IS4228
Information technology and financial services

Lecture 1

15 August, 2023

NUS
National University of Singapore

Module details

Instructor: Xiaofan Li

- *E-mail: li.x@nus.edu.sg*

Teaching Assistant: TBD

Class participation

- **Poll Everywhere**
  - pollev.com/is4228
  - Join with your NUS email and account!
  - Important for your class participation score!

- **Quizzes, Q&A, surveys will be operated through this platform.**

Course expectations

This module expects you to achieve:

- **Understand and be able to apply fundamental theories of finance**
- **Understand the role of information technologies in finance**
- **Learn some cutting edge applications of information technologies in finance**
- **Able to think about future applications of information technologies in finance**

Assessment

- **Class Participation** **5%**
- **Individual Assignments** **5%*5=25%**
- **Mid-term test** **35%**
- **Group Project** **35%**

Individual assignments

- **5 Individual assignments**
- **Will be published after Lecture 2-6, respectively**
- **Due before the lecture time next week (6:30 pm the following Tuesday)**

Mid-term test

- **Semi-closed book (A 2-sided A4 cheat sheet is allowed)**
- **Will be taken on the lecture time of Week 7**
- **Questions in similar formats to individual assignments**

Group project

- **Groups of 3 to 4, you can form by yourselves**
  - Registration google sheet will be shared later
  - If you want to have a, for example, telegram group to form groups and discuss other module related issues, I can help advertise.
- **Deliverables include a report and a presentation**
  - More details will be shared after the midterm
- **Presentation on Week 12-13**
- **Among the 35 points**
  - 15 to report
  - 20 to presentation
  - Both factored by peer evaluation

Overview

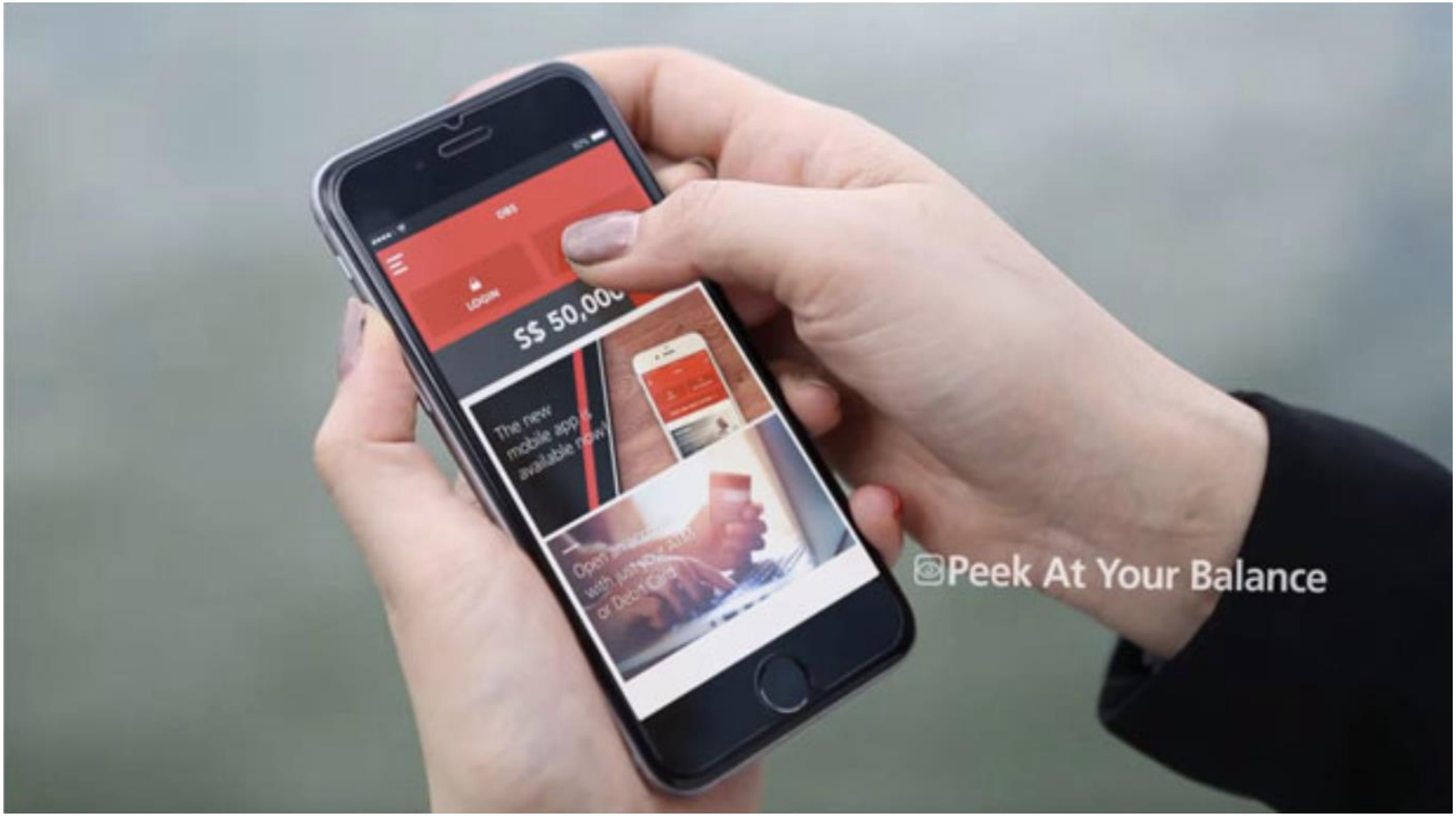
- **Introduction to Fintech**
- **Time value of money**
- **Banks and challenges from nonbanks**

