million and can produce 50,000 toys per year.
  - You sell the toys for $10, generating $500,000 in revenue per year.
  - Assume that the machine is the only input, you have certainty about the revenue, there is no maintenance and the machine has a 10 year lifespan.

Internal Rate of Return: Example

- If you borrow $4 million, is the revenue enough to make the payments?
- We need to calculate the internal rate of return (IRR) of this investment:
  - It is **the interest rate that equates the present value from the cash flow of an investment with its cost.**

Internal Rate of Return: Example

- Balance the cost of the machine against the revenue.
  - $4 million today versus $500,000 a year for ten years.
- At the internal rate of return, the cost of the machine is equal to the present value of all the yearly revenues.
  - Solve for ***i*** - the internal rate of return. (NB: we can use the notation *i* or *r*)

Internal Rate of Return: Example

- Solving for *i*,

$$\$4{,}000{,}000 = \frac{\$500{,}000}{(1+i)^1} + \frac{\$500{,}000}{(1+i)^2} + \frac{\$500{,}000}{(1+i)^3} + \ldots\ldots + \frac{\$500{,}000}{(1+i)^{10}}$$

- i = 4.28%
- As long your borrowing cost is less than 4.28%, then you should buy the machine.
- **Knowing the cash flows (and dates), this IRR calculation is a way to identify the break even funding cost**.

Key Formulas: Fixed Cash Flows + Residual Value

- Often there are cases with fixed cash flows over the tenor of the transaction and one final **but different** amount on maturity date leading to this:

$$DCF = \sum_{k=1}^{k=n} \frac{C}{(1+i)^k} + \frac{P}{(1+i)^n}$$

FINA 1303

FOUNDATIONS OF INTEREST RATES Part II

Veronique Lafon-Vinais

Associate Professor of Business Education - Department of Finance

HKUST BUSINESS SCHOOL 香港科大商學院

Overview

Foundations of Interest Rates

DCF

Basics of Interest Rates

Students will establish an understanding of

1. Bond Pricing Basics
   1. Zero Coupon Bond
   2. Coupon Bond
2. Computing interest for short term debt

Bond Basics

- A bond is a financial instrument promising to make a series of payments on specific dates. It is similar to a loan but unlike loans, bonds are securities (negotiable, transferable financial instruments)
- Bonds are legal contracts between an issuer and the investors (buyers) that:
  - Require the issuer to make payments to the buyer, and
  - Specify in great detail all the terms and conditions, including what happens in case the issuer fails to make a payment (called "event of default")

Bond Basics: Coupon Bond

- The most common type of bond is **a coupon bond**:
  - Issuer is required to make regular payments, called *coupon* payments.
  - The interest the issuer pays, and which is used to calculate the coupons, is the *coupon rate*.
  - The frequency of the coupon payments is annual or semi-annual (USA).
  - The date on which the principal of the bond is repaid is the *maturity date*.
  - The final payment includes (1) the principal, face value, or par value of the bond and (2) the final coupon payment.

Coupon Bond

Script coupon bond as buyer would receive a certificate with coupons attached.

Coupons not yet paid

Key Formulas: Bond Price

- That formula for fixed cash flows with a residual value on maturity date is also the general formula that covers many different cases of DCF calculations but is also the way (for you for now) to value bonds based on Coupon (*C*), Principal (*P*), Number of Years (*n*), Yield To Maturity (*i*):

$$Bond\ Price = \frac{C}{(1+i)^1} + \frac{C}{(1+i)^2} + \cdots + \frac{C}{(1+i)^n} + \frac{P}{(1+i)^n}$$

$$\textbf{Bond Price} = \frac{C.[1-(1+i)^{-n}]}{i} + \frac{P}{(1+i)^n}$$

Key Formulas: Bond Price

- If P=0 that is our mortgage case (in part I),
- If P=0 and n=∝ AND i > 0, then it is a consol or a perpetual bond:

$$\boxed{\textbf{Bond Price} = \frac{C}{i}}$$

- If C= 0 it is a Zero-Coupon Bond:

$$\boxed{\textbf{Bond Price} = \frac{P}{(1+i)^n}}$$

Zero Coupon Bonds

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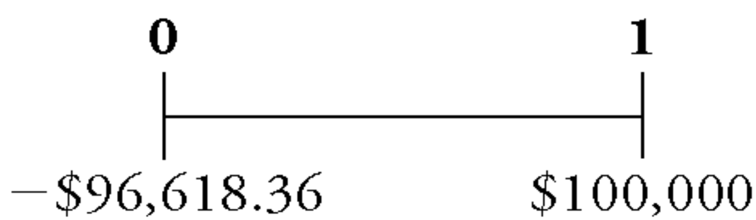
Zero-Coupon Bonds

- Zero-coupon bonds
  - Only two cash flows
    - The bond's market price at the time of purchase
    - The bond's face value (principal *P*) at maturity

$$\textbf{Bond Price} = \frac{P}{(1+i)^n}$$

Zero-Coupon Bonds - Example

- A one-year zero-coupon bond with a $100,000 face value has an initial price of $96,618.36
  - If you purchased this bond and held it to maturity, you would have the following cash flows:



Zero-Coupon Bonds

- Yield to Maturity of a Zero-Coupon Bond
  - The **discount rate** that sets the **present value** of the promised bond payments **equal to** the current **market price** of the bond
  - This is the same problem as when we solved for the rate of return
  - Yield to Maturity of an n-Year Zero-Coupon Bond:

$$1 + YTM_n = \left(\frac{Face\,Value}{Price} \right)^{1/n}$$

Example: Yields for Different Maturities

- Suppose the following zero-coupon bonds are trading at the prices shown below per $100 face value.
- **Determine the corresponding yield to maturity (YTM) for each bond.**

Maturity	1 year	2 years	3 years	4 years
Price	$96.62	$92.45	$87.63	$83.06

Example: Yields for Different Maturities

- We can use our equation to solve for the YTM of the bonds.

$$1 + YTM_n = \left(\frac{Face\,Value}{Price} \right)^{1/n}$$

- The table gives the prices and number of years to maturity.

Example: Yields for Different Maturities

- We have

$$YTM_1 = (100/96.62)^{1/1} - 1 = 3.50\%$$

$$YTM_2 = (100/92.45)^{1/2} - 1 = 4.00\%$$

$$YTM_3 = (100/87.63)^{1/3} - 1 = 4.50\%$$

$$YTM_4 = (100/83.06)^{1/4} - 1 = 4.75\%$$

Example: Yields for Different Maturities

- Solving for the YTM of a zero-coupon bond is **the same process we used to solve for the rate of return.**
- Indeed, the YTM is the rate of return of buying the bond.
- NB: we can do it quickly in our calculator, where we solve for *i*, with *n* = tenor (number of periods) *PMT* is zero (no coupons), *FV* is $100 (par value) and *PV* is the price (with negative cash flow)

Your Turn!

- Suppose the following zero-coupon bonds are trading at the prices shown below per $100 face value.
- Determine the corresponding yield to maturity for each bond.

Maturity	**1 year**	**2 years**	**3 years**	**4 years**
Price	$98.52	$96.59	$94.23	$91.48

Your Turn (PRS please)

- The YTMs are
  - 1 year bond:
    - 1.2%
    - 1.5%
    - 1.7%
  - 2 year bond:
    - 1.6%
    - 1.75%
    - 1.8%
  - 3 year bond:
    - 1.9%
    - 2.0%
    - 2.5%
  - 4 year bond:
    - 2.0%
    - 2.25%
    - 3%

Solution: Yields for Different Maturities

- We can solve for the YTM of the bonds. The table gives the prices and number of years to maturity.
- NB: we can do it quickly in our calculator, where we solve for *i*, with *n*= tenor (number of periods) *PMT* is zero (no coupons), *FV* is $100 (par value) and *PV* is the price (with negative cash flow)

Solution: Yields for Different Maturities

- We have

$$\text{YTM}_1 = (100/98.52)^{1/1} - 1 = 1.50\%$$

$$\text{YTM}_2 = (100/96.59)^{1/2} - 1 = 1.75\%$$

$$\text{YTM}_3 = (100/94.23)^{1/3} - 1 = 2.00\%$$

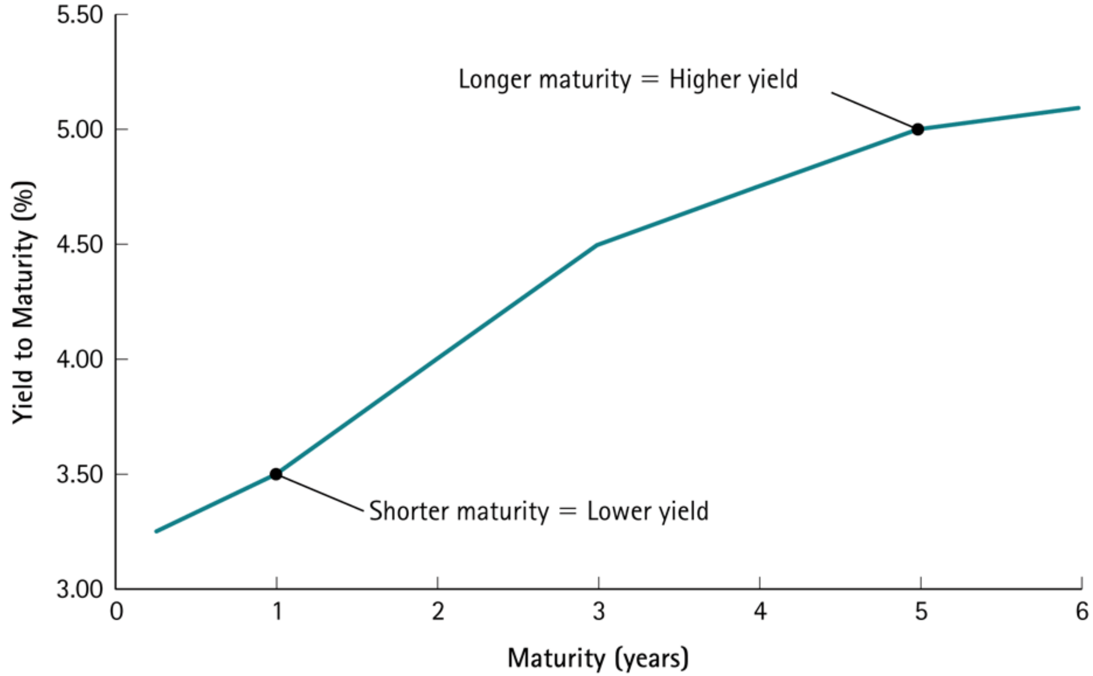
$$\text{YTM}_4 = (100/91.48)^{1/4} - 1 = 2.25\%$$

Solution: Yields for Different Maturities

- Solving for the YTM of a zero-coupon bond is the same process we used to solve for the rate of return.
- Indeed, the YTM is the rate of return of buying the bond.

Example: Computing the Price of a Zero-Coupon Bond

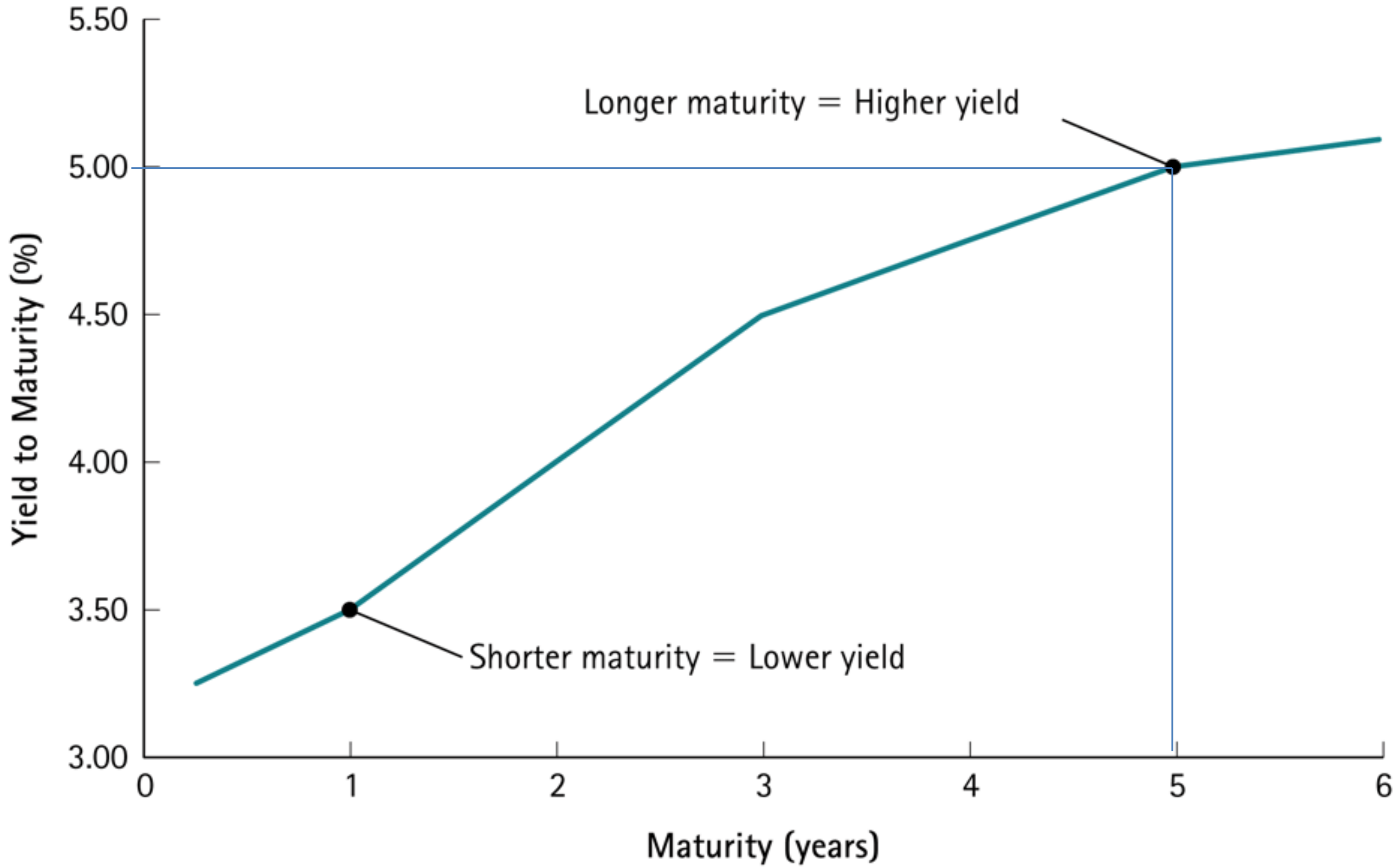
- Given the yield curve below, what is the price of a 5-year "risk-free" zero-coupon bond with a face value of $100?



