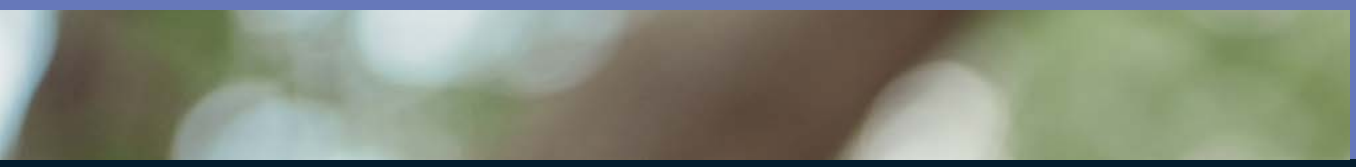

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THEMATIC INSIGHTS

Fintech Innovation

The transformation of financial services through technology

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Contents

Financial services and disruption

Financial Services is the second largest sector in the global economy. It generates trillions in annual revenue while commanding some USD 12 trillion[1] in equity market capitalization. It is also a sector that might once have seemed impervious to disruption: protected (as well as constrained) by regulation and dominated by incumbents benefitting from seemingly sticky client relationships.

But today one can easily discern change. The US retail banking franchises seem to have lost their daily point of contact with their customers,[2] credit card franchises are losing share to marketplace lenders[3] while 50-year-old stock brokerages are seeing lower trading volumes than 5-year-old trading apps.[4] Ride-hail companies are taking deposits.[5] Social media giants are attempting to launch multi-national currencies[6] and e-commerce companies are launching loan offerings.[7]

1 As of August 31st, 2020. Assumes global listed market capitalization of $92 trillion (per the World Federation of Exchanges) of which 12.9% is attributable to the financial sector.

2 "Cash App vs. Venmo", page 16, https://ark-invest.com/white-papers/cash-app-vs-venmo/

3 https://ark-invest.com/analyst-research/credit-card-industry/

4 https://www.cnbc.com/2020/08/10/robinhood-reports-more-monthly-trades-than-rivals-charles-schwab-e-trade-combined.html

5 https://www.uber.com/us/en/ride/how-it-works/uber-cash/

6 https://techcrunch.com/2019/06/18/facebook-libra/

7 https://www.americanbanker.com/news/alibaba-launches-interest-free-financing-for-u-s-small-businesses

The catalysts for **fintech disruption**

Put simply, financial services companies offer three fundamental functions[8] (i) the securing of savings[9], (ii) transfers and transactions across time and space[10] and (iii) information generation and risk assessment.[11] Each of these key economic services appears to be experiencing a profound and technologically-driven transformation.

Historically the financial sector has seemed largely resistant to disruption — any durable innovation has ultimately reinforced the incumbents. The difference today seems to lie in the combination of multiple vectors of disruption. The innovations we describe below are driven by the growth and development of mobile connected devices, artificial intelligence, cloud computing and blockchain technologies. Individually, each one provides a mechanism to change a fundamental financial function with a substantial efficiency gain. However, their coincident emergence in the same business cycle seems to have amplified the combined disruptive potential of fintech innovation. Deflationary forces arising from technologically enabled innovation and declining cost curves could boost the unit growth, productivity and profitability of successful fintech companies.

8 Adapted from Robert Merton's "A Functional Perspective of Financial Intermediation" which identifies 6 core functions performed by the financial system. See https://www.jstor.org/stable/3665532?read-now=1&seq=2

9 Maps to Merton's function 2: "a mechanism for the pooling of funds…"

10 Includes transfers across space and time (via loans and lending). Maps to Merton's functions 1 and 3: "…a payments system" and "a way to transfer economic resources through time and across geographic regions" respectively.

11 Maps to Merton's functions 4, 5 and 6 which declare that the financial system provides: "a way to manage uncertainty…", "provides price information that helps coordinate decentralized decision-making", and a way to resolve conflicts in information asymmetries respectively.