Introduction to Fintech

- **What is finance?**

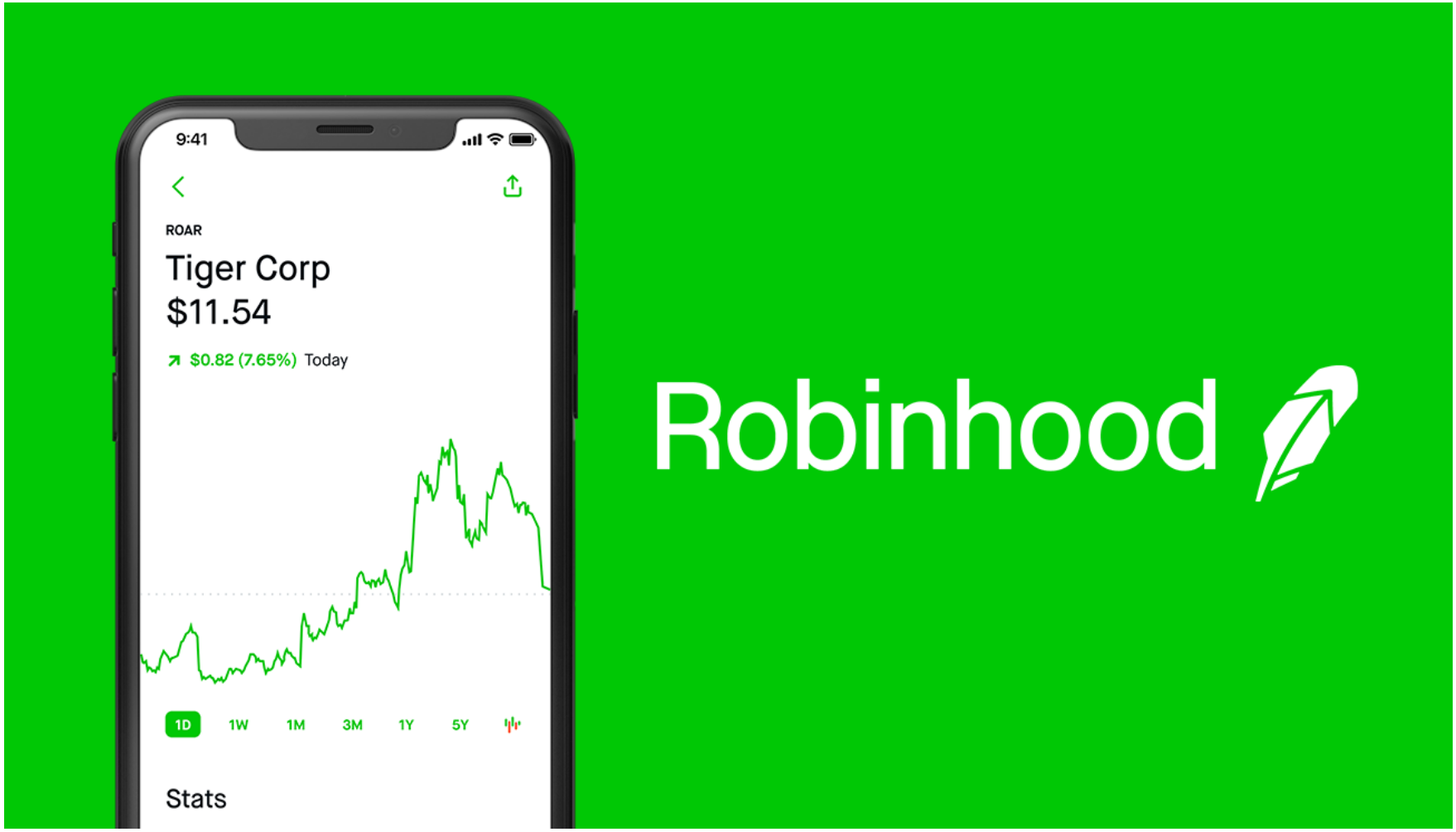
- **What is fintech?**
  - using new technology to compete with traditional financial methods in the delivery of financial services.

