

RECENT DEVELOPMENTS IN FINTECH: WHAT'S NEW

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AGENDA

- “Fintech Stack”
- Artificial Intelligence (AI) and Machine Learning (ML)
- Other Fintech Topics
- Regulatory Environment for Responsible Innovation



“FINTECH STACK”

CONSUMER FINANCIAL DATA*

As a result of digitization, vast amounts of data now exist in forms that can be readily aggregated and analyzed with computing power.

- Online and mobile applications that draw on these data make it possible for consumers to view banking and other financial account information, often held at different financial institutions, on a single platform, monitor the performance of their investments in real-time, compare financial and investment products, and even make payments or execute transactions.
- Applications can also assist with automatic savings, budget advice, credit decisions, and fraud and identity theft detection in real-time.

Multiple companies developing & deploying applications and tools which inter-operate seamlessly in order to deliver innovative financial services products and services may be referred to as the “Fintech Stack”.

- It has given rise to a new sector of nonbank financial institutions focused on products and services utilizing data aggregation, based on data obtained with the consumer’s consent.
- The rise of such financial institutions presents questions regarding the way in which they operate and are currently regulated.

* Source: U.S. Treasury report (July 2018) *“A Financial System That Creates Economic Opportunities: Nonbank Financials, Fintech, and Innovation”*

WHAT IS DATA AGGREGATION?

Consumers create vast amounts of data every moment which can inform about their personal preferences, spending habits, savings & investing behaviors, transactions histories, earnings characteristic, etc

- ▶ *Fintech companies recognize that having access such data can be helpful – and in many cases essential – to identifying, developing and/ or offering innovative financial products and services to better serve the needs of target consumers*

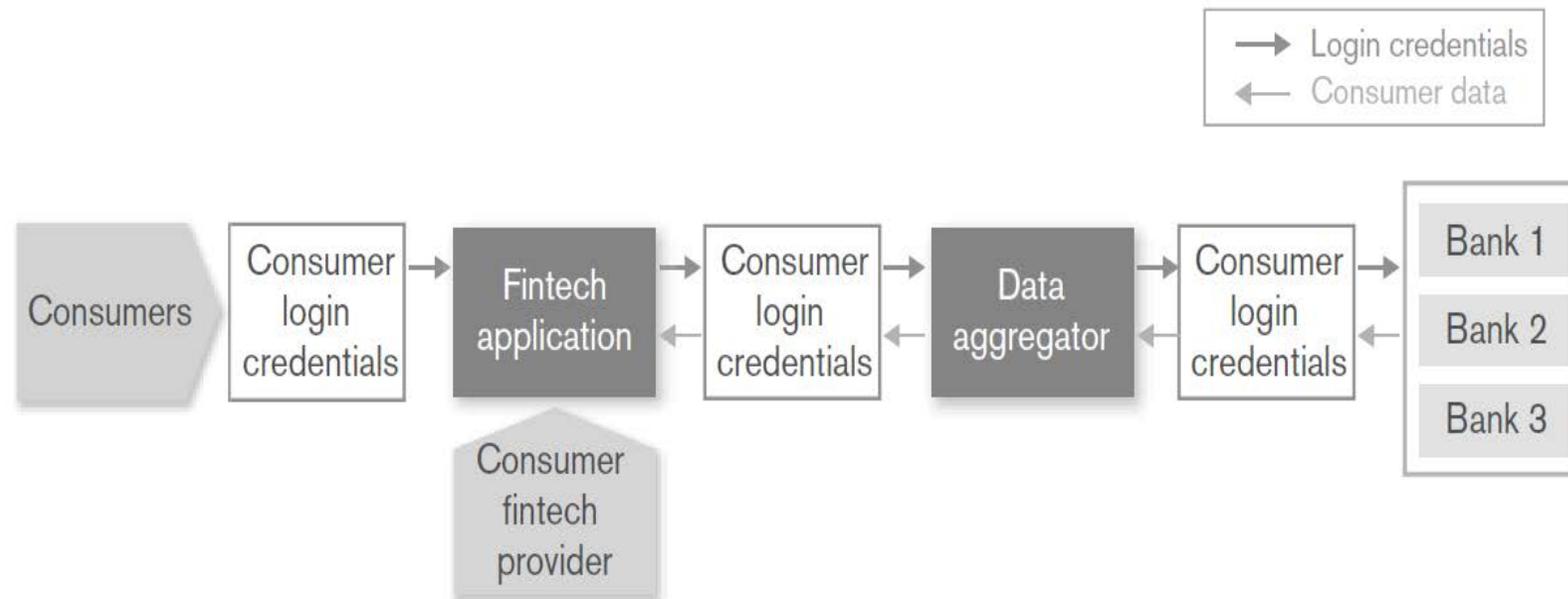
“Data Aggregation” refers to the process of compiling and making available such data in usable manners

- ▶ *It is generally not feasible for individual Fintech companies to build interfaces with thousands of banks to collect these data, but they can obtain access using Data Aggregators*

“Data Aggregators” are companies which specialize in providing these data services. Other companies may also provide access to such data. We collectively refer herein to all of these companies as “Data Providers”

HOW DATA AGGREGATION WORKS: SCREEN SCRAPING*

“Screen scraping” is a crude method for accessing bank data albeit this may be only feasible method for many community banks

