人工智慧投資分析

Artificial Intelligence for Investment Analysis

AI 金融科技: 金融服務創新應用

(AI in FinTech: Financial Services Innovation and Application)

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EMBA, IMTKU (M2399) (8540)
Thu 12,13,14 (19:20-22:10) (D503)

Min-Yuh Day
戴敏育
Assistant Professor
專任助理教授
Dept. of Information Management, Tamkang University
淡江大學 資訊管理學系
http://mail. tku.edu.tw/myday/

2018-09-20

課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
1	2018/09/13	人工智慧投資分析課程介紹 (Course Orientation on Artificial Intelligence for Investment Analysis)
2	2018/09/20	AI 金融科技: 金融服務創新應用 (AI in FinTech: Financial Services Innovation and Application)
3	2018/09/27	機器人理財顧問與AI交談機器人 (Robo-Advisors and AI Chatbots)
4	2018/10/04	投資心理學與行為財務學 (Investing Psychology and Behavioral Finance)
5	2018/10/11	財務金融事件研究法 (Event Studies in Finance)
6	2018/10/18	人工智慧投資分析個案研究 I (Case Study on Artificial Intelligence for Investment Analysis I)

課程大綱 (Syllabus)

週次 (Week)　日期 (Date)　內容 (Subject/Topics)

7 2018/10/25 Python AI投資分析基礎
(Foundations of AI Investment Analysis in Python)

8 2018/11/01 Python Pandas量化投資分析
(Quantitative Investing with Pandas in Python)

9 2018/11/08 Python Scikit-Learn 機器學習
(Machine Learning with Scikit-Learn In Python)

10 2018/11/15 期中報告 (Midterm Project Report)

11 2018/11/22 TensorFlow 深度學習財務時間序列預測 I
(Deep Learning for Financial Time Series Forecasting with TensorFlow I)

12 2018/11/29 TensorFlow 深度學習財務時間序列預測 II
(Deep Learning for Financial Time Series Forecasting with TensorFlow II)

課程大綱 (Syllabus)

週次 (Week)　日期 (Date)　內容 (Subject/Topics)

13 2018/12/06 人工智慧投資分析個案研究 II
(Case Study on Artificial Intelligence for Investment Analysis II)

14 2018/12/13 TensorFlow 深度學習財務時間序列預測 III
(Deep Learning for Financial Time Series Forecasting with TensorFlow III)

15 2018/12/20 投資組合最佳化與程式交易
(Portfolio Optimization and Algorithmic Trading)

16 2018/12/27 自然語言處理 (Natural Language Processing)

17 2019/01/03 期末報告 I (Final Project Presentation I)

18 2019/01/10 期末報告 II (Final Project Presentation II)

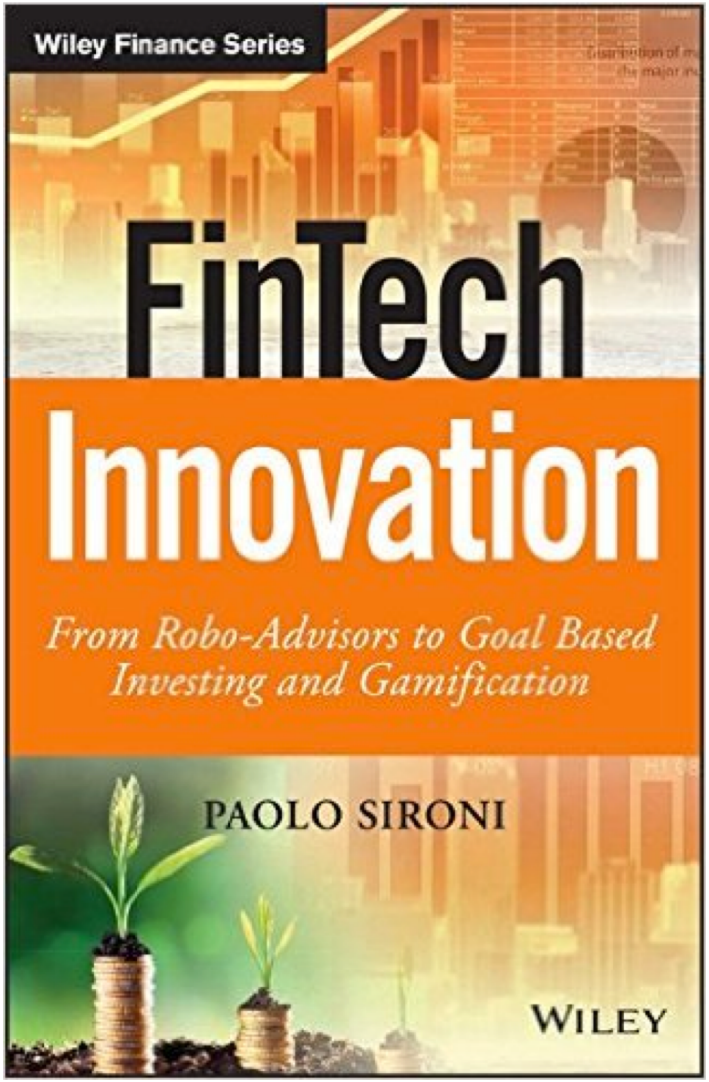
AI in FinTech: Financial Services Innovation and Application

Paolo Sironi (2016)

FinTech Innovation:

From Robo-Advisors to Goal Based Investing and Gamification,

Wiley



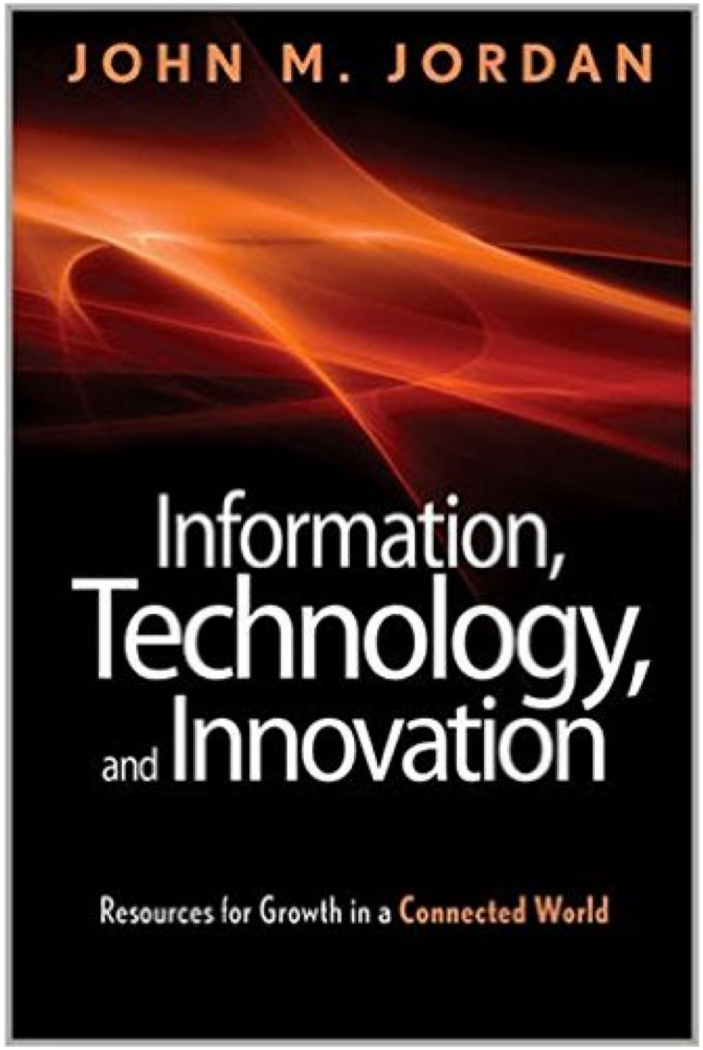
Source: https://www.amazon.com/FinTech-Innovation-Robo-Advisors-Investing-Gamification/dp/1119226988

John M. Jordan (2012),

Information, Technology, and Innovation:

Resources for Growth in a Connected World,

Wiley



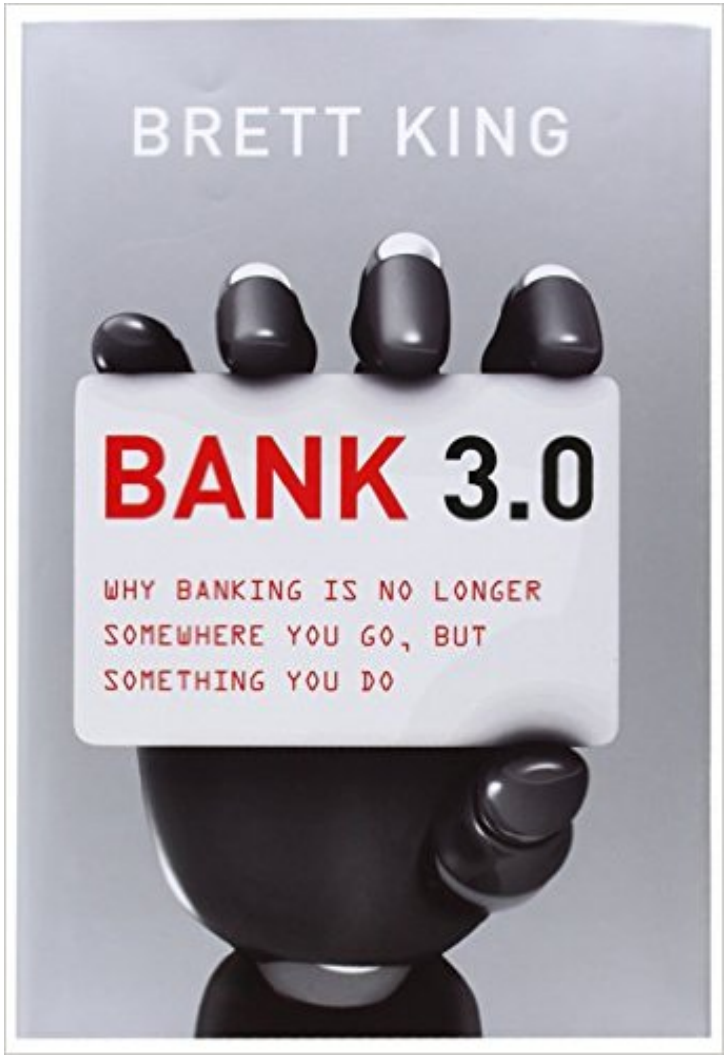
Source: https://www.amazon.com/Information-Technology-Innovation-Resources-Connected/dp/1118155785

Brett King (2012),

Bank 3.0

Why banking is no longer somewhere you go, but something you do,

Marshall Cavendish International Asia Pte Ltd



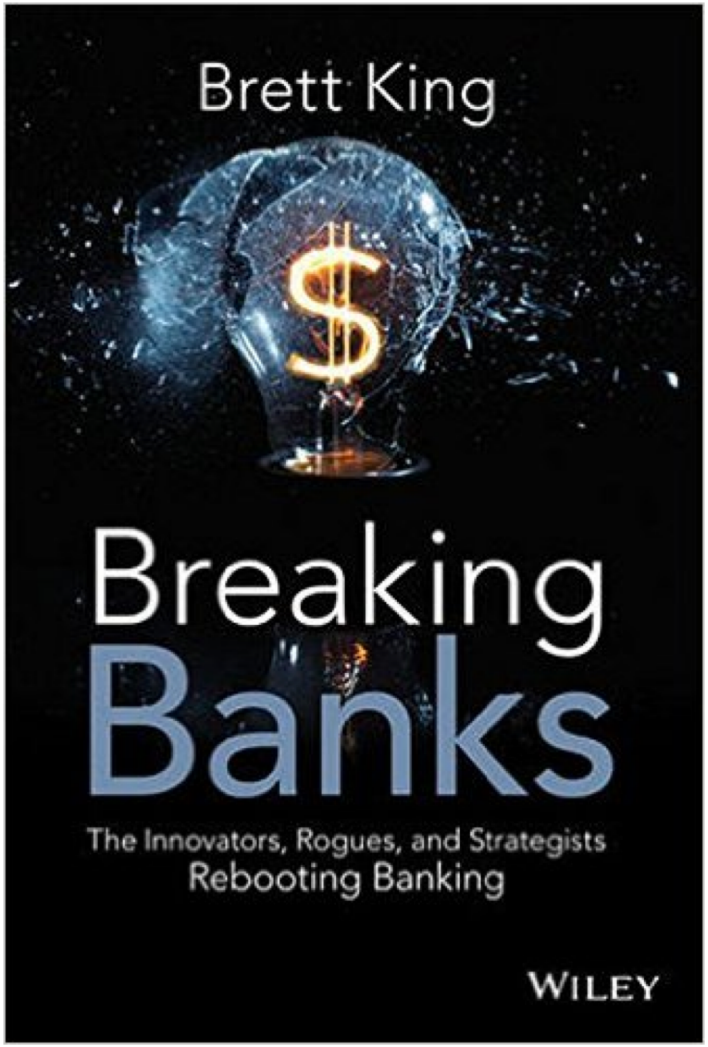
Source: https://www.amazon.com/Bank-3-0-Banking-Somewhere-Something/dp/1118589637

Brett King (2014),

Breaking Banks:

The Innovators, Rogues, and Strategists Rebooting Banking

Wiley



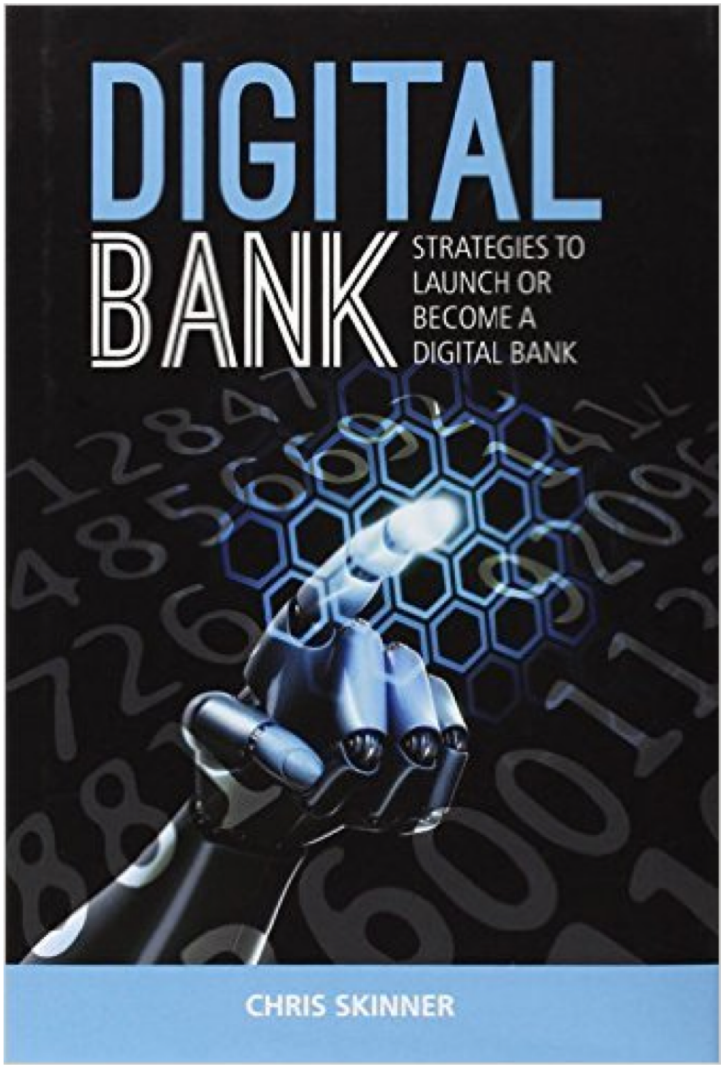
Source: https://www.amazon.com/Breaking-Banks-Innovators-Strategists-Rebooting/dp/1118900146

Chris Skinner (2014),

Digital Bank:

Strategies to Launch or Become a Digital Bank,

Marshall Cavendish International Asia Pte Ltd

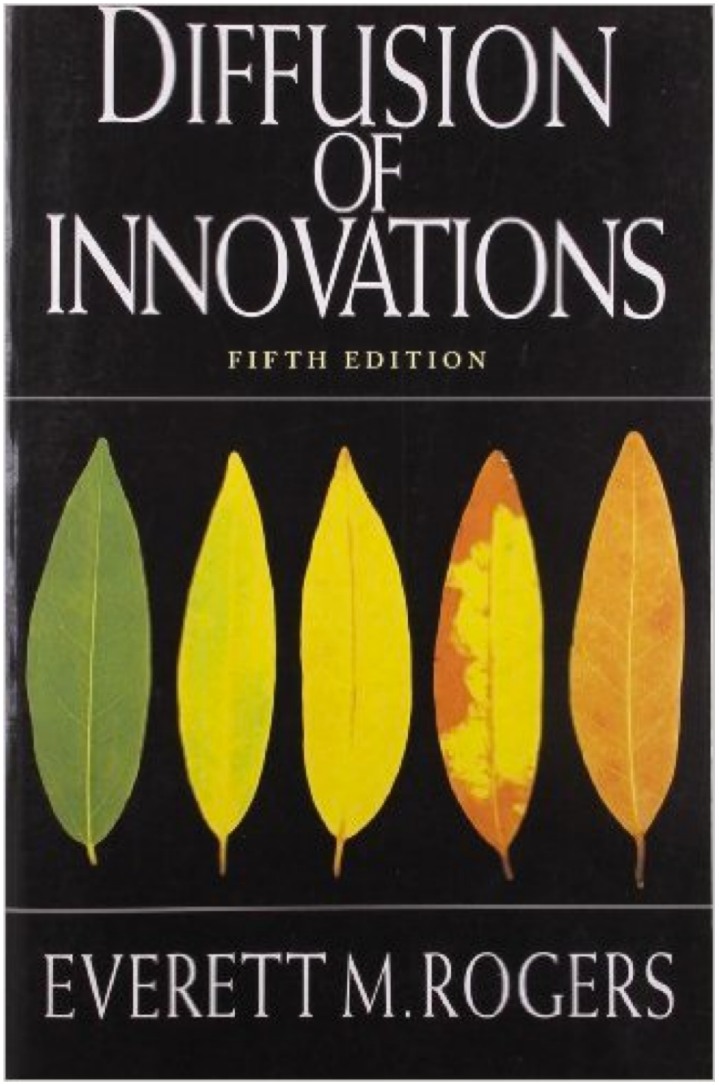


Source: https://www.amazon.com/Digital-Bank-Strategies-Launch-Become/dp/9814516465

Everett M. Rogers (2003),

Diffusion of Innovations,

5th Edition, Free Press



(Rogers, 1962; 1971; 1983; 1995; 2003)

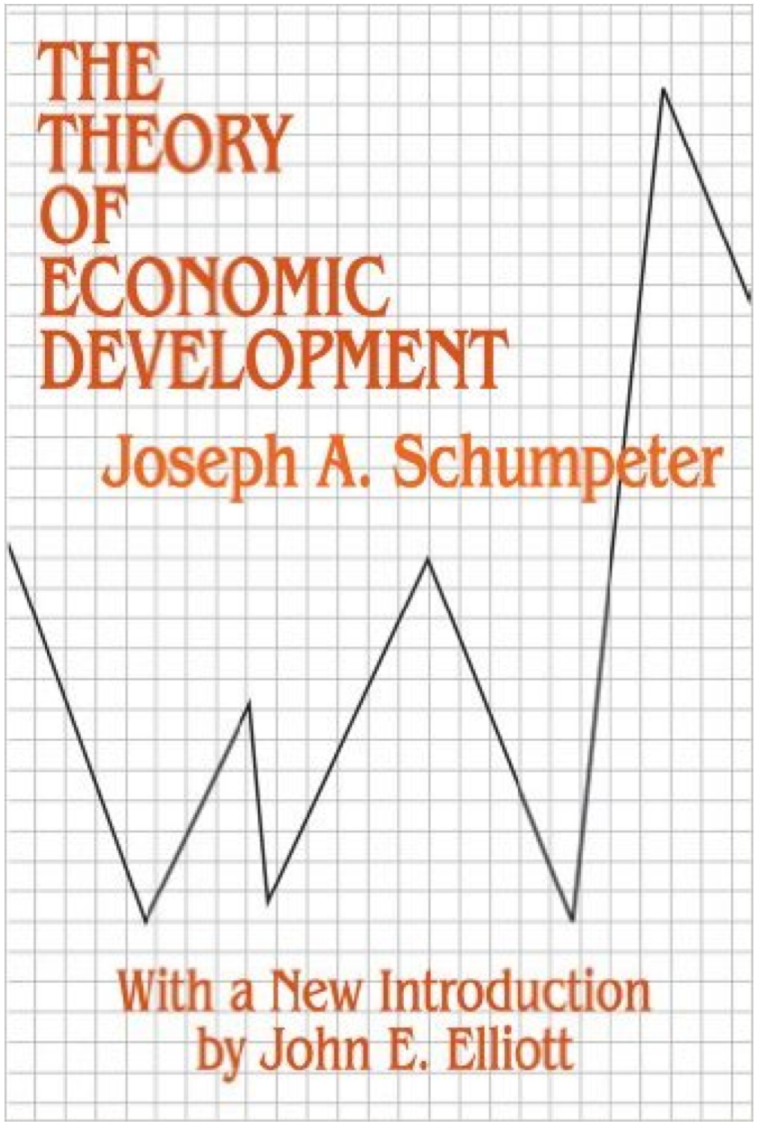
Source: https://www.amazon.com/Diffusion-Innovations-5th-Everett-Rogers/dp/0743222091

Joseph A. Schumpeter,

The Theory of Economic Development:

An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle,

Transaction Publishers, 1982

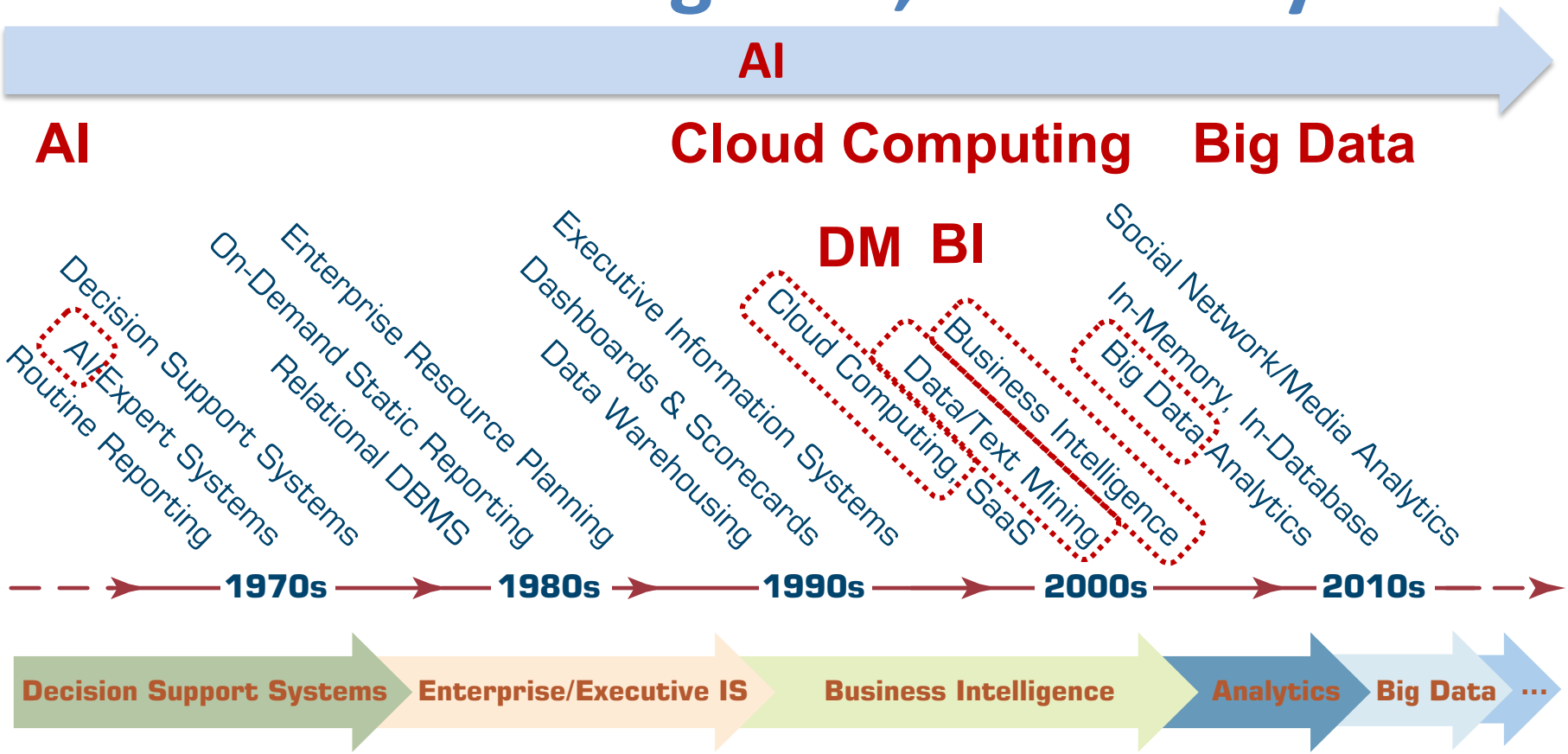


(Schumpeter, 1912)

Source: https://www.amazon.com/Theory-Economic-Development-Interest-Business/dp/0878556982

AI, Big Data, Cloud Computing

Evolution of Decision Support, Business Intelligence, and Analytics



Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017),
Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson


AI

Definition of Artificial Intelligence (A.I.)