Example of fintech – mobile bank



Example of fintech – mobile transaction

Example of fintech – trading apps



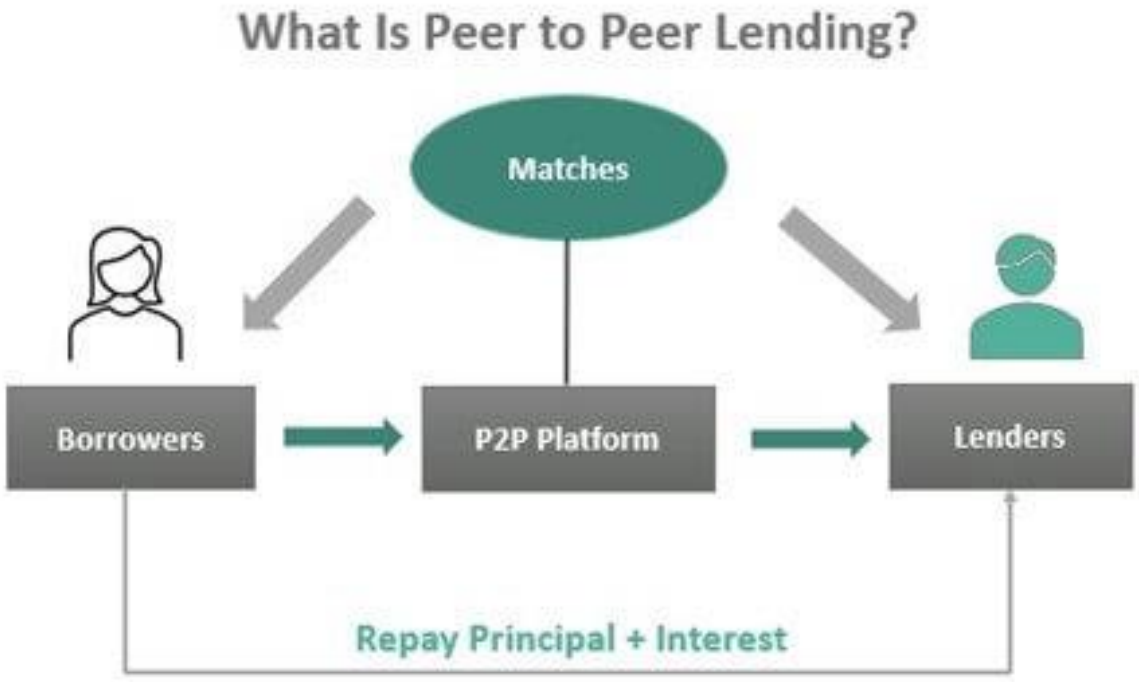
Example of fintech - crowdfunding

Example of fintech - blockchain

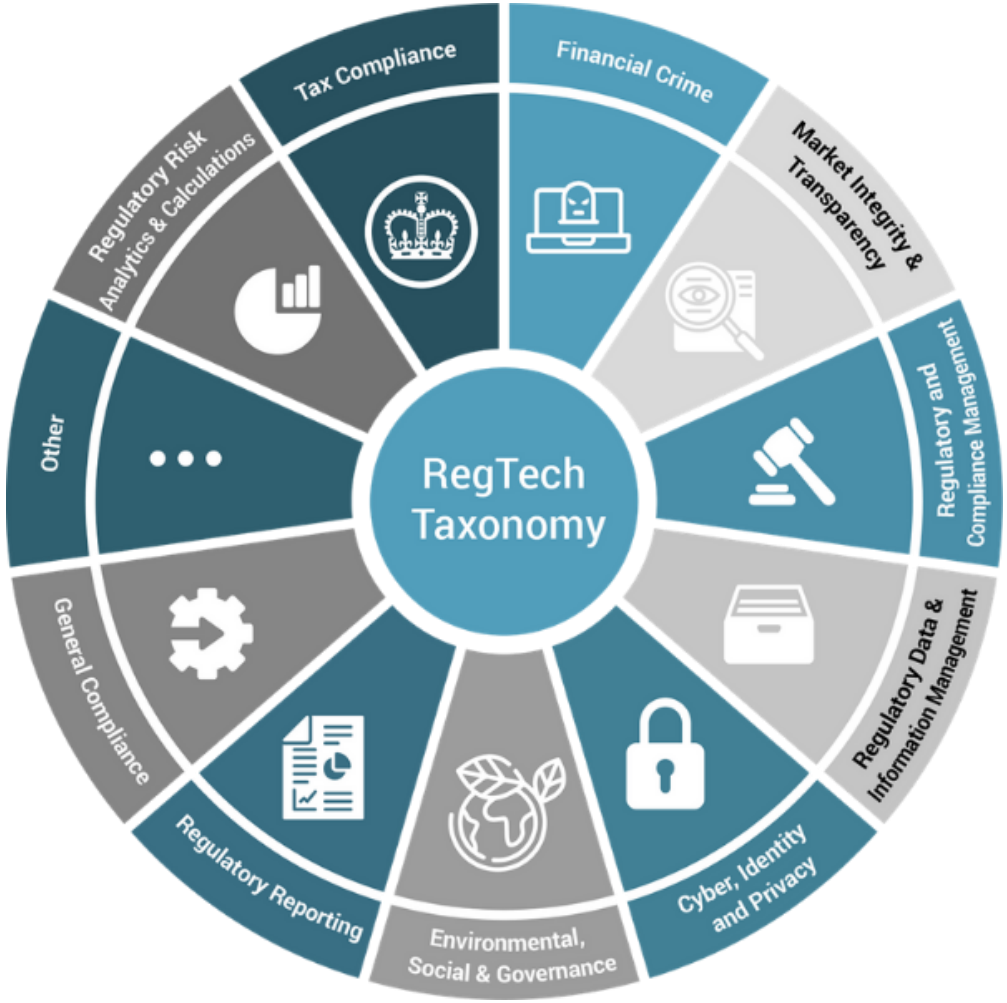
Example of fintech - insurtech

Example of fintech – robo advisor

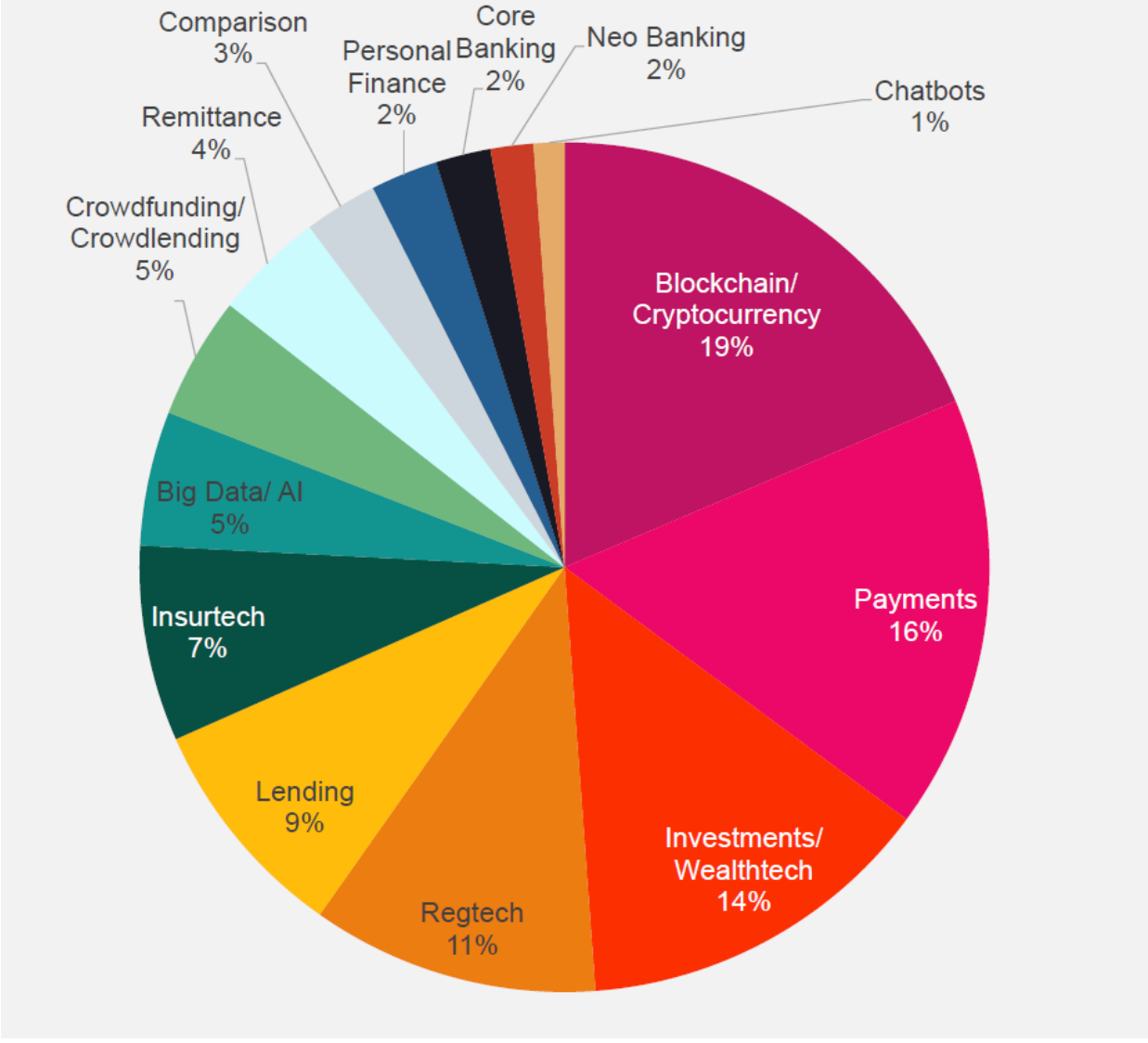
Example of fintech – p2p lending



Example of fintech - regtech



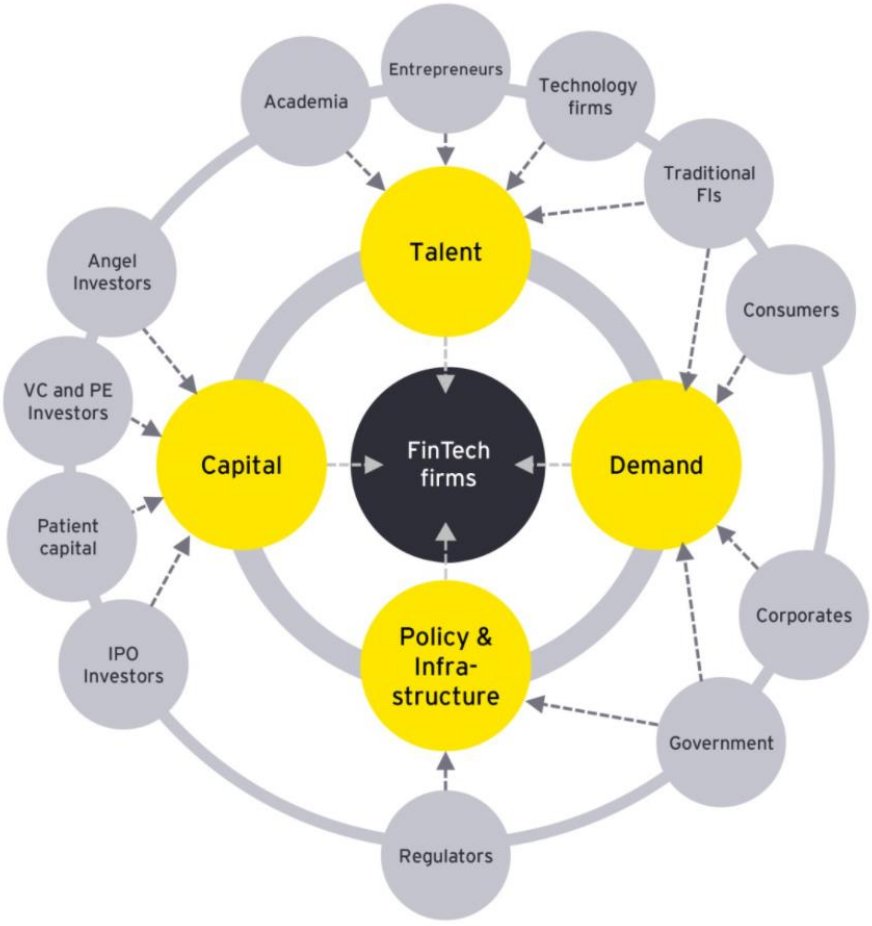
Singapore fintech landscape



FinTech Ecosystem

Source E&Y: How FinTechs are moving mountains and moving mainstream

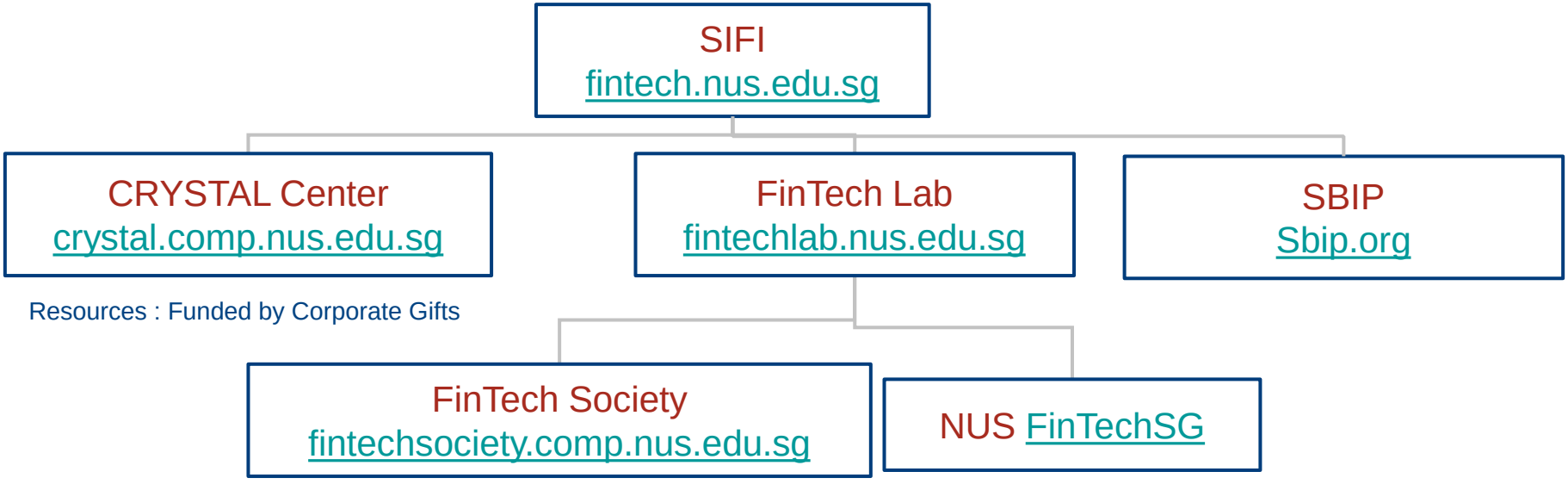
https://www.ey.com/en_gl/financial-services-emeia/how-fintechs-are-moving-mountains-and-moving-mainstream



NUS Computing: Research & Experiential Learning

Vision: “To transform our daily lives, safely, through Fintech”

Mission: Educate the Ecosystem: Regulators, Lawyers, Corporates, Students



“As digitisation becomes an essential anchor for our economy, it is crucial to provide companies with a foundation – including knowledge, experience and resources – for future-ready talent and enterprises to truly succeed. The NUS FinTech Lab is at the forefront of this mission to join forces across the industry, and provide the best collective intelligence and tools for everyone to navigate the digital future,”

- Professor Mohan Kankanhalli, Dean of NUS School of Computing and Chairman of the FinTech Lab Advisory Board.

