

From Financial Tsunami to FinTech

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**Information and Communications
Laboratories**

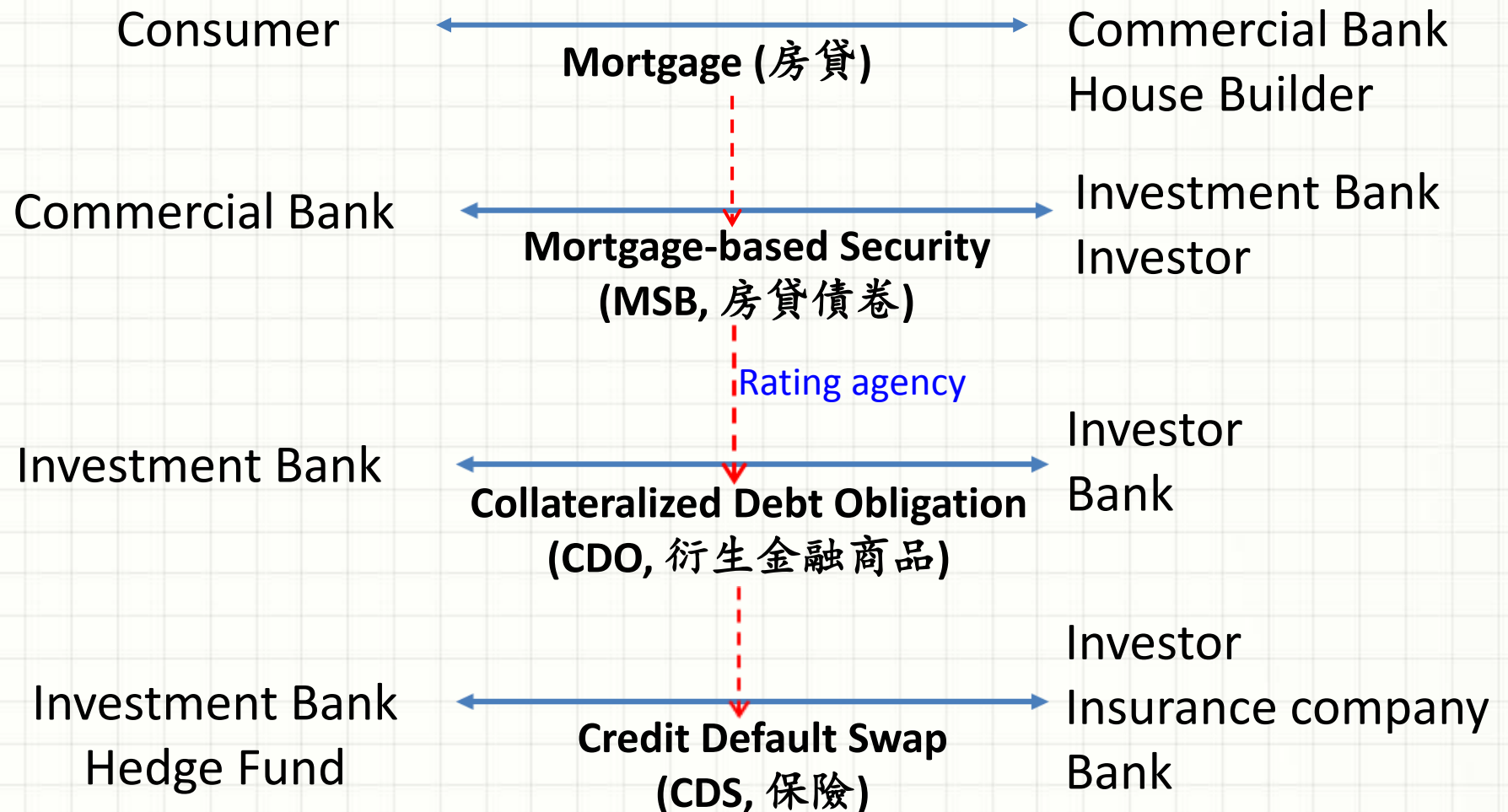


A CAUTIONARY TALE ON 2008 FINANCIAL TSUNAMI

A Near Armageddon

- Worst recession since the 1930 Great Depression
- Price tag:
 - Estimated GDP loss is **\$12.8 trillion**.
 - **8.8 million jobs** were lost.
 - **9.3 million Americans** lost their health insurance.
 - **11 million homeowners**, almost 1 in 4, are saddled with mortgages higher than the value of their homes.
 - The largest 5 investment banks ceased to exist.
 - Two out of the Big Three auto makers went bankrupt.
- What actually happened?