Artificial Intelligence

"… the science and engineering of making intelligent machines"

(John McCarthy, 1955)

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

Artificial Intelligence

"… technology that thinks and acts like humans"

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

Artificial Intelligence

"… intelligence exhibited by machines or software"

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

4 Approaches of AI

Thinking Humanly	**Thinking Rationally**
Acting Humanly	**Acting Rationally**

Source: Stuart Russell and Peter Norvig (2016) , Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson International

4 Approaches of AI

2. Thinking Humanly: The Cognitive Modeling Approach	**3. Thinking Rationally: The "Laws of Thought" Approach**
1. Acting Humanly: The Turing Test Approach (1950)	**4. Acting Rationally: The Rational Agent Approach**

Source: Stuart Russell and Peter Norvig (2016) , Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson International

AI Acting Humanly: The Turing Test Approach (Alan Turing, 1950)

- Natural Language Processing (NLP)
- Knowledge Representation
- Automated Reasoning
- Machine Learning (ML)
- Computer Vision
- Robotics

Source: Stuart Russell and Peter Norvig (2016) , Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson International

Boston Dynamics: Atlas

#13 ON TRENDING

What's new, Atlas?

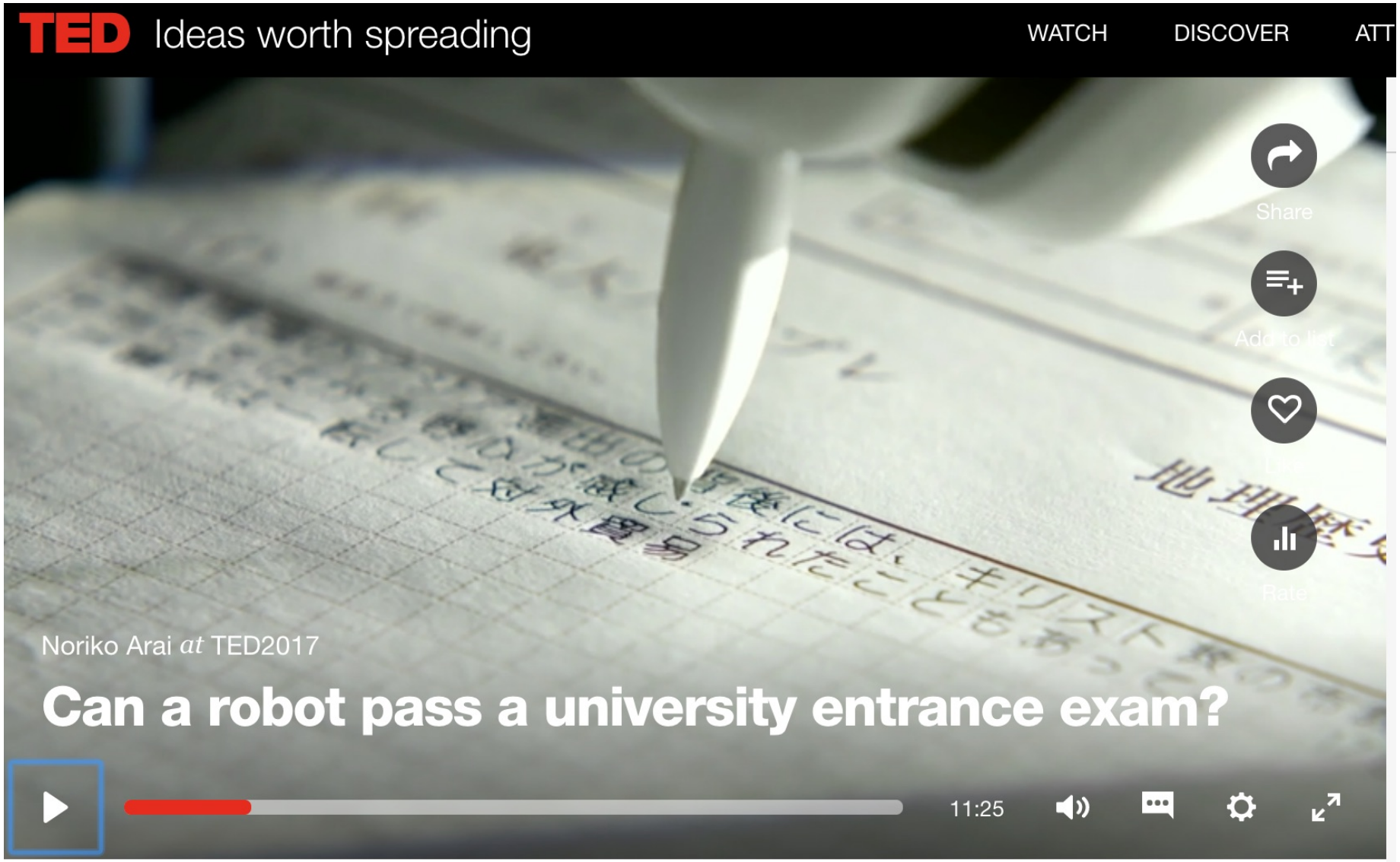
https://www.youtube.com/watch?v=fRj34o4hN4I

Humanoid Robot: Sophia

https://www.youtube.com/watch?v=S5t6K9iwcdw

Can a robot pass a university entrance exam?

Noriko Arai at TED2017



https://www.ted.com/talks/noriko_arai_can_a_robot_pass_a_university_entrance_exam
https://www.youtube.com/watch?v=XQZjkPyJ8KU

Artificial Intelligence (A.I.) Timeline

A.I. TIMELINE

1950
TURING TEST
Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence

1955
A.I. BORN
Term 'artificial intelligence' is coined by computer scientist, John McCarthy to describe "the science and engineering of making intelligent machines"

1961
UNIMATE
First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line

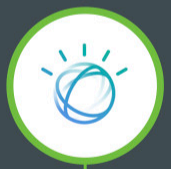
1964
ELIZA
Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans

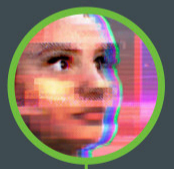
1966
SHAKEY
The 'first electronic person' from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions

A.I. WINTER
Many false starts and dead-ends leave A.I. out in the cold

1997
DEEP BLUE
Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov

1998
KISMET
Cynthia Breazeal at MIT introduces KISmet, an emotionally intelligent robot insofar as it detects and responds to people's feelings





1999
AIBO
Sony launches first consumer robot pet dog AiBO (AI robot) with skills and personality that develop over time

2002
ROOMBA
First mass produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes

2011
SIRI
Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S

2011
WATSON
IBM's question answering computer Watson wins first place on popular $1M prize television quiz show *Jeopardy*

2014
EUGENE
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human

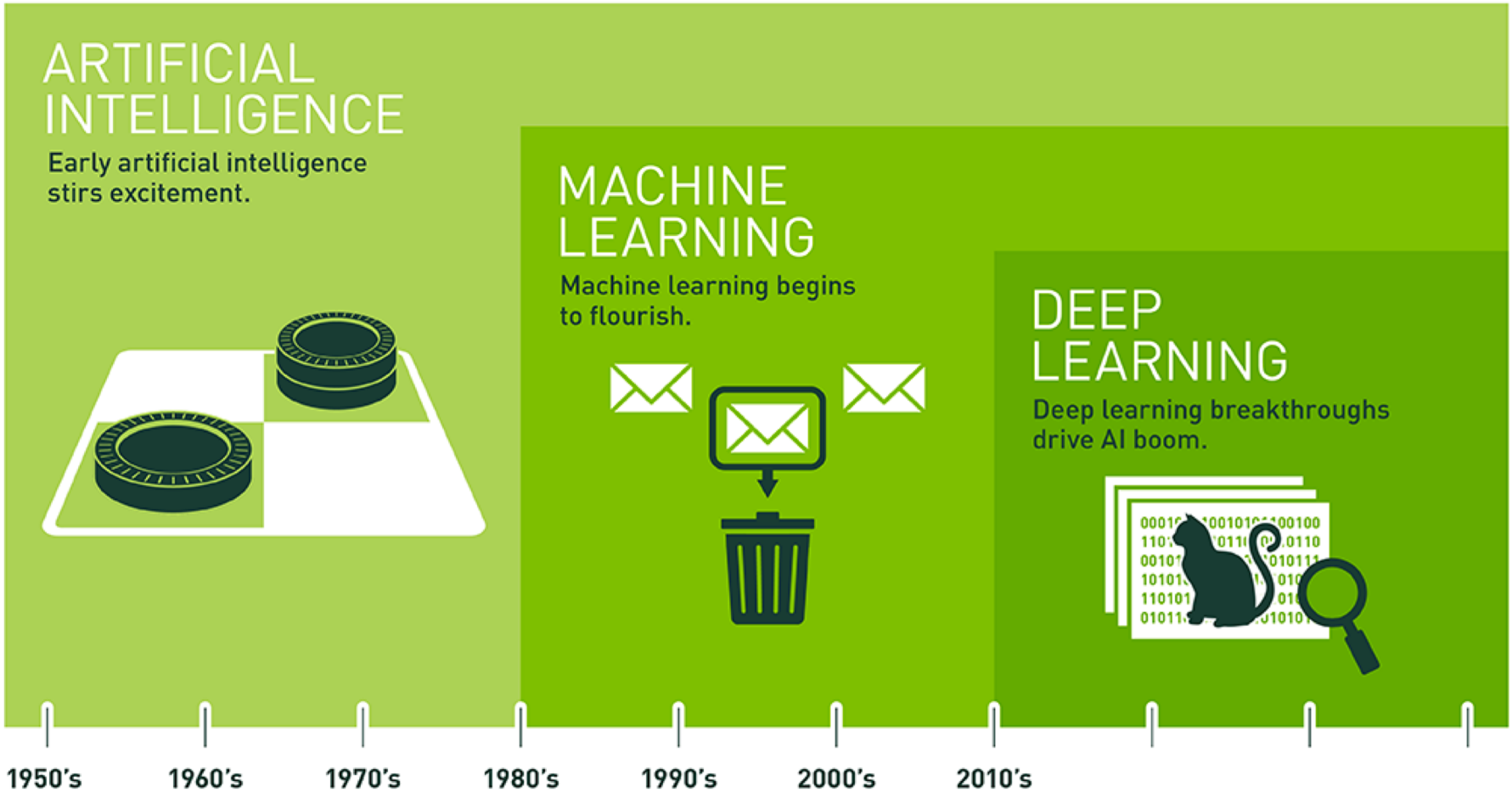
2014
ALEXA
Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks

2016
TAY
Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments

2017
ALPHAGO
Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^{170}) of possible positions

Source: https://digitalintelligencetoday.com/artificial-intelligence-timeline-infographic-from-eliza-to-tay-and-beyond/

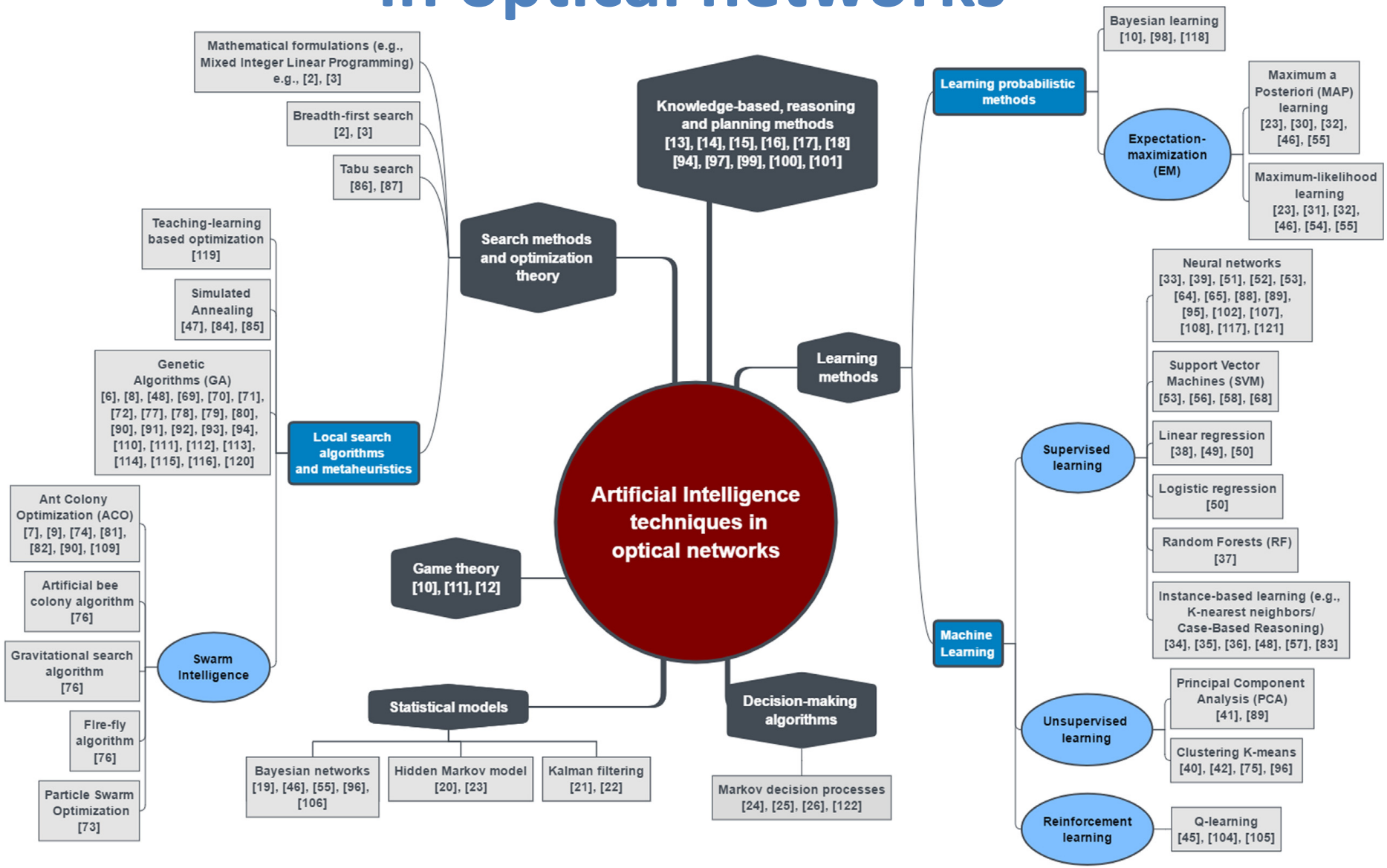
Artificial Intelligence
Machine Learning & Deep Learning



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Source: https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

Artificial intelligence (AI) in optical networks



Source: Javier Mata, Ignacio de Miguel, Ramón J. Durán, Noemí Merayo, Sandeep Kumar Singh, Admela Jukan, and Mohit Chamania (2018),

FinTech

Financial Technology

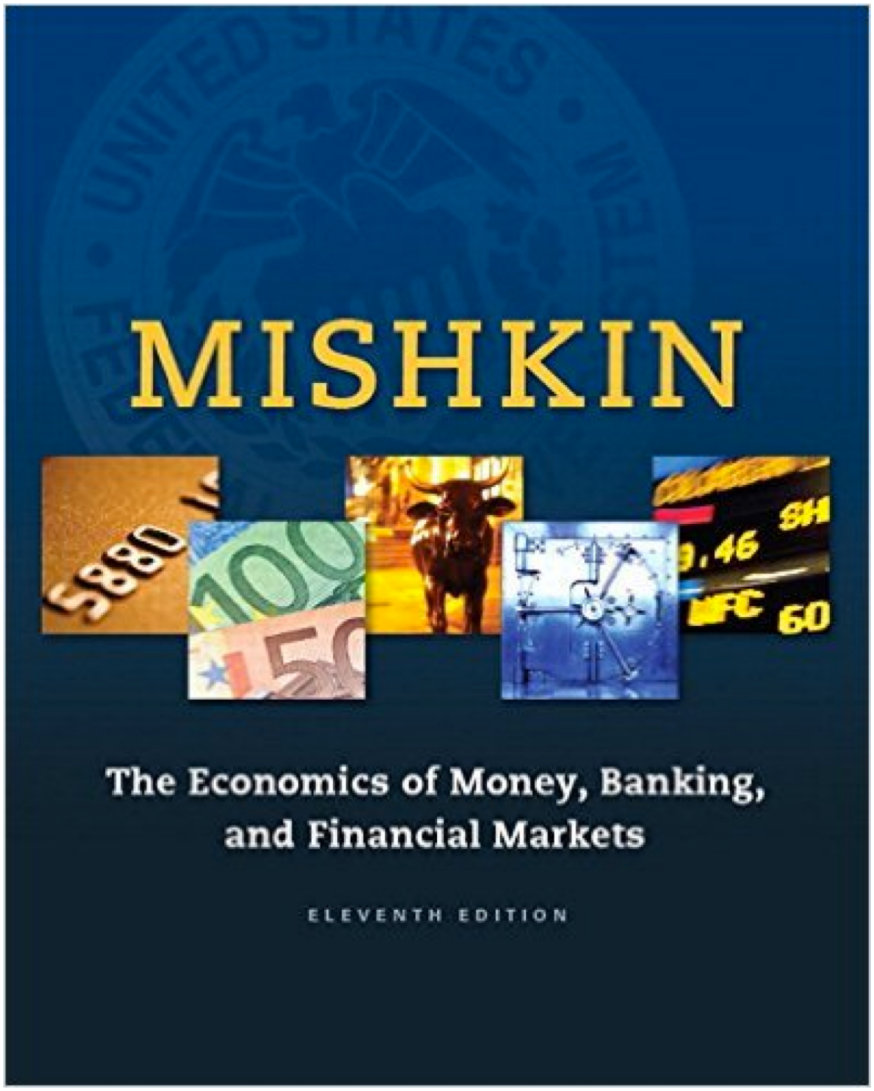
FinTech

Financial Technology
FinTech

"providing
financial services
by making use of
software and
modern technology"

Source: https://www.fintechweekly.com/fintech-definition

Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson

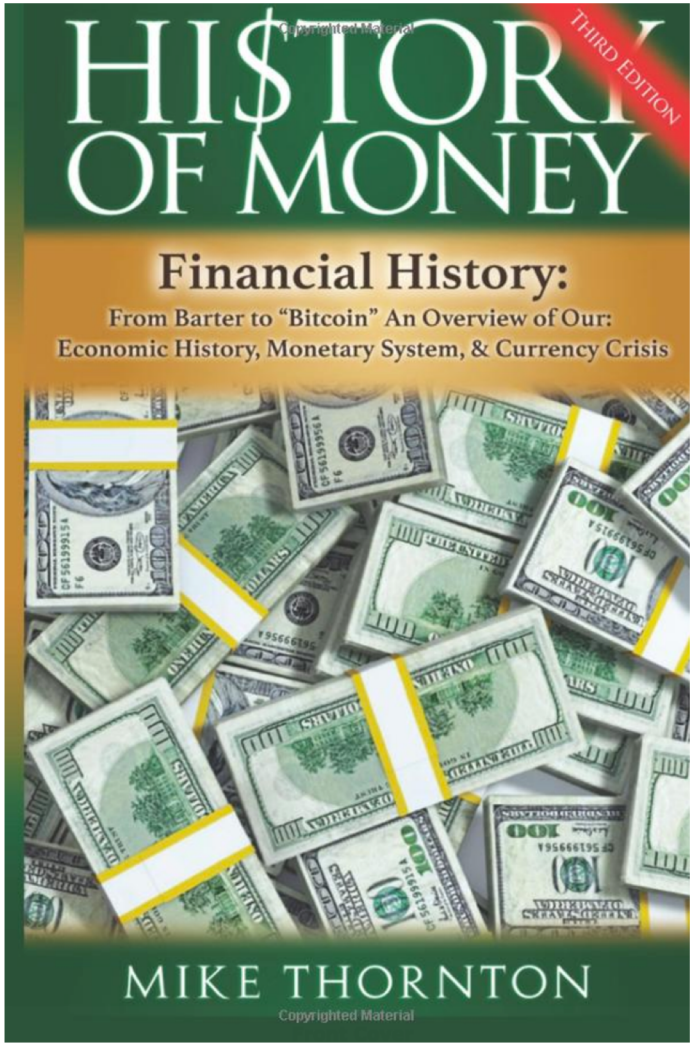


Source: https://www.amazon.com/Economics-Banking-Financial-Markets-Pearson/dp/0133836797

Mike Thornton (2016),

History of Money: Financial History:

From Barter to Bitcoin - An Overview of Our Economic History, Monetary System & Currency Crisis, CreateSpace Independent Publishing Platform



Source: https://www.amazon.com/History-Money-Financial-Overview-Economic/dp/154107582X

Money and Financial History

- Why is a printed piece of paper worth anything?
- How can a coin be worth more or even less than the number stamped on it?
- Why is digital money real money?
- How can money be worth more or less than it was yesterday?