Example: Computing the Price of a Zero-Coupon Bond

- We can use the bond's yield to maturity to compute the bond's price as the present value of its face amount, where the discount rate is the bond's yield to maturity.
- From the yield curve, the yield to maturity for **5-year** "risk-free" zero-coupon bonds is **5.0%**.

Zero-Coupon Yield Curve Consistent with the Bond Prices in Example



Example: Computing the Price of a Zero-Coupon Bond

- Execute:

$$\text{Bond Price} = \frac{P}{(1+i)^n}$$

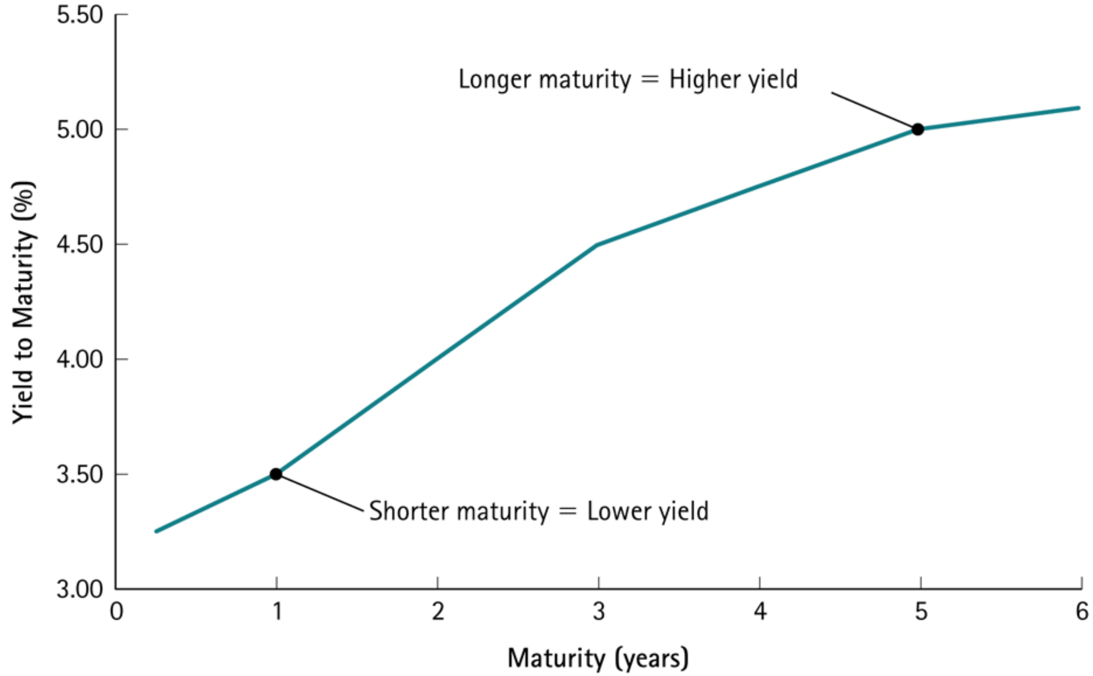
$$P = 100 / (1.05)^5 = 78.35$$

Example: Computing the Price of a Zero-Coupon Bond

- We can compute the price of a zero-coupon bond simply by computing the **present value** of the face amount using the bond's yield to maturity.
- Note that the price of the 5-year zero-coupon bond is even lower than the price of the other zero-coupon bonds in Example 6.1, because the face amount is the same but we must wait longer to receive it.

Your Turn!

- Given the yield curve below, what is the price of a **3-year** risk-free zero-coupon bond with a face value of **$900**?



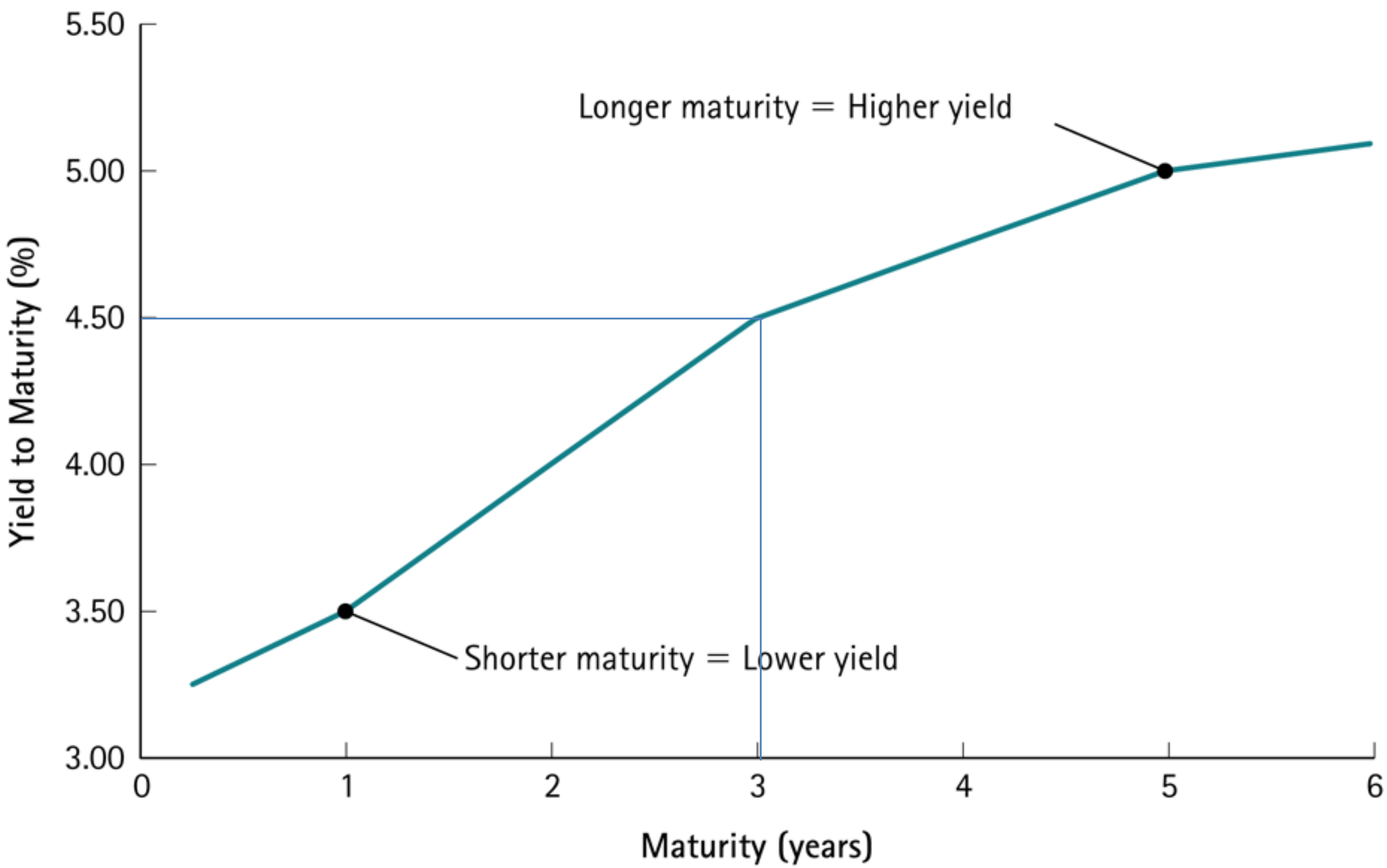
Your Turn (PRS please)

- The price is:
- $900
- $879
- $788.67

Solution: Computing the Price of a Zero-Coupon Bond

- We can use the bond's yield to maturity to compute the bond's price as the present value of its face amount, where the discount rate is the bond's yield to maturity.
- **From the yield curve**, the yield to maturity for **3-year** risk-free zero-coupon bonds is **4.50%**.

Zero-Coupon Yield Curve Consistent with the Bond Prices in Example



Solution: Computing the Price of a Zero-Coupon Bond

Execute:

$$\textbf{Bond Price} = \frac{P}{(1+i)^n}$$

$$P = 900 \,/\, (1.045)^3 = \$788.67$$

U.S. Government Securities "Treasuries"

Video on Tbills: https://www.youtube.com/watch?v=aVvDy9gVe90

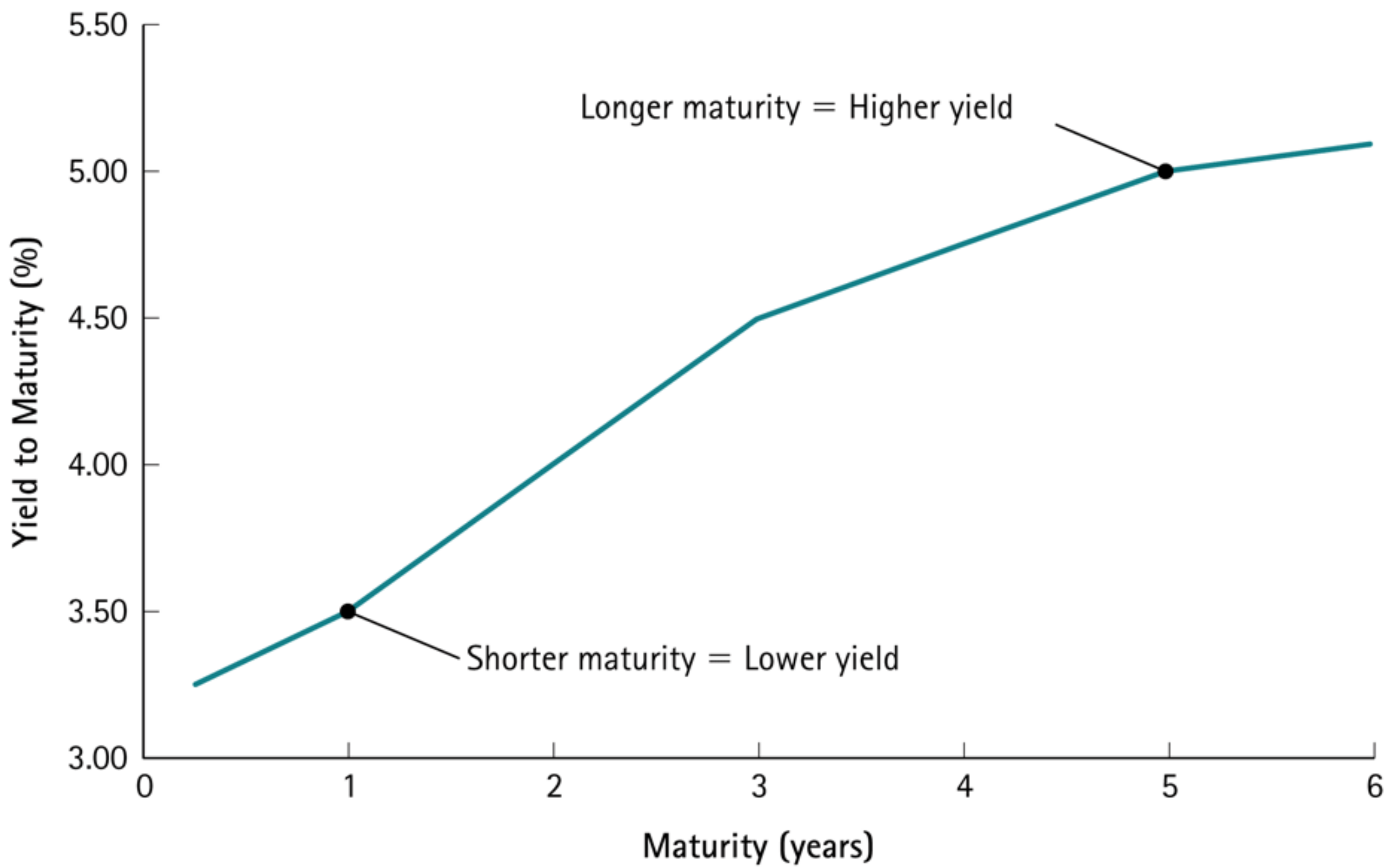
https://www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Documents/auctions.pdf

Treasury Security	Type	Original Maturity
Bills	Discount	4, 13, 26, and 52 weeks
Notes	Coupon	2, 3, 5, and 10 year
Bonds	Coupon	20 and 30 year

Because of their short tenor, US T-Bills are zero coupon. They trade at a discount to yield.