The Gist



Mortgage-Backed Security (MSB)

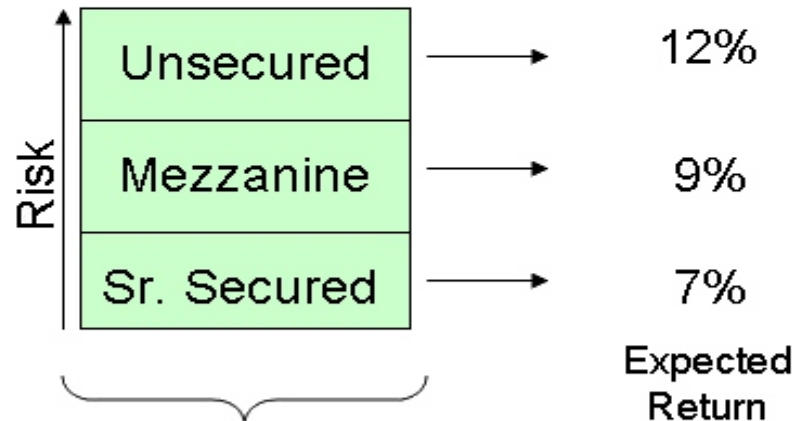
Mortgages



Mortgage
Pool



Mortgage Backed Security
a.k.a. "Collateralized Debt Obligation"
(divided into "tranches"
and sold at dif. levels of risk)



a.k.a. "Derivatives"
(broken up into groups and 'derived'
from the original pool)

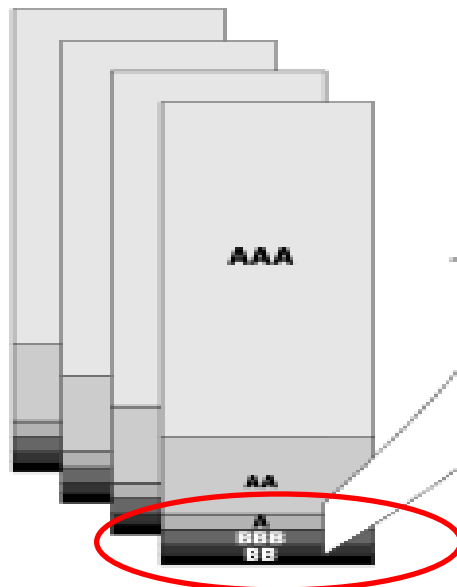
Collateralized Debt Obligation (CDO)

Collateralized Debt Obligations

Collateralized debt obligations (CDOs) are structured financial instruments that purchase and pool financial assets such as the riskier tranches of various mortgage-backed securities.

1. Purchase

The CDO manager and securities firm select and purchase assets, such as some of the lower-rated tranches of mortgage-backed securities.



**New pool
of RMBS
and other
securities**

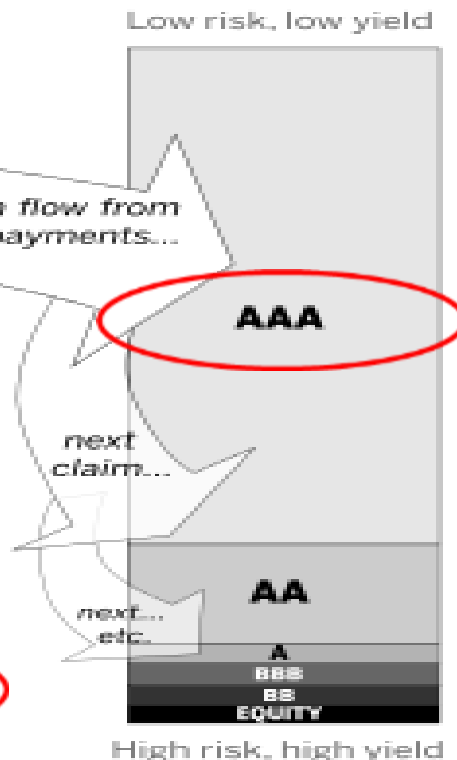
2. Pool

The CDO manager and securities firm pool various assets in an attempt to get diversification benefits.

First claim to cash flow from principal & interest payments...