Source: Mike Thornton (2016), History of Money: Financial History: From Barter to Bitcoin - An Overview of Our Economic History, Monetary System & Currency Crisis, CreateSpace Independent Publishing Platform

Money

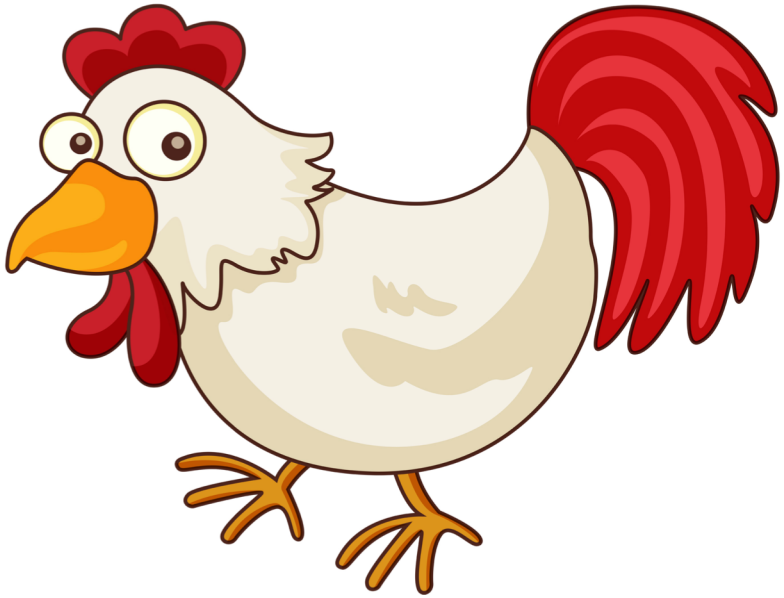
Exchange

Barter

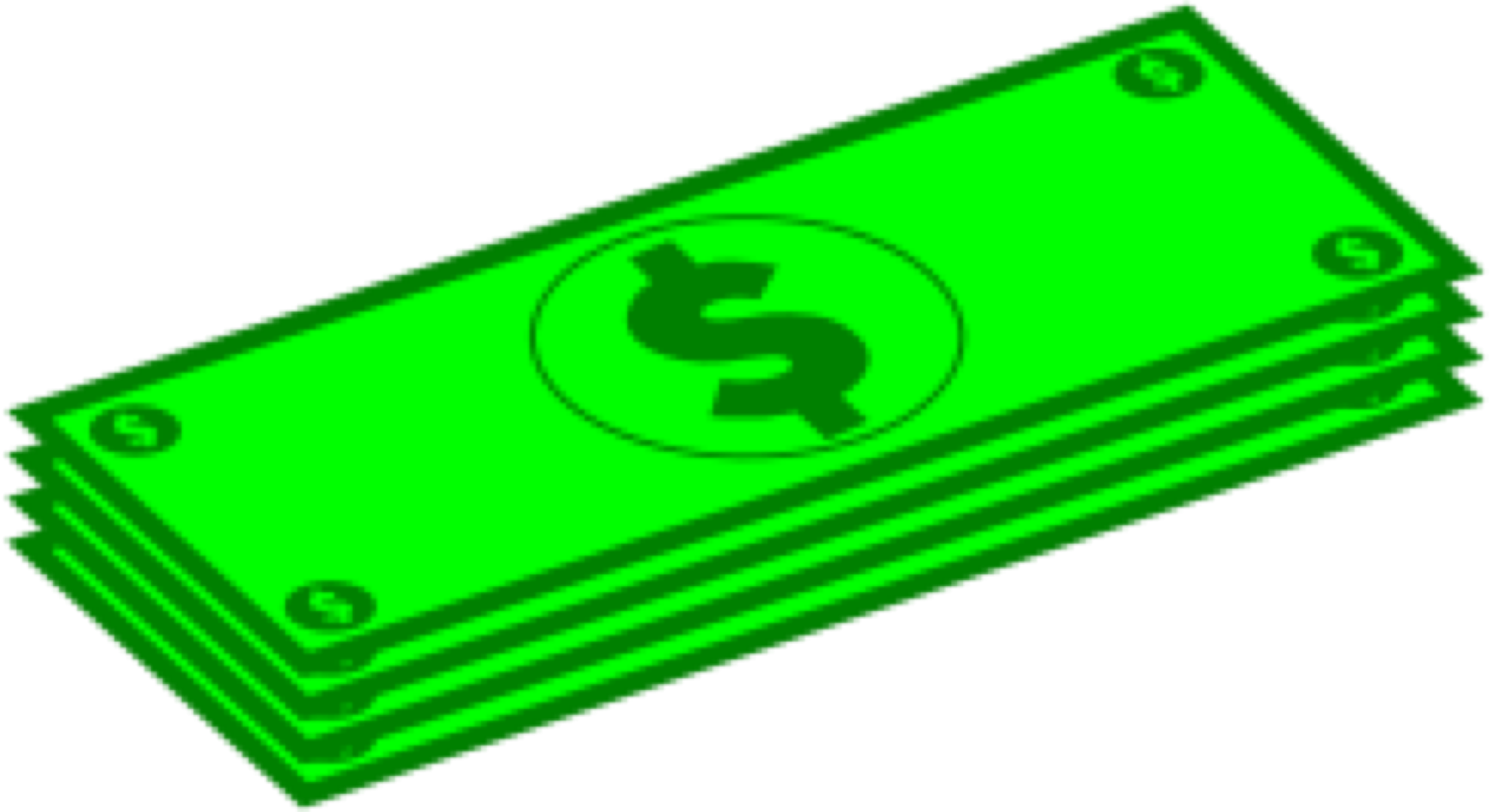
Barter

Source: https://www.jacksonvillebarter.com/

Barter



Money



Source: http://www.wpclipart.com/money/bills/bills_2/stack_of_bills_2.png.html

Bills

Source: http://www.wpclipart.com/money/bills/bills_2/stack_of_bills_2.png.html

Gold Bullion Coin

Source: http://www.wpclipart.com/money/coins/American_buffalo_gold_bullion_coin_front.jpg.html

Gold Bullion Coin

Source: http://www.wpclipart.com/money/coins/American_buffalo_gold_bullion_coin_back.jpg.html

Coin US Penny

Source: http://www.wpclipart.com/money/coins/coin_US_penny_2.png.html

Gold Bricks

Source: http://www.wpclipart.com/money/gold/gold_bricks_stacked.jpg.html

Financial Services

Financial Services

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Financial Services

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Treasure

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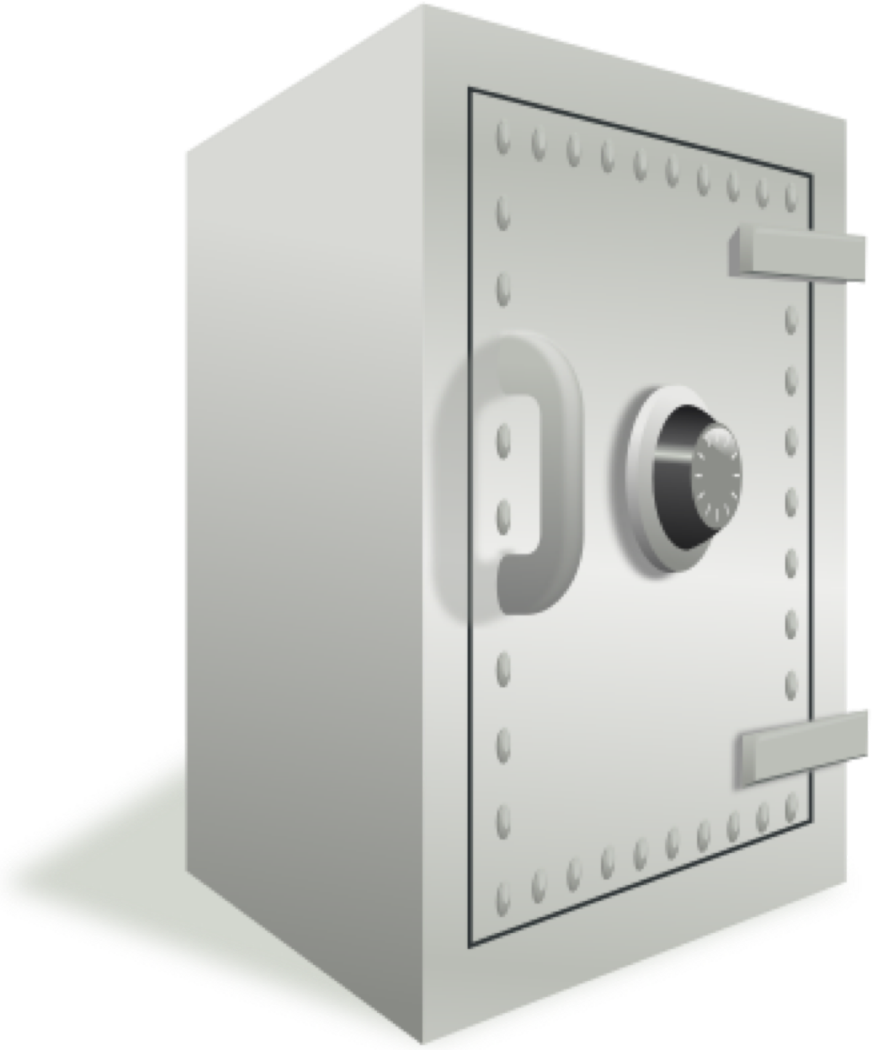
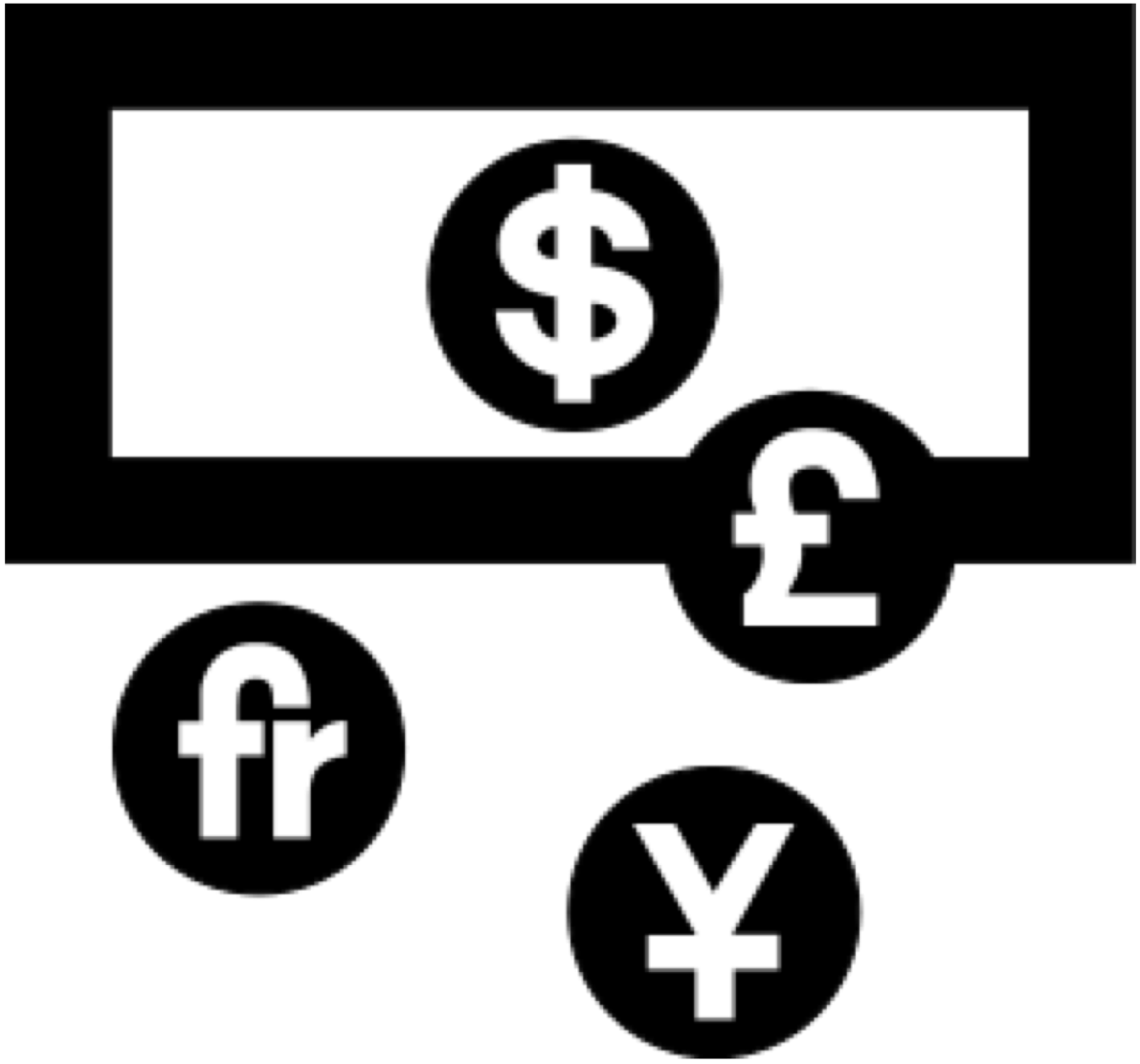
Safe



Source: http://www.wpclipart.com/money/safe/steel_safe.png.html

Currency Exchange



Source: http://www.wpclipart.com/signs_symbol/BW/travel_symbols/currency_exchange.png.html

Market

Financial Services

Financial Services

Source: http://www.crackitt.com/7-reasons-why-your-fintech-startup-needs-visual-marketing/

Financial Revolution with Fintech

Source: http://www.hedgethink.com/fintech/european-fintech-top-100/

FinTech: Financial Services Innovation

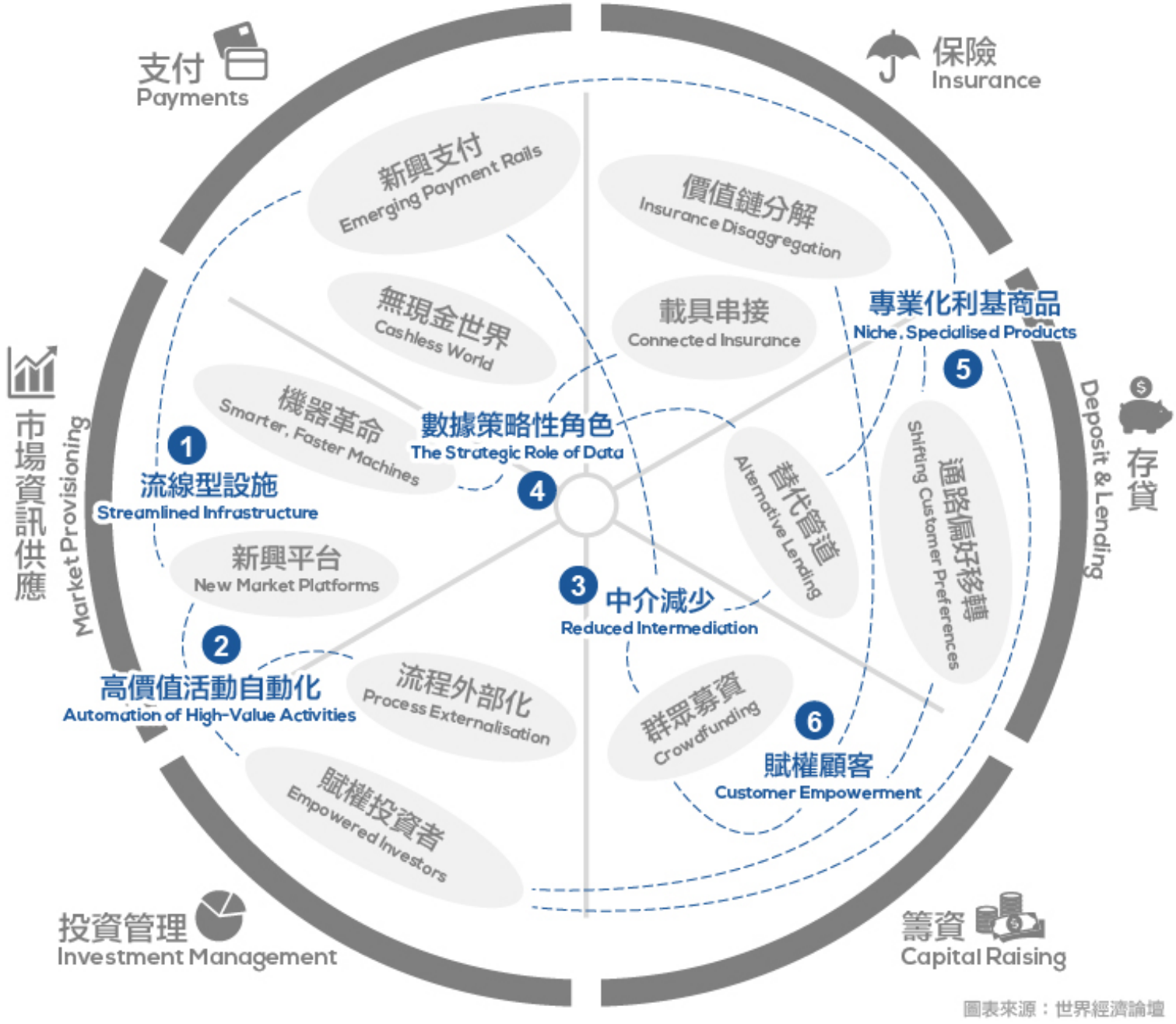
Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

FinTech:

Financial Services Innovation

1. Payments
2. Insurance
3. Deposits & Lending
4. Capital Raising
5. Investment Management
6. Market Provisioning

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf



圖表來源：世界經濟論壇

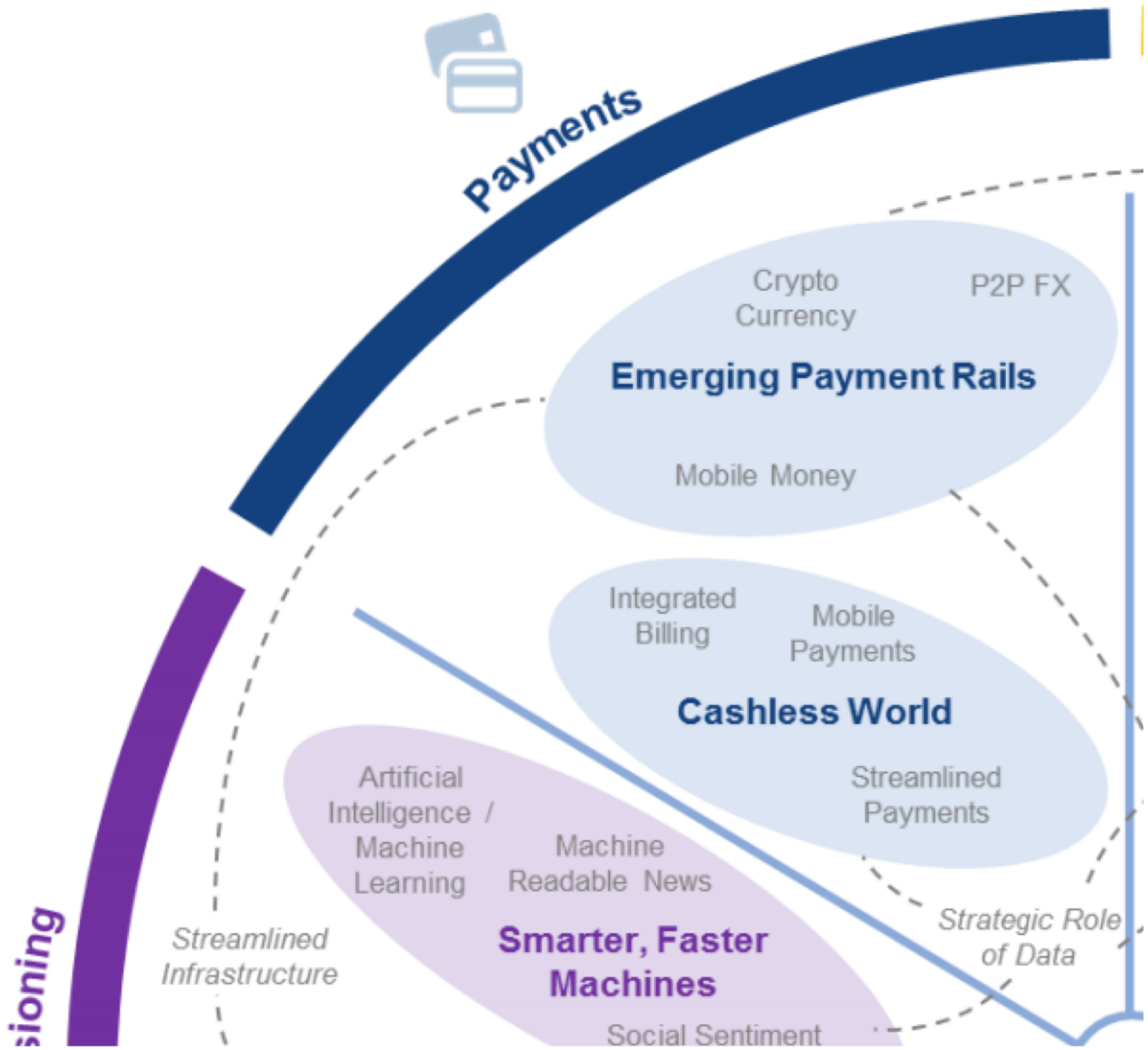
Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/