The 30 year T-Bond is called the "long bond"

Zero-Coupon Yield Curve



Coupon Bonds

Coupon Bonds

- Coupon bonds
  - Pay face value at maturity
  - Also make regular coupon interest payments
- Return on a coupon bond comes from:
  - The difference between the purchase price and the principal value
  - Periodic coupon payments
- To compute the yield to maturity of a coupon bond, we need to know the coupon interest payments, and when they are paid

Key Formulas: Bond Price

- That formula for fixed cash flows with a residual value on maturity date is also the general formula that covers many different cases of DCF calculations but is also the way (for you for now) to value bonds based on Coupon (*C*), Principal (*P*), Number of Years (*n*), Yield To Maturity (*i*):

$$Bond\ Price = \frac{C}{(1+i)^1} + \frac{C}{(1+i)^2} + \cdots + \frac{C}{(1+i)^n} + \frac{P}{(1+i)^n}$$

$$\textbf{Bond Price} = \frac{C.[1-(1+i)^{-n}]}{i} + \frac{P}{(1+i)^n}$$

Example: Computing the Yield to Maturity of a Coupon Bond

- Consider a five-year, $1,000 bond with a 2.2% coupon rate and semiannual coupons .
- If this bond is currently trading for a price of $963.11, **what is the bond's yield to maturity?**

Example: Computing the Yield to Maturity of a Coupon Bond

- We can solve it by financial calculator, or a spreadsheet. To use a financial calculator, we enter the price we pay as a negative number for the PV (it is a cash outflow), the coupon payments as the PMT, and the bond's par value as its FV. Finally, we enter the number of coupon payments remaining (10) as N.

	N	I/Y	PV	PMT	FV
Given:	10		-963.11	11	1,000
Solve for:		**1.50**			
Excel Formula: =RATE(NPER,PMT,PV,FV)= RATE(10,11,-963.11,1000)					

Example: Computing the Yield to Maturity of a Coupon Bond

- Therefore, ***y*** = 1.50%.
- Because the bond pays coupons semiannually, this yield is for a **six-month** period.
- We convert it to an APR (annual percentage rate) by multiplying by the number of coupon payments per year.
- Thus the bond has a yield to maturity equal to a **3.0% APR** with semiannual compounding.

Example: Computing the Yield to Maturity of a Coupon Bond

- As the equation shows, the yield to maturity is the discount rate that equates the present value of the bond's cash flows with its price.
- Note that the YTM is higher than the coupon rate and the price is lower than the par value.

Example: Computing a Bond Price from Its Yield to Maturity

- Consider a five-year, $1,000 bond with a 2.2% coupon rate and semiannual coupons.
- Suppose interest rates drop and the bond's **yield to maturity** decreases to **2%** (expressed as an APR with semiannual compounding).
- What **price** is the bond trading for now?

Example: Computing a Bond Price from Its Yield to Maturity

- Given the yield, we can compute the price.
- First, note that a 2.0% APR is equivalent to a semiannual rate of 1.0%.
- Also, recall that the cash flows of this bond are 10 payments of $11, paid every 6 months, and one lump-sum cash flow of $1,000 (the face value), paid in 5 years (ten 6-month periods).
- We can compute the effective annual yield from the bond's yield to maturity expressed as an APR.

Example: Computing a Bond Price from Its Yield to Maturity

- We can use a financial calculator:

	N	I/Y	PV	PMT	FV
Given:	10	1.0		11	1,000
Solve for:			**-1,009.47**		
Excel Formula: = PV(RATE,NPER,PMT,FV)=PV(.01,10,11,1000)					

Your Turn!

- Consider a **nine-year**, $1,000 note with a **3%** coupon rate and **semiannual** coupons.
- If this bond is currently trading for a price of **$1,038.32**, **what is the bond's yield to maturity**?

Your Turn (PRS please)

- The bond's YTM (on an APR basis) will be:
- 1.26%
- 2.52%
- 3.16%

Solution: Computing the Yield to Maturity of a Coupon Bond

- From the cash flow timeline, we can see that the bond consists of 18 payments of $15, paid every 6 months, and one lump-sum payment of $1,000 in 9 years (eighteen 6-month periods).
- We can solve for the yield to maturity.
- However, we must use 6-month intervals consistently.

Solution: Computing the Yield to Maturity of a Coupon Bond

- We can solve it by financial calculator, or a spreadsheet. To use a financial calculator, we enter the price we pay as a negative number for the PV (it is a cash outflow), the coupon payments as the PMT, and the bond's par value as its FV. Finally, we enter the number of coupon payments remaining (10) as N.

	N	I/Y	PV	PMT	FV
Given:	18		-1038.32	15	1,000
Solve for:		**1.26**			
Excel Formula: =RATE(NPER,PMT,PV,FV)= RATE(18,15,-1038.32,1000)					

Solution: Computing the Yield to Maturity of a Coupon Bond

- Therefore, ***y*** = 1.26%.
- Because the bond pays coupons semiannually, this yield is for a six-month period.
- We convert it to an APR by multiplying by the number of coupon payments per year.
- Thus the bond has a yield to maturity equal to a **2.52%** APR with semiannual compounding.
- As the equation shows, the yield to maturity is the discount rate that equates the present value of the bond's cash flows with its price.

Bond Pricing Recap

Bond Pricing

- The relationship between the bond price and interest rates is very important.
  - Bonds promise fixed payments on future dates, so the higher the interest rate, the lower their present value.
- The value of a bond varies ***inversely*** with the interest rate used to calculate the present value of the promised payment.

Bond Pricing Example

- Bond terms and conditions:
  - Par Value / Face Value: US$1000
  - Coupon Rate: 3.15%
  - Coupon Frequency: Annual
  - Tenor: 7 years
  - Else: N/A
- Key terms for calculations:
  - Annual Coupon Amount (PMT): US$1000 x 3.15% = US$31.50
  - Principal Payment (FV): US$1000
  - Nbr Payments (NPER): 7

Bond Pricing Example

- Then depending on what is available, Bond Price (*PV*) or interest rate, Yield To Maturity "*YTM*" (*i*) it's possible to calculate the other:

$$Bond\ Price = \frac{\$31.5}{(1+i)^1} + \frac{\$31.5}{(1+i)^2} + \cdots + \frac{\$31.5}{(1+i)^7} + \frac{\$1000}{(1+i)^7}$$

- If YTM = *i* = 2%,

$$Bond\ Price = \frac{\$31.5}{(1+2\%)^1} + \frac{\$31.5}{(1+2\%)^2} + \cdots + \frac{\$31.5}{(1+2\%)^7} + \frac{\$1000}{(1+2\%)^7}$$

$$Bond\ Price = \$1074.43 = 107.44\% \times Par\ Value$$

- If YTM = *i* = 4%,

$$Bond\ Price = \frac{\$31.5}{(1+4\%)^1} + \frac{\$31.5}{(1+4\%)^2} + \cdots + \frac{\$31.5}{(1+4\%)^7} + \frac{\$1000}{(1+4\%)^7}$$

$$Bond\ Price = \$948.98 = 94.90\% \times Par\ Value$$

Bond Pricing

- Par, Premium, Discount
  - If YTM is equal to Coupon Rate then Bond Price = 100% of Par Value (the bond trades "at par")
  - If YTM is higher than Coupon Rate then Bond Price < 100% of Par Value (the bond trades "at a discount")
  - If YTM is lower than Coupon Rate then Bond Price > 100% of Par Value
  - (the bond trades "at a premium")
  - The Tenor further amplifies those variations

Interest for short term debt instruments

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Money Market (≤1 Year) Rates

- For debt instruments within a year, interest calculations as well as names are different!
- Money market instruments include: Time Deposits, T Bills, Certificate of Deposits, Commercial Paper, Bankers' Acceptances, Forward Rate Agreements (FRA) including those listed in future markets.
- The interest are calculated as follow:

$$Interest = Notional\,.\,Interest\ Rate.\frac{Number\ of\ Days}{Number\ of\ Days\ in\ Year}$$

Simple Interest on Short Term Loans

Simple interest applied to short term loans:

$$\boxed{FV = PV\,[\,1 + r \times (d/y)]}$$

Where

- FV = Future Value
- PV = Present Value
- r = interest rate
- d = number of days to term
- y = year basis used in calculation

The DIY Dilemma

- On 1st January 2010, Delta Investments Yield has HK$10 million excess cash to invest for 2 months; the treasurer considers the following options:
- Placing the money in 2 month fixed deposit in Sunny Bank Ltd that pays **3%** on a money market (actual/365) day basis
- Buying a Lucky Gold Company bond with a remaining maturity of 2 months that yields **3%** on a bond basis (30/360)
- What should DIY do?

The DIY Dilemma (Continued)

- *Ceteris paribus*, what is the only difference between the two options?
- What **other** factors should DIY consider?
- How do we compare the two options?
  - Interest calculation: Principal * Interest rate * DTM/year
  - Why is that important?

The DIY Dilemma (Continued)

To compare the two options, we need to answer the following questions:

- How do we calculate the number of days to maturity?
- How is the number of days in the year defined?

Day Count Conventions

- **Day count convention** (year basis) is the market convention used in calculating interest expressed as a ratio of number of days in a month (d) to number of days in a year (y)
- Most common conventions:

	Actual	30
Actual	X	
365	X	
360	X	X

Market	Calculation Convention	Coupon Structures	Coupon Payment	Day Count Convention
Brunei Darussalam	N/A	N/A	N/A	N/A
Cambodia	N/A	N/A	N/A	N/A
China	Yield to Maturity	Fixed coupon mostly; two listed float –rate treasury bonds	Annual	Actual/365
Hong Kong	Yield to Maturity	EFBNs are issued on a discount basis	EFBNs are issued on a discount basis	Government: Actual/365
Japan	Yield to Maturity	Fixed coupon; float-rate for 15yr maturities	Semi-annual coupon	Government: Actual/Actual
Indonesia	Yield to Maturity	Fixed and variable coupons for government bonds; Variable rate bonds for some recapitalization bond issues	Quarterly or semi annual depending on the terms of the bonds	Government: Actual/Actual
Korea, Republic of	Yield to Maturity	All coupon-bearing bonds. Some Municipal bond (Seoul Sub) issues are deferred amortized and some MSB are discounted	Annual or semi-annual	Government: Actual/Actual
Lao PDR	N/A	Fixed	Annual	N/A
Malaysia	Yield to Maturity; Internal rate of return of cash flows	Fixed for government bonds	Annual or semi-annual	Government: Actual/Actual Corporate: Actual/365
Myanmar	N/A	Fixed	N/A	N/A
Philippines	Yield to Maturity	FXTNs/RTBs, fixed coupon; T-bills/CMBs, zero coupon	Semi-annual except for RTBs	Government: Actual/Actual Corporate: Actual/365
Singapore	Yield to Maturity	Varies depending on instrument	SGS Bond: Semi-annual coupon	SGS Bond: Actual/Actual
Thailand	Yield to Maturity	Fixed for government bonds; Floating rate notes are also issued	Semi-annual	Government: Actual/365
Vietnam	Varies depending on the instrument	Varies depending on instrument	Varies depending on the instrument	Varies depending on the instrument

The DIY Dilemma (Continued)
Day Count Conventions

Sunny Bank

- Actual/365
- Interest calculation:

  10,000,000*3%*actual number of days in 2 months/365

Lucky Gold

- 30/360
- Interest calculation:

  10,000,000*3%*(30 days/month for 2 months)/360

Can we do the calculation?
When does the deposit start and when does it mature?

The DIY Dilemma (Continued)

After the treasurer agrees a trade with the banker, it takes time for the transaction to be executed: the trade date is generally not the same as the settlement date

- What do we need to know?