The digital wallets opportunity

Digital wallets could potentially significantly reduce the cost and friction of concluding transactions and transferring funds; the second of the core financial functions.

The story starts in 2005. Vodafone saw that African mobile phone subscribers were transferring cell phone minutes as a proxy for traditional currency. They collaborated with its local partner, Safaricom, to build an SMS based digital wallet system known as M-Pesa. The commercial launch took place in 2007 and by 2013, gross transaction flows through M-Pesa were equivalent to 43% of Kenya's GDP.[12] Even on feature phones, digital wallets provided utility sufficient to capture transaction volume in a country where traditional financial infrastructure was underdeveloped.

With the worldwide penetration of biometric-ID enabled smartphones, digital wallets (secure stores on digital devices to store funds and facilitate transactions) could be positioned to compete against the largest retail banking franchises.

In 2013 WeChat, an instant messaging app owned by Chinese tech company Tencent, launched WeChat Pay, a service that enabled users to send micropayments via the messaging app. By the end of 2013, WeChat Pay had 30 million active users. After the end of the Chinese New Year in January 2014, digital cash gift-giving through the app saw users rise to 100 million.[13] As of the end of 2018, the digital payment service had 800 million monthly active users.[14]

Exhibit 1:
The largest financial insitutions globally by number of accounts

Source: ARK Invest (2020), Company information for institutions that publish retail customer numbers.

On the basis of active accounts, one could consider WeChat to be the second largest financial service provider in the world, trailing only the Agricultural Bank of China's 837 million retail customers.[15] In third place would be another Chinese digital wallet: Alibaba's Alipay with 710 million monthly actives.[16] Both surpass Industrial & Commercial Bank of China, the largest bank by assets in the world, with its 590 million personal account customers.[17]

The potential of digital wallets to transform money flows can be seen in Chinese transaction statistics. Mobile payments volumes in China grew from USD 1.5 trillion in 2013 (when WeChat Pay first launched) to more than USD 50 trillion by 2019, roughly 3.5x China's GDP.[18] This mobile volumes multiple is indicative of the gobal scope for mobile-based facilitators of transaction flows.[19]

12 https://www.economist.com/special-report/2014/05/08/the-end-of-a-monopoly?frsc=dg%7Cd

13 https://www.fastcompany.com/3065255/china-wechat-tencent-red-envelopes-and-social-money

14 https://pay.weixin.qq.com/index.php/public/wechatpay_en

15 http://www.abchina.com/en/investor-relations/investment-value/business-edges/

16 https://www.fastcompany.com/90543469/jack-mas-ant-group-gears-up-for-what-could-be-the-biggest-ipo-in-history

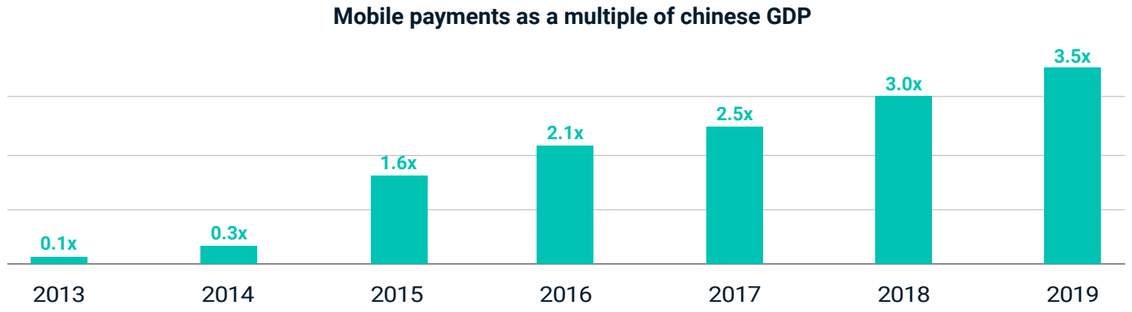
17 https://www.dnb.com/business-directory/company-profiles.industrial_and_commercial_bank_of_china_limited.de498c21f26679595d9e8f43c1d63a52.html