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Top Blockchain University: National University of Singapore

Industry

Top Blockchain University: National University of Singapore

Overview

- **Introduction to Fintech**
- **Time value of money**
- **Banks and challenges from nonbanks**

The time value of money

- **Generally, a dollar today is worth more than a dollar in one year.**
- **If you have $1 today, you can invest it. For example, if you deposit it in a bank account paying 7% interest, you will have $1.07 at the end of one year.**
- **We call the difference in value between money today and money in the future the time value of money.**

Interest rate

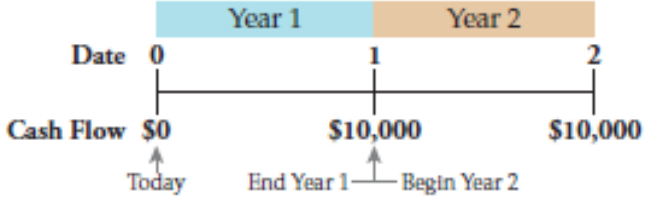
- **Exchange rate across time**
- **The rate that converts money from one point in time to another.**
- **Define risk-free interest rate, r_f, for a given period as the interest rate at which money can be borrowed or lent without risk over that period.**
- **has units of "$ in one year/$ today"**

Present Versus Future Value

- **Assume the interest rate $r_f = 7\% = 0.07$**
- **$ 1 today = $ 1 today * 1.07 $ in one year/$ today**
  = $ 1.07 in one year
- **When expressing the transaction above in terms of dollars today ($ 1 today), we call it the present value.**
- **When expressing it in terms of dollars in the future ($ 1.07 in one year), we call it the future value.**
- **To compute the present value of a future cash flow, we need to discount it, where the discount factor is $1/(1+ r_f)$**
  - $ 1.07 in one year = $ 1.07*1/(1+0.07) = $ 1 today

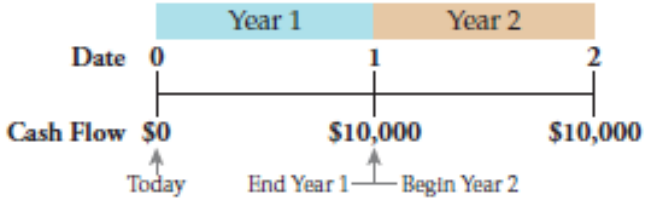
The timeline

- **Valuation of cash flows lasting several periods**
- **A series of cash flows lasting several periods is referred to as a stream of cash flows.**
- **Can be represented on a timeline**

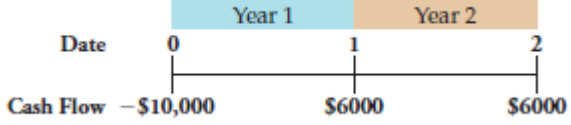


- **A timeline where someone scheduled to make two payments to you of $10,000 at the end of each of the next two years.**

The timeline



- **Each point on the timeline represents a specific date.**
- **Date 0: today**
- **The space between date 0 and date 1 then represents the time period between these dates.**
- **Date 1 signifies both the end of year 1 and the beginning of year 2.**



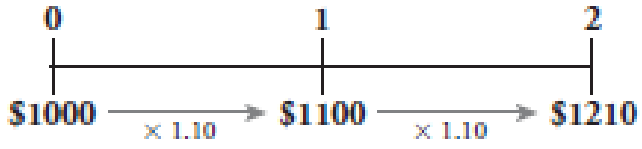
- **A timeline can capture both inflows (positive) and outflows (negative) of cash.**

The three rules of time travel

- **Financial decisions often require comparing or combining cash flows that occur at different points in time.**
- **Rule 1:** ***it is only possible to compare or combine values at the same point in time.***
- **Rule 2:** ***to move a cash flow forward in time, you must compound it.***
- **Rule 3:** ***to move a cash flow back in time, you must discount it.***

Compounding

- **Assume a 10% interest rate and we have $1000 on date 0**



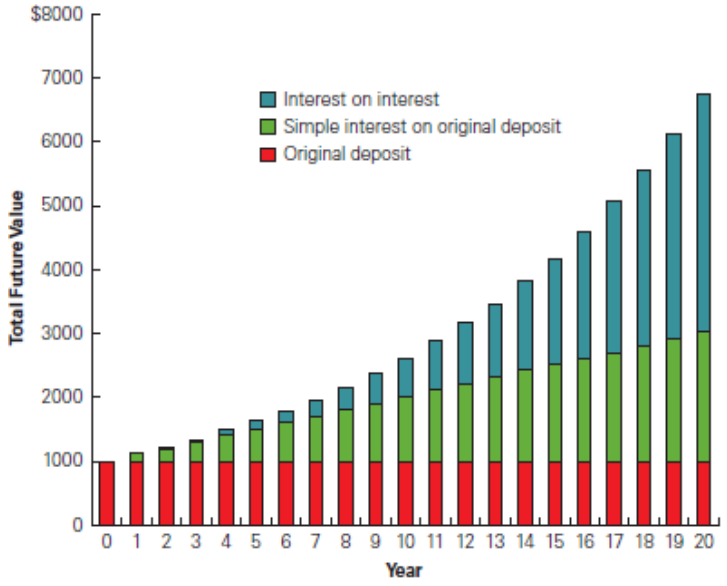
- **$FV_n = C*(1+r)*(1+r)*\ldots*(1+r) = C*(1+r)^n$**

n times

- **Future value at the end of year *n*. (C is the cash flow now, and r is the interest rate)**

The power of compounding

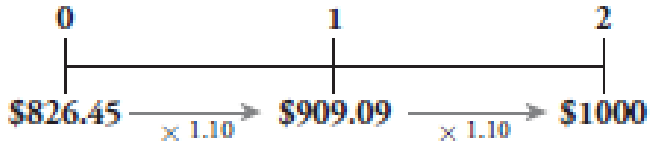
- **The growth is exponential**
- **$1000 * $(1.10)^7$ = $1948.72**
- **$1000 * $(1.10)^{20}$ = $6727.50**
- **$1000 * $(1.10)^{75}$ = $1,271,895.37**



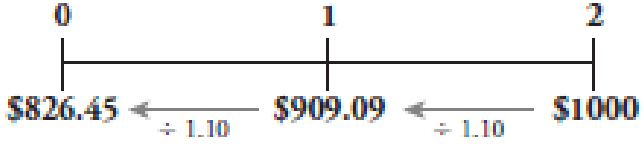
- **Rule of 72： Years to double is approximately 72/interest rate in percent**
  - 10% interest rate → A bit more than 7 years to double
  - 8% interest rate → around 9 years to double