The DIY Dilemma (Continued)

Trade and Value Dates

- When does the DIY Treasurer call his banker?
  - The trade date
- When can the money be invested?
  - The value/settlement date
- When can the money be returned?
  - The maturity date

Trade, Value & Maturity Dates

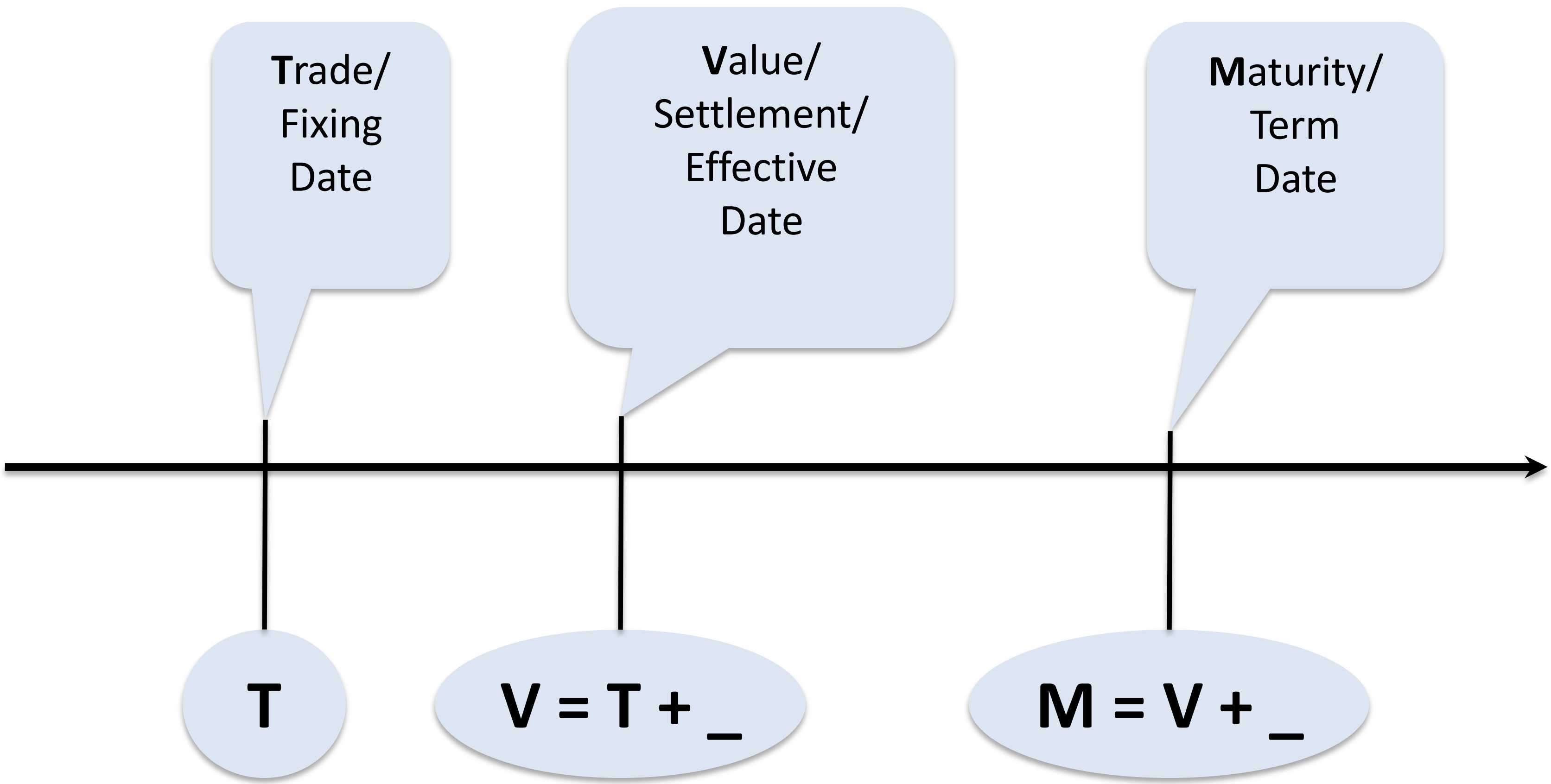
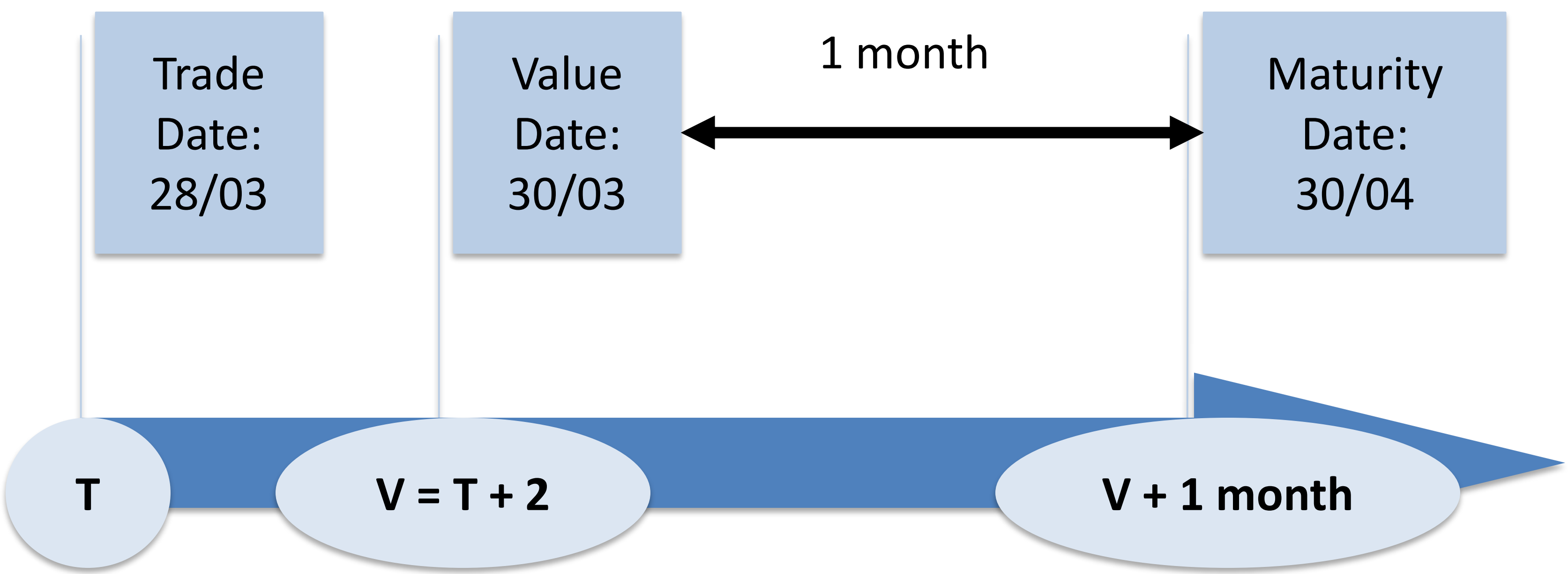


Illustration: 1 Month Deposit



The DIY Dilemma (Continued)
Trade and Value Dates

Sunny Bank

- Trade date : ?
- Value date: (spot) T+ 2 business days
- Maturity date : V+ 2 months

Lucky Gold

- Trade date : ?
- Value date: (spot) T+ 2 business days
- Maturity date : V+ 2 months

But, wait a minute… 1st January is a public holiday!

The DIY Dilemma (Continued)

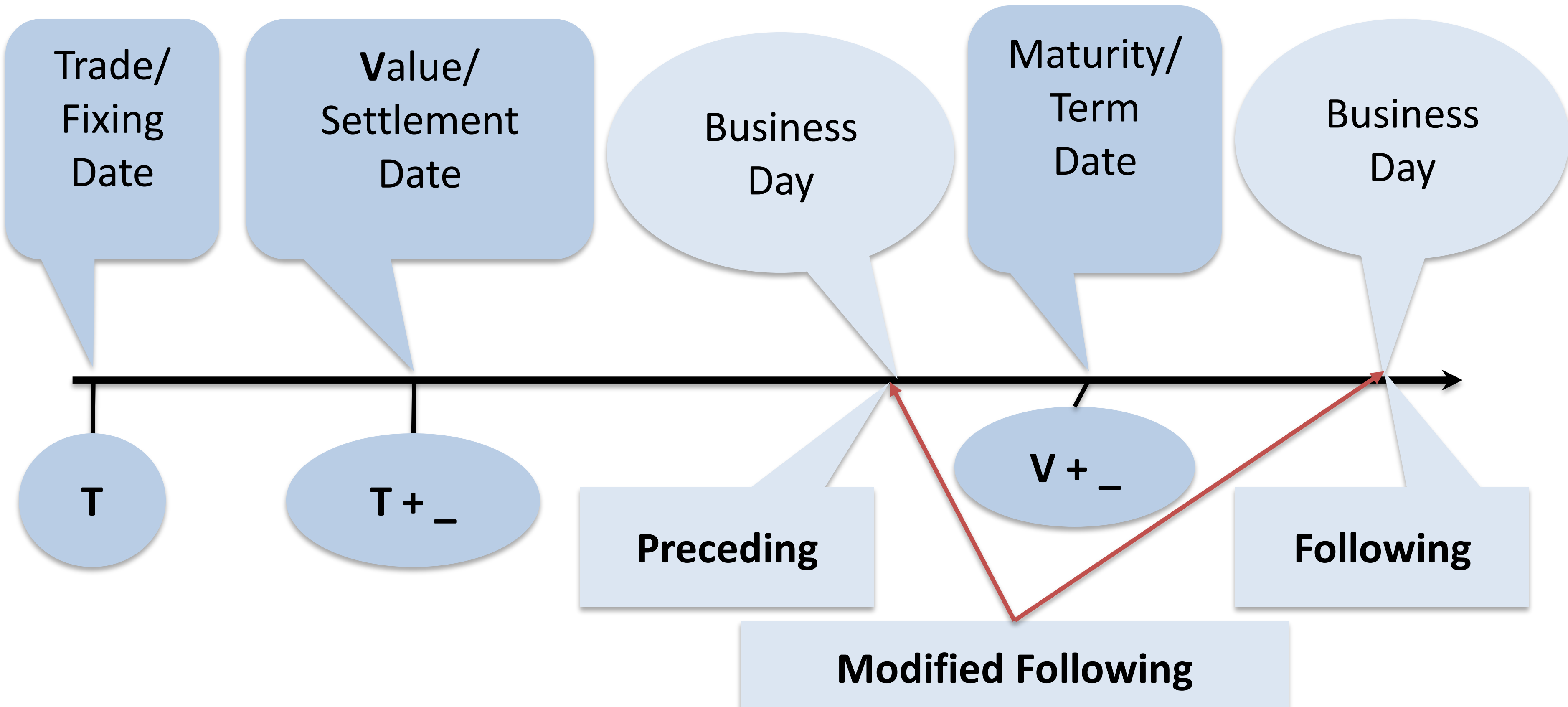
Business Day Definitions

- 1st January 2010 (Friday) is a public holiday in HK => DIY's treasurer cannot reach his banker and has to wait for the next **banking day** to agree a trade
  - The next day when banks are open is Monday 4th January, which is the Trade Date
- Let's assume market convention is **spot** (T+2) for deposits and bond purchases
  - The Value Date will be T + 2 : Wednesday 6th January
- To determine the Maturity Date we need to compute 2 (calendar) months from the Value Date
  - that is to say Saturday 6th March
- But Saturday is not a banking day, what do we do?

Business Day Conventions

- Market convention for adjusting payment dates in response to days that are **not business days**
- Definition of "business day"
- Most common business day conventions:
  - Following
  - Preceding
  - Modified following

Business Day Conventions



The DIY Dilemma (Continued)
Trade and Value Dates

Sunny Bank

- Trade date : Monday 4th January
- Value date: Wednesday 6th January
- Maturity date : (applying modified business day): Monday 8th March

Lucky Gold

- Trade date : Monday 4th January
- Value date: Wednesday 6th January
- Maturity date : (applying modified business day): Monday 8th March

Now we can calculate DTM using the relevant convention

The DIY Dilemma (Continued)
DTM applying day count convention

Sunny Bank

- Day count convention: actual/365
- Means we count the actual number of days in the relevant months and 365 days in a year
- January = 25 days (31-6) + February 28 days + March 8 days
- DTM = 61 days

Lucky Gold

- Day count convention: 30/360
- Means each month is assumed to have 30 days and the year 360 days
- January = 24 days (30-6)+ February 30 days+ March 8 days
- DTM = 62 days

The DIY Dilemma Solution

Sunny Bank

- Trade date : 4 January 2010
- Value date: 6 January
- Maturity date : 8 March
- DTM = 61
- Interest:= 10,000,000*3%*61/365

= 50,136.99

Lucky Gold

- Trade date : 4 January 2010
- Value date: 6 January
- Maturity date : 8 March
- DTM = 62
- Interest = 10,000,000*3%*62/360

= 51,666.67

Ceteris paribus, DIY should invest in Lucky Gold bond

Your turn! Supreme Bank

- Trade date: Friday 29 January 2010
- Supreme Bank (HK) Ltd borrows HK$ 50 million for 1 month from KS Lee Bankers (HK) Co at 5 % p.a.
- What amount of interest will Supreme Bank pay?