FinTech: Financial Services Innovation

圖表來源：Fugle團隊整理

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/

1 FinTech: Payment



Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

1

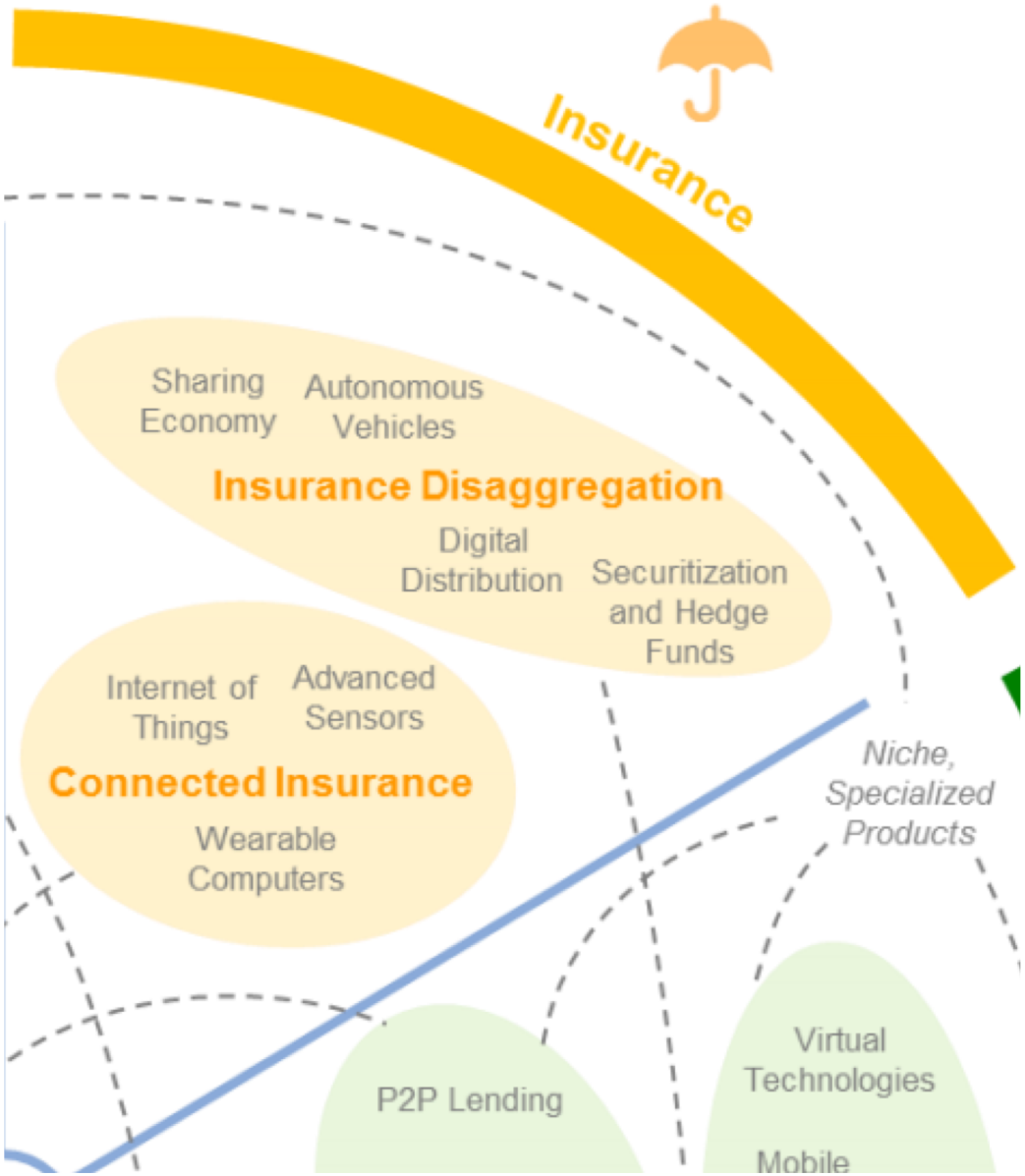
FinTech: Payment
Cashless World
Emerging Payment Rails

圖表來源：Fugle團隊整理

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/

2

FinTech: Insurance



Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

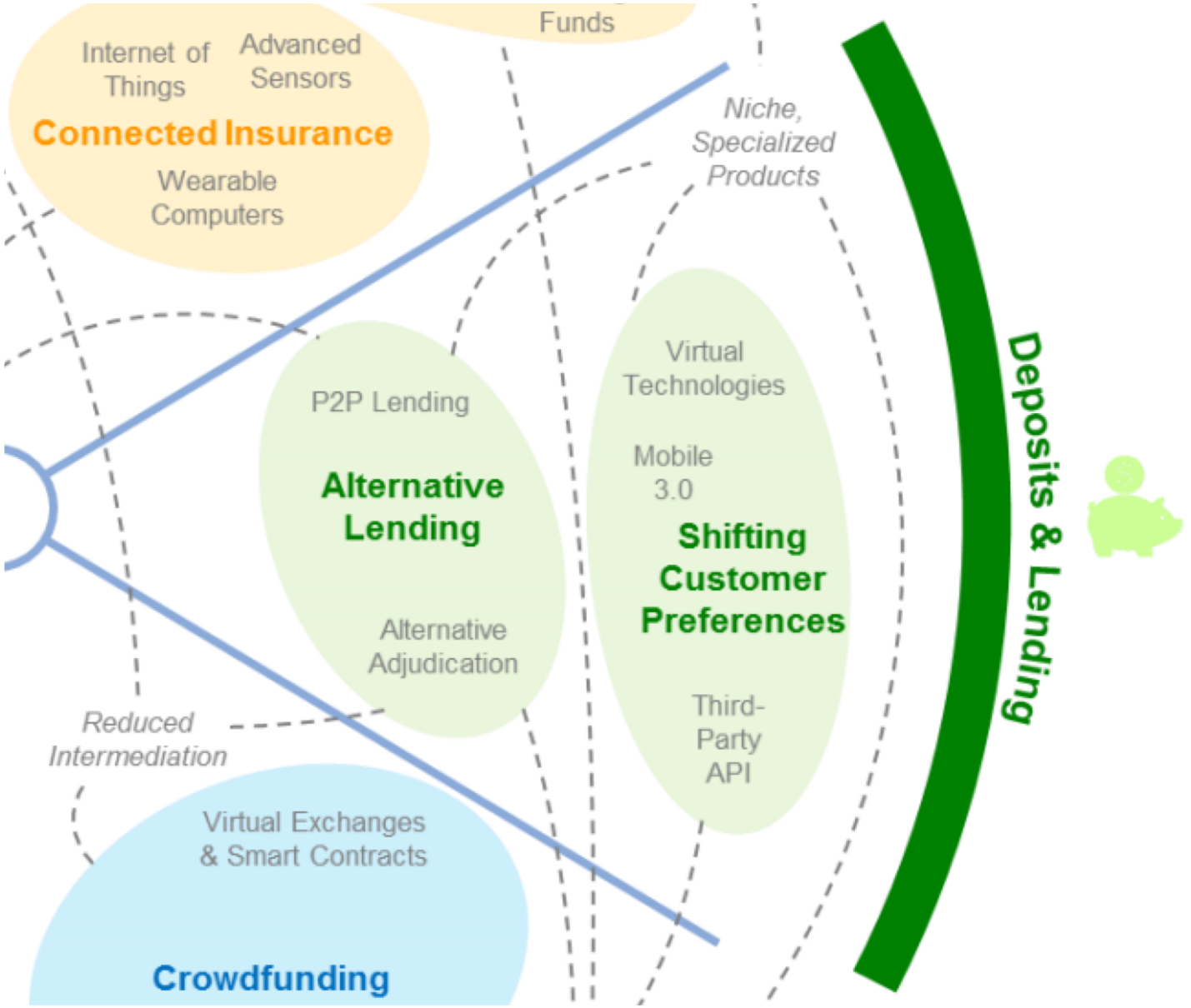
2

FinTech: Insurance
Insurance Disaggregation
Connected Insurance

圖表來源：Fugle團隊整理

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/

3 FinTech: Deposits & Lending



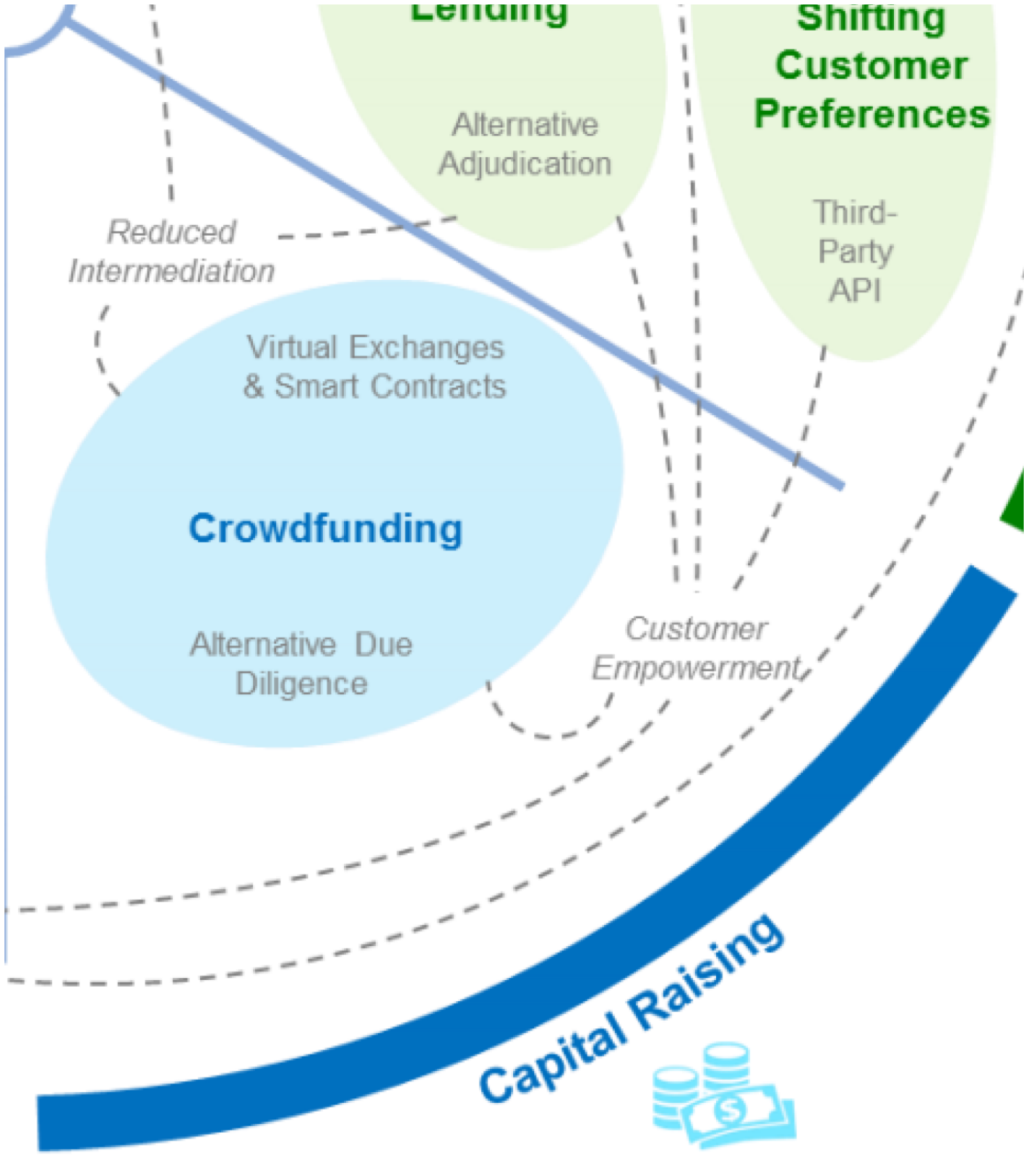
Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

3 FinTech: Deposits & Lending
Alternative Lending
Shifting Customer Preferences

圖表來源：Fugle團隊整理

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/

4 FinTech: Capital Raising



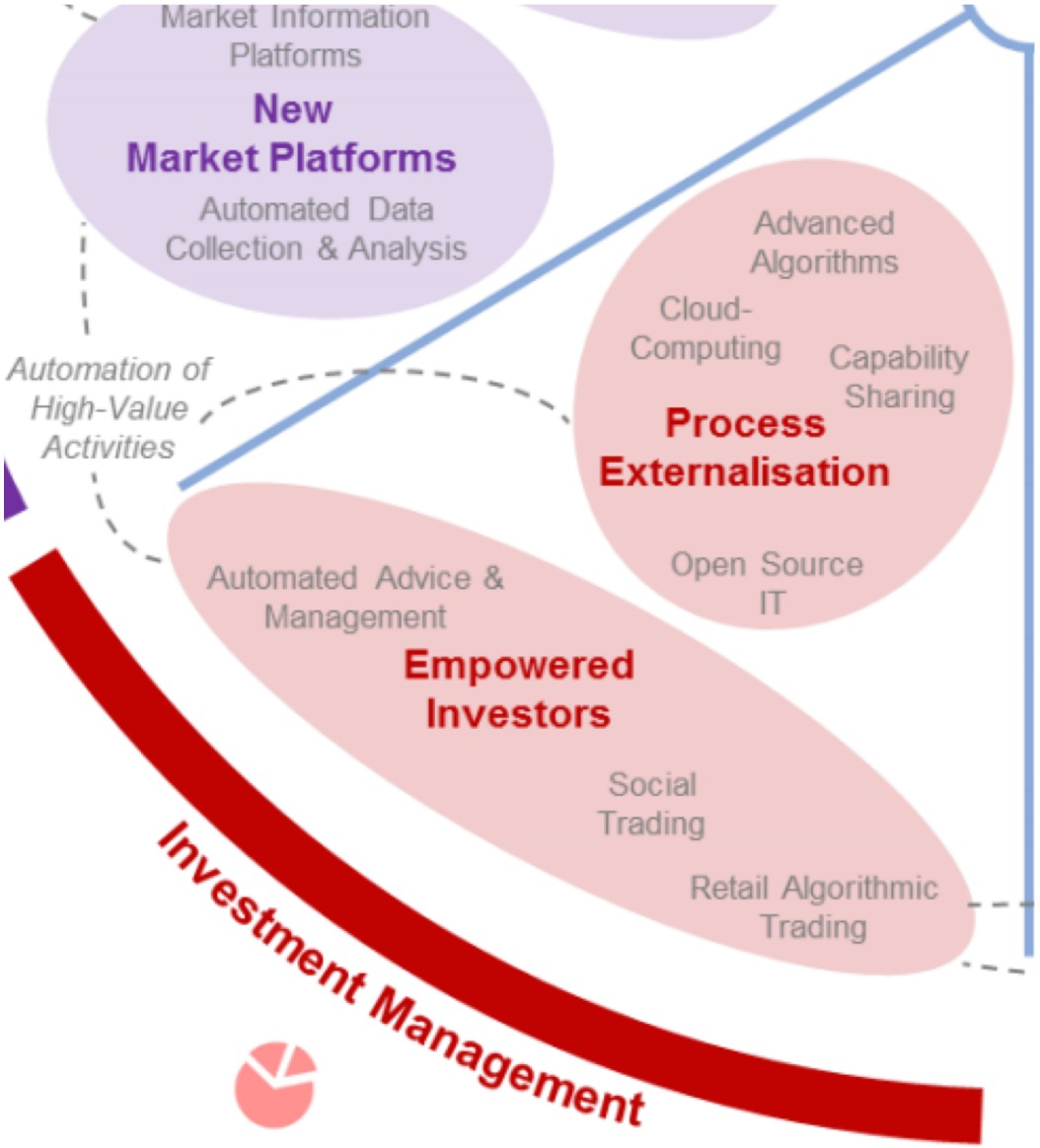
Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

4 FinTech: Capital Raising Crowdfunding

圖表來源：Fugle團隊整理

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/

5 FinTech: Investment Management



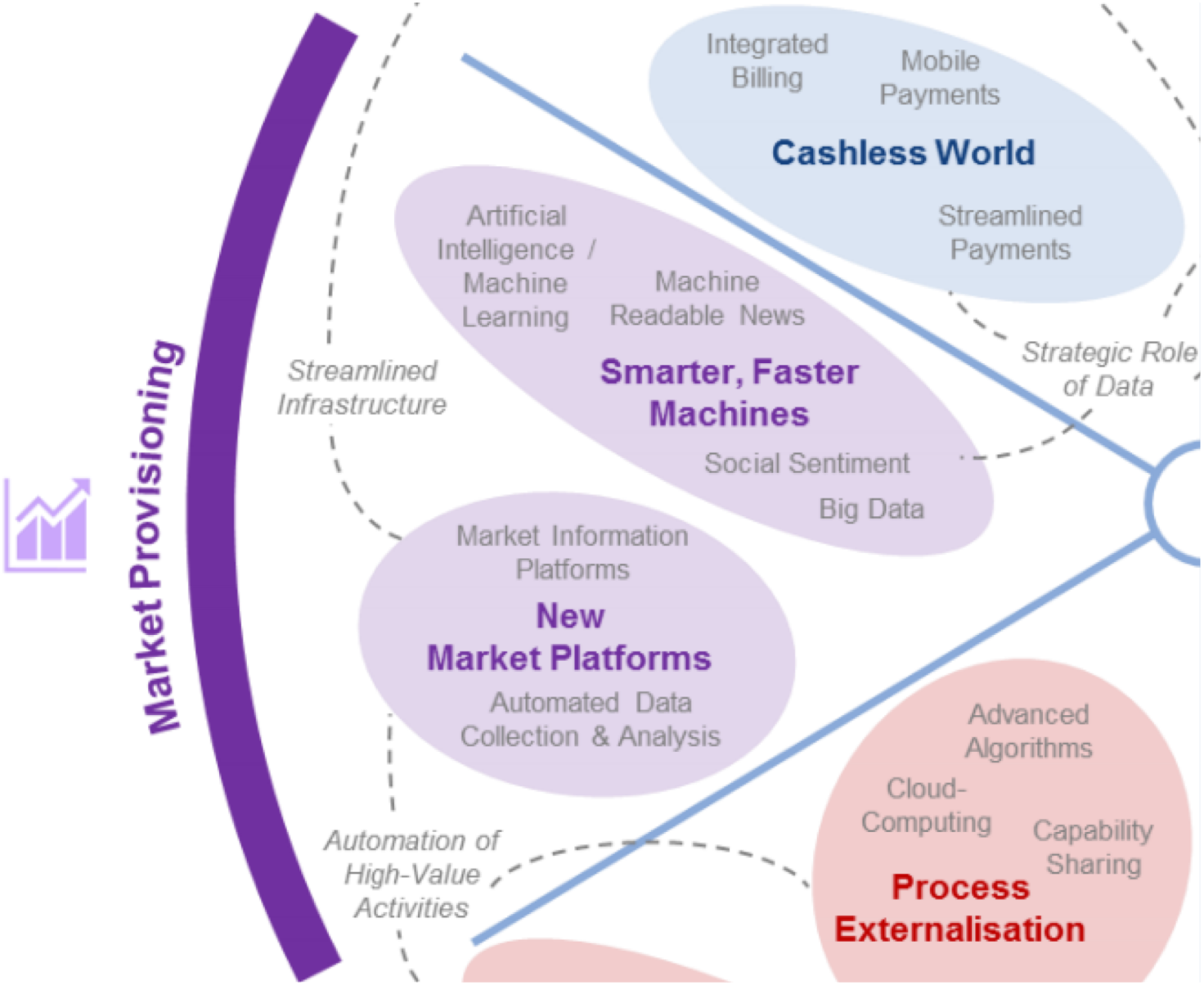
Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

5 FinTech: Investment Management
Empowered Investors
Process Externalization

圖表來源：Fugle團隊整理

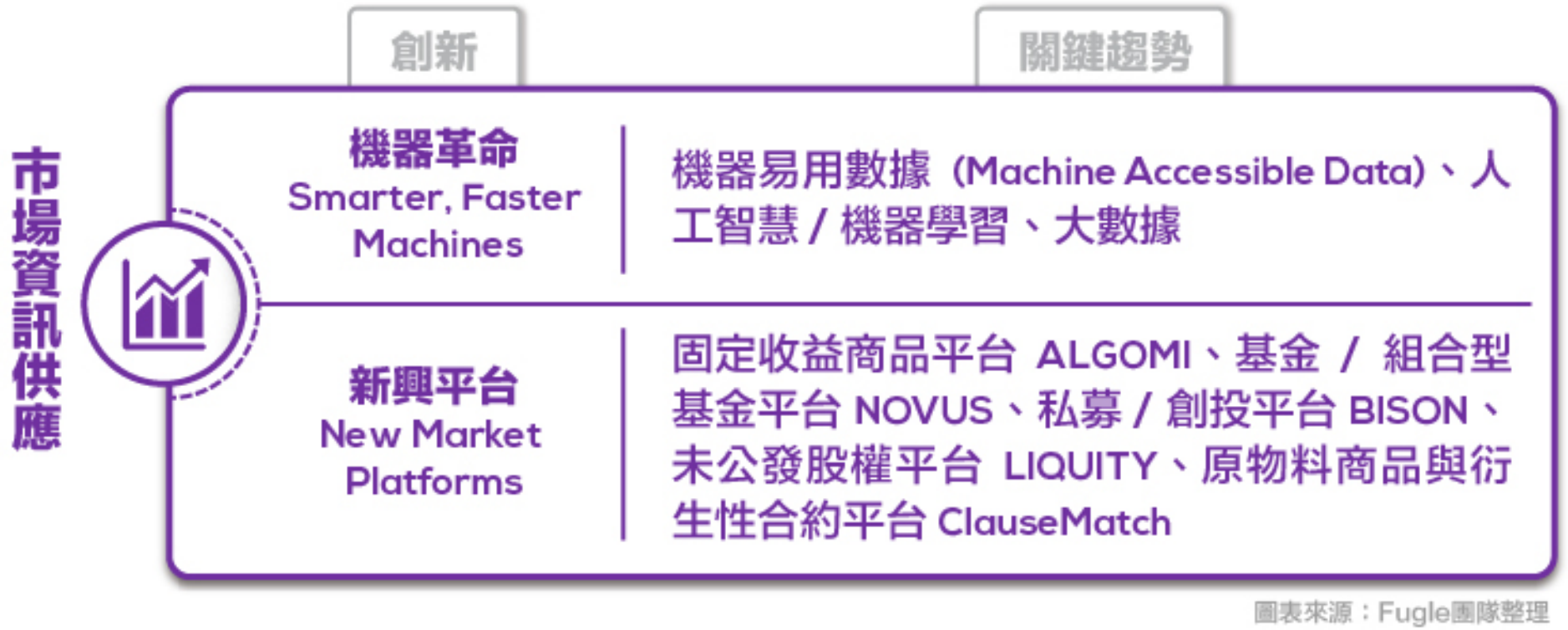
Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/