Discounting

- **If we receive $1000 at the end of year 2, it is equivalent to**



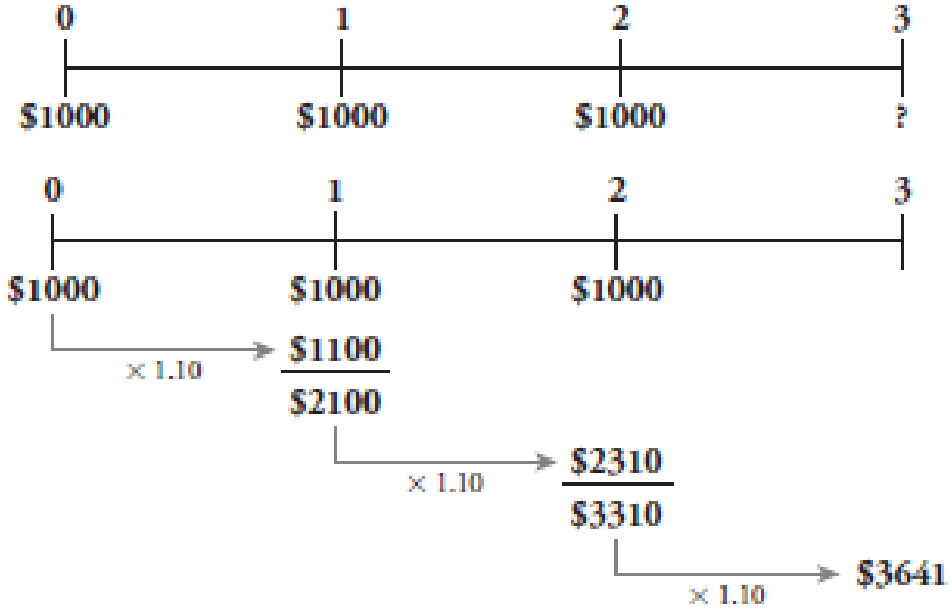
- **Therefore, this $1000, need to be discounted as $826.45 at date 0**



- **$PV=C/(1+r)^n$**
- **C is the cash flow at the end of year n, r is the interest rate**

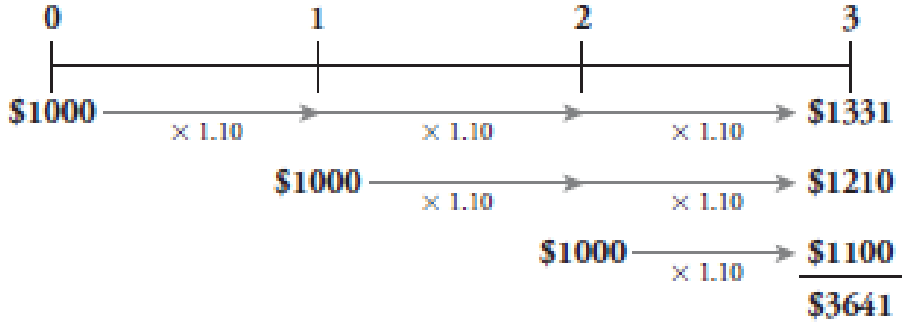
Applying the Rules of Time Travel

We plan to save $1000 today, and $1000 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?



Applying the Rules of Time Travel

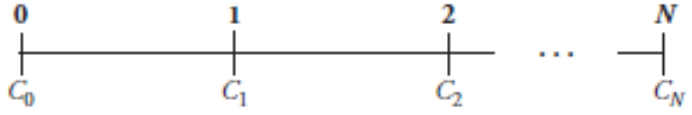
- **Another approach**



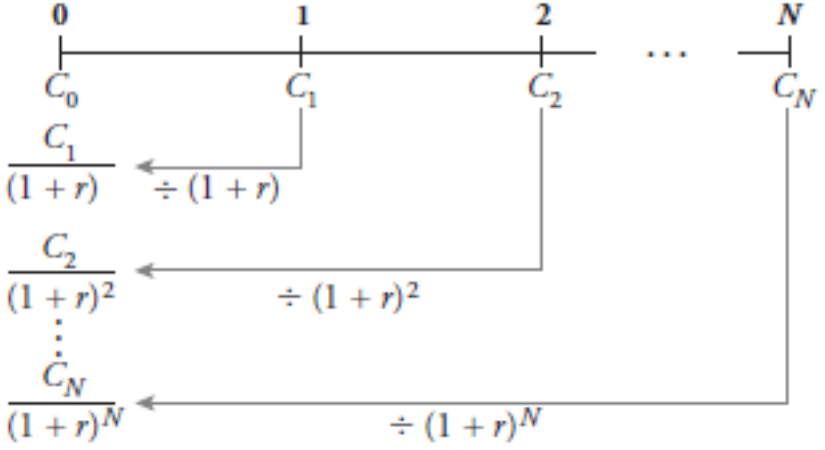
- **The order of applying the rules does not matter.**

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.**



- **For a given interest rate r, the cash flow above is equivalent to**



Valuing a Stream of Cash Flows

- **The general formula for the present value of a cash flow stream is therefore**

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

- **Or**

$$PV = \sum_{n=0}^{N} PV(C_n) = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n}$$

Overview

- **Introduction to Fintech**
- **Time value of money**
- **Banks and challenges from nonbanks**