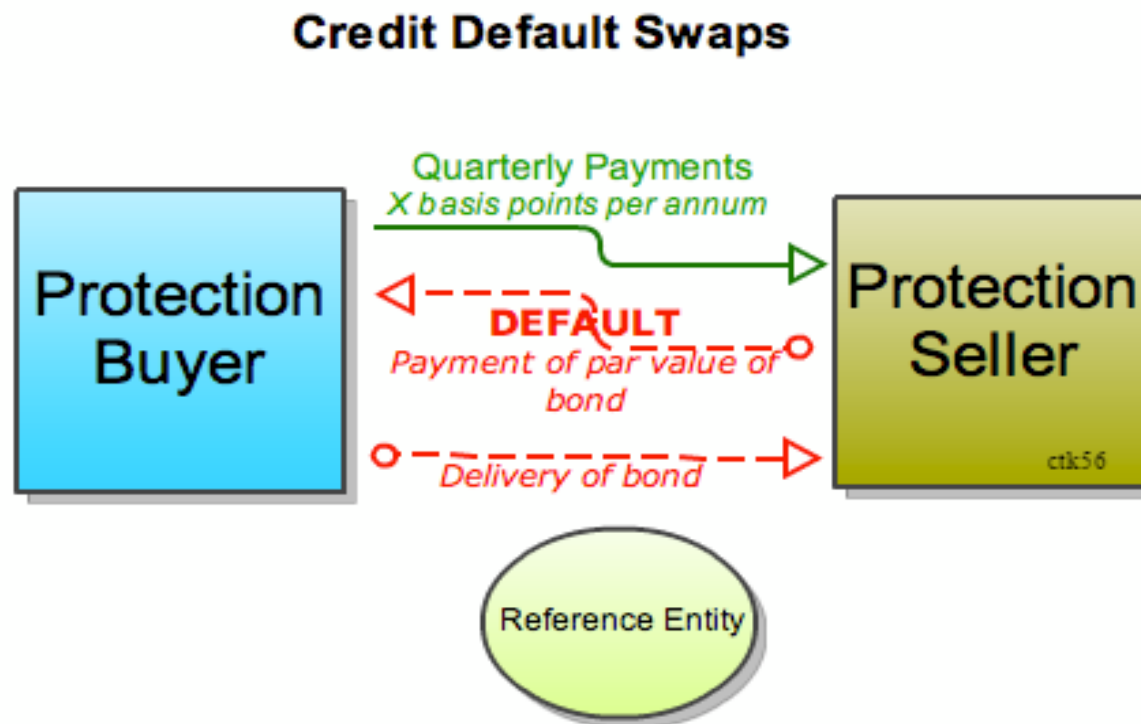
3. CDO tranches

Similar to mortgage-backed securities, the CDO issues securities in tranches that vary based on their place in the cash flow waterfall.