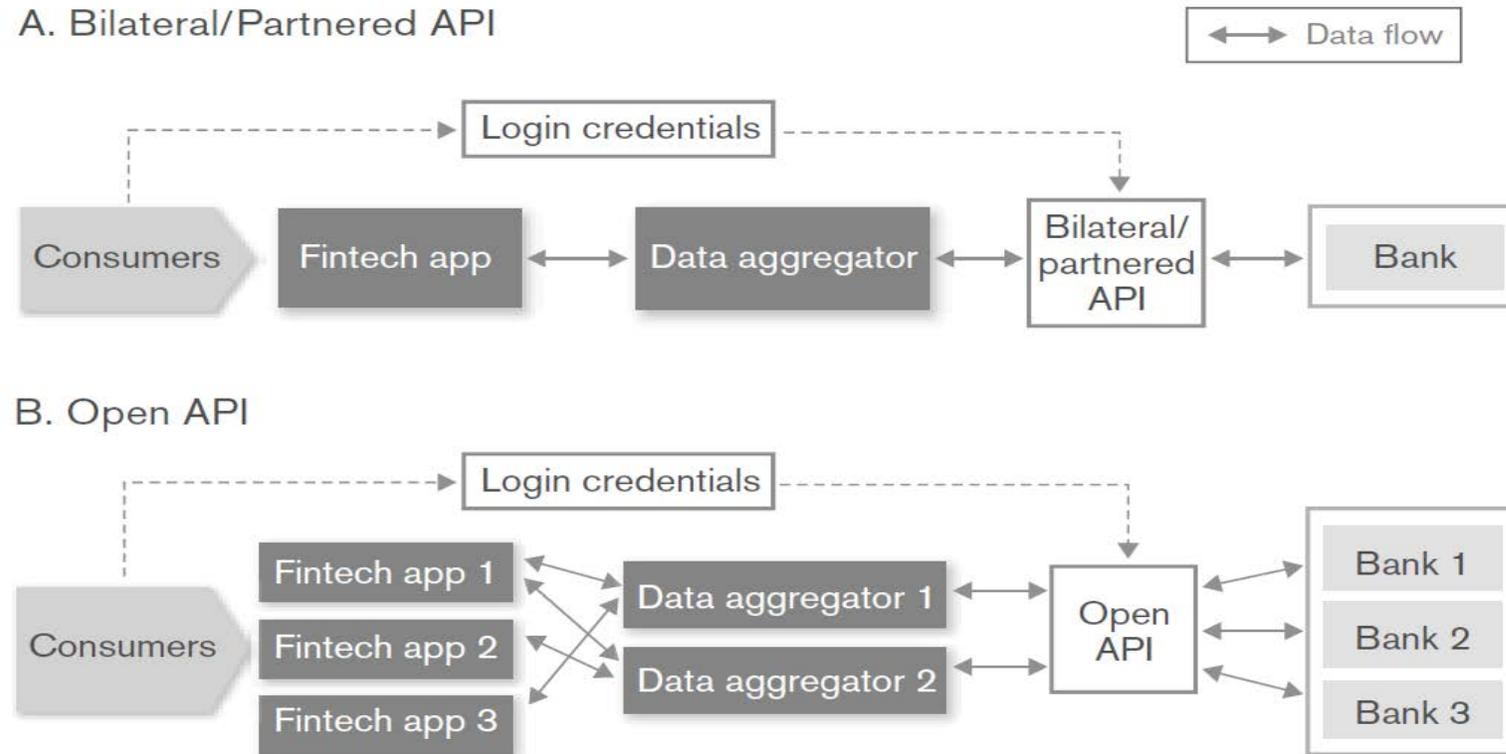


Source: Treasury staff analysis.

* Source: U.S. Treasury report (July 2018) *“A Financial System That Creates Economic Opportunities: Nonbank Financials, Fintech, and Innovation”*

HOW DATA AGGREGATION WORKS: APIs*

APIs can provide seamless interoperability to connect with Fintech's technology



Source: Treasury staff analysis.

* Source: U.S. Treasury report (July 2018) *"A Financial System That Creates Economic Opportunities: Nonbank Financials, Fintech, and Innovation"*

BENEFITS & POTENTIAL RISKS

Enhanced Financial Services

- ▶ New Products & Services: e.g. Amounts & frequency of deposits & payments records may help identify and design more effective savings & investing solutions for target consumers
- ▶ Credit Underwriting: e.g. Transactions histories can provide additional support for credit qualification and result in improved credit scores
- ▶ Distribution Channels & Marketing: e.g. Frequently visited shops and associated locations may help identify potential new distribution channels and marketing opportunities
- ▶ Payments: e.g., Ability to read data from – and post data to – disparate databases, such as different bank accounts, can enable “app-driven” payment services

Data Privacy

- ▶ Do consumers understand the permissioning of what of their data can be used (or shared with whom), for what purpose(s), and for what amount of time?

Data Security

- ▶ Data aggregators may not be subject to the same data security requirements as banks

Data Uses

- ▶ Tensions can arise between innovations that may solve consumer problems vs consumer protections
- ▶ Data-implied AI/ML outcomes may not be explainable nor amenable to independent validation