Supreme Bank: What Do We Need to Know?

- What is the market convention for value date?
  - Deposits: spot (T + 2)
- What is the day count convention?
  - Actual/365
- What is the business day definition?
  - Banking days in HK
  - Modified Following applies to maturity date

Supreme Bank Solution Steps

- First calculate the Value Date
  - V = T + 2
  - V =
- Then determine the Maturity Date
  - M = V + (calendar) month adjusted by the business day convention
  - M =
- Calculate DTM
  - DTM =
- Calculate interest applying day count convention
  - Interest =

Supreme Bank solution

- Trade date: 29 January (Friday)
- Value date: 2 February (Tuesday)
- Maturity date: 2 March (Tuesday)
- DTM: 28
- Convention: actual/365
- Interest: 191,780.82

FINA 1303

FOUNDATIONS OF FINANCIAL INSTITUTIONS

Veronique Lafon-Vinais

Associate Professor of Business Education - Department of Finance

HKUST BUSINESS SCHOOL 香港科大商學院

Course Map

Overview

Financial Institutions

- **Role of Financial Institutions**
- Types of Financial Institutions
- Financial Intermediation
- Conflicts of Interest

Role of financial institutions

Financial services industry links organizations needing capital with those able to provide it

Major contributor to economy in UK, US, HK….

NYSE and Wall Street

Source: Wikipedia

City of London, the Square Mile

Source: www.freefoto.com

Course Map

Overview

Financial Institutions

- Role of Financial Institutions
- **Types of Financial Institutions**
- Financial Intermediation
- Conflicts of Interest

Types of Financial Institutions

Financial Intermediaries

Depository Institutions
- Commercial Banks
- Credit Unions
- Mutual/Savings Banks
- Building Societies

Other Financial Intermediaries
- Insurance Companies
- Pension Funds
- Mutual Funds
- Money Market Funds
- Finance Companies

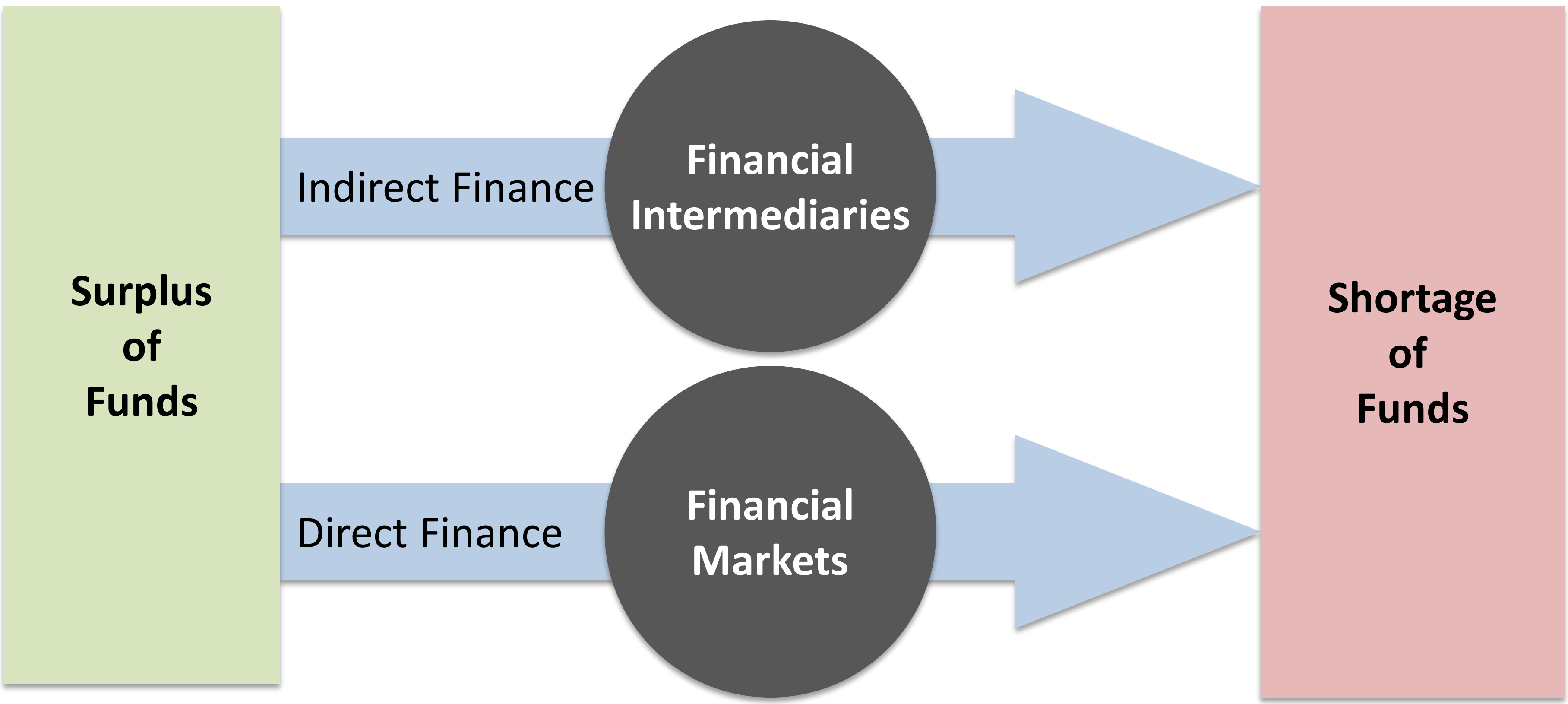
Issue checkable deposits

Issue financial claims

Other Financial Institutions

- Securities Firms
- Brokers
- Dealers
- Investment Banks
- ……

Financial System



Financial institutions that are **not** financial intermediaries

- Brokers
- Dealers
- Investment banks
- Custodians
- Trustees

Brokers

- Act **on behalf** of their clients
- Charge a commission (fee) for the service
- Do **NOT** take positions
- Examples:
  - Real estate broker: will put together a buyer and a seller and charge a fee
  - Insurance broker: will find the "right" policy for his clients among various possible insurance companies
  - Stock broker: will execute orders on behalf of clients on the exchange

Dealers

- Act as **PRINCIPAL**
- Takes **positions** and carries inventories
- Makes money from the difference (the **spread**) between the price at which he buys the assets (bid) and the price at which he sells them (offer)
- **Market makers** are dealers who post 2-way prices and "make markets" thus providing liquidity
- Examples:
  - FX dealer
  - Primary dealer in government securities
  - Securities dealers in certain exchanges

Course Map

Overview

Financial Institutions

- Role of Financial Institutions
- Types of Financial Institutions
- **Financial Intermediation**
- Conflicts of Interest

Financial Intermediaries

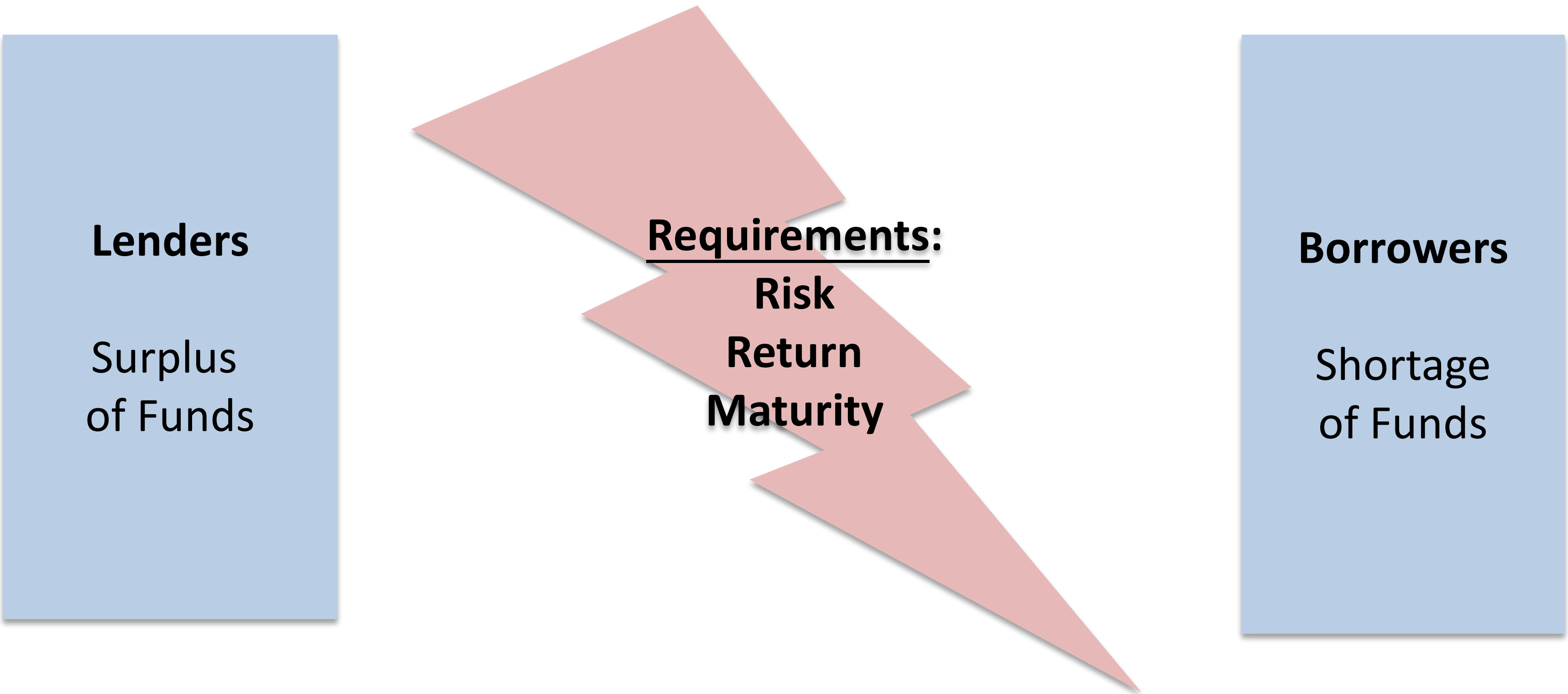
Deposit Intermediaries

- Commercial Banks
- Savings Banks
- Mutual Banks
- Post Office
- Central Bank

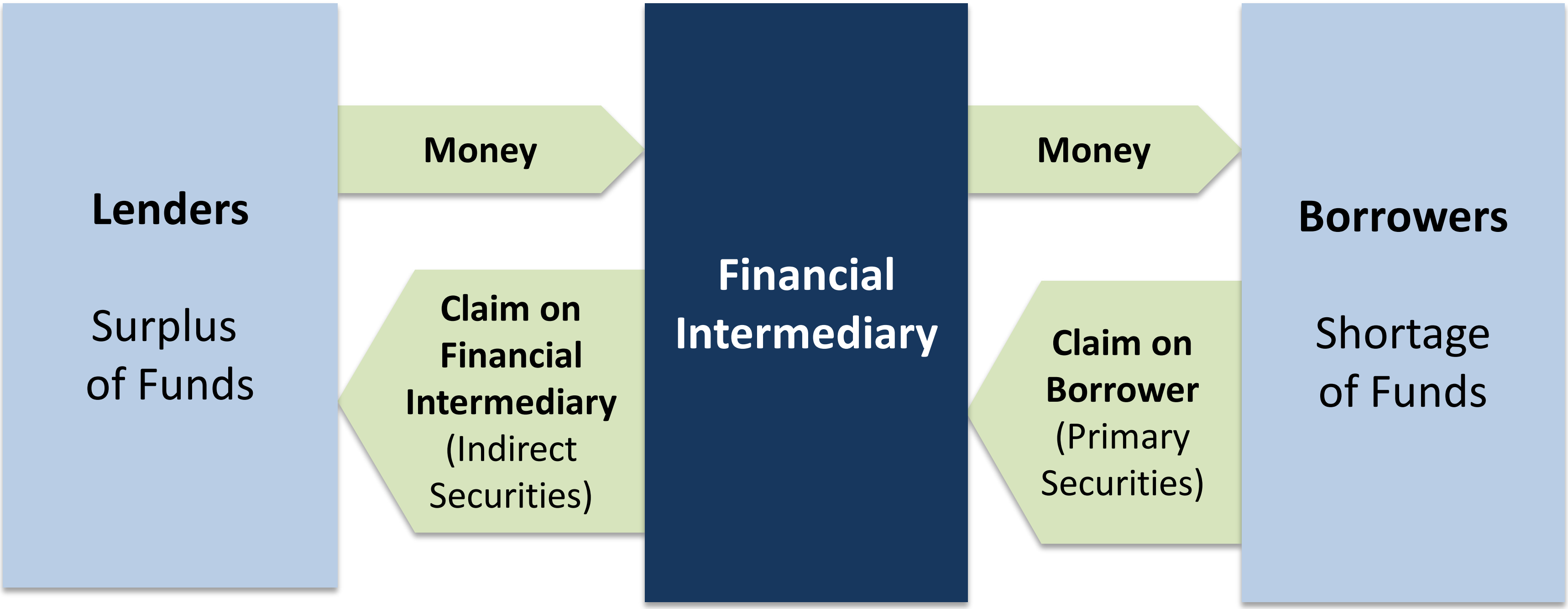
Non-Deposit Intermediaries

- Contractual Intermediaries
  - Insurers
  - Pension Funds
- Portfolio Institutions
  - Unit trusts
- Other FIs
  - Finance Companies

Financial Intermediation



Financial Intermediation (Cont)



Function of Financial Intermediaries

- Engage in process of **indirect finance**
- **More important source of finance than securities markets**
- Reduce **transactions costs** and **asymmetric information**
  - Reduce transactions costs by developing expertise and taking advantage of **economies of scale**
  - Low transaction costs increase profits and allow some intermediaries to provide **liquidity services**
    - Checking accounts that enable them to pay their bills easily
    - Depositors can earn interest on checking and savings accounts and yet still convert them into goods and services whenever necessary

Example?