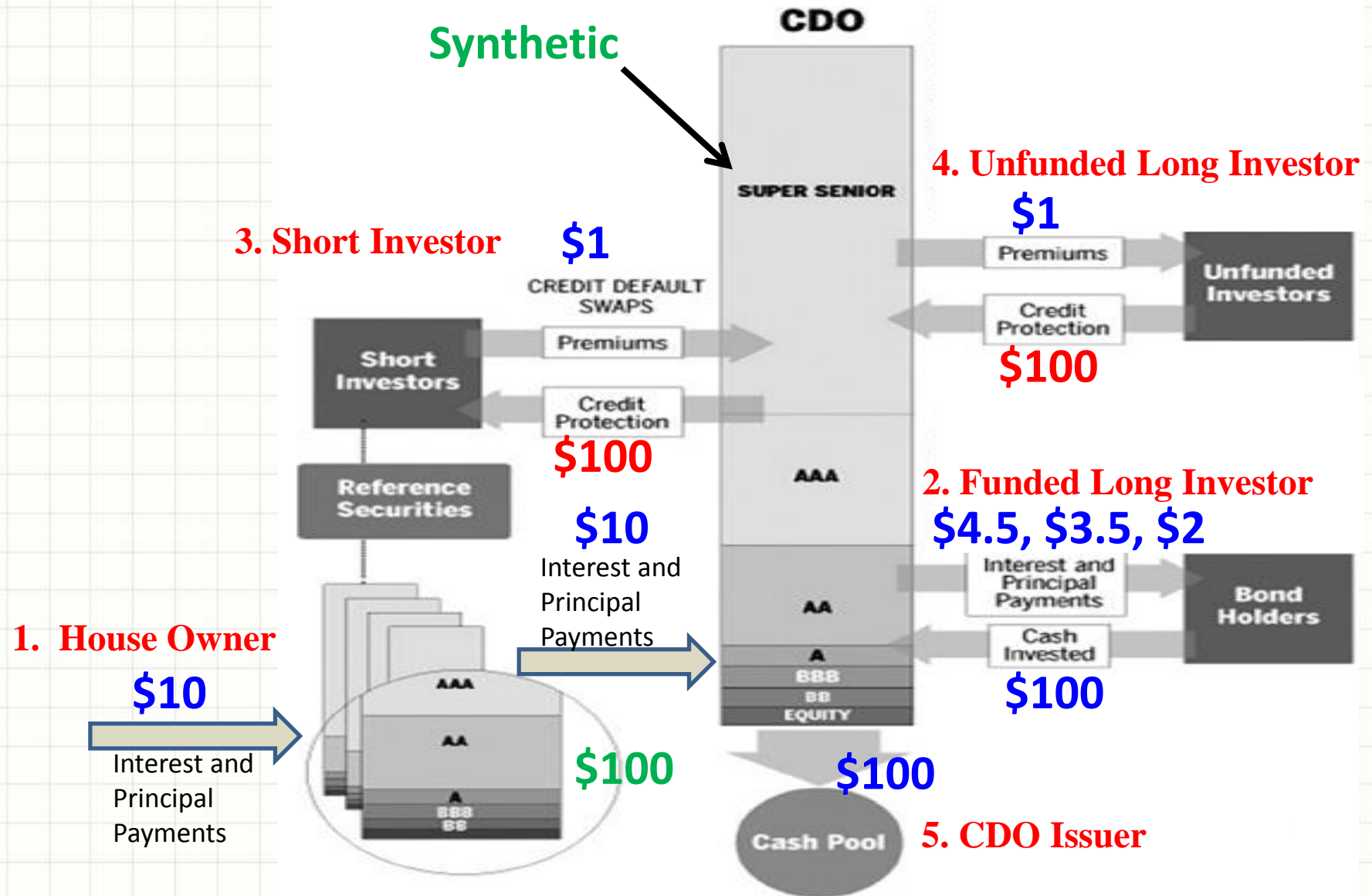


Credit Default Swap (CDS)

- How to short a CDO?
- An insurance against the default of a CDO
- **Naked** CDS
 - Unbounded market size → 80% of the CDS market
 - Arsonist buying a fire insurance on a victim's house



Synthetic CDO



The Big Short

- **Amplification of Risk** due to CDS and synthetic CDO
 - In 2006, 1.2 trillion subprime loans vs. 5 trillion synthetic CDOs
 - In 2012, only 2 billion of synthetic CDOs existed.
- **Short investors** used **heavy leverage** to bet against the housing market.
- **Consumers** are able to borrow more and more money from bank to pay for mortgage because of **rising housing price**.
- When the housing market crashed, all hells broke loose...
 - **Frozen liquidity** → **banking system failure** → **global recession**
 - **Losers**: consumer, builder, bank, investment bank, insurance company, investor
 - **Winner**: short investor
 - **John Paulson** → \$4 billion in 2007 and \$4.9 billion in 2010



The First Cracking Sounds

- **Early in 2006:** commercial banks stopped subprime lending and **AIG** stopped selling CDS
- **December 2006:** **Goldman Sachs [1]** started buying CDS
- **April 2007:** **New Century Financial** filed for Chapter 11
- **October 2007:** **Merrill Lynch [3]** announced a \$8.4 billion loss
- **March 2008:** **Bear Stearns [5]** was acquired for \$2 a share by **JP Morgan Chase** in a fire sale, with a \$30B backing from US gov.
- **July 2008:** **Indymac Bank**, the 7th-largest mortgage originator in the US, was placed into receivership of the US government
- **July 2008:** Accumulative loss of major banks in mortgage-based securities reached \$475B
- Most bond insurance companies that provided insurance against subprime CDO tranches all crashed in 2008

Days of Reckoning

- **9/7/2008**: US gov. took over of **Fannie Mae** and **Freddie Mac**, which guaranteed about half of U.S.'s **\$12T** mortgage market.
- **9/14/2008**: **Merrill Lynch [3]** was sold to **Bank of America** amidst fears of a liquidity crisis.
- **9/15/2008**: **Lehman Brothers [4]** filed for bankruptcy protection.
- **9/17/2008**: The US Federal Reserve lent \$85 billion to **American International Group (AIG)** to avoid bankruptcy.
- **9/25/2008**: **Washington Mutual** was sold to **JP Morgan**.
- **9/29/2008**: **Citigroup** acquired banking operations of **Wachovia**.
- **10/6-10**: Worst week for the US stock market in 75 years. The Dow Jones lost 22.1 percent.



Too Big to Fail

- **10/3/2008**: President Bush created TARP with \$700B.
- **10/14/2008**: The US gov. injected \$125B into **nine** largest US banks by taking an equity position in them. **Goldman Sachs [1]** and **Morgan Stanley [2]** became depository banks
- **11/17/2008**: The US gov. gave out extra \$33.6B to 21 banks.
- **11/24/2008**: The US gov. agreed to rescue **Citigroup** with \$20B after its stock price plummeted by 60% in one week
- Fed's **Quantitative Easing** (QE): Buying bonds or financial assets from private financial institutions rather than Treasury bonds
 - 11/2008 to 10/2014: **\$4.5 trillion** in accumulated asset over QE 1/2/3
 - Interest rate was raised by 0.25% on 12/16/2015
 - **Stimulating domestic private lending** vs. **exporting bubbles/inflation to the rest of the world**



Culprit Analysis

- Collapse of mortgage underwriting standards
- Predatory lending: adjustable-rate mortgage
- Complex and ungrounded financial innovations
- Inability to accurately estimate risks
- Conflict of interest is rife in investment banking operations
 - Simultaneously selling CDO and buying CDS
 - Investing client assets on risky instruments vs. returning them to clients
- Overleveraging in banks: high debt/asset ratio
 - Off-balance sheet
 - 5 largest investment banks, Fannie Mae and Freddie Mac had over \$9 trillion in debt or guarantee obligations in 2007 without being regulated like depository banks

Lessons

- Bubble, especially housing bubble, is the root cause of many financial crises, e.g. the 1987 savings and loan crisis.
- **Dodd–Frank Wall Street Reform and Consumer Protection Act**, passed in 2010, addressed some of the observed problems.
- **No major bank leaders were prosecuted**, and Wall Street excesses have returned to its pre-crisis level.
 - **Occupy Wall Street Movement**, aka **1% vs. 99%**
- **Greed can never be cured** → when will the next financial tsunami come
 - Emergence of CDO-like instruments: **Bespoke Tranche Opportunity** because of negative or zero interest rate policy
- What about Financial Technology (Fintech)?