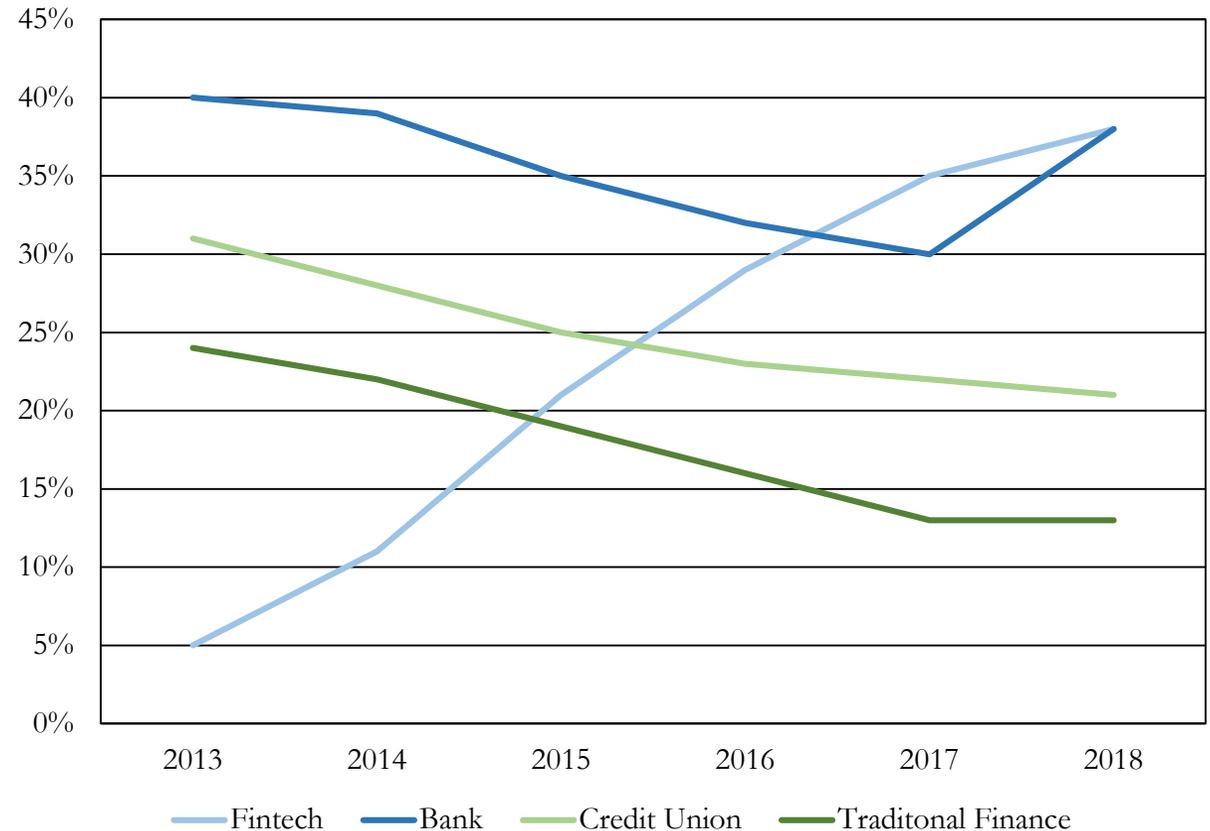
BANK AND FINTECH PARTNERSHIPS

- Since virtually no tech companies have the license necessary to perform banking services, many are teaming up with existing banks to offer a variety of services
 - Including Checking accounts, credit cards and bank-end and regulatory work
 - Banks originate loans on behalf of fintech partners as well as purchase loans underwritten by fintech partners
 - More than half of large SMBs are engaged with Fintech Lenders in some way.
- Examples
 - Cambr of StoneCastle and digital banking platform Q2 Holdings
 - Cambr offers tech companies ability to accept deposits
 - Spreads cash from tech companies to up to hundreds of financial institutions
 - Cash is insured under Federal Deposit Insurance Corp.'s \$250,000
 - Benefits
 - Allows smaller banks to grow and make local loans
 - Risks
 - Potential regulatory issues

BANK AND FINTECH PARTNERSHIPS

- Fintech Lending
 - Nonbank lending that employs innovative uses of the internet and emerging data analytic technologies to provide credit to consumers and small businesses
 - \$36 billion in originations for 2017
 - \$28 billion in personal loans (3.4 % of bank loans) and \$8 billion (2.7 % of bank loans) in small business loans
- Challenger Digital Banks
 - Chime – a challenger digital bank that offers early wage access, round up savings and no account maintenance or overdraft fees.
 - Has 5 million online checking accounts, \$2.5 billion transaction volume
 - 20 % of customers consider their digital banks as their primary bank
 - But 50 % of customers only wanted to try them out
 - Is seen as alternative to traditional banks for mostly low-to-middle-income consumers without a college degree
 - Most of growth is through word of mouth/referrals

Surge in Fintech Lending



ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

WHAT ARE ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING?

- 1950: “Computing Machinery and Intelligence,” Alan Turing
 - Can machines think?
 - Turing’s Test: Do you realize you are talking with a computer?
- There’s no single definition of artificial intelligence that is universally accepted by practitioners.



WHAT ARE ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING?

- Most progress has been in “Narrow Artificial Intelligence”
 - General AI – person-like intelligence over a full range of cognitive tasks
 - Narrow AI – specific application areas (e.g., games, translation, self-driving cars, image recognition)
- In particular, most current applications have involved “Machine Learning,” a type of narrow artificial intelligence
 - “A field of study that gives computers the ability to learn without being explicitly programmed,” Arthur Samuel, 1959



WHAT ARE ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING?

- How do you learn without being explicitly programmed?
- Imagine that we are trying to build a computer program that recognizes images of cats.
 - Before machine learning, we used the “Expert Systems Approach”
 - Programmers sit down with human experts
 - Identify “rules” and translate them into software code
 - For example: four legs, a tail, two ears
 - With machine learning you work “backwards”
 - Give the algorithm a lot of pictures
 - Tell the algorithm which pictures are cats
 - Ask the algorithm to find its own rules for identifying cats
 - Google famously did this in 2012.