18 8 trillion Yuan to 347 trillion Yuan https://www.cgap.org/research/publication/china-digital-payments-revolution http://www.chinabankingnews.com/2020/03/19/chinas-online-payments-transactions-rise-37-14-yoy-in-2019-mobile-payments-up-67-57/

19 GDP is indicative of the final purchase price paid for the good produced, but along the way the underlying raw materials will have been sold to a parts manufacturer who will then on-sell those parts to an assembler, who may provide finished inventory to a wholesaler who then breaks up volumes for retailers.

Exhibit 2:
Mobile payments as a multiple of China's GDP (%)

Source: PBoC and Ark Invest

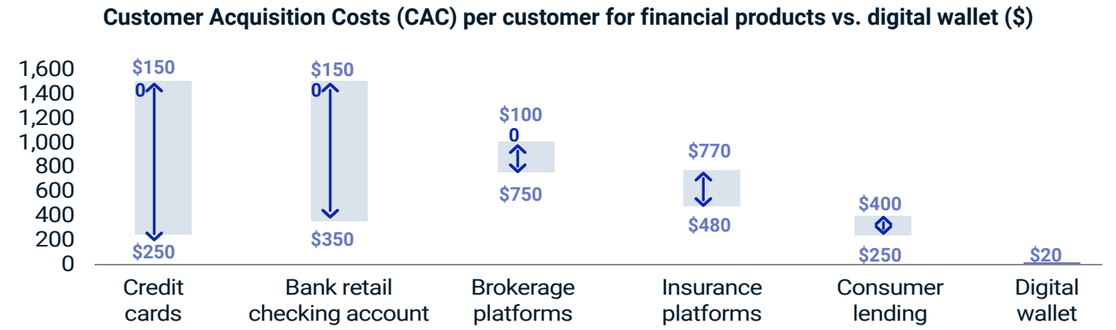


Gross transactions sum to well in excess of the final purchase price and the frictionless payments enabled by digital wallets only exacerbate this effect. Cash transfers, e.g. the small denominations that friends might exchange after settling a restaurant bill, that would previously have been invisible in transaction flow statistics now get captured by the digital wallet providers. Online micro-tipping and micro-transaction business models have emerged where previously they were not practically possible. To facilitate and encourage such transactions, digital wallet providers often reduce or eliminate transaction charges. By doing so, these platforms can then inexpensively accrue customers that may slough off valuable data which can be upsold into more profitable business lines.

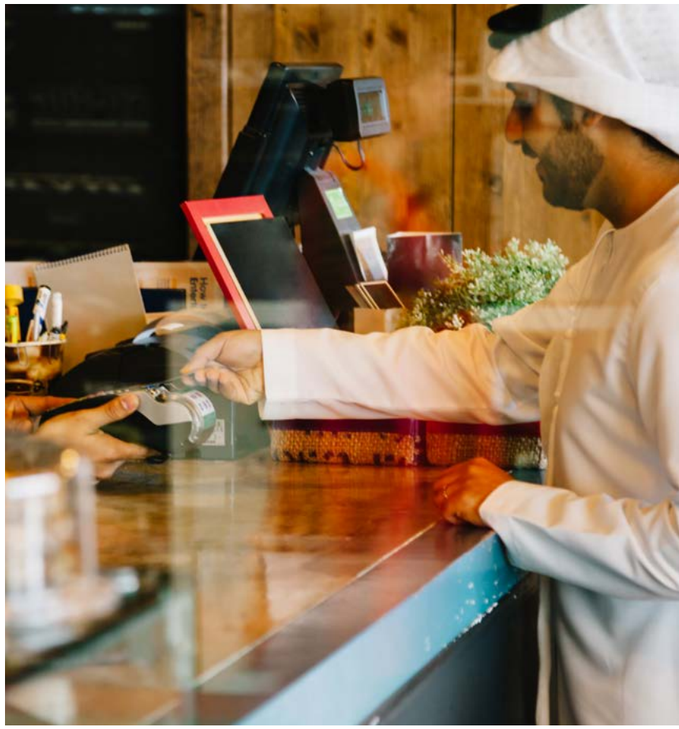
Digital wallet providers plan that peer-to-peer transfers enable them to amass network-effect-protected high-engagement user bases. Such users may become advocates for the product, thus on-boarding friends and family. This can lead to inexpensive customer acquisition costs for successful peer-to-peer digital wallet providers. Square's Cash App has acquired new customers for as little as USD 20 in promotional spend.[20] This contrasts with traditional US retail banks that have averaged a little over USD 900 per new customer.[21]