EMERGENCE OF FINANCIAL TECHNOLOGY

Nature of Financial Service

- Basically a **database update** problem
 - Payment
 - Lending/borrowing
 - Trading
 - Investing
- The only other barriers are **trust**, which is what regulation is for, and **risk**, which needs to be estimated and managed.
- Like publishing, financial service is fundamentally digital and is thus susceptible to disruption by internet services.
- And now the day of reckoning is coming.....

Financial Technologies (FinTech)

- Make it more convenient for bank users
 - E-banking
- Make banks more efficient
 - Unmanned banking
- Make banks more competitive traders
 - Algorithmic trading machine
- Obsolete banks with more convenient and cheaper internet-based services
 - Payment
 - Lending
 - Investment
 - Insurance

FinTech Services

- Methodology: go through every detailed step in standard financial service flows, and explore how IT can facilitate, simplify or remove it.
- Examples:
 - Payment: Square, Stripe
 - Money exchange: **Transferwise**, Worldremit
 - Virtual currency: ChangeCoin, CHAIN, Codius
 - Financing: **Zestfinance**, HelloWallet, **Vouch**, **Fluent Network**
 - P2P lending: Zopa, Lending Club
 - Crowdfunding: IndieGoGo, Kickstarter
 - Investment Robot: **EquityZen**, **Kensho**, Visible Alpha, Mint
 - Insurance: **Zenefits**, FounderShield, AccuScore, **Cuvva**

MyNetWorth (我的淨值)

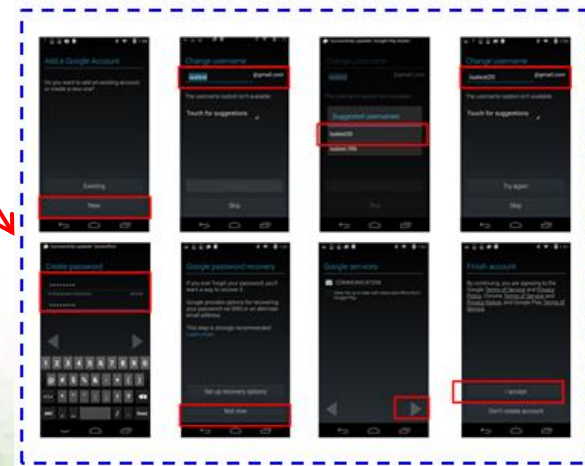
- Goal: The easiest way to find out a person's net worth
- Visibility is the basis of all management
 - Real-time personal health status monitoring
 - Real-time personal finance status monitoring
- Service model: provide a free up-to-date consolidated view of the bank accounts of an individual in an easy-to-use fashion
 - Bank accounts, credit card accounts, investment fund accounts, insurance accounts, retirement fund accounts, etc.
- Approaches
 - API economy
 - Automation of e-banking apps
- Business model: personal wealth management