The time & money spent on carrying out financial transactions

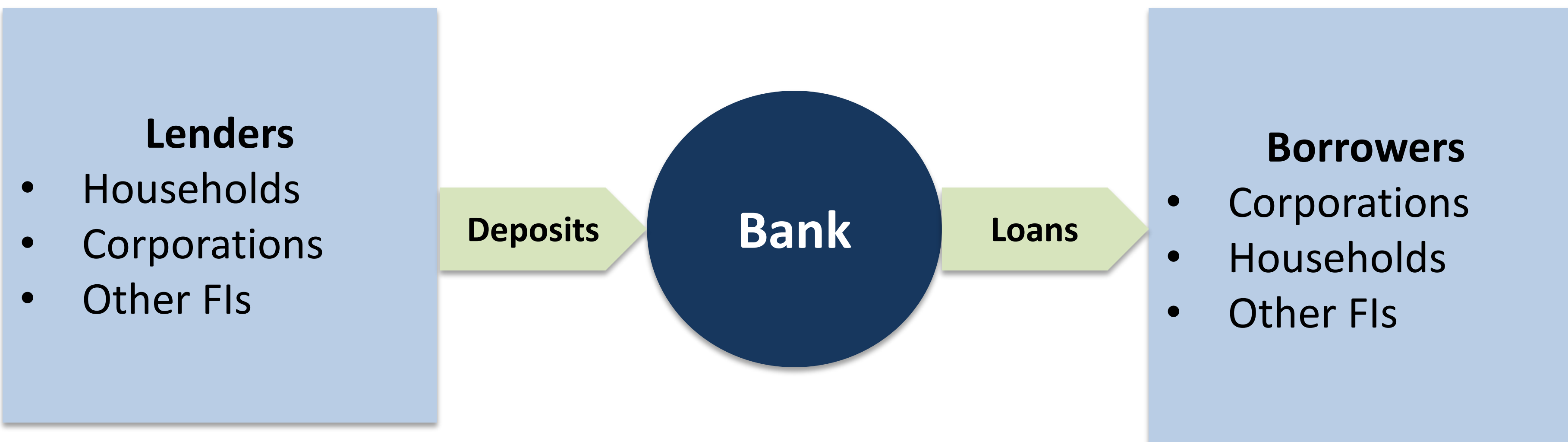
?

The reduction in transaction costs per dollar of transaction as the size (scale) of transaction increases

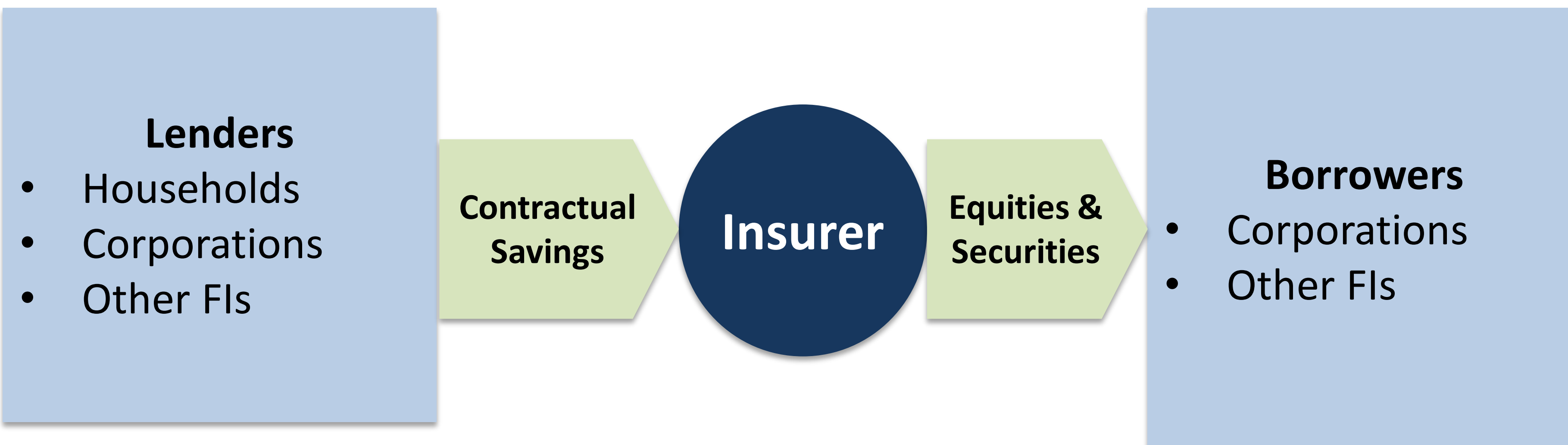
Function of Financial Intermediaries

- Another benefit made possible by the financial intermediaries' low transaction costs is that they can **help reduce the exposure of investors to risk**, through a process known as **risk sharing**
  - Financial intermediaries create and sell assets with lesser risk to one party in order to buy assets with greater risk from another party
  - This process is referred to as **asset transformation**, because in a sense risky assets are turned into safer assets for investors
- Banks can also enjoy **economies of scope** by providing multiple services to their customers

Banks as Financial Intermediaries



Insurers as Financial Intermediaries



Services performed by financial intermediaries

- Monitoring Costs
  - Collect information and monitor firms activities at a lower cost than individual actors due to economies of scale
- Liquidity and Price Risk
  - The financial claims issued by financial intermediaries give savers liquidity and lower price risk
- Transaction Cost Services
  - Are reduced as a result of economies of scale

Services performed by financial intermediaries (Cont)

- Maturity Intermediation
  - Financial intermediaries bear and manage the risk of mismatching the maturities of their assets and liabilities
- Denomination Intermediation
  - By pooling their savings, financial intermediaries allow small investors to buy assets which would have been inaccessible due to large minimum investment size (e.g. bonds)

Services provided by financial intermediaries benefiting the overall economy

- **Money Supply Transmission**
  - Depository institutions are the conduit through which monetary policy actions impact the rest of the financial system and the economy in general
- **Credit Allocation**
  - Financial intermediaries are the major and sometimes only source of financing for particular sectors of the economy
- **Intergenerational Wealth Transfers**
  - Financial intermediaries such as life insurance companies or pension funds provide savers with the ability to transfer wealth from one generation to another
- **Payment Services**
  - The efficiency with which the depository institutions provide payment services directly benefits the economy

Test Your Understanding

- Is a mutual fund a financial intermediary?
  - Yes
  - No
- Is a stock broker a financial intermediary?
  - Yes
  - No
- How do dealers make money?
  - They charge a commission
  - The difference between bid and offer

Course Map

Overview

Financial Institutions

- Role of Financial Institutions
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- **Conflicts of Interest**

What are conflicts of interest and why are they important?

- Financial intermediaries engage in a variety of activities to collect, produce, and distribute information. By providing multiple services, they realize **economies of scope**. ?
- However, these services may be competing with one another, and this creates the potential for a **conflict of interest**:
  - Whereby one party has **incentives** to act in its own interest rather than in the interests of the other party
  - Conflicts of interest generate **incentives** to provide false or misleading information
- We care about these conflicts of interest because a reduction in the quality of information increases the presence of asymmetric information.

Source: Mishkin/Eakins

Ethics and Conflicts of Interest

Recent cases of conflict of interest:

- Underwriting and research in investment banking
- Auditing and consulting in accounting firms
- Credit assessment and consulting in credit-rating agencies
- Universal banking
- …..

"I try not to break the rules, but merely to test their elasticity"

Bill Veeck as cited in FT 24/8/07 article "Derivatives Dodges"

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Approaches to remedying Conflicts of Interest

- Leave It to the Market
- Regulate for Transparency
- Supervisory Oversight
- Separation of Functions
- Socialization of Information Production

Sarbanes-Oxley "SOX" Act of 2002

Section 404 requires an annual "internal control report", which must be certified by auditors and personally signed off by two executives.

Passed following the public outcry over corporate scandals. Six major components:

- Established the Public **Company Accounting Oversight Board** to supervise accounting firms
- Prohibited public accounting firms from engaging in non-audit services to a client it is also auditing
- Members of the board's audit committee must be **independent**
- Required the **reporting of off-balance sheet activities**
- Appropriated additional funding for the SEC
- Increased the charges for white-collar crimes and obstruction

Source: Mishkin/Eakins

Global Legal Settlement of 2002

The New York Attorney General and several of the largest U.S. investment banks reached an agreement which key terms included:

- **$1.4 billion** in fines
- Firms must severe the link between underwriting and research activities
- **Spinning** is banned
- Firms must make public analyst recommendations and target prices
- Brokerage firms required to obtain third-party, independent research for their clients

"The widespread practice on Wall Street of giving shares of IPOs -- which often jumped in value in the first days of trading -- to preferred and prospective clients in what appeared to be an effort to bolster investment banking business"
Source: NY Times 28/9/02

Asymmetric Information: Adverse Selection and Moral Hazard

Adverse Selection

- One party in a transaction has better information than the other party
- **Before** transaction occurs: Potential borrowers most likely to produce adverse outcome are ones most likely to seek loan and be selected

Examples?

Moral Hazard

- One party has an incentive to behave differently once an agreement is made between parties
- **After** transaction occurs: Hazard that borrower has incentives to engage in undesirable (immoral) activities making it more likely that won't pay
  loan back

Current Issues

- Central banks face moral hazard in subprime crisis
- Rating agencies face increased scrutiny as result of conflict of interest in rating of structured products
- Government bailout vs. bonuses
- Insider trading
- ……

FINA 1303
THE SELL-SIDE: COMMERCIAL BANKS

Veronique Lafon-Vinais

Associate Professor of Business Education - Department of Finance

HKUST BUSINESS SCHOOL 香港科大商學院

Course map

Overview

Financial Institutions

Sell Side

Commercial Banking

1. **What are Commercial Banks?**
2. Bank Management
3. Types of Risk in Banking
4. Measuring Bank Performance
5. Current Issues