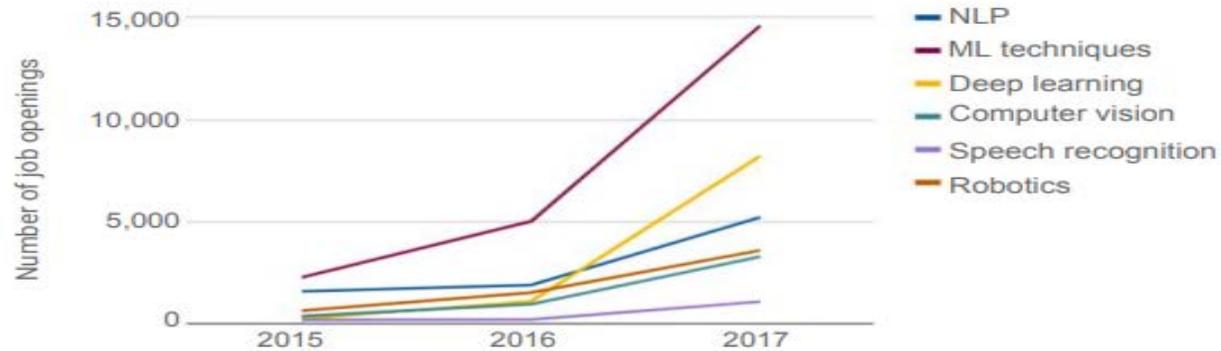
WHAT ARE ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

- There are two major schools of machine learning:
 - Supervised Learning
 - The machine learning algorithm is taught by example by giving it the answers to the test (e.g., pictures of cats)
 - The operator iteratively gives the machine the correct answers, to “train” the model to a higher level of accuracy
 - Unsupervised Learning
 - The machine learning algorithm studies data to identify patterns.
 - No answer key is given to the computer.

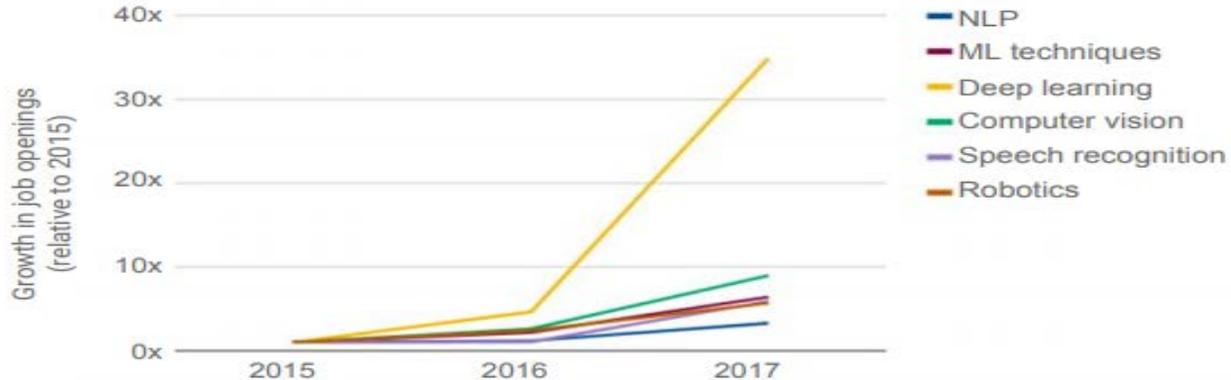
WHAT ARE ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

- There's a lot of interest in machine learning these days...