Unified e-Banking App



automate

automate

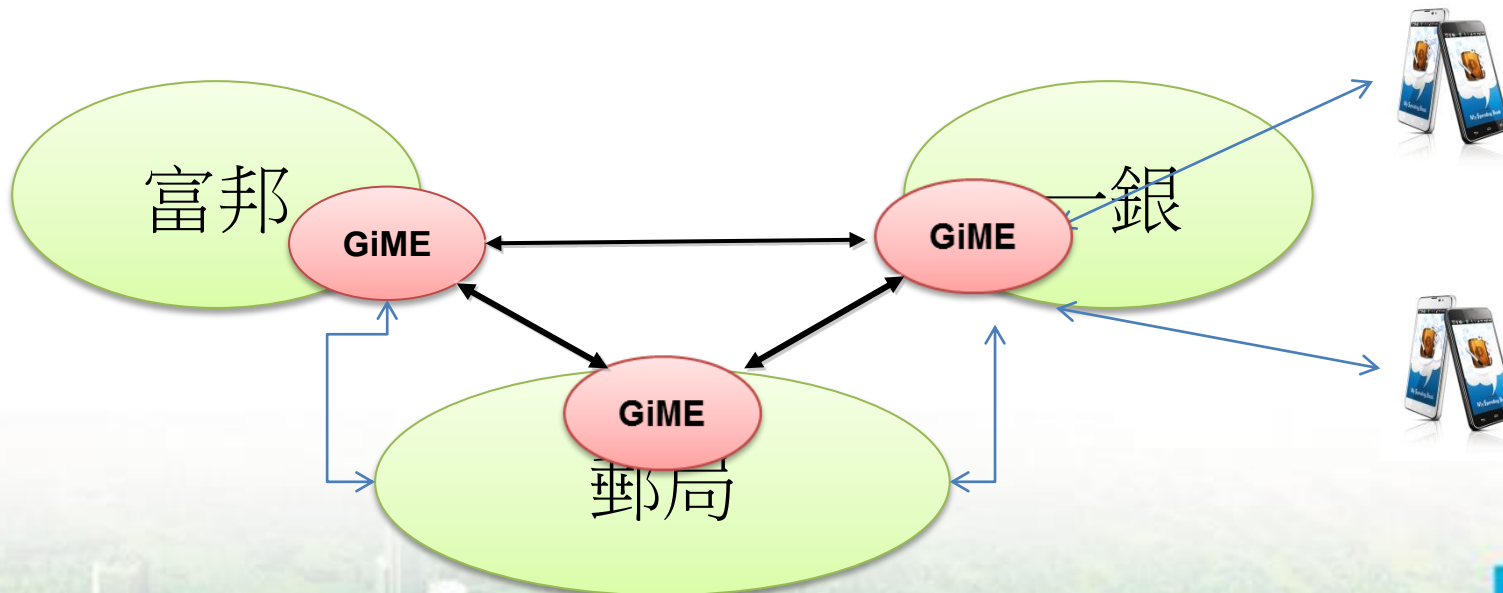


GiME (人情帳): C2C Payment

- Goal: Record the financial dimension of social networks
- Service model: a recording service for friend-to-friend money and gift exchanges
 - A pays B X dollars: no money changes hand, just an IOU record
 - A gives B a gift
- The debts from A to B and the debts from B to A can cancel each other.
- When the net debt from A to B exceeds a threshold, the system alerts A to clear it. Clearing could be done in cash exchange, or via intra-bank or inter-bank fund transfer.
- Detailed IOU records with timestamps and event annotations are kept forever.
- Extended from money exchange to gift exchange

Key Insight

- Problem: Inter-bank fund transfer costs money.
- Solution:
 - Take advantage of 郵局行動金融服務
Why? 每位大學生幾乎都有郵局帳號
 - **Virtual** inter-bank fund transfer



MySpendingBook (花冊)

- Goal: **The easiest way to find out how one spends his/her money**
- Service Concept: A personal or family **archive** of electronic invoices (電子發票) stored in Ministry of Finance
- **Free** services offered to consumers
 - A **permanent** record of all spendings involving electronic invoices
 - Basic analysis tools for spending records
 - Donation of e-invoice awards to charities
 - Discount notification and e-coupon delivery
 - Exchange and trade of e-coupons
 - Formation of purchase groups for **store-initiated** volume discounts
 - Active initiation of **consumer-initiated** volume discounts
 - Giving ratings and reviews on products/services



Example

我的發票

正常顯示
依中獎發票顯示

104年 財政部獎號

待	12/15	竹東工研門市部	75元
待	12/16	竹東工研門市部	31元
待	12/16	竹東工研門市部	36元
待	12/21	竹東工研門市部	31元
待	12/23	遠東巨城購物中心股份有限公司新竹	240元
待	12/28	竹東工研門市部	27元
待	12/29	竹東工研門市部	34元
待	12/29	竹東工研門市部	60元
待	12/29	安心食品服務股份有限公司工研院分公司	70元

財政部中獎號碼

民國104年09-10月

特別獎	一千萬	07332260
特獎	兩百萬	20119263
頭獎	二十萬	
二獎	四萬(末7碼)	76833937
三獎	一萬(末6碼)	28338875
四獎	四千(末5碼)	83689131
五獎	一千(末4碼)	
六獎	兩百(末3碼)	
增開六獎	兩百(末3碼)	096
		819
		105

George
pcpcchen@gmail.com

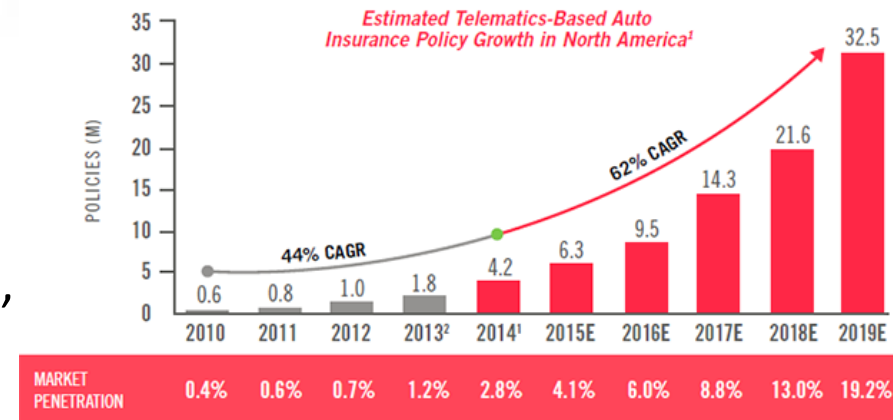
個人資料
使用者設定
中獎號碼列表

Insurance Technology (InsurTech)