6 FinTech: Market Provisioning



Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

6 FinTech: Market Provisioning Smarter, Faster Machines New Market Platforms

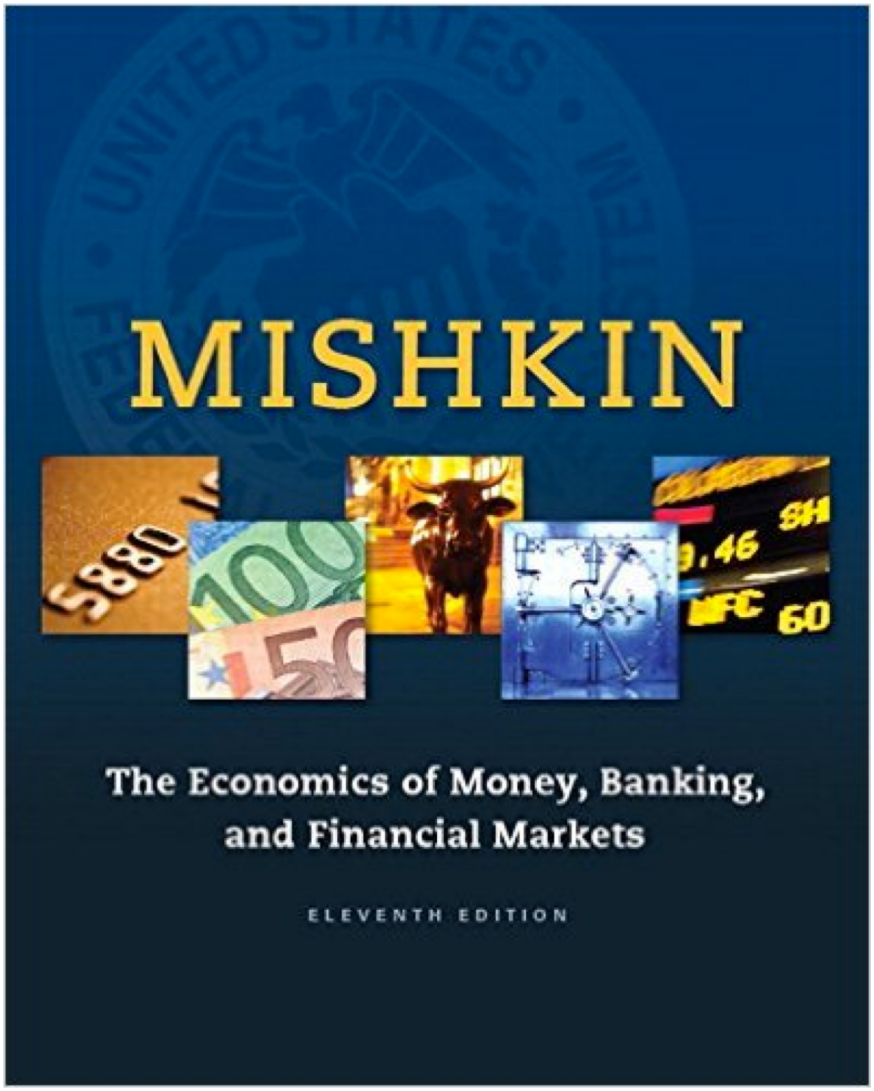


圖表來源：Fugle團隊整理

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/

The Economics of Money, Banking and Financial Markets

Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson



Source: https://www.amazon.com/Economics-Banking-Financial-Markets-Pearson/dp/0133836797

Economics of Money, Banking and Financial Markets

1. Money, Banking, and Financial System
2. Financial Markets
3. Financial Institutions
4. Central Banking and the Conduct of Monetary Policy
5. International Finance and Monetary Policy
6. Monetary Theory
7. Financial Services Industry

Source: Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson

INTRODUCTION

1. Why Study Money, Banking, and Financial Markets?
2. An Overview of the Financial System
3. What Is Money?

FINANCIAL MARKETS

4. Understanding Interest Rates
5. The Behavior of Interest Rates
6. The Risk and Term Structure of Interest Rates
7. The Stock Market, the Theory of Rational Expectations, and the Efficient Market Hypothesis

FINANCIAL INSTITUTIONS

8. An Economic Analysis of Financial Structure
9. Banking and the Management of Financial Institutions
10. Economic Analysis of Financial Regulation
11. Banking Industry: Structure and Competition
12. Financial Crises

Source: Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson

CENTRAL BANKING AND THE CONDUCT OF MONETARY POLICY

13. Central Banks and the Federal Reserve System

14. The Money Supply Process

15. The Tools of Monetary Policy

16. The Conduct of Monetary Policy: Strategy and Tactics

MONETARY THEORY

19. Quantity Theory, Inflation, and the Demand for Money
20. The IS Curve
21. The Monetary Policy and Aggregate Demand Curves
22. Aggregate Demand and Supply Analysis
23. Monetary Policy Theory
24. The Role of Expectations in Monetary Policy
25. Transmission Mechanisms of Monetary Policy

Source: Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson

Financial Services Industry

26. Financial Crises in Emerging Market Economies
27. The ISLM Model
28. Nonbank Finance
29. Financial Derivatives
30. Conflicts of Interest in the Financial Services Industry

Why Study Money, Banking, and Financial Markets?

Why Study Money, Banking, and Financial Markets?

- To examine how financial markets such as bond, stock and foreign exchange markets work
- To examine how financial institutions such as banks and insurance companies work
- To examine the role of money in the economy

Financial Markets

- Markets in which funds are transferred from people who have an excess of available funds to people who have a shortage of funds
  - Bond market
  - Stock market
  - Foreign exchange market

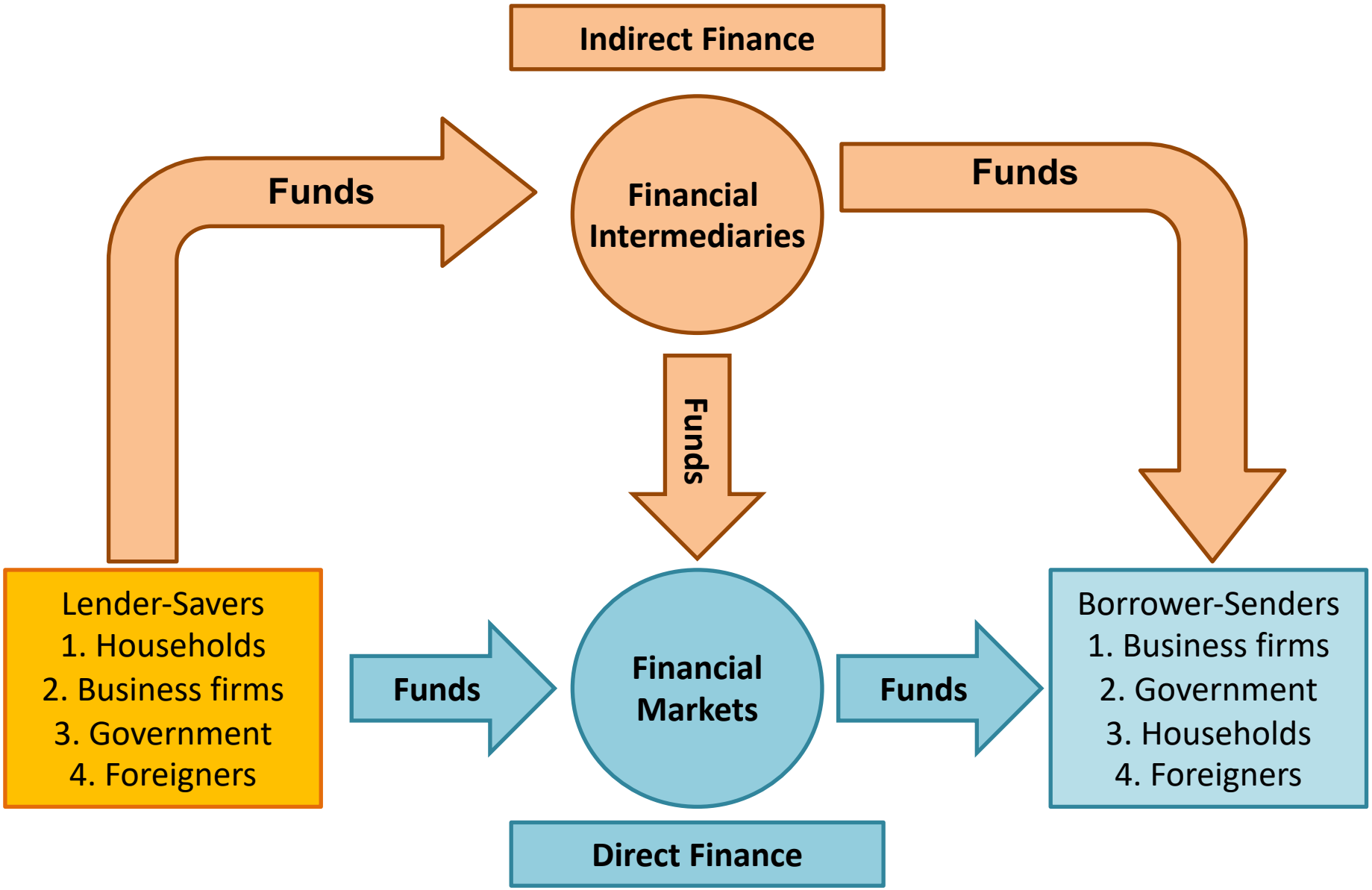
Financial Institutions

- Financial Intermediaries: institutions that borrow funds from people who have saved and make loans to other people:
  - Banks: accept deposits and make loans
  - Other Financial Institutions: insurance companies, finance companies, pension funds, mutual funds and investment banks
- Financial Innovation: the advent of the information age and e-finance

Money and Business Cycles

- Money plays an important role in generating business cycles
- Recessions (unemployment) and expansions affect all of us
- Monetary Theory ties changes in the money supply to changes in aggregate economic activity and the price level

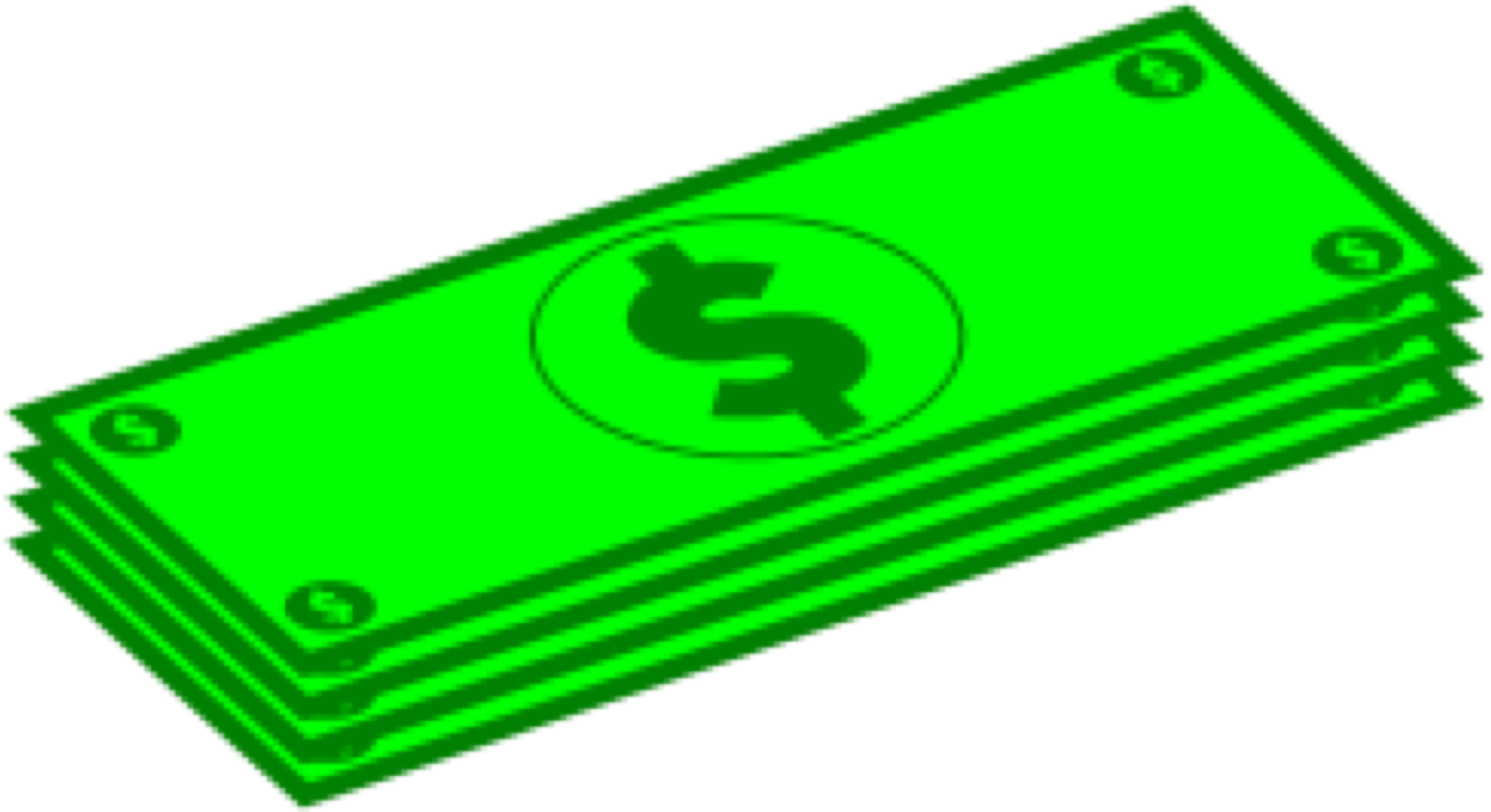
Overview of the Financial System



Source: Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson

What is Money?

Money



Source: http://www.wpclipart.com/money/bills/bills_2/stack_of_bills_2.png.html

Bills

Source: http://www.wpclipart.com/money/bills/bills_2/stack_of_bills_2.png.html

Meaning of Money

- Money (=money supply) any vehicle used as a means of exchange to pay for goods, services or debts.
- In today's society, any asset that can quickly be transferred into cash is considered money.
- The more liquid an asset is, the closer it is to money.
- In economics, money does not mean wealth nor does it mean income.

Source: Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson

Functions of Money

- Medium of Exchange
- Unit of Account
- Store of Value

Source: Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson

Medium of Exchange

- By eliminating barter, this function of money increases efficiency in a society.
- As human societies started to engage in exchange money had to be invented.
- Any technological change that reduces transaction costs increases the wealth of the society.
- Any technological change that allows people to specialize also increases wealth.

Source: Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson

Unit of Account

- We use money to measure the value of goods and services.
- Suppose we had 4 goods and no money. How do we measure the price of each good?
  - A in terms of B
  - B in terms of C
  - C in terms of D
  - A in terms of C
  - A in terms of D
  - B in terms of D

N!/2(N-2)!

- Money allows to quote prices in terms of currency only.

Store of Value

- All assets are stored value.
- Money, although without any return, is still desirable to hold because it allows purchases immediately.
- Other assets take time (transaction costs) to use as a payment for purchases.
- The more liquid an asset is, the less transaction cost it carries.
- Inflation erodes the value of money.

Evolution of the Payments System

- Commodity Money:
  - valuable, easily standardized and divisible commodities (e.g. precious metals, cigarettes).
- Fiat Money:
  - paper money decreed by governments as legal tender.

Electronic Money

- Debit Cards
  - Instant transfer from your checking account to merchant's checking account.
- Stored Value Card
  - Gift cards.
- Electronic Cash
  - Account set up on a person's PC from her bank whereby she can buy products over the Internet.
- Electronic Checks
  - Checks written on PC and sent through the Internet.

Benefits of Paper Checks

- Cheaper than telecommunications network.
- Provide receipts.
- Allow float.
- May be more secure; avoid hacker problems.
- Do not leave a wealth of information trail.

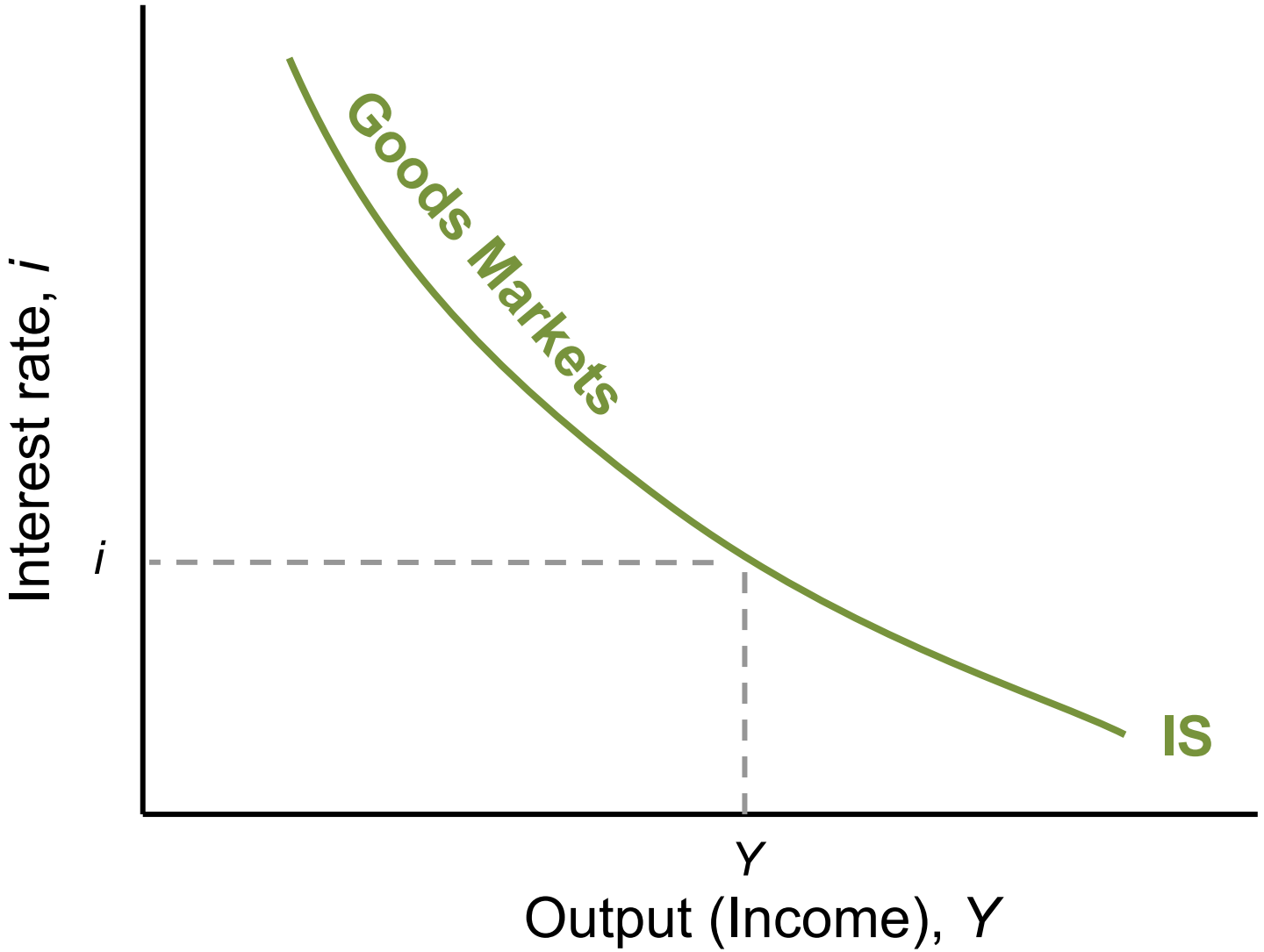
Measuring Money

- M1:
  - Currency, demand deposits, travelers checks.
- M2:
  - M1, saving deposits, small time deposits, retail MMMF.
- M3:
  - M2, large time deposits, repos, Eurodollar deposits, institutional MMMF.
- MZM:
  - M2, institutional MMMF minus small time deposits.
- Growth rates of these aggregates do not always go hand in hand, making monetary policy difficult since signals are conflicting.