Exhibit 3:
Customer acquistion costs for financial products vs. digital wallets (USD)

Source: ARK Research estimates, 2020



The lower customer acquisition cost can allow digital wallets such as the Cash App to profitably offer financial services to lower-balance customers than can be serviced by traditional banks. Traditional banks may lose money on customers with less than $6,600 in their deposit accounts while digital wallets may be able to profitably service the same customer with less than USD 150 on deposit.[22] Moreover, because the typical peer to peer transfer user accesses her app multiple times a week (compare a traditional bank customer visit a branch once a month), digital wallets have more opportunities to cross-sell customers into other financial services. In China, digital wallets already offer lending, insurance and savings products. Other countries seem likely to see the same playbook.



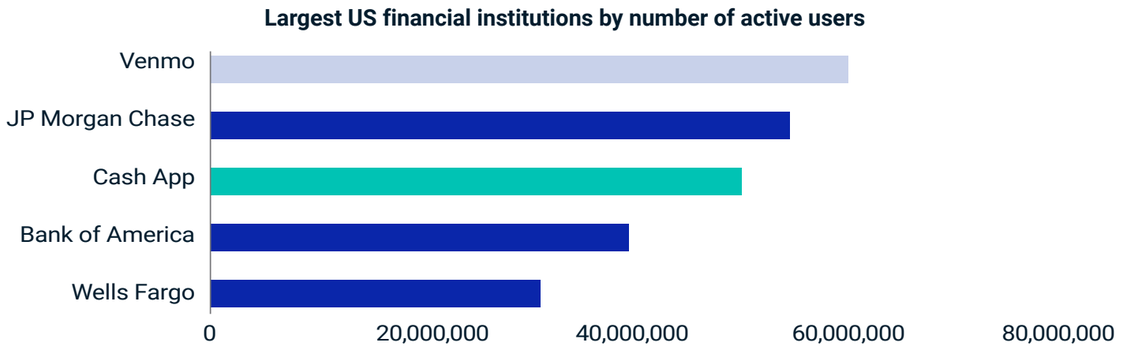
20 https://www.fool.com/investing/2019/05/16/square-spends-20-to-acquire-each-new-cash-app-user.aspx

21 https://ark-invest.com/analyst-research/digital-wallets/

22 https://ark-invest.com/analyst-research/digital-wallet-companies/

Exhibit 4:
US financial institutions ranked by number of active users

Source: ARK Research estimates, 2020



ARK Investment Management LLC, 2020. Source: Company disclosures, ARK esttimates. Quarterly active users for JP Morgan Chase, Bank of America, Wells Fargo. Annual active users for Venmo and Cash App.

ARK Invest forecast that digital wallet providers globally can convert their data access and engaged customers into other business lines. Roughly half of WeChat Pay's homescreen is devoted to non-financial functions as the platform on-sells customers into e-commerce and digital services.[23] Retail establishments will happily pay to offer discounts to customers if WeChat can get them in through the front door.[24] Already used by tens of millions in the US and hundreds of millions of users globally, digital wallets are becoming natural gateways for financial services such as wealth management, insurance, banking, personal finance and lending instruments such as credit cards.