- Many issues could be solved by ICL technologies
 - Premium calculation based on accurate risk profiling
 - Maximize the percentage of insured with low risk
 - Name of the game: Take into accounts as many factors as possible to derive the most comprehensive profile and thus most competitive premium
 - Keep insurance claim rate low
 - Actively encourage good behavior
 - Simplify insurance claim process
 - Effectively detect insurance fraud
 - Provide best support for the insured at time of need

Usage-based Auto Insurance

- Insurance premium is tied with
 - Driving distance (Odometer)
 - Actual roads travelled (GPS)
 - Time of driving
 - Degree of congestion (GoogleMap)
 - Driving behavior: speeding, sudden braking, frequent lane changes, using smartphones while driving, distraction, or drunk driving
 - Sensor choices: OBD II, Smartphone, In-vehicle video recorder
- Mechanisms to encourage good driving behavior and thus decrease insurance claims
 - Peer-to-peer insurance: peer pressure in social networks
 - Active reward mechanisms at the right momemts



Regulatory Technology (RegTech)

- Vision:

I have a dream. It is futuristic, but realistic. It involves a Star Trek chair and a bank of monitors. It would involve tracking the global flow of funds in close to real time (from a Star Trek chair using a bank of monitors), in much the same way as happens with global weather systems and global internet traffic. Its centerpiece would be a global map of financial flows, charting spill-overs and correlations.¹

Andy Haldane, Chief Economist, Bank of England (2014)

- Benefits:

- Reduce compliance cost and risk of traditional financial institutions
- Enable **data-driven regulation** for regulators
- Balance the regulatory requirements and financial service innovations
 - Fintech is going to be as developed as Regtech allows

RegTech Examples

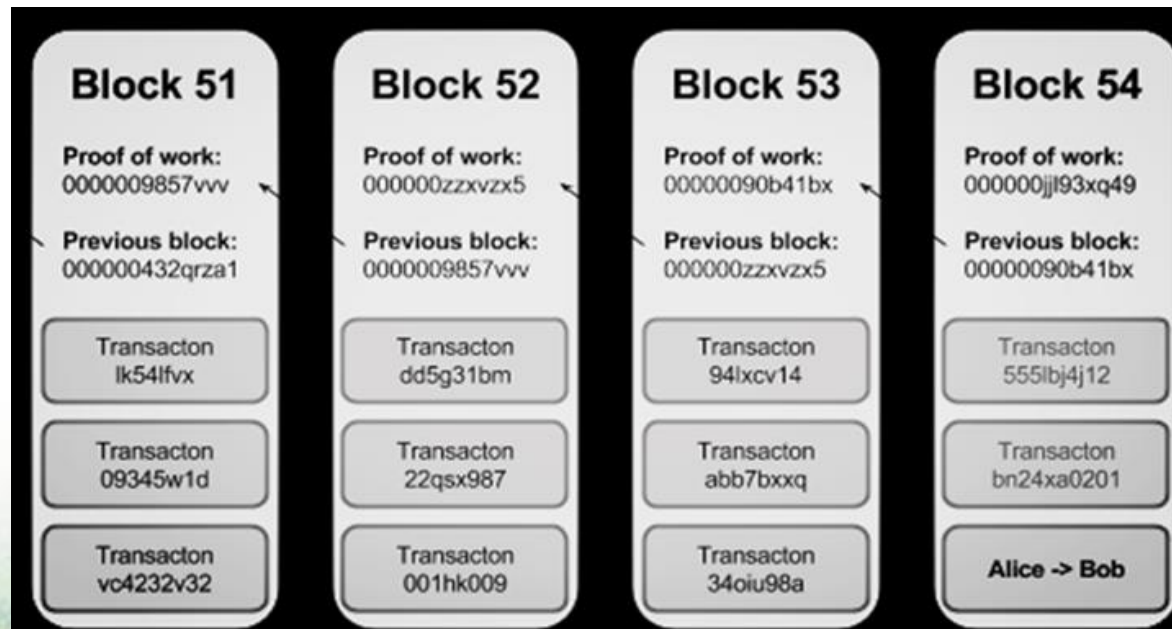
- Categories:
 - Risk data aggregation and management, and regulatory reporting
 - Modeling, scenario analysis and forecasting
 - Real-time trading monitoring and surveillance
 - Identity verification
 - Scalable automated regulatory report analysis
- Examples:
 - **Trade fraud detection**: AlgoDynamix, Sybenetix
 - Compliance risk assessment: Corlytics
 - Risk aggregation and analysis: Percentile
 - **Know-your-customer** and Customer due diligence: Passport
 - **Shareholding disclosure**: Fundapps
 - Data protection: CheckRecipient