The IS Curve

The IS (Investment/Saving) Curve

The IS (Investment/Saving) Curve



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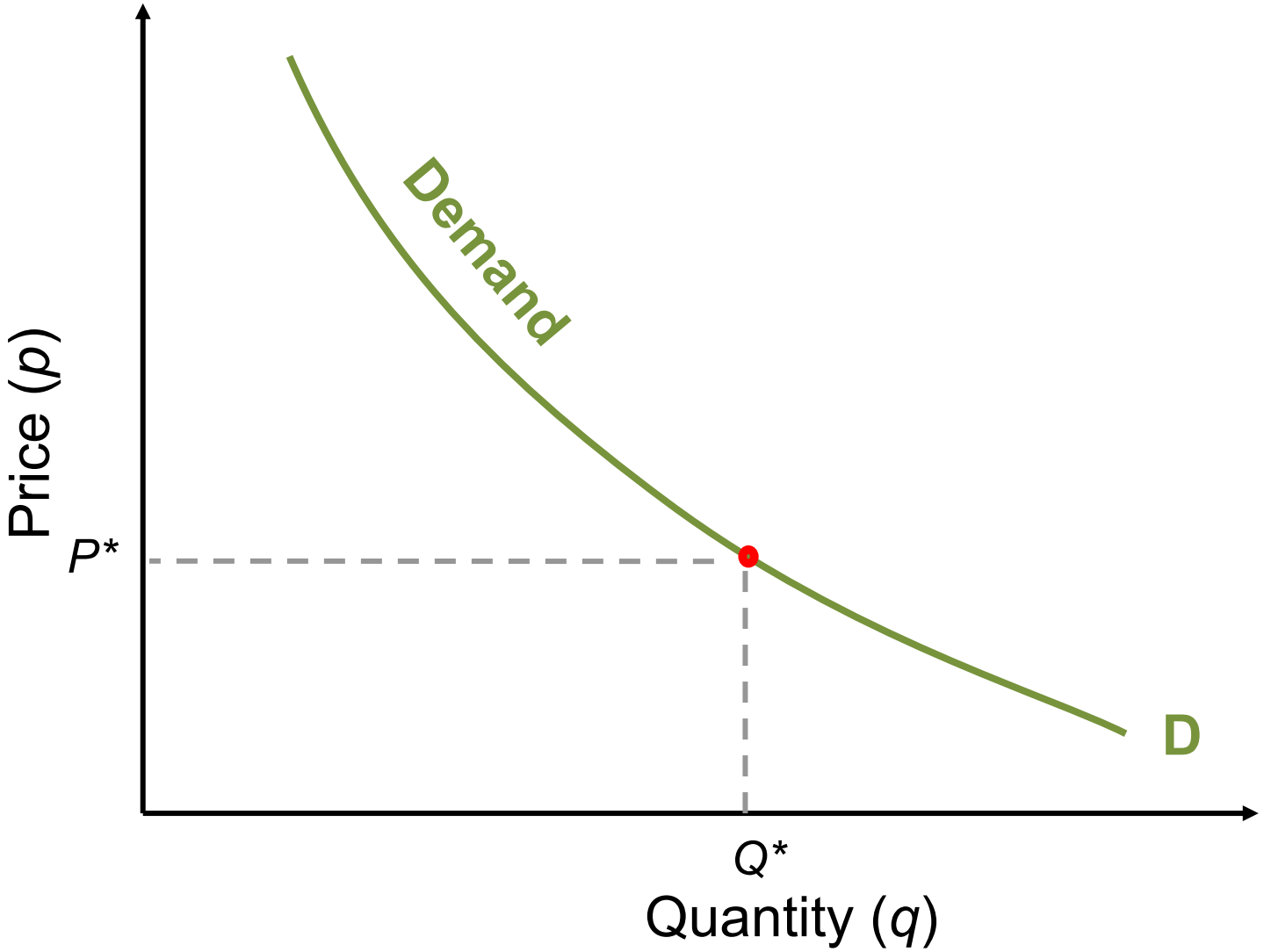
Demand



Source: Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson

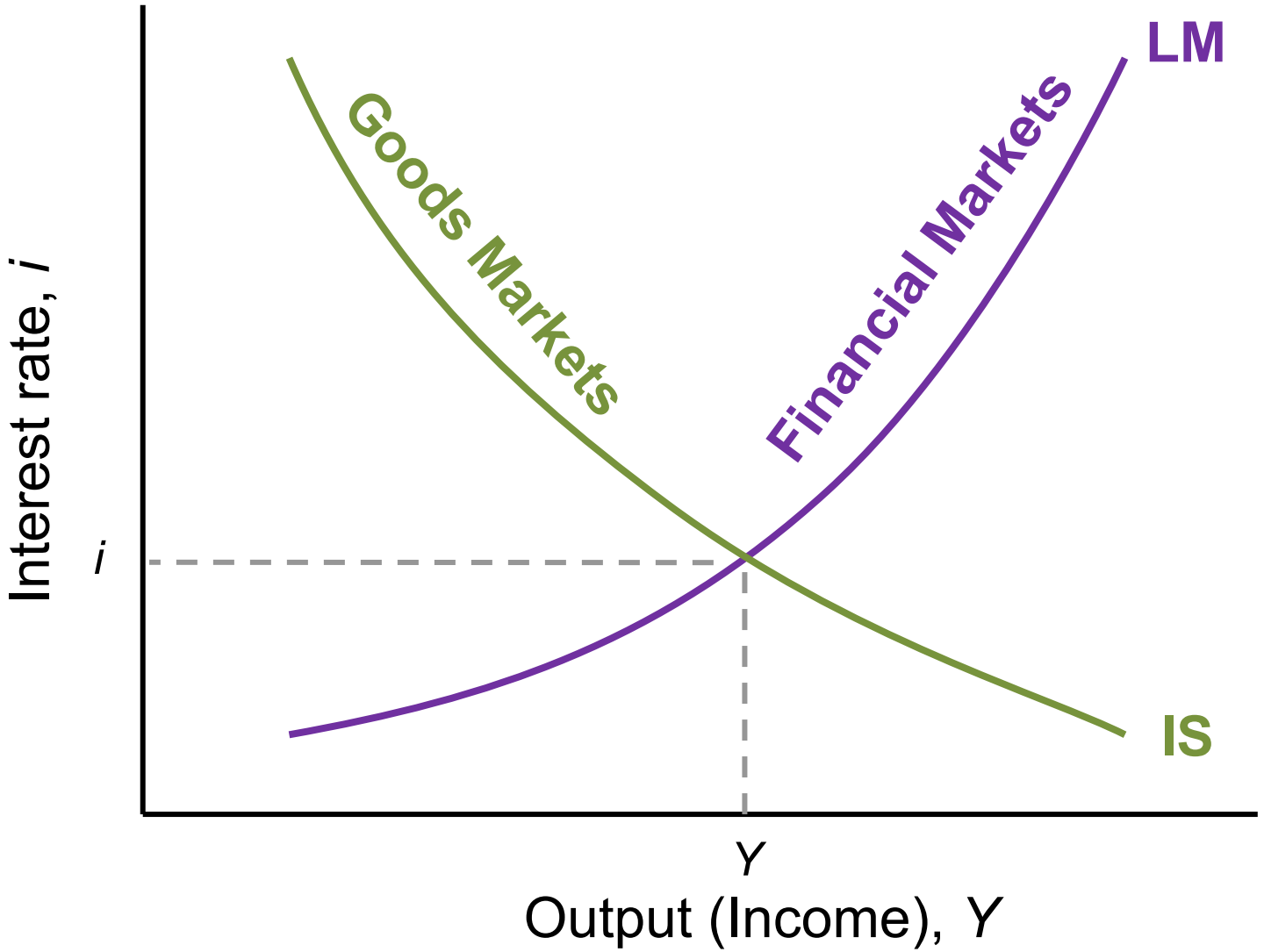
The ISLM Model

Goods and Financial Markets:

The ISLM Model

(Investment Saving – Liquidity Preference Money Supply) model

The ISLM Model (Investment Saving – Liquidity Preference Money Supply) model



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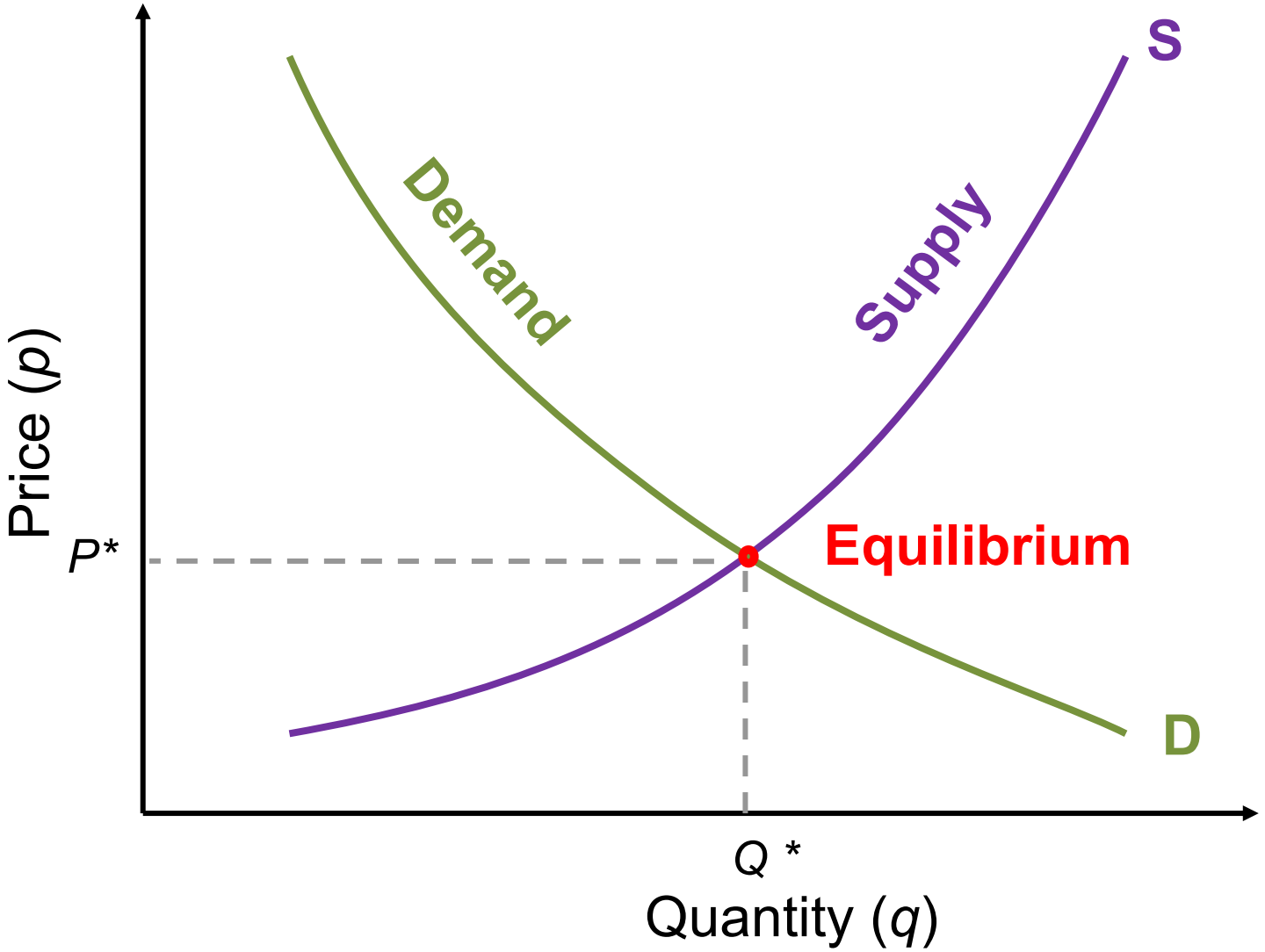
Supply and Demand



Source: Frederic S. Mishkin (2015), The Economics of Money, Banking and Financial Markets, 11th Edition, Pearson

Artificial Intelligence and Deep Learning for Fintech

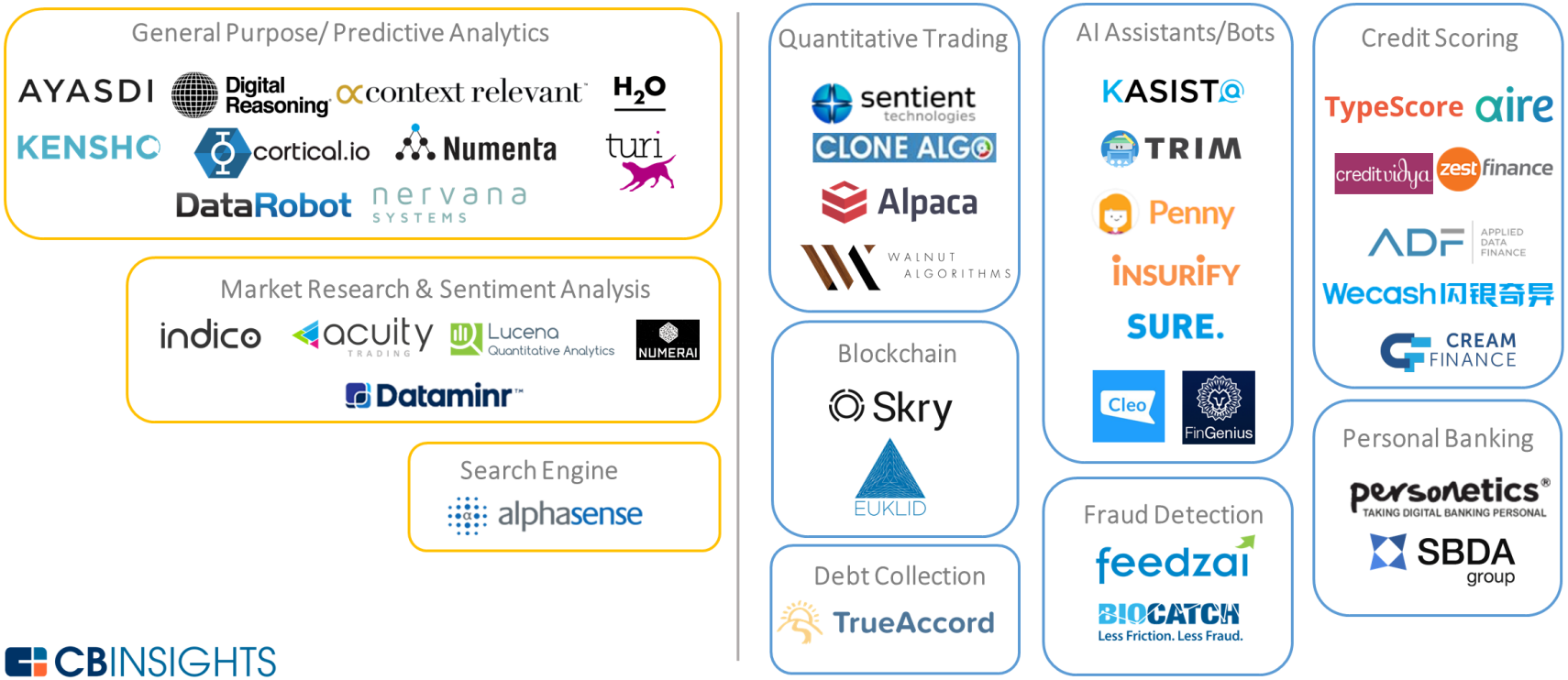
From Algorithmic Trading to Personal Finance Bots: 41 Startups Bringing AI to Fintech

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/

From Algorithmic Trading To Personal Finance Bots: 41 Startups Bringing AI To Fintech

AI in Fintech

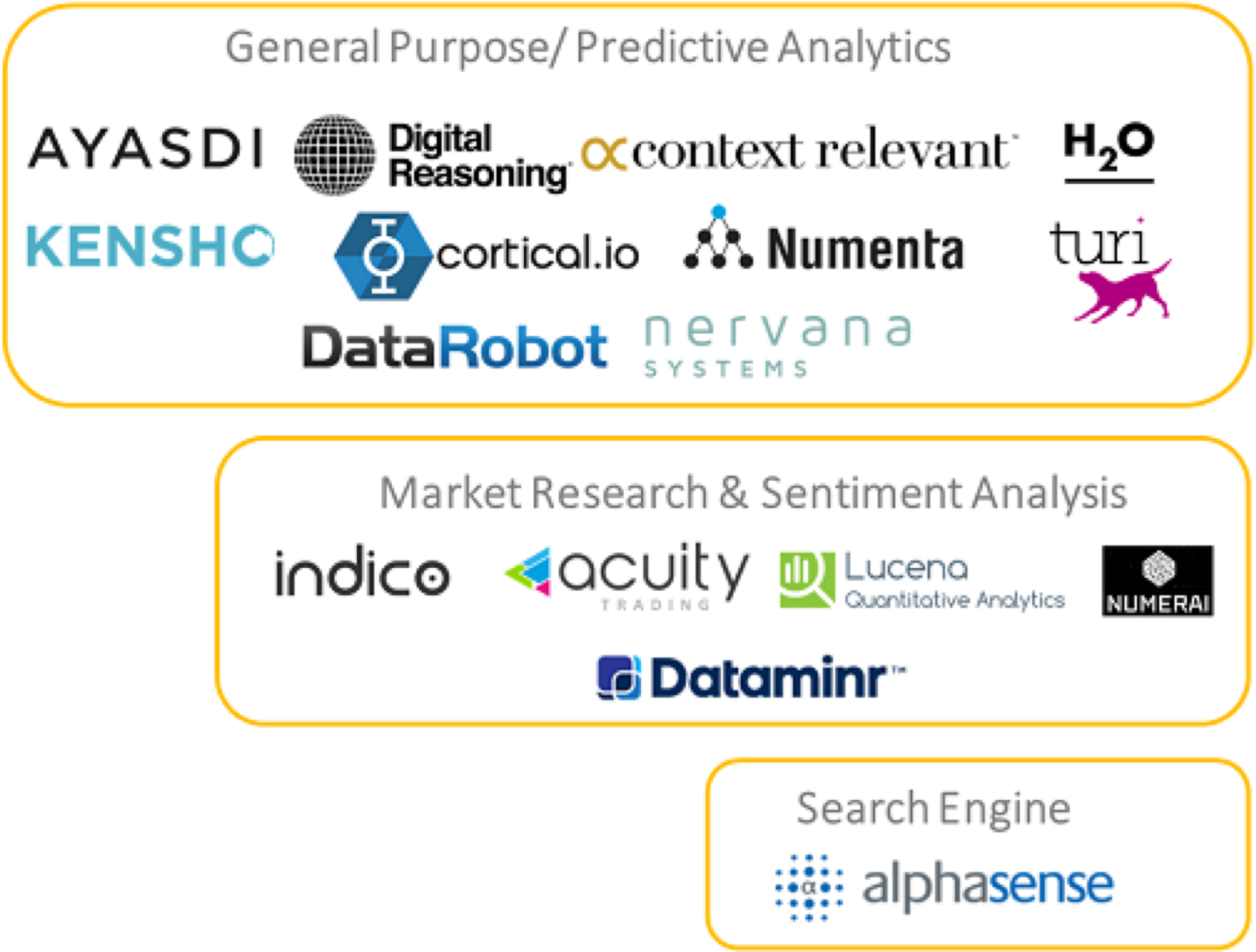
41 Startups Bringing Artificial Intelligence To Fintech



CBINSIGHTS
www.cbinsights.com

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/

Artificial Intelligence (AI) in Fintech



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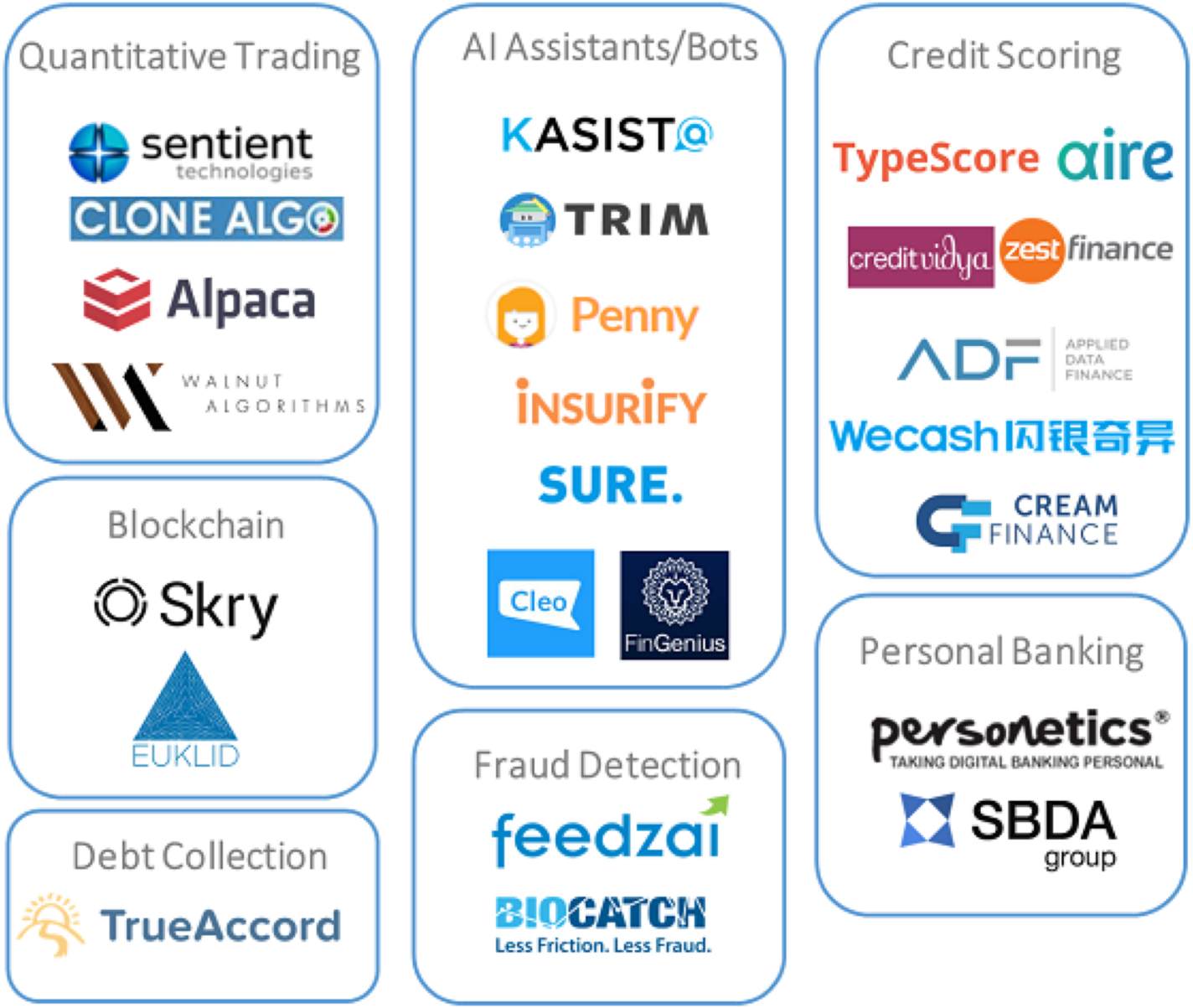
Artificial Intelligence (AI) in Fintech