23 Page 21: https://research.ark-invest.com/hubfs/1_Download_Files_ARK-Invest/White_Papers/Big-Ideas-2019-ARKInvest.pdf?hsCtaTracking=389fa33c-10c9-4345-8c9e-e457b82977f8%7C7114deb8-15db-4540-81d7-4a5f7de51e66

24 See, for example, Groupon's business model.

Impact of neural networks and **machine learning**

The idea of automating credit assessments is not new. Credit bureaus that collect data on end customers date back to at least 1776 when London's "Society of Guardians for the Protection of Trade Against Swindlers and Sharpers" was founded.[25] In the US, corporate borrower ratings were introduced by the Mercantile Agency (later a part of Dun & Bradstreet) in 1864.[26] The Retail Credit Corporation (later Equifax) was founded in 1899. It evolved from an Atlanta grocery store's "Good Customer" list into a nationwide database tracking millions of individual end-consumers by the mid twentieth century.[27] The roots of automated credit assessment is often traced to the Fair Isaac Corporation (FICO), which began selling its credit-scoring system to lenders in 1958 and created the standardized FICO score in 1989.[28]

The FICO score has proven durable—it is used in over 90% of lending decisions[29]—and yet it is a blunt instrument. On its own, a FICO score cannot tell a digital wallet provider whether a particular string of money transfers may part of a fraud, or whether or not a hair salon's cash flow fluctuations are seasonally typical or under stress. Nor can it help to make an instantaneous insurance assessment on a customer buying a new digital camera. And yet FICO scores are used by car insurers, landlords, potential employers, cell phone companies, and of course lenders.[30]

The world has changed since 1989. The introduction of the FICO score coincided with the birth of the World Wide Web.[31] Today, modern digital companies can operate at a data advantage against slower, traditional financial intermediaries. For example, a car manufacturer may have a better understanding of the safety of the driver than an auto insurer. The company providing a salon with its point of sale terminal may have a better understanding of the company's cash flow characteristics than its bank. An e-commerce company may have a better sense of a consumer's ability to repay a loan than a credit card provider.

25 https://tradelinesupply.com/history-credit-bureaus/

26 https://time.com/3961676/history-credit-scores/

27 https://www.wired.com/1995/09/equifax/

28 https://www.fico.com/en/about-us#history

29 https://www.cnbc.com/2019/05/10/those-credit-scores-you-see-may-not-be-what-lenders-use.html

30 https://www.debtreductionservices.org/who-can-check-your-credit-report/

31 https://home.cern/science/computing/birth-web/short-history-web

There is a reason that Tesla is offering auto insurance,[32] Square is cashflow financing small businesses,[33] and Alibaba will let you pay later.[34] These companies have new access to proprietary data streams that are directly relevant to the underwriting being performed.

The amount of data being generated per-person has increased almost 30-fold over the past decade. The deluge of data has been well-reported but it is worth reflecting on within a credit assessment context. The average US credit record gets updated once a month with the addition of a scanty 6.5 new data points.[35] 45 million Americans, almost 20% of the adult population, have insufficient data to receive a credit score at all.[36] The same is true for 2/3rds of the global population.[37] And yet consumers are sloughing off all kinds of interesting information that could be used for credit assessment and risk forecasting. There are approximately twice as many global social media users as there are people with credit data,[38] and researchers have demonstrated that social media data when combined with semi-supervised machine learning techniques can meaningfully improve credit assessment ability.[39]