Banks

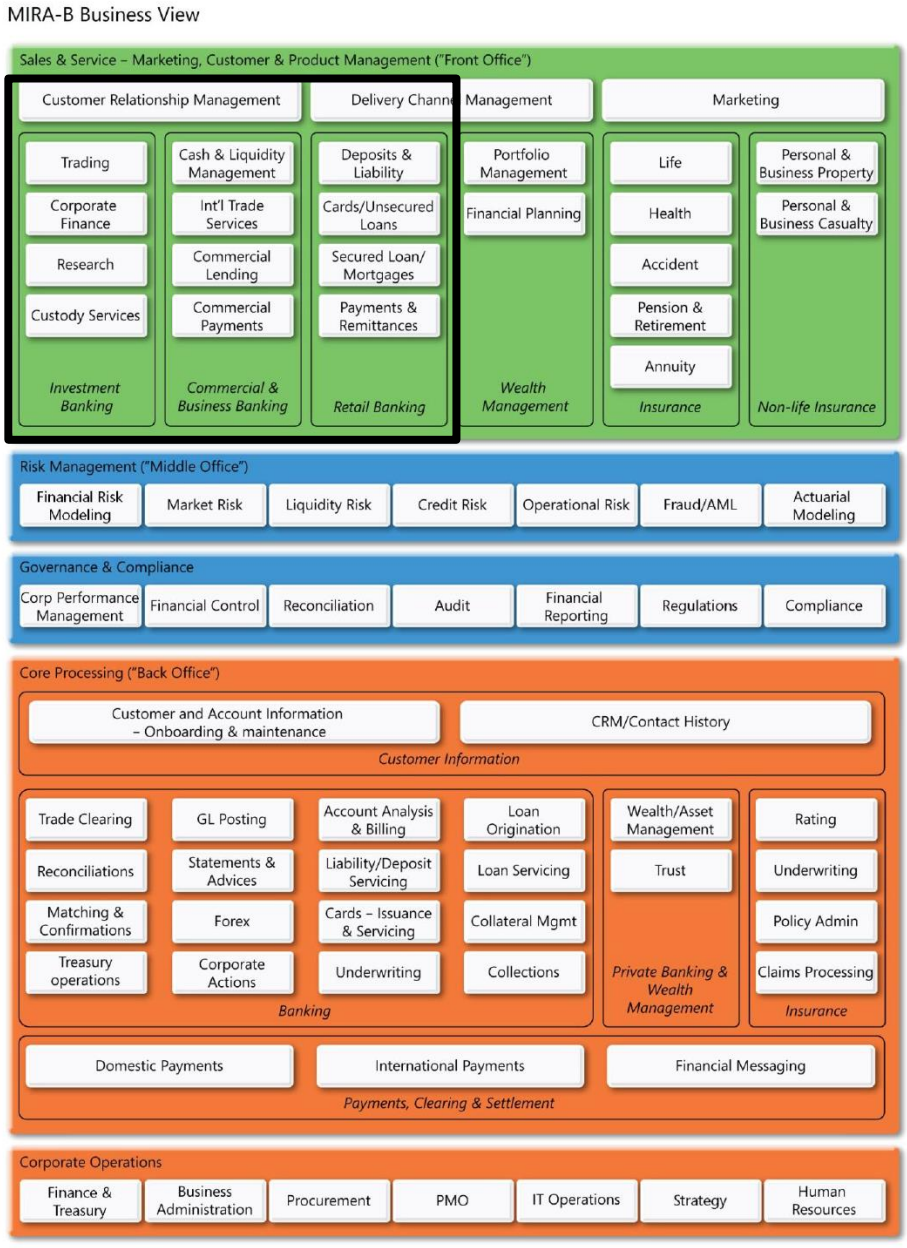
- **Fundamental function**
  - Marketplace for time value of money

- **Earn interest rate difference between borrowers and lenders.**

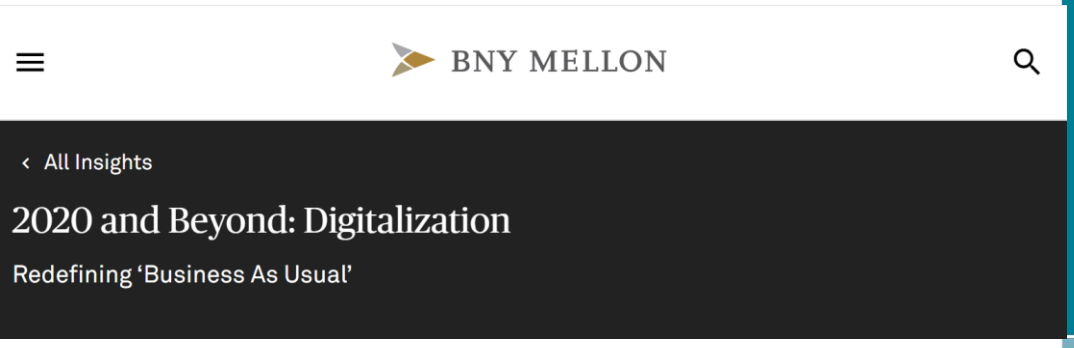
Traditional Banking Architecture

- **Front Office:**
  - Investment Banking
  - Commercial & Business Banking
  - Retail Banking
- **Back Office:**
  - Payments
  - Corporate Operations
  - Procurement
  - Project Management Office (PMO)
  - IT Operations

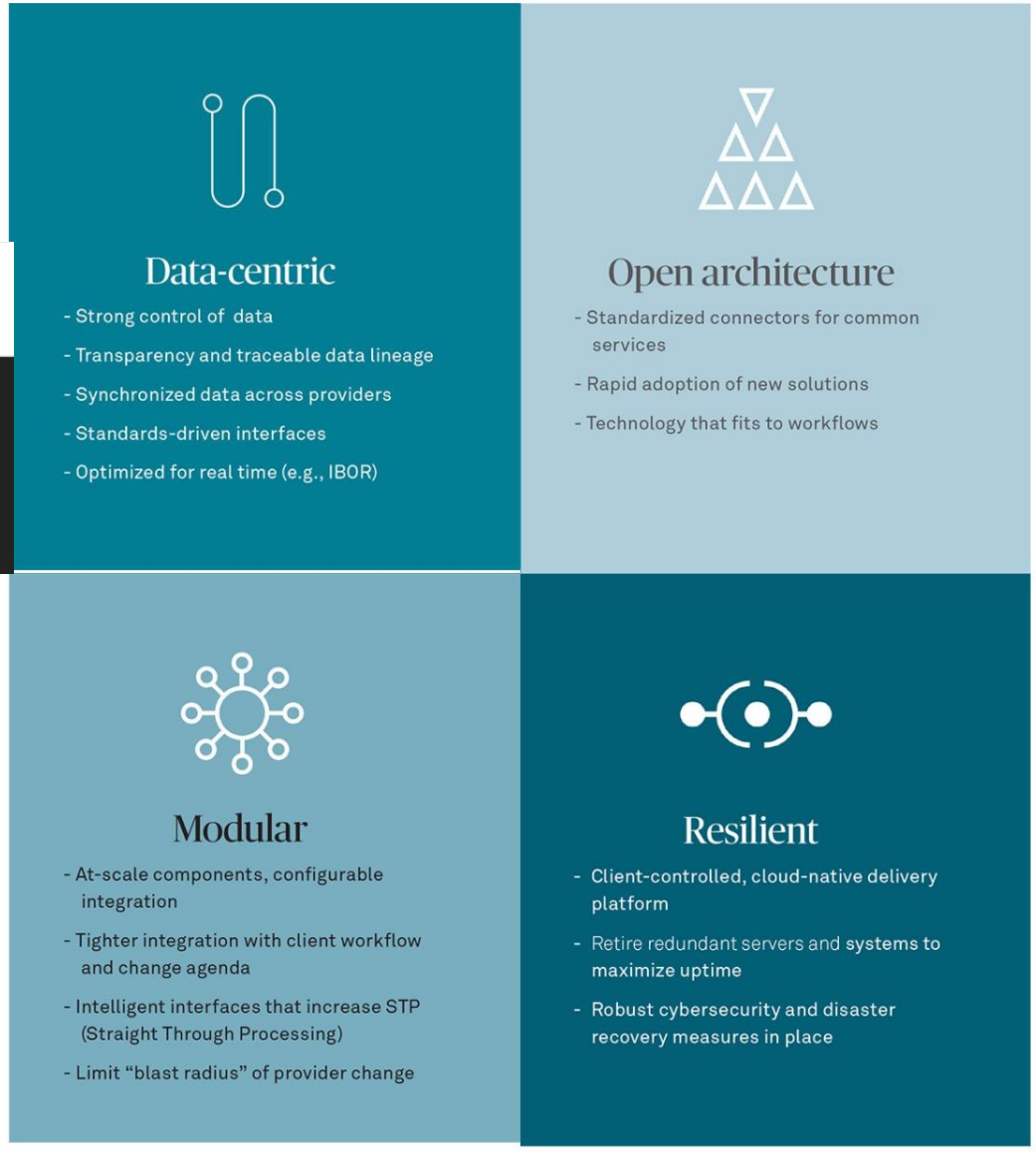
- **Source: IBM MIRA-B Figure 4 Business View (pages 10 to 21)**