Blockchain Overview

- The underpinning of Bitcoin: A **distributed** and **replicated** database that keeps track of coin ownership, is irrevocable, and is not administered by a central authority
- Economic mechanism design
 - **Voting** mechanism to reach consensus among distributed nodes
 - **Reward** mechanism to encourage participation in the assurance of data irrevocability
- Evolution towards autonomous distributed database
 - A centralized database
 - A distributed database with each node administered by the same authority
 - A distributed database with each node administered by a different authority
 - A distributed database with each node administered by a different authority that may not play by the rules

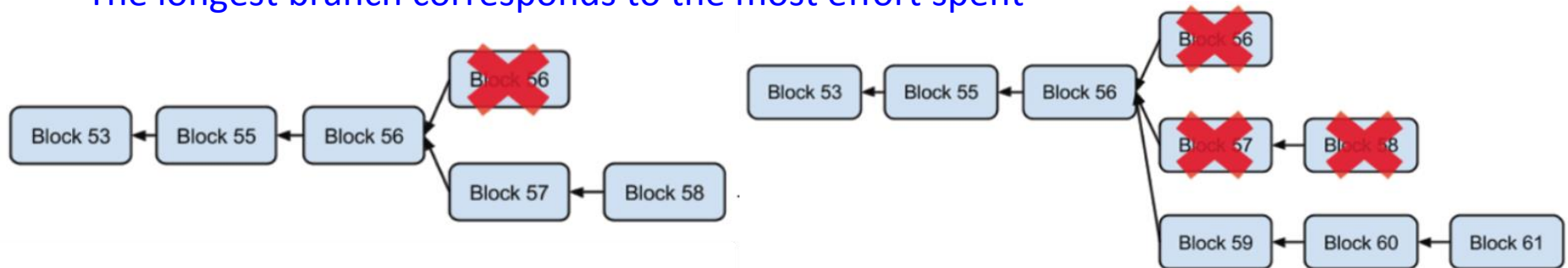
Basics of Public Blockchain

- **Clients**: generate **transaction records** and/or read the database
- **Miners**: group transaction records into blocks, generate **qualified blocks** and send them to participants
- **Participants**: maintain a copy of the database and the log by receiving qualified blocks, verifying them, appending them to the log, and propagating the transaction records contained within to the database



Proof of Work (POW)

- A miner generates a new **qualified** block from a set of transaction records by computing a Merkle tree of the transaction records and the hash value of the existing block to which the new block is to be attached.
 - Every new block implicitly contains information in the entire sequence of blocks that precede it, i.e., **the blocks are chained**.
 - The attachment point is the frontier of the longest branch in the blockchain.
 - **The longest branch corresponds to the most effort spent**



- Compute nonce such that $f(\text{merkel_hash_value}, \text{nonce}) < D$, where D is a difficulty target. The effort to find nonce serves to
 - Reduces the collision among miners competing to generate new qualified blocks
 - Makes it harder to tamper with the existing chain of blocks

Current Status of Blockchain

- Type: **Public** vs. **Consortium** vs. **Private**
- **Private** vs. **Public** Blockchain: A choice on degree of decentralization
 - How to become a participant node:
 - Permissionless vs. **Permission-based**
 - How to become a miner: generate qualified blocks
 - Economic incentives vs. **Duty**
 - How to become a user: generate transaction records
 - Censorship resistance vs. **Permission-based**
- Challenges:
 - Compelling applications are hard to find
 - Performance is too slow: <10 updates/sec vs. > 1000 updates/sec
 - Data veracity

Data Alchemy Service Model

- No. 1 problem in Data Economy: **How to effectively combine closed and administratively disparate data islands to maximize their collective value**
 - Maintenance of data ownership
 - Profit distribution according to contributions
- Secure Multi-party computation
 - Let D_i is private data of P_i , $i = 1, 2, \dots, n$. Wish to perform a computation $f(D_1, D_2, \dots, D_n) = (Y_1, Y_2, \dots, Y_n)$. Y_i is private output value for P_i .
 - **Correctness**: Parties correctly compute $f()$.
 - **Privacy**: For P_1, P_2, \dots, P_n , each player's input remains private.
 - **Output Delivery**: Protocol never ends until everyone receives an output.
 - **Fairness**: If one party gets the answer, so does every one else.

Summary

- **FinTech**, **InsurTech** and **RegTech** are on the rise.
 - Competition takes the form of innovations on service models rather than unique IT technologies.
 - Innovation Methodology: go through every detailed step in standard financial service flows, and ask how IT can facilitate, simplify or remove it.
 - Disintermediation via decentralization: P2P X
- **InsurTech** is one of the most compelling IoT applications
- **RegTech** is about automation of regulatory report delivery and analysis and **data-driven compliance**
- **Distributed trust** system builds trust without a central authority



Thank You!

Questions and Comments?

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