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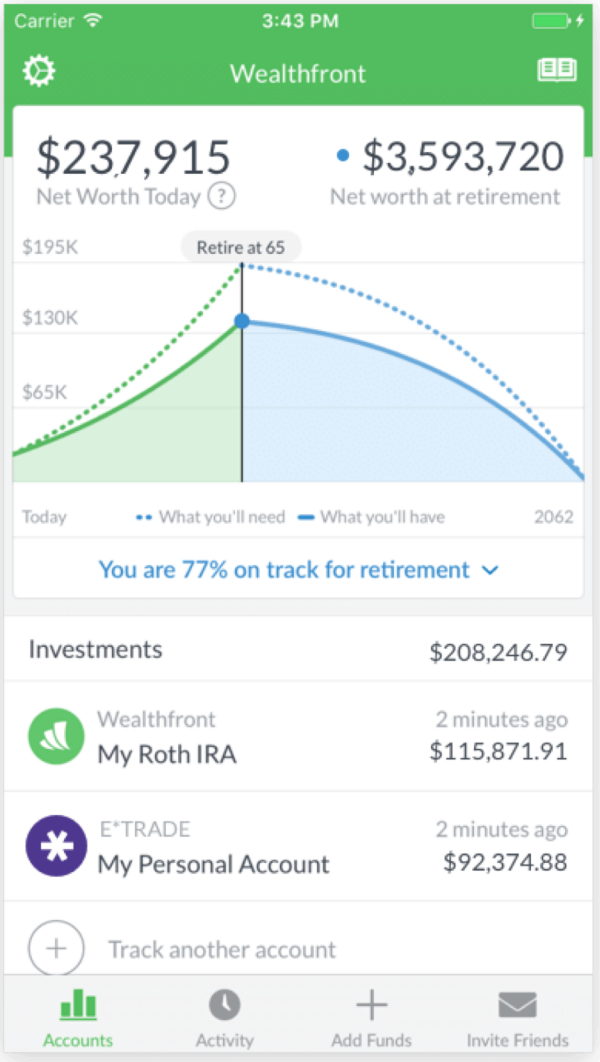
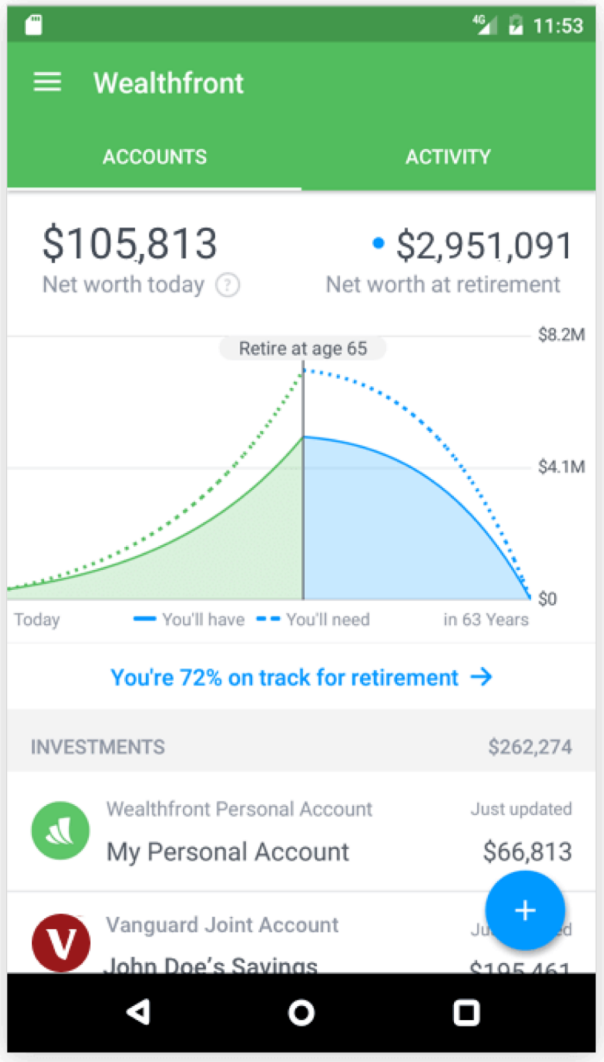
wealthfront

Wealthfront Robo Advisor





Source: https://www.wealthfront.com/

Financial Services

Technology Innovation

Innovation

Source: https://www.merriam-webster.com/dictionary/innovation

Innovation:

a new idea, method, or device

Source: https://www.merriam-webster.com/dictionary/innovation

Innovation: something new

Source: https://www.merriam-webster.com/dictionary/innovation

Novelty :

something new or unusual

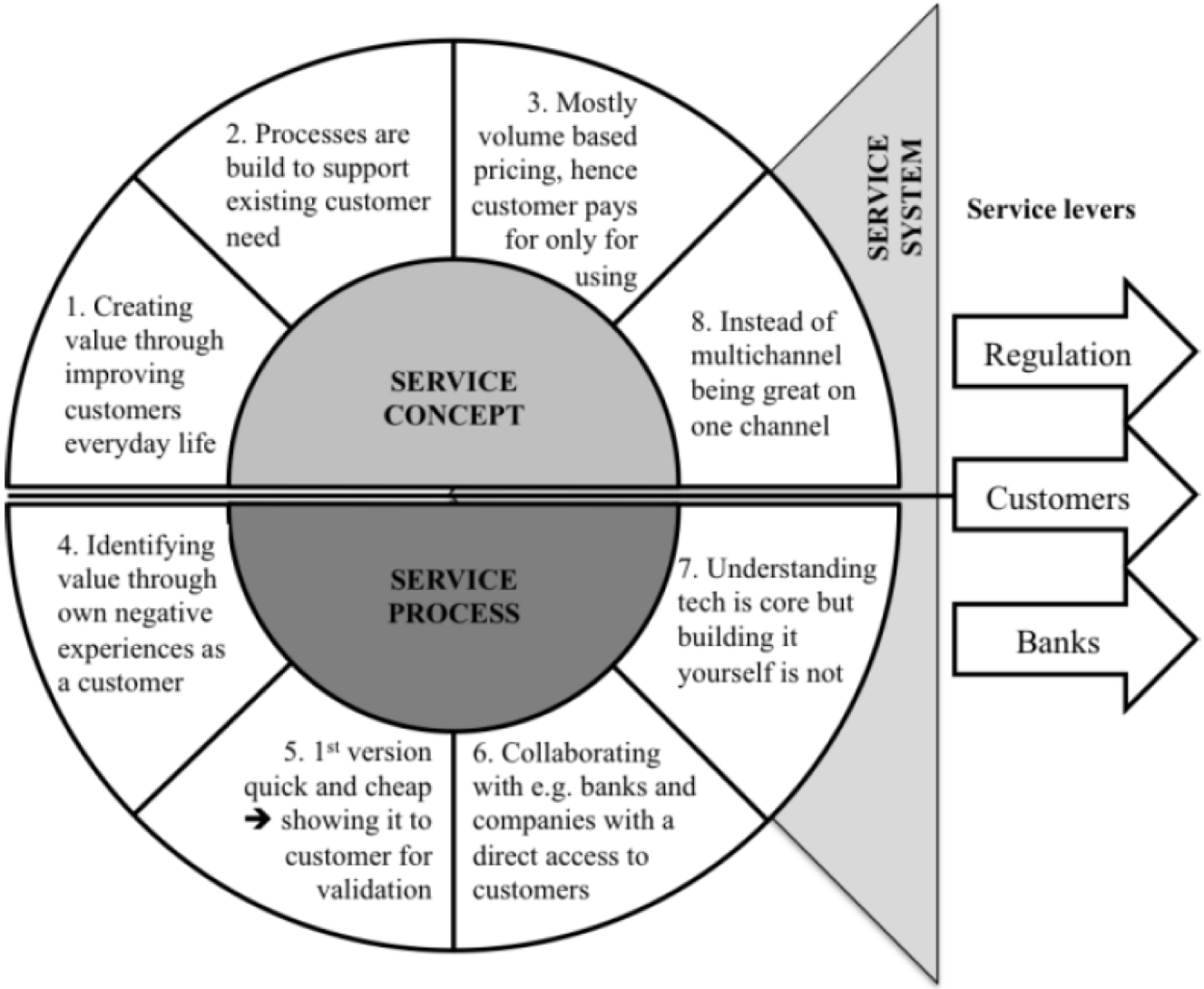
the novelty of a self-driving car

Source: https://www.merriam-webster.com/dictionary/novelty

Creativity is not a new Idea.

Creativity is an old belief you leave behind

FinTechs as Service Innovators: Analysing Components of Innovation



Source: Riikkinen, Mikko, Kaisa Still, Saila Saraniemi, and Katri Kallio. "FinTechs as service innovators: analysing components of innovation." In *ISPIM Innovation Symposium*, The International Society for Professional Innovation Management (ISPIM), 2016.

Innovation

"a process of searching and recombining existing knowledge elements"

Source: Savino, Tommaso, Antonio Messeni Petruzzelli, and Vito Albino. "Search and recombination process to innovate: A review of the empirical evidence and a research agenda." International Journal of Management Reviews (2017).

Search and recombination process to innovate: A review of the empirical evidence and a research agenda

Source: Savino, Tommaso, Antonio Messeni Petruzzelli, and Vito Albino. "Search and recombination process to innovate: A review of the empirical evidence and a research agenda." International Journal of Management Reviews (2017).

Innovation Research in Economics, Sociology and Technology Management

Source: Gopalakrishnan, Shanti, and Fariborz Damanpour.
"A review of innovation research in economics, sociology and technology management." *Omega* 25, no. 1 (1997): 15-28.

Innovation Research in Economics, Sociology and Technology Management

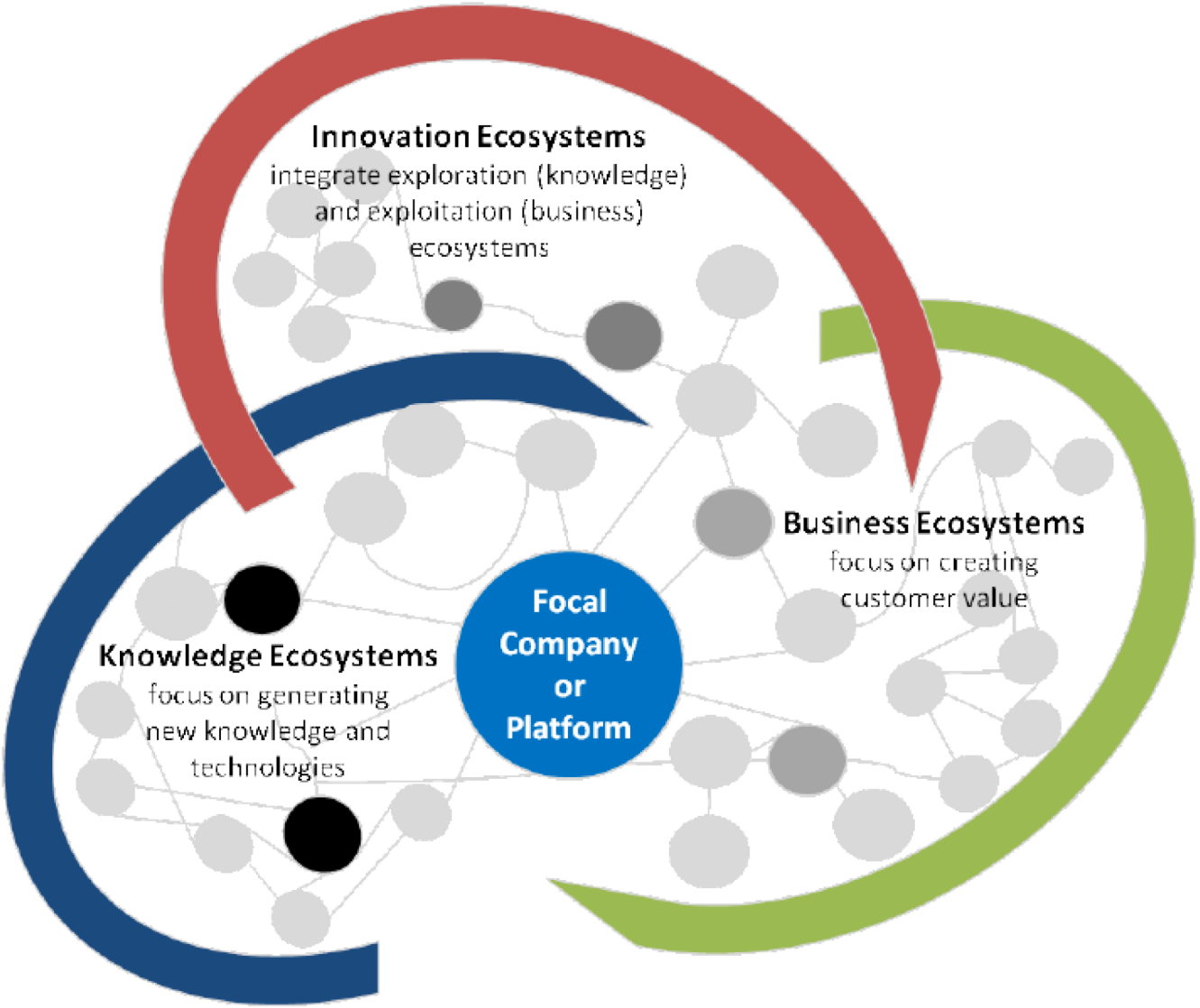
	Stage of process	Level of study	Type of innovation
Economists	Generation Idea generation Project definition	Industry	Product and process Only technical Only radical
Technologists			
Contextual technologists	Generation Commercialization and marketing Diffusion	Innovation (in the industry context)	Product and process Only technical Radical and incremental
Organizational technologists	Generation Idea generation Problem solving adoption Adoption Initiation	Organizational Sub-system	Product and process Only technical Radical and incremental
Sociologists			
Variance sociologists	Adoption Initiation Implementation	Organization	Product and process Technical and administrative Radical and incremental
Process sociologists	Adoption Initiation Implementation	Innovation (at the organizational level)	Product and process Technical and administrative Radical and incremental

Source: Gopalakrishnan, Shanti, and Fariborz Damanpour.
"A review of innovation research in economics, sociology and technology management." *Omega* 25, no. 1 (1997): 15-28.

Business, Innovation, and Knowledge Ecosystems

Source: Valkokari, Katri. "Business, innovation, and knowledge ecosystems: how they differ and how to survive and thrive within them." *Technology Innovation Management Review* 5, no. 8 (2015).

Business, Innovation, and Knowledge Ecosystems



Source: Valkokari, Katri. "Business, innovation, and knowledge ecosystems: how they differ and how to survive and thrive within them." *Technology Innovation Management Review* 5, no. 8 (2015).

Innovation Ecosystems Characteristics

	Business Ecosystems	Innovation Ecosystems	Knowledge Ecosystems
Baseline of Ecosystem	Resource exploitation for customer value	**Co-creation of innovation**	Knowledge exploration
Relationships and Connectivity	Global business relationships both competitive and co-operative	Geographically clustered actors, different levels of collaboration and openness	Decentralized and disturbed knowledge nodes, synergies through knowledge exchange
Actors and Roles	Suppliers, customers, and focal companies as a core, other actors more loosely involved	**Innovation policymakers, local intermediators, innovation brokers, and funding organizations**	Research institutes, innovators, and technology entrepreneurs serve as knowledge nodes
Logic of Action	A main actor that operates as a platform sharing resources, assets, and benefits or aggregates other actors together in the networked business operations	Geographically proximate actors interacting around hubs facilitated by intermediating actors	A large number of actors that are grouped around knowledge exchange or a central non-proprietary resource for the benefit of all actors

Source: Valkokari, Katri. "Business, innovation, and knowledge ecosystems: how they differ and how to survive and thrive within them." *Technology Innovation Management Review* 5, no. 8 (2015).

Diffusion of Innovation Theory (DOI)

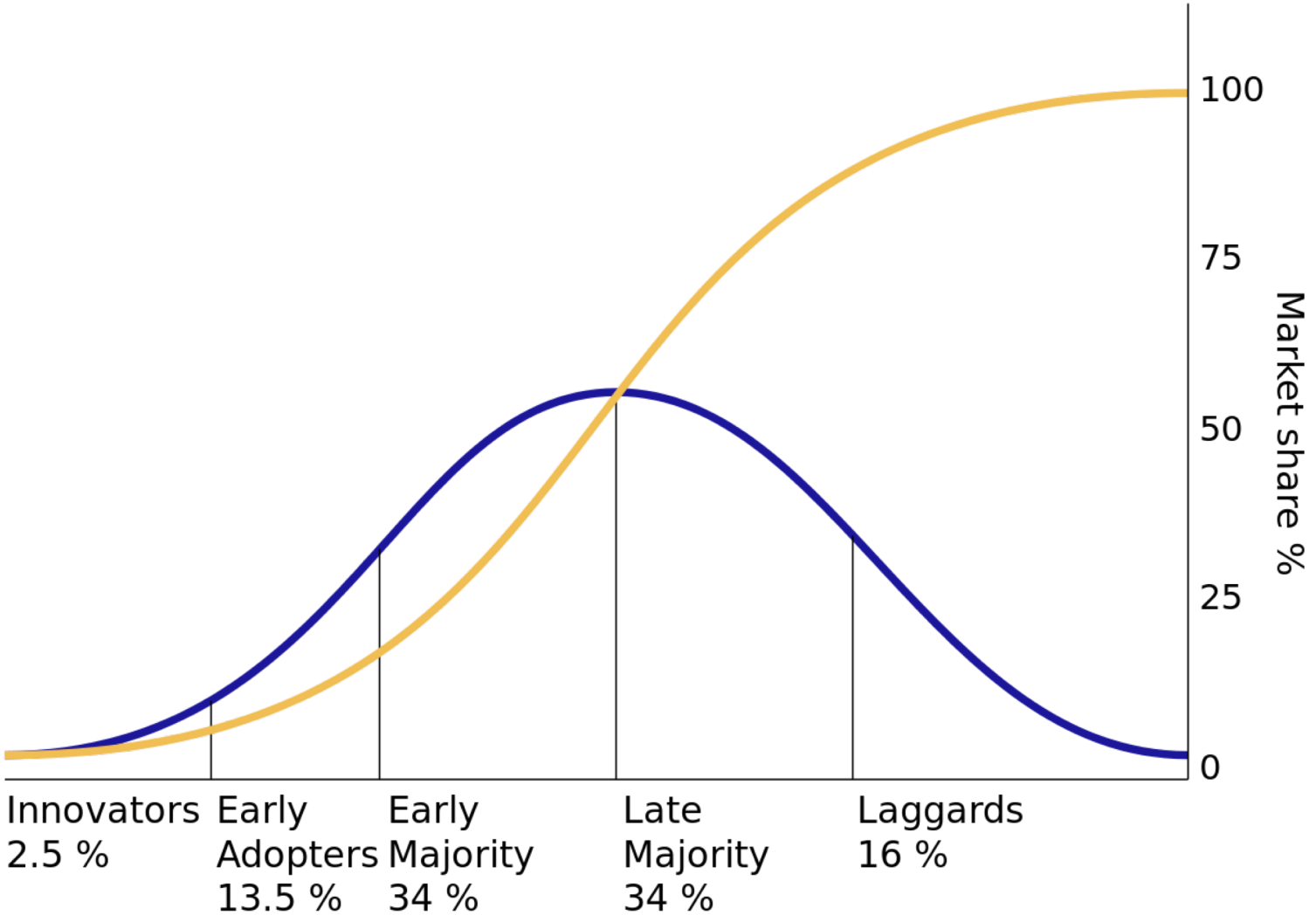
Source: Everett M. Rogers (2003), “Diffusion of Innovations”, Free Press, 5th Edition

Innovation (Diffusion of Innovation)

1. Relative advantage
2. Compatibility
3. Complexity
4. Trialability
5. Observability

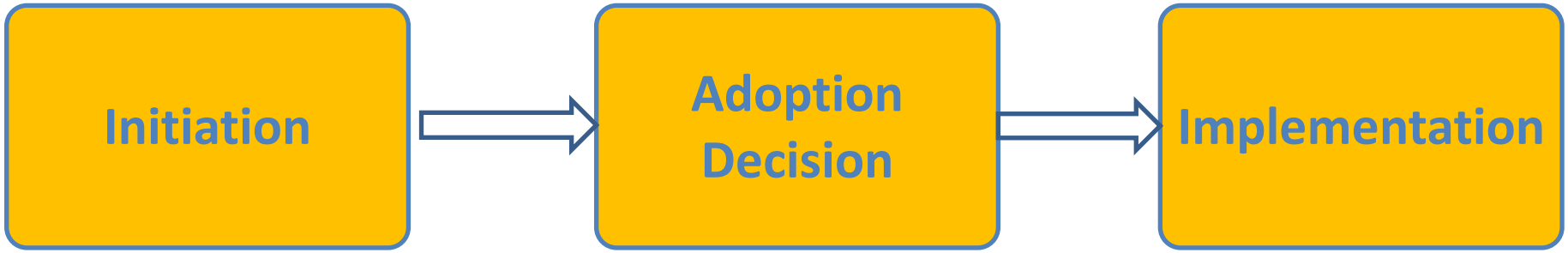
Source: Everett M. Rogers (2003), “Diffusion of Innovations”, Free Press, 5th Edition

Diffusion of Innovation



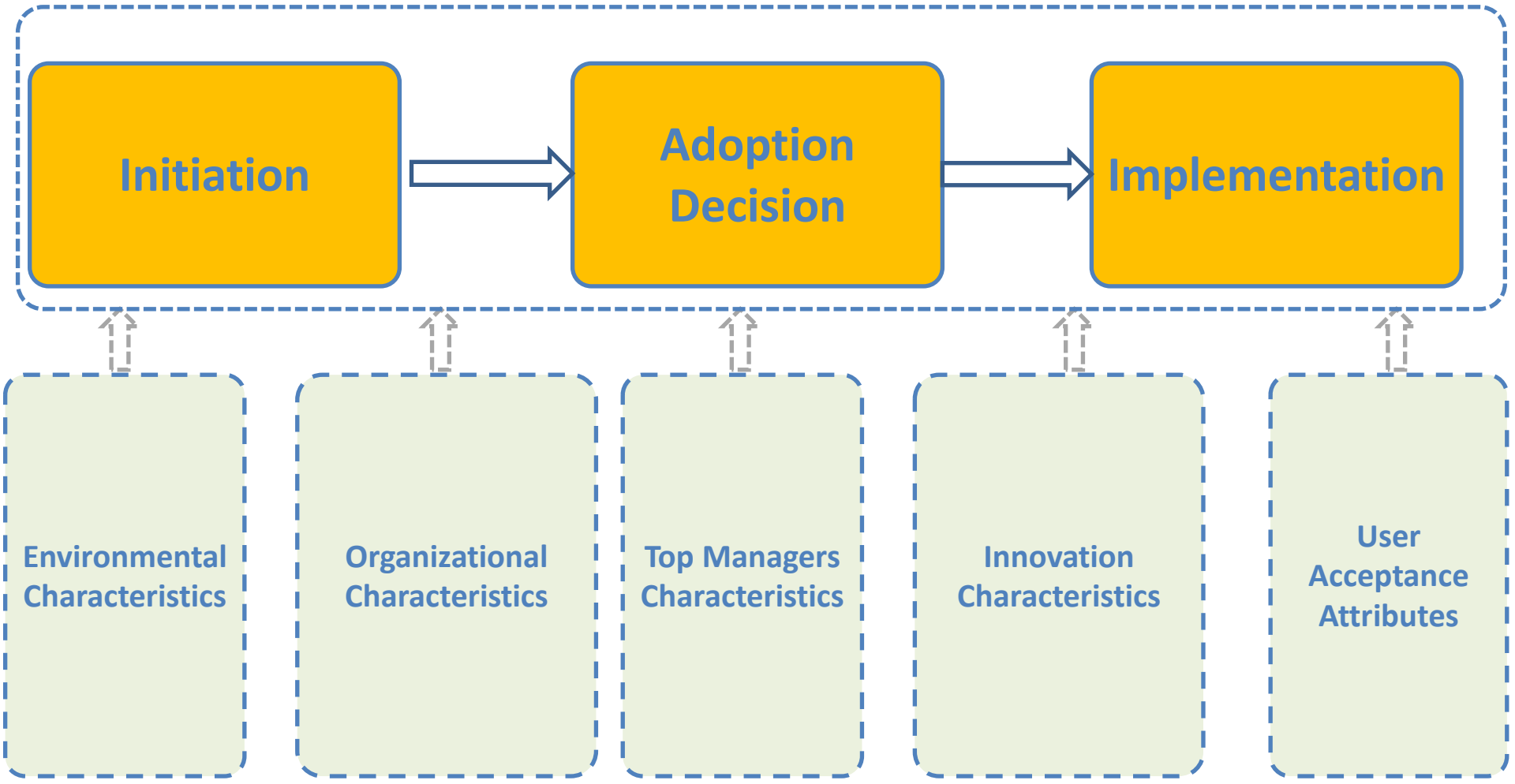
Source: https://en.wikipedia.org/wiki/Diffusion_of_innovations

Innovation Adoption Process



Source: Pichlak, Magdalena.
"The innovation adoption process: A multidimensional approach." Journal of Management and Organization 22, no. 4 (2016): 476.