Job openings by AI skills required (2015 – 2017)
Source: Monster.com

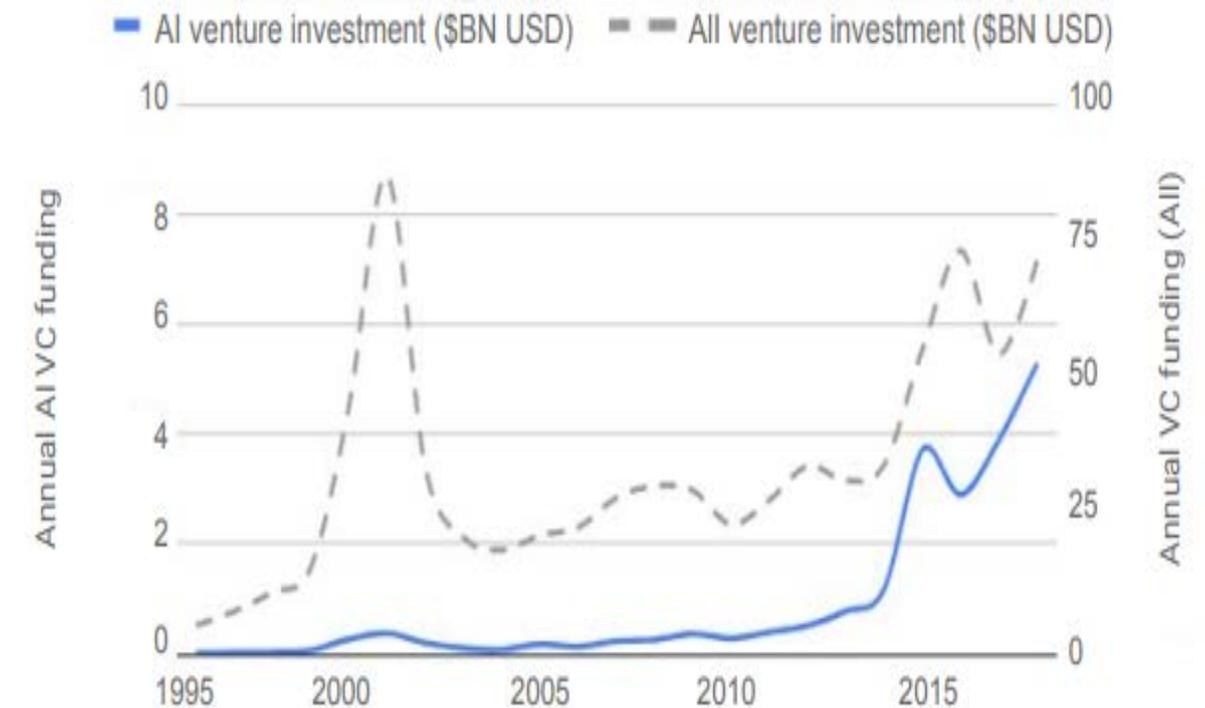


Growth of job openings by AI skills required (2015 – 2017)
Source: Monster.com



Note: While AI job openings are increasing across the board, they still represent a very low number of job openings for computer engineers.

Annual VC funding of AI startups (U.S., 1995 – 2017)
Source: Sand Hill Econometrics



WHAT ARE ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

... because the three primary ingredients for machine learning are now widely available:

- Algorithms
- Data
- Computing power



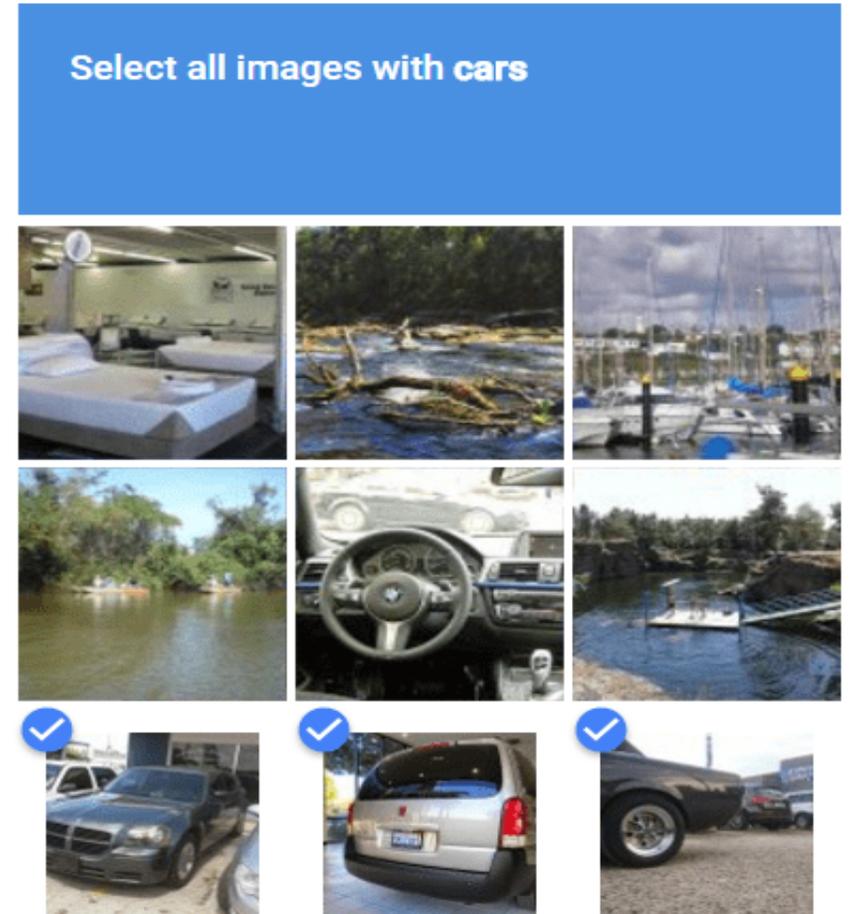
Jonathan Libov @libovness · Jan 4

Remember: Every time you misidentify a traffic light in a Captcha, a self-driving car hits a pedestrian

113

5.3K

18K



CONCERNS RAISED OUTSIDE OF BANKING

- Transparency and explainability
 - In the 1990's, researchers at the at the University of Pittsburgh created a machine learning algorithm to predict whether serious complications would develop in patients who presented with pneumonia
 - The program determined that having asthma, combined with pneumonia, led to better outcomes than patients that did not have asthma
 - Accordingly if you only had pneumonia, the algorithm would often recommend that you be admitted – but if the same person had pneumonia and a history of asthma, it would recommend that the patient be sent home
 - The algorithm (and its users) didn't account for an important correlation: patients with pneumonia and asthma had better outcomes because they were often automatically admitted to intensive care.