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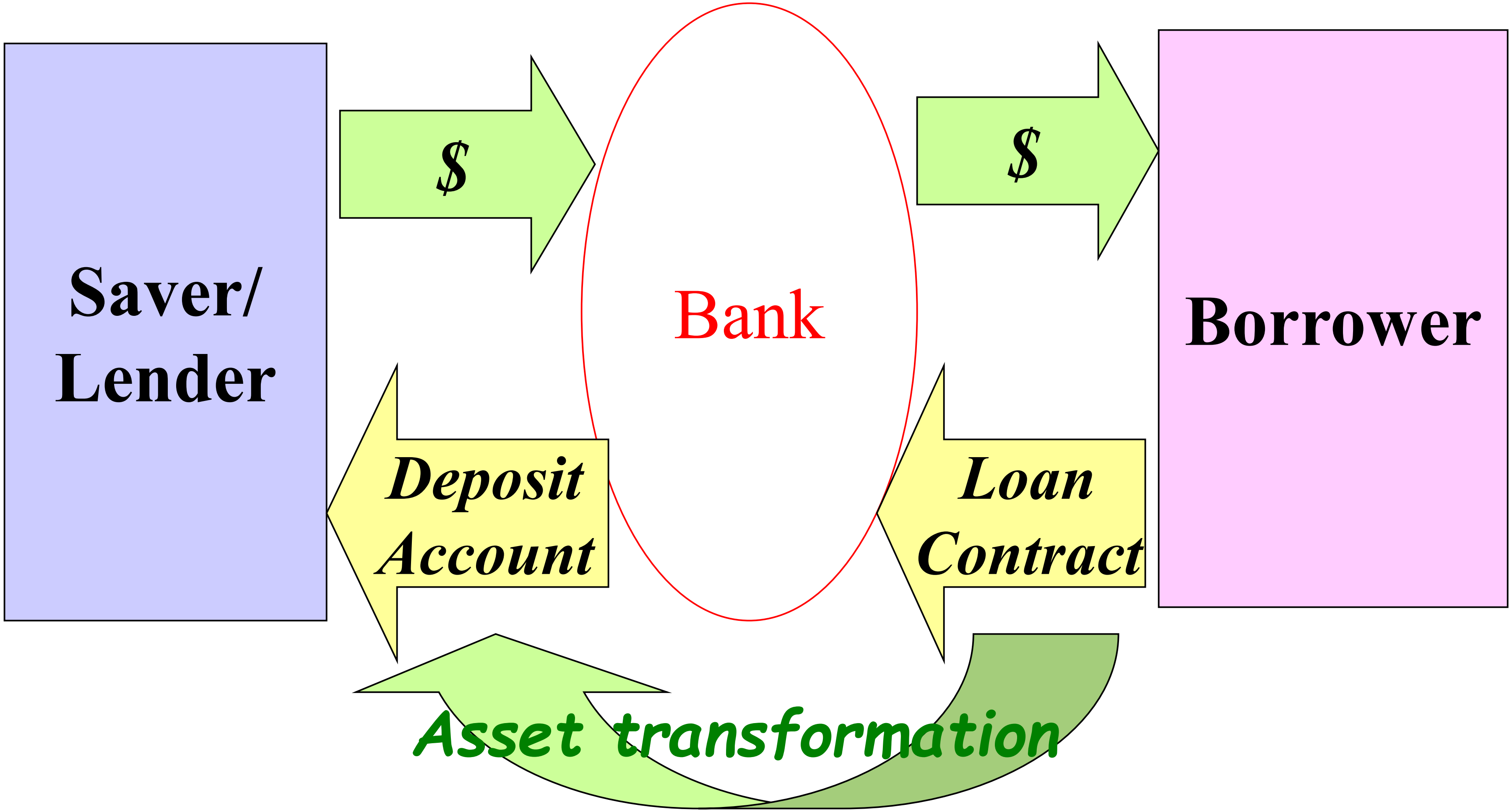
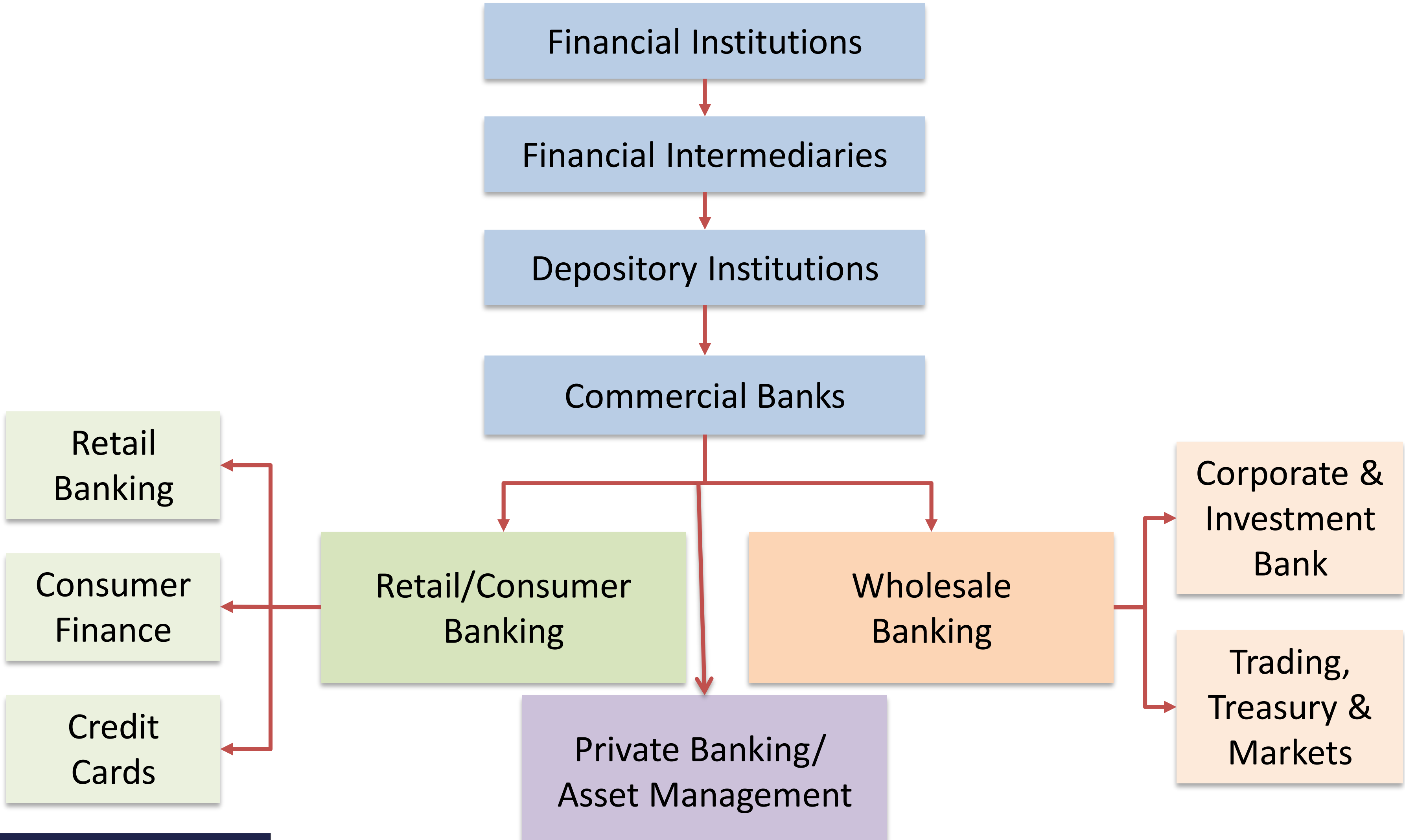
Banks as financial intermediaries



Commercial Banks



What are Commercial Banks?

Commercial Banking

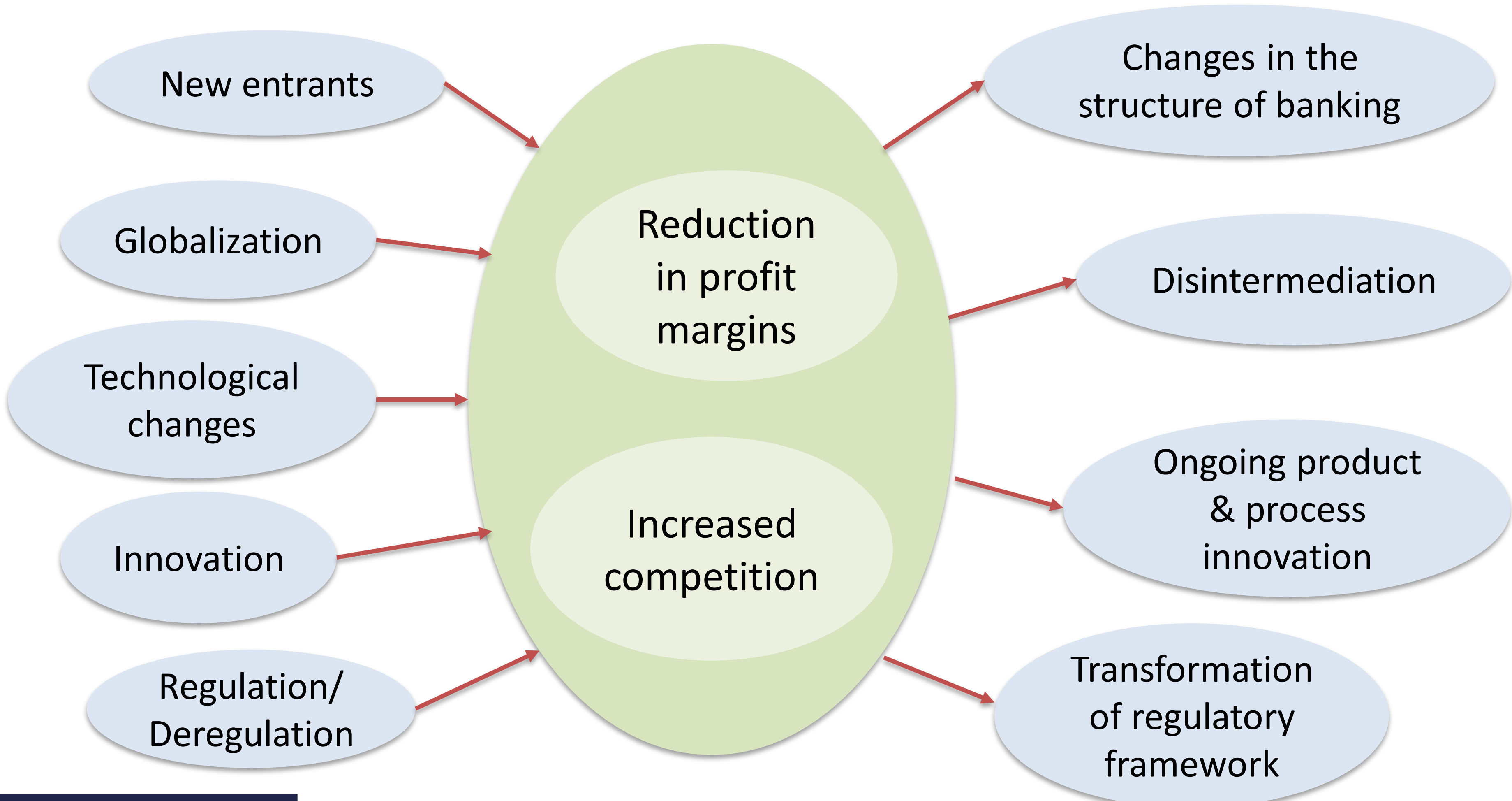
Retail banking

- Clients = Retail (individuals)
- Provide residential and consumer loans
- Accepting small deposits

Wholesale banking

- Clients = Corporates and Institutionals (large size → wholesale)
- Provide commercial and industrial loans
- Funded with deposits and purchased funds

Forces shaping International Banking



Commercial Banks

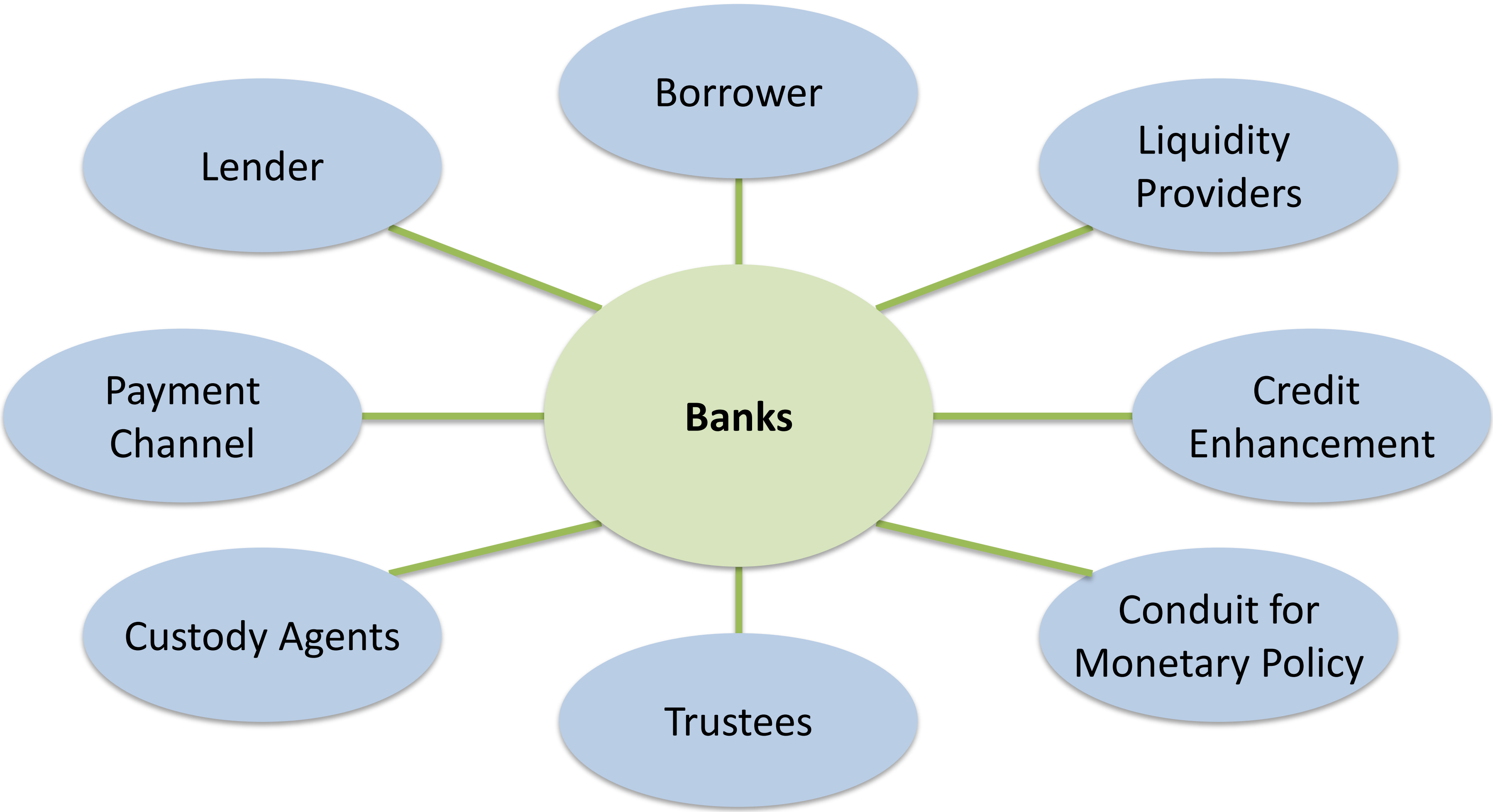
Traditional products and services:

- Deposit accounts
- Credit services
- Payment and collection services
- Trade services
- FX services
- Credit enhancement or payment guaranty
- Agent or fiduciary services

New products and services

- Investment banking services
- Consulting services
- Risk management services
- Broker/dealer services
- Insurance services
- Asset management

Multiple Role of Banks

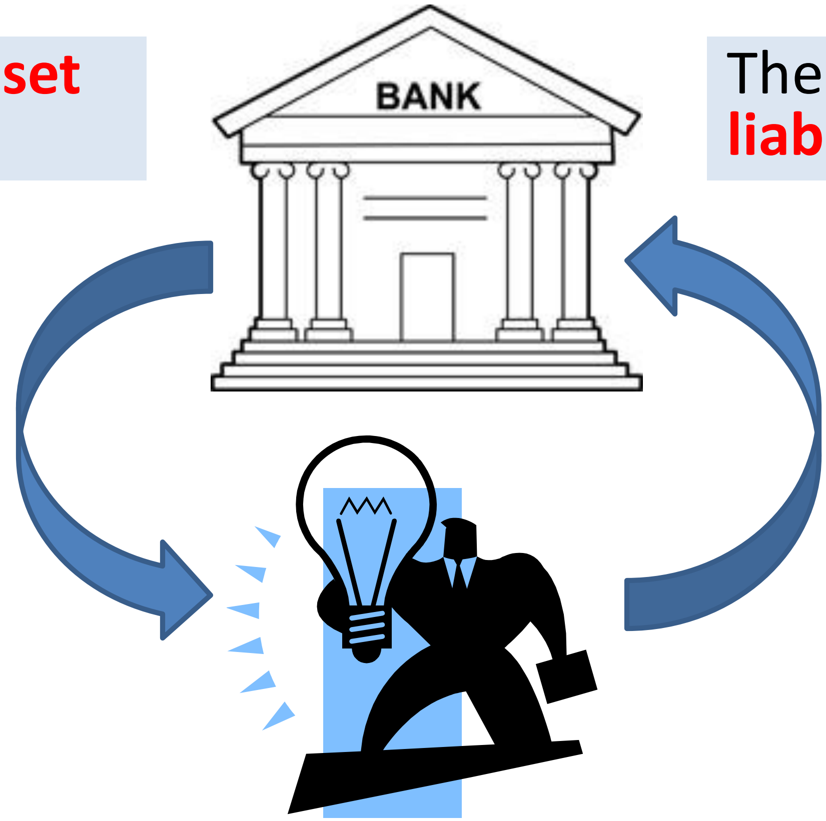


Money creation: how it works

The loan is an **asset** for the bank

The deposit is a **liability** for the bank

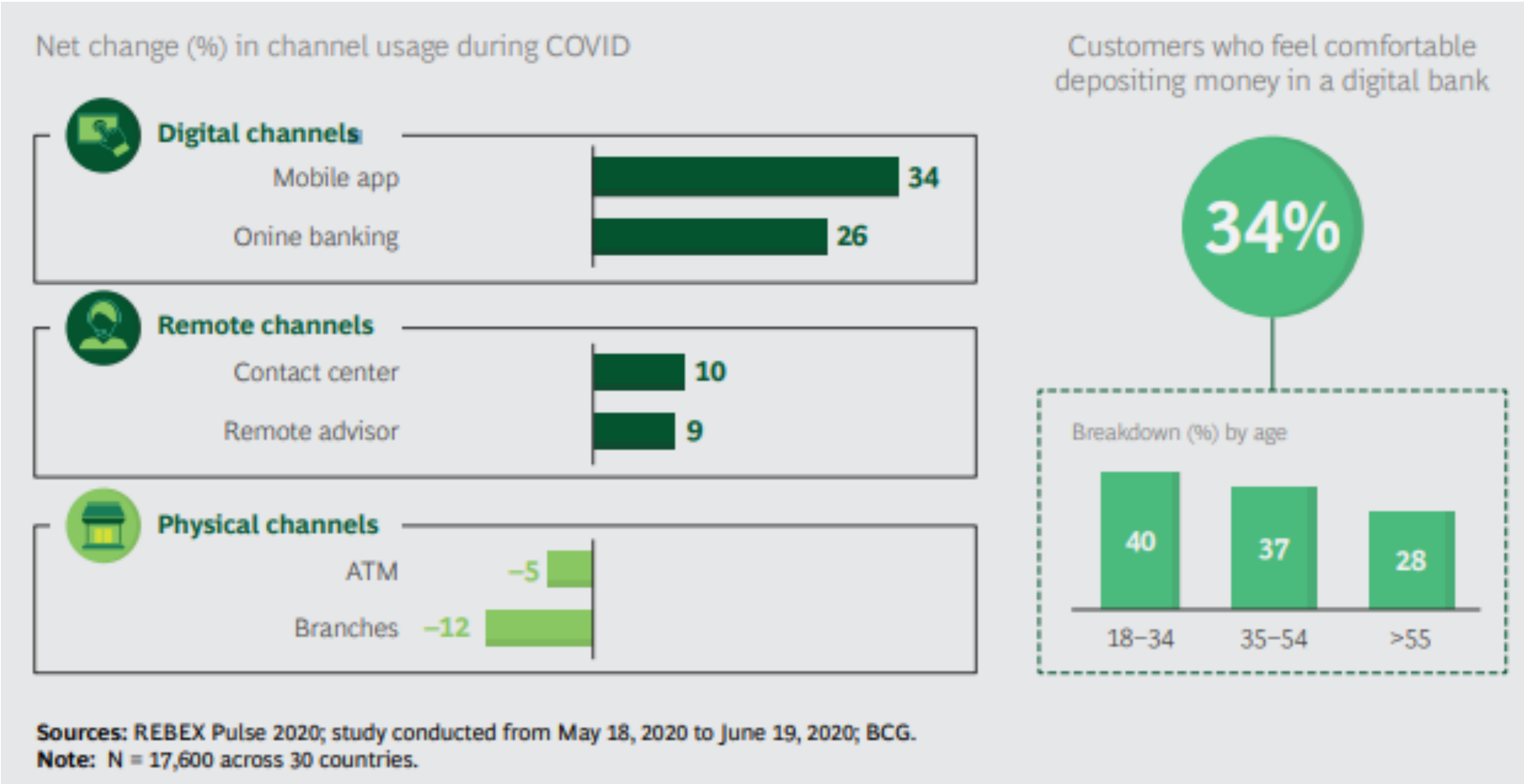
The bank makes a **loan** to the business



The bank deposits the money from the loan into a **deposit** account for the business

Bank deposits are part of the **money supply**

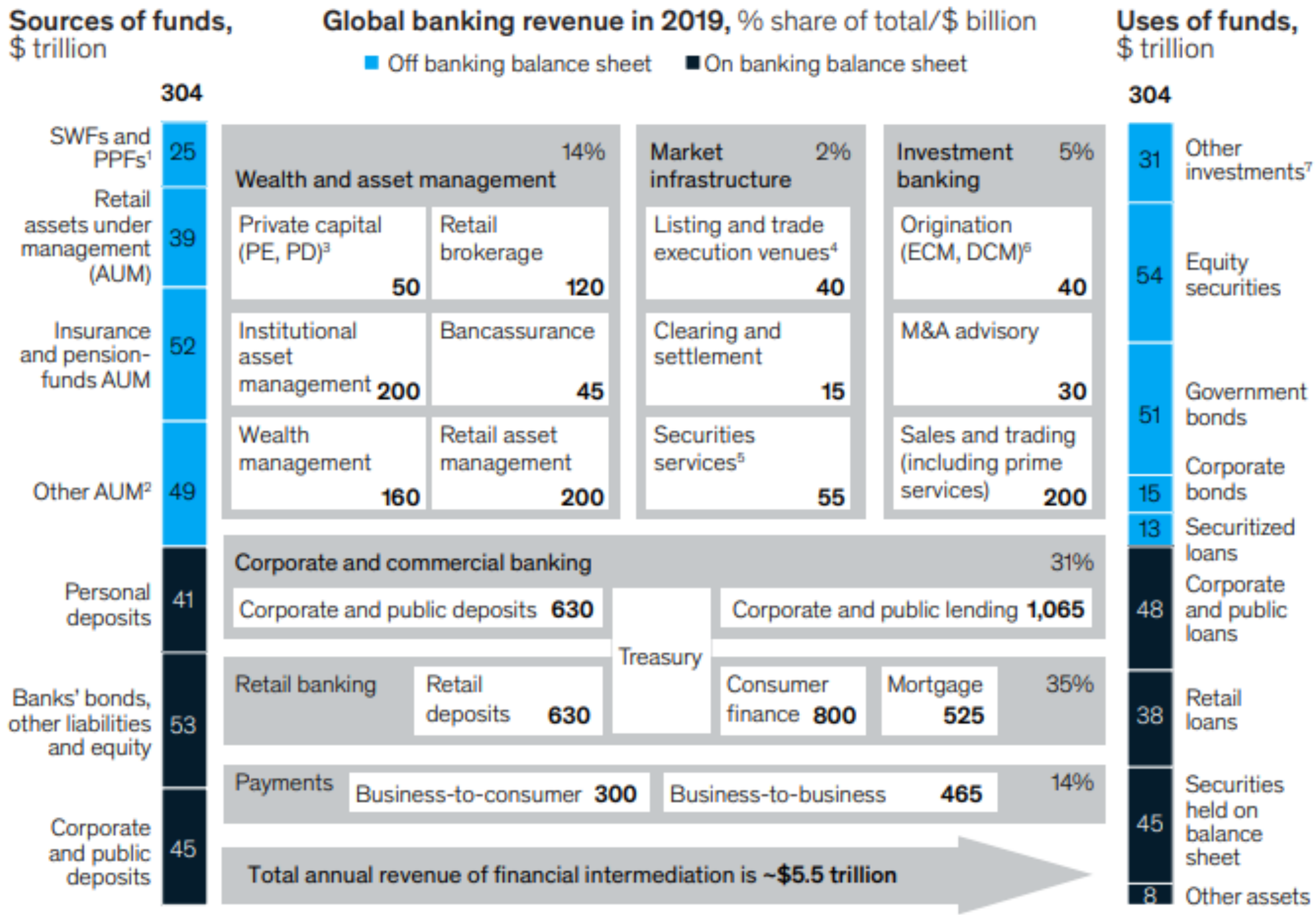
Customers are increasingly turning to digital banking



Source: BCG Dec 2020

Global Financial Intermediation

Global financial intermediation is a complex system that generated about $5.5 trillion in annual revenue in 2019.



[1]Sovereign-wealth funds and public-pension funds. [2]Endowments and foundations, corporate investments. [3]Private equity, private debt. [4]Includes exchanges, inter-dealer brokers, and alternative venues but excludes dark pools. [5]Custody, fund administration, corporate trust, security lending, net interest income, collateral management, and ancillary services provided by custodians. [6]Equity capital markets, debt capital markets. [7]Real estate, commodities, private capital investments, derivatives.

Source: SWF Institute; McKinsey Capital Markets and Investment Banking Pools; McKinsey Global Institute McKinsey Panorama Global Banking Pools; McKinsey Performance Lens Global Growth Cube

Source: McKinsey Global Banking report 2020

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What are Commercial Banks?

Course map

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Bank Management

4 primary concerns of bank managers:	Aspects of bank management:
• Make sure bank has enough cash to pay deposit outflows	• Liquidity management
• Pursue an acceptably low level of risk by acquiring assets with low default rate and diversifying asset holdings	• Asset management
• Acquire funds at low cost	• Liability management
• Decide the amount of capital the bank should maintain and acquire this capital	• Capital management

ALM