Innovation Adoption Process



RBV=
Resource-Based View

DOI =
Diffusion of Innovation Theory

TAM=
Technology Acceptance Model

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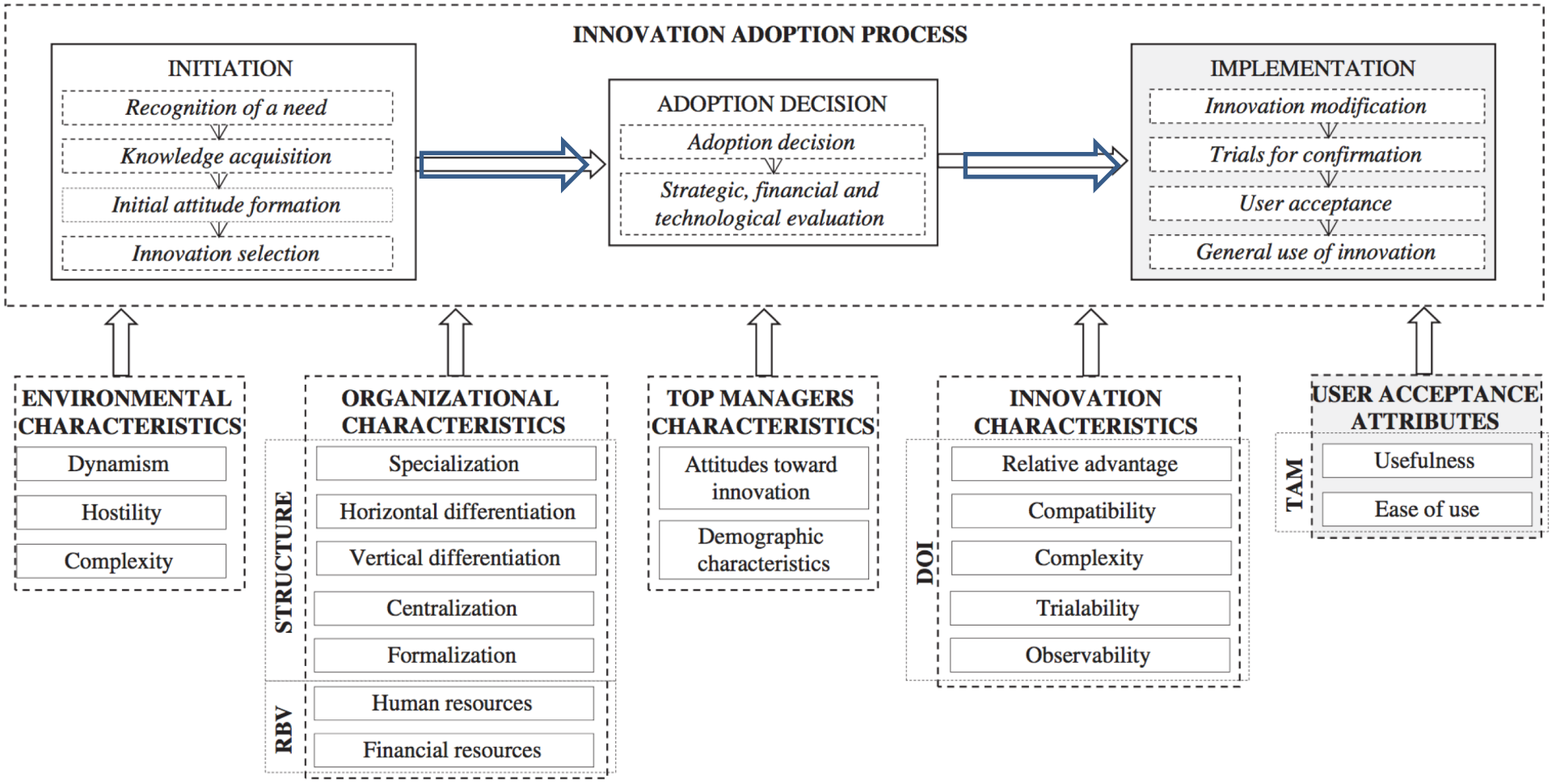
Innovation Adoption Process



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Innovation Adoption Process

Factors		Initiation					Adoption decision					Implementation				
		Mean	Me	Q3	Q1	QD	Mean	Me	Q3	Q1	QD	Mean	Me	Q3	Q1	QD
Environmental characteristics	Dynamism	3.4	3	4	2.75	0.625	3.6	4	4	3	0.5	4	4	5	4	0.5
	Hostility	3.3	3	4.25	3	0.625	3.9	4	4.25	3.75	0.25	3.7	4	4.5	3.5	0.5
	Complexity	4.5	5	5	4	0.5	3.2	3	4	2.75	0.625	3.3	3	4.25	3	0.625
Organizational characteristics	Specialization	3.8	4	4.25	3.75	0.25	2.9	3	4	2	1	2	2	3.25	2	0.625
	Horizontal differentiation	2.8	3	3.75	2.75	0.5	2.7	3	3.5	2	0.75	2	2	3.5	2	0.75
	Vertical differentiation	2.1	2	3.25	2	0.625	3.3	3	4	2.5	0.75	3.1	3	4	2.75	0.625
	Centralization	2	2	3.25	2	0.625	3.8	4	4.25	3.75	0.25	3.9	4	4.25	3.75	0.25
	Formalization	2.1	2	3	1.75	0.625	3	3	4.25	3	0.625	3.3	3	4	3	0.5
	Human resources	4.9	5	5	4.5	0.25	4	4	5	4	0.5	4.1	4	5	4	0.5
	Financial resources	3.2	3	4	2.5	0.75	4.1	4	4.25	3.75	0.25	4.8	5	5	4	0.5
Top managers characteristics	Top managers attitude towards innovation	4.1	4	4.5	4	0.25	3.9	4	4.25	3.75	0.25	4	4	4.5	3.5	0.5
	Top managers demographic characteristics	2.3	2	3.25	1.75	0.75	2	2.5	3	1	1	2.2	2	3	1.5	0.75
Innovation characteristics	Relative advantage	3	3	4	2.75	0.625	4.4	4.5	5	4	0.5	3.1	3	4	2.75	0.625
	Compatibility	2.8	3	3.5	2	0.75	3.9	4	4.25	3.75	0.25	3.9	4	4.25	3.75	0.25
	Complexity	3.6	4	4.25	3.75	0.25	3.8	4	4	3.75	0.125	3.9	4	4.25	3.75	0.25
	Trialability	3.2	3	4	2.75	0.625	3.1	3	4	2.5	0.75	4.1	4	5	4	0.5
	Observability	3.4	3.5	4.25	3	0.625	3.1	3.5	4	2	1	3.3	3	4.25	3	0.625
User acceptance attributes	Usefulness											3.2	3	4	2	1
	Ease of use											4	4	5	4	0.5

Note.
Me = median; Q = quartile; QD = quartile deviation.

Source: Pichlak, Magdalena.
"The innovation adoption process: A multidimensional approach." Journal of Management and Organization 22, no. 4 (2016): 476.

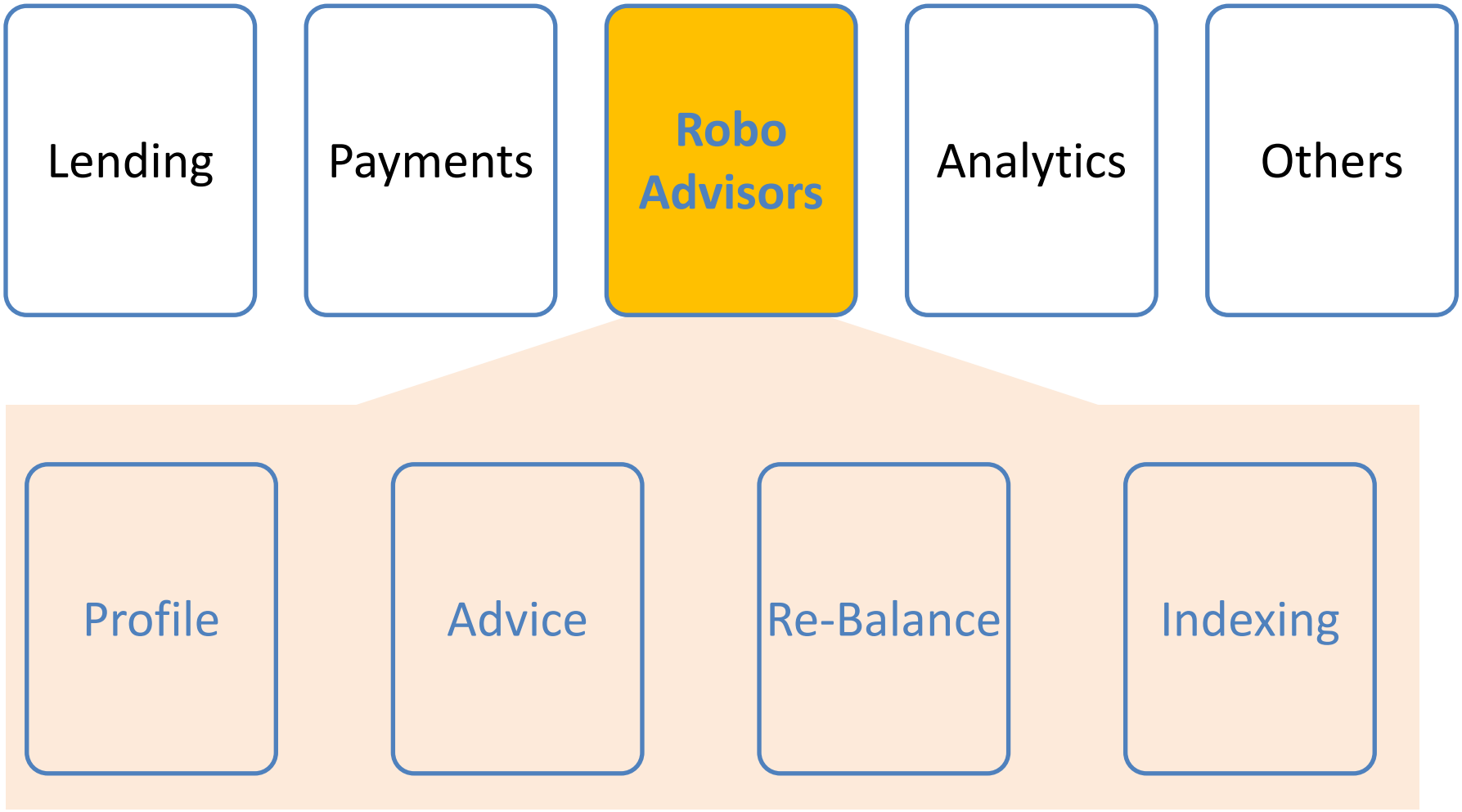
Innovation Adoption Process

Initiation			*Adoption decision*			*Implementation*		
Factors	*Round 1*	*Round 2*	*Factors*	*Round 1*	*Round 2*	*Factors*	*Round 1*	*Round 2*
Complexity in the environment	4.5	4.2	Dynamism in the environment	3.6	3.4	Dynamism in the environment	4.0	3.8
Specialization	3.8	3.4	Hostility in the environment	3.9	4.0	Hostility in the environment	3.7	3.4
Horizontal differentiation	2.8	3.1	Centralization	3.8	3.8	Centralization	3.9	3.8
Human resources	4.9	5.0	Human resources	4.0	4.2	Formalization	3.3	3.2
Top managers attitude towards innovation	4.1	4.3	Financial resources	4.1	4.4	Human resources	4.1	4.4
Innovation complexity	3.6	3.3	Top managers attitude towards innovation	3.9	4.0	Financial resources	4.8	5.0
			Relative advantage	4.4	4.1	Top managers attitude towards innovation	4.0	4.4
			Innovation compatibility	3.9	3.6	Innovation compatibility	3.9	3.8
			Innovation complexity	3.8	3.8	Innovation complexity	3.9	3.9
						Innovation trialability	4.1	3.9
						Ease of use	4.0	4.2

Source: Pichlak, Magdalena.
"The innovation adoption process: A multidimensional approach." Journal of Management and Organization 22, no. 4 (2016): 476.

FinTech Innovation

FinTech high-level classification



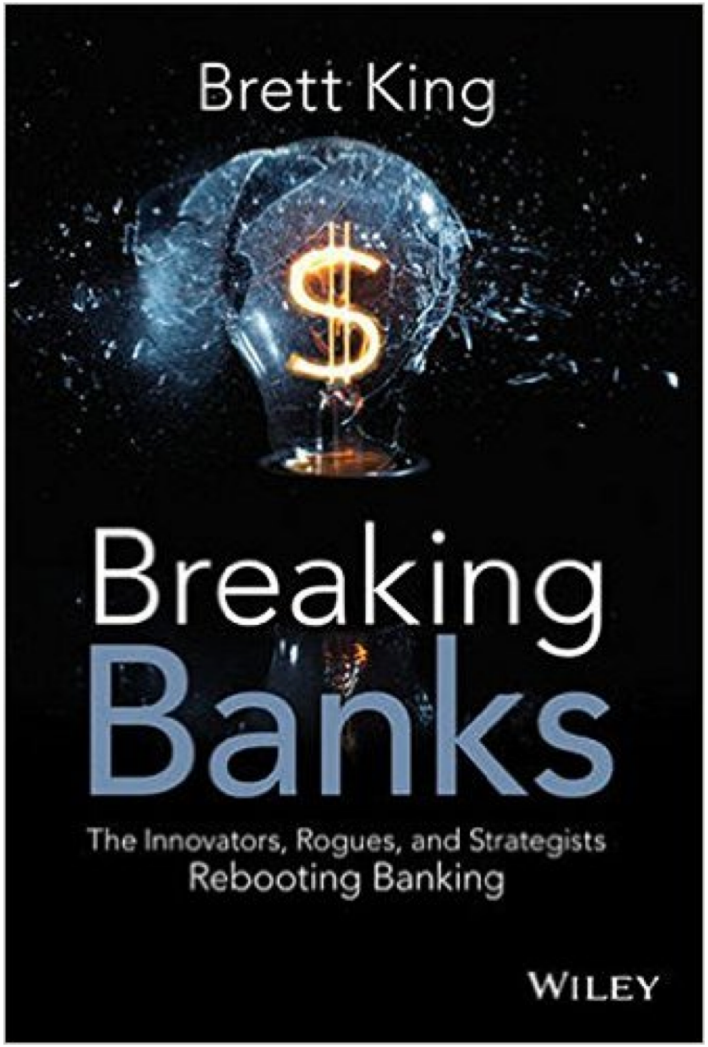
Source: Paolo Sironi (2016), "FinTech Innovation: From Robo-Advisors to Goal Based Investing and Gamification", Wiley.

Brett King (2014),

Breaking Banks:

The Innovators, Rogues, and Strategists Rebooting Banking

Wiley



Source: https://www.amazon.com/Breaking-Banks-Innovators-Strategists-Rebooting/dp/1118900146

"In the next 10 years, we'll see more **disruption** and **changes** to the **banking** and **financial industry** than we've seen in the preceding 100 years."

(Brett King, 2014)

Source: Brett King (2014), Breaking Banks: The Innovators, Rogues, and Strategists Rebooting Banking, Wiley

Fintech: Financial Technology

Disrupting Banking: The Fintech Startups That Are Unbundling Wells Fargo, Citi and Bank of America

Source: https://www.cbinsights.com/blog/industry-market-map-landscape/

Fintech: Unbunding the Bank

Source: https://www.cbinsights.com/blog/disrupting-banking-fintech-startups-2016/

Fintech: Unbunding the Bank

Wealth Management: Wealthfront

Source: https://www.cbinsights.com/blog/disrupting-banking-fintech-startups-2016/

Fintech: Financial Technology

Disrupting European Banking: The FinTech Startups That Are Unbundling HSBC, Santander, and BNP

Source: https://www.cbinsights.com/blog/industry-market-map-landscape/

Unbundling of a European Bank

CB INSIGHTS

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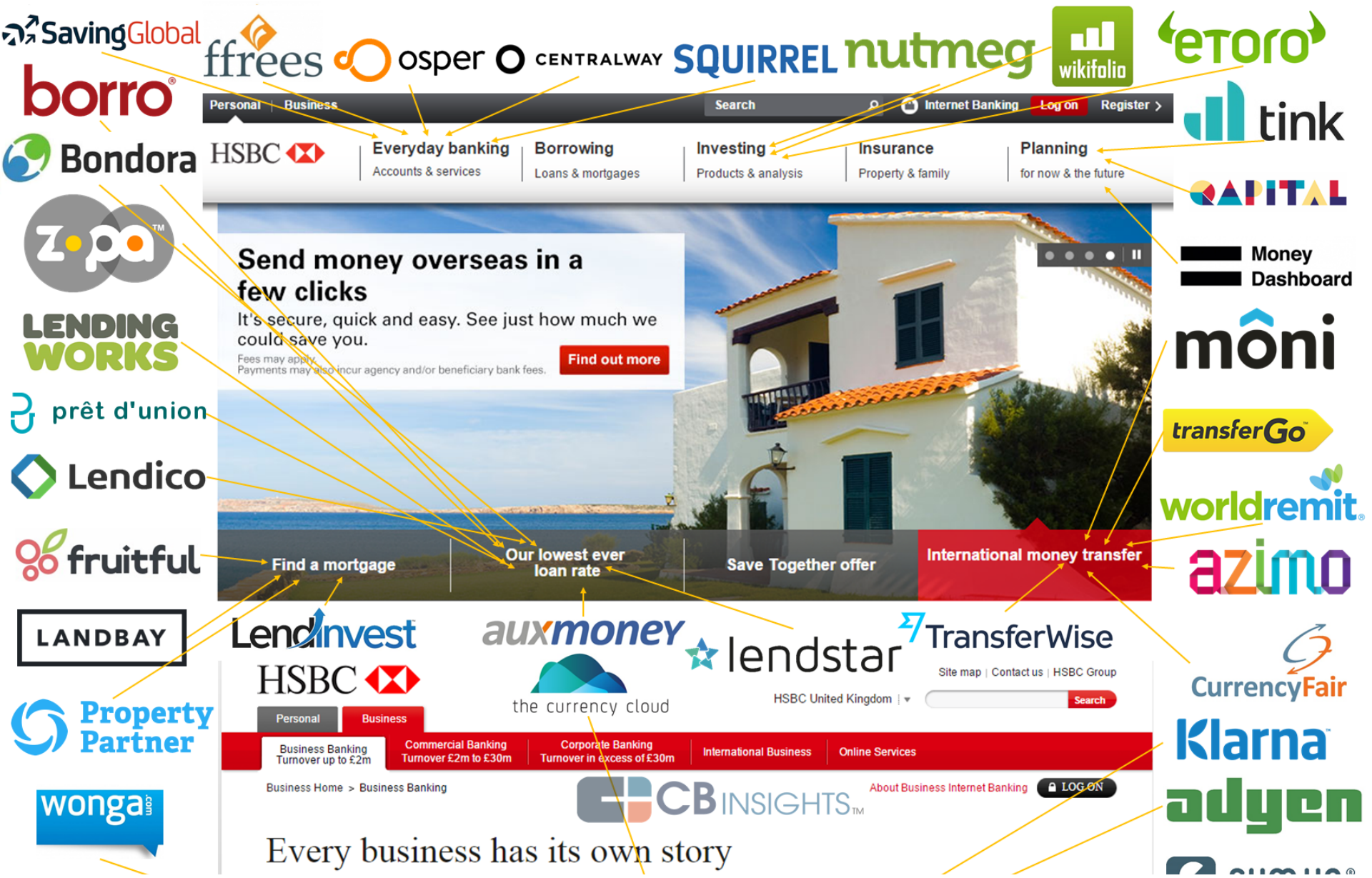
Source: https://www.cbinsights.com/blog/disrupting-european-banking-fintech-startups/

Unbundling of a European Bank



Source: https://www.cbinsights.com/blog/disrupting-european-banking-fintech-startups/

Financial Technology (Fintech) Categories

1. Banking Infrastructure
2. Business Lending
3. Consumer and Commercial Banking
4. Consumer Lending
5. Consumer Payments
6. Crowdfunding
7. Equity Financing
8. Financial Research and Data
9. Financial Transaction Security
10. Institutional Investing
11. International Money Transfer
12. Payments Backend and Infrastructure
13. Personal Finance
14. Point of Sale Payments
15. Retail Investing
16. Small and Medium Business Tools

Source: http://www.venturescanner.com/financial-technology

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