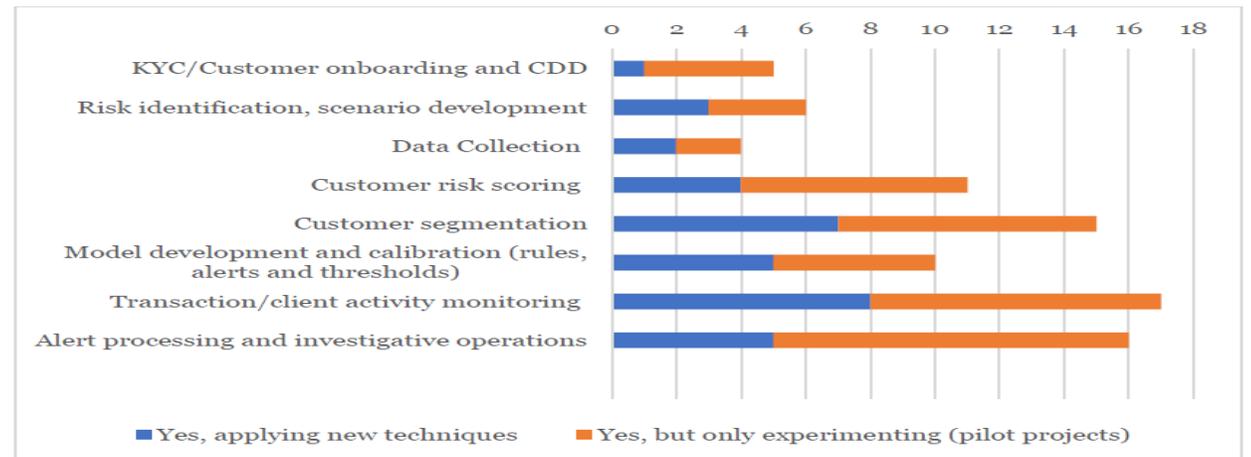
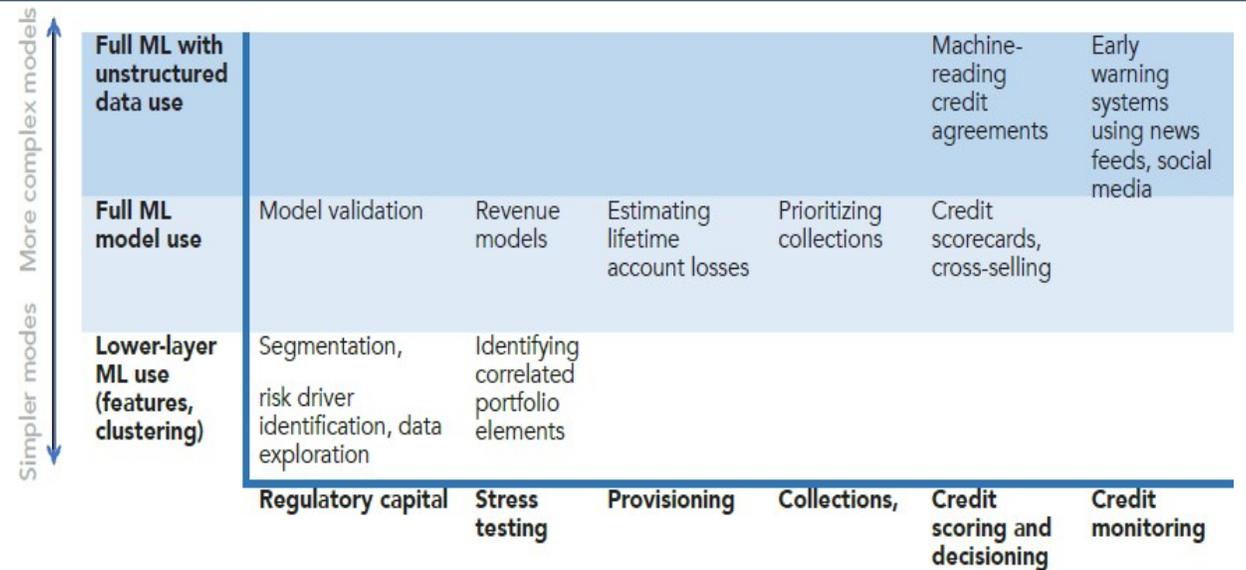
HOW ARE BANKS USING MACHINE LEARNING?

What we are seeing

- Fraud detection and prevention
 - Employee management
 - Cybersecurity breach notification
 - Fraudulent transaction identification
 - Login/call center fraud
- Bank Secrecy Act/Anti- Money Laundering
 - Flagging Suspicious Activities
- Consumer credit scoring
- Text ingestion
 - Company statements
 - Checks
 - Financial crime documentation
- Retail customer engagement
 - Chatbots
 - Customer segmentation
 - Customer relationship management (cross-marketing)
- Risk controls
 - Stress testing
 - Liquidity risk management
 - Derivatives hedging

HOW ARE BANKS USING MACHINE LEARNING?

- A March 2018 Institute of International Finance global survey of 60 financial institutions' use of machine learning tools in their credit business lines illustrates a wide range of use cases
- An October 2018 global survey of 59 financial institutions by the Institute of International Finance of the use of machine learning in anti-money laundering shows:
 - 35% firms are already applying machine learning tools to their anti money laundering work, with another 34% experimenting and another 29% making plans to do so.
- The goal is to assist, not replace analysts – with a focus on reducing false positives