New Architecture



https://www.bnymellon.com/apac/en/insights/all-insights/2020-and-beyond-digitalization.html



Deposits & Lending: Alternative Models of Lending

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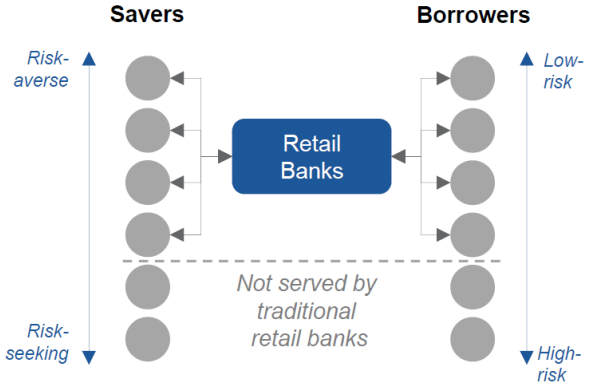
In a risk-averse economy, retail banks' model of intermediating savers and borrowers has reduced accessibility to loans for subprime customers

How do financial institutions facilitate lending activities today?

- Retail banks receive savings from their account holders and provide interest on the savings in return. In most countries, regulators mandate banks to insure and hold minimum reserve on the savings held
- Using the saved funds, retail banks originate loans to borrowers and receive interest in return. The availability of loans and the interest rates are determined by the adjudication of borrowers' risk profiles, typically using credit scores
- Typically, interest received on loans are higher than interest paid on savings to account for default risks and other operational costs
- The breadth of borrowers served is dependent on each bank's risk appetite, which is generally related to the size and scale of the banks (e.g., riskier borrowers tend to be served by tier 2/3 banks or balance sheet lenders)



Evolution of traditional lending models

- Following the 2008-2009 global financial crisis, customer trust surrounding financial services quickly dissipated
- Regulators also mandated increased safety measures around loans (e.g., higher capital requirements) which resulted in many banks tightening loan requirements
- This mutual loss of confidence created a lending gap, leaving a considerable portion of borrowing needs underserved by financial institutions
- Furthermore, customer preferences in financial services are rapidly changing, demanding more transparency, efficiency and control over their savings and loans

Key characteristics of traditional models

Limited Access
A growing lending gap limits the availability of loans to individuals and companies with higher risk profiles

Slow Speed
Traditional adjudication processes with multiple layers of approval limits the banks' ability to process loans in timely manner

Margin for Error
Traditional adjudication models and credit scores tend to miss suitable lending opportunities in a virtual economy

Poor Customer Experience
Highly manual adjudication processes and requirements fall short of increasing expectations on customer experiences

Limited Control
Borrowers have limited visibility and control over the uses of funds and interest rates earned

Low Return
Operational inefficiency and reduced risk appetite of banks result in low returns on savings

Deposits & Lending: Shifting Customer Channel Preferences

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These changing customer preferences have manifested in a number of innovations emerging across primary account providers

What are the key innovations manifested by shifting customer channel preferences?

Virtual Banks

- "Direct Banks" first emerged in the 1990s based on telephone banking and have since evolved to become more "virtual," relying on online / mobile channels
- Most virtual banks established to date have been subsidiaries of large traditional financial institutions, targeting their price-sensitive customer segments
- Today, improved technology is allowing virtual banks to offer new and compelling value propositions beyond just lower cost

Case studies

fidor BANK

Fully virtual "community" bank in Germany, offering innovative products such as game currency wallet and high degree of social media integration

Other Examples

SIMPLE mBank ZUNO by Raiffeisen Bank International

Evolution of Mobile Banking

- Rapid adoption of mobile devices has led many financial institutions to quickly add digital channels for basic transactions
- However, these channels often struggle to meet customers' demands for fully functional mobile platforms
- Free of legacy systems, non-traditional players are emerging to offer mobile apps that make financial transactions even more effortless for customers (e.g., P2P money transfer, photo bill payment, voice recognition)

Case studies

popmoney

Provides financial institutions with a mobile / online solution that enables fast, easy and low cost consumer to consumer money transfer via email and text across institutions

Other Examples

Mitek USAA

Banking as Platform

- Legacy systems and competing priorities limit the speed at which traditional players can offer innovative online and mobile tools; particularly for smaller institutions where the cost to deliver a full suite of solutions to meet diverse customer needs can be prohibitive
- Banking-as-platform movement aims to standardise APIs across financial institutions allowing 3rd party developers to easily build and integrate customer-facing enhancements to the institutions' core offerings

Case studies

CRÉDIT AGRICOLE

Runs an app store for its customers to download a wide range of additional functionalities to its core online and mobile platform by exposing its API to external developers

Other Examples

OPEN BANK PROJECT YODLEE

Digital Banks

Thank you!

Acknowledgement: some of the slides are contributed by Keith B. Carter