REGULATORY FRAMEWORKS TO CONSIDER

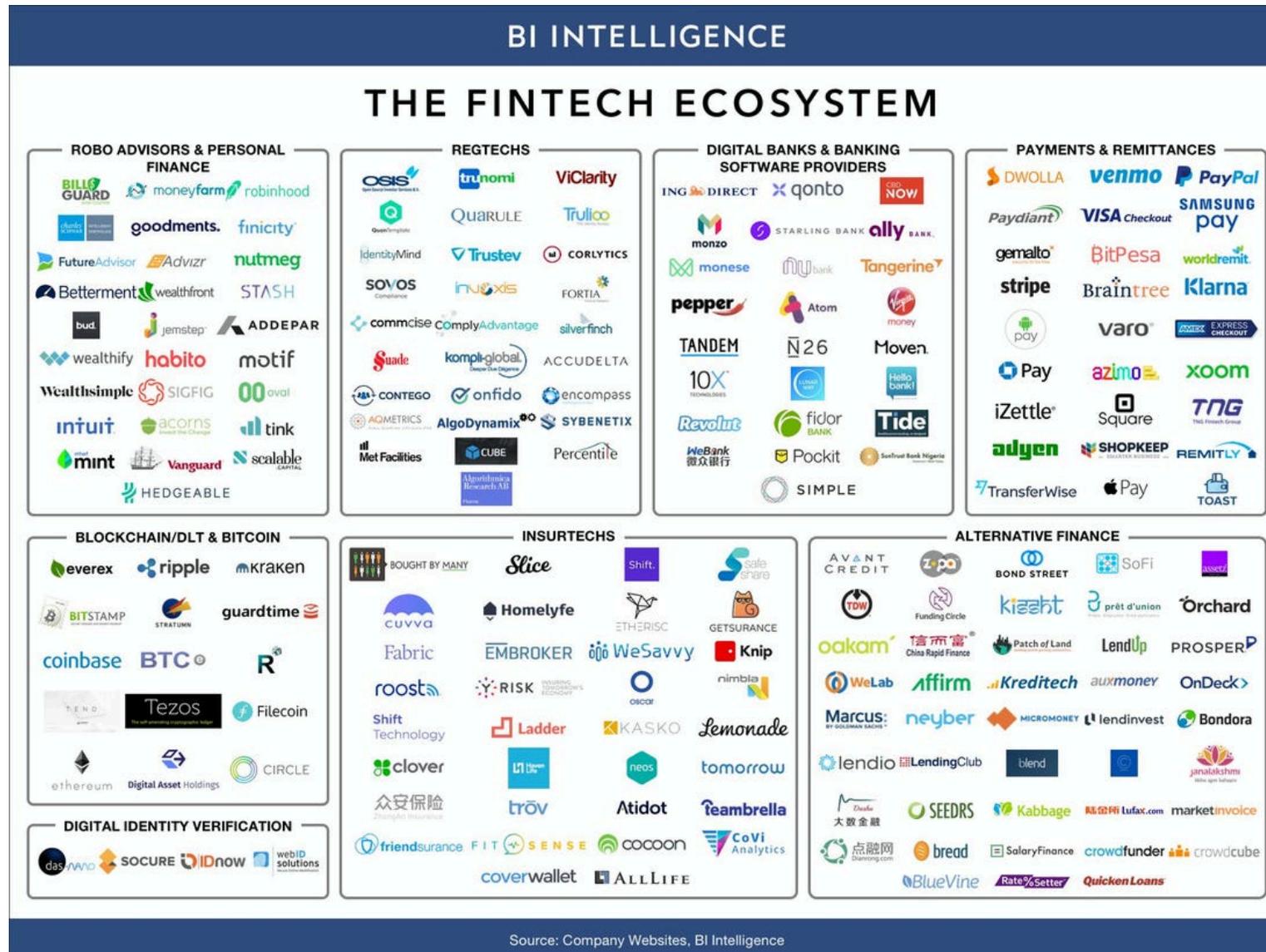
- Regulators may need to consider the prospects for AI-based tools to counter AI-based threats
- Regulators may be able to apply automated tools in the collection, analysis, and reporting of bank information
- Guidance on Model Risk Management, (SR 11-7)
 - Importantly, the guidance recognizes that not all aspects of a model may be fully transparent, as with proprietary vendor models, for instance.
 - Banks can use such models, but the guidance highlights the importance of using other tools (like “circuit breakers”) to cabin or otherwise mitigate the risk of an unexplained or opaque model.
 - Importantly, models should always be interpreted in context.

REGULATORY FRAMEWORKS TO CONSIDER

- Outsourcing (Third-Party) Risk Management Guidance (SR 13-19 / CA 13-21)
 - The guidance discusses best practices for supervised firms regarding due diligence, selection, and contracting processes in selecting an outside vendor.
 - It also describes ways that firms can provide oversight and monitoring throughout the relationship with the vendor, and considerations about business continuity and contingencies for a firm to consider before the termination of any such relationship.
- Guidance has to be read in the context of the relative risk and importance of the specific use-case in question.
 - We have long taken a risk-focused supervisory approach. The level of scrutiny should be commensurate with the potential risk posed by the approach, tool, model, or process used.
- In some cases, statutes and regulations make that risk weighting explicit – consumer, in particular
 - In the US, the Equal Credit Opportunity Act (ECOA) and the Fair Credit Reporting Act (FCRA) include requirements for creditors to provide notice of the factors involved in taking actions that are adverse or unfavorable for the consumer.
 - These requirements apply in all cases, large or small.

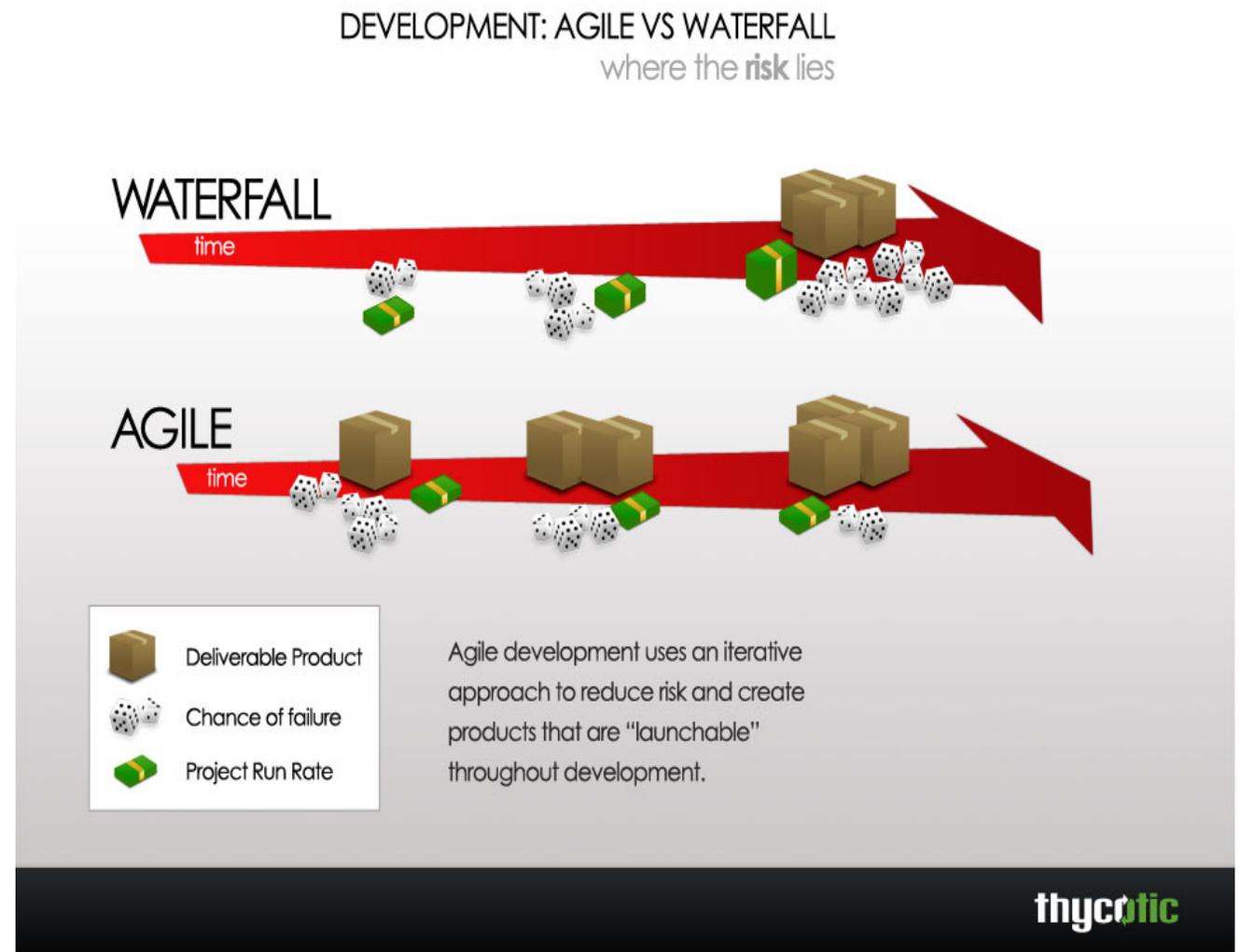
OTHER FINTECH TOPICS

WHAT ELSE ARE YOU SEEING?



AGILE DEVELOPMENT

- Increasingly seeing agile development approaches by banks and their fintech partners
- Agile Development vs. Traditional Development
 - Traditional Development
 - Linear development where product is delivered all at once
 - Agile Development
 - Iterative approach to software delivery that builds software incrementally
- Benefits
 - Flexibility
 - Adapts to feedback and gets customer what they want
 - Cost of change is lower



DISTRIBUTED LEDGER TECHNOLOGY

Distributed ledger technologies (DLTs) – such as Blockchain – represent innovations in network protocols allowing users to share database(s) that can be quickly updated and relied upon without reliance on trusted-party verification.

- Within banking benefits broadly pertain to eliminating need for reconciliations and reducing roles (and/or eliminating) some intermediaries thereby increasing execution speeds and reducing costs
- Range of activities which may be feasible for future migration to DLTs is further expanded though the use of “smart contracts”

Potential concerns may include:

- Immutable nature of DTLs may but pose challenges for correcting transaction execution mistakes and/or correcting unintended consequences of smart contracts
- Inherent limits to speeds permissible due to network through-put constraints, could drive size and memberships of consortiums using a given DLT solution
- Also impacting consortium composition, members need to agree on protocols. The larger the membership; the more difficult it may be to achieve required agreements
- Increased use of DLTs highlights challenges for safe & secure storage of “private keys”

CRYPTOCURRENCY

Cryptocurrencies are digital tokens which can be used as a means of payment. They are examples of particular “uses cases” for DLTs

- Bitcoin being the most well-known cryptocurrency deployed using Blockchain

In general, it is useful to consider 3 characteristics of cryptocurrencies:

- (1) potentially varying exchange rate to sovereign fiat currency,
- (2) designed to have stable value relative to sovereign fiat currency
- (3) regarding stable-value cryptocurrencies, unless it's a sovereign currency, the stable value would necessarily be maintained by through use of collateral.

The effectiveness of a cryptocurrency to serve as (i) store of value, (ii) unit of account, and/or (iii) medium of exchange, can vary depending on its aforementioned characteristics (1), (2) and (3).

Most banks currently have little (if any) direct interaction with cryptocurrencies

SUPERVISORY RISKS

SUPERVISORY RISKS

Risk considerations:



REGULATORY ENVIRONMENT FOR RESPONSIBLE INNOVATION

REGULATORY ENVIRONMENT FOR RESPONSIBLE INNOVATION

How do we foster a regulatory environment for responsible innovation?

- Regulatory tech
- Innovation-related guidance
- Industry engagement and collaboration efforts
- Special purpose charters
- Supervisory tech