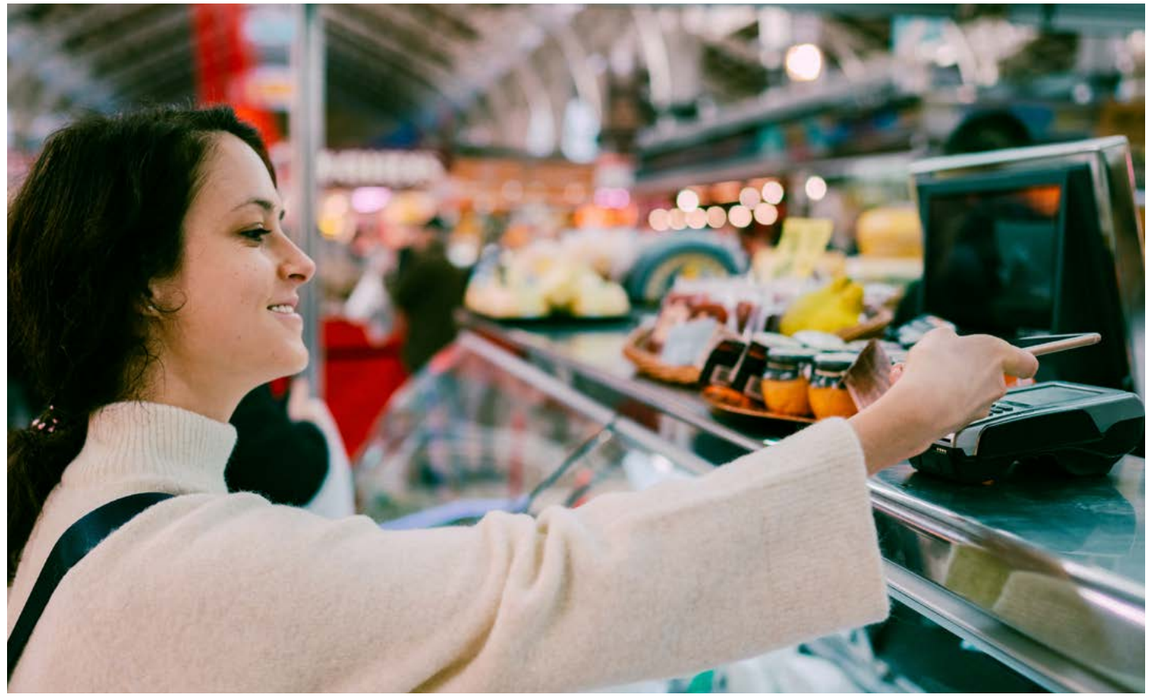


Exhibit 5:
Global gigabytes of data generated per capita 2010 vs 2020

Source: IDC, ARK Invest

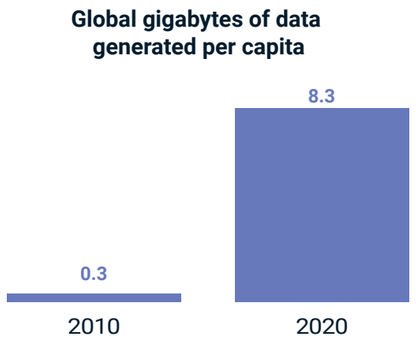
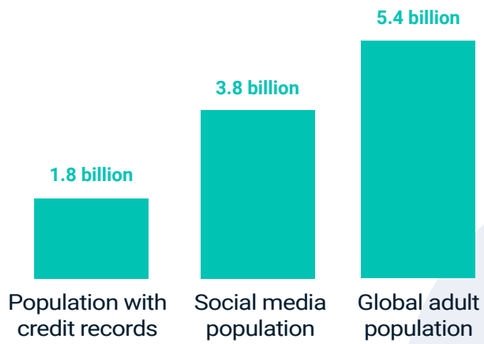


Exhibit 6:
Data generating population vs global population

Source: World Bank, wearesocial.com, International Census Database, ARK Invest (2020)



The usefulness of alternative data advantages those companies with proprietary access to it. That the company providing IP cameras, and WiFi-connected locks is better placed to efficiently price theft insurance to that end-consumer seems inevitable. Doing so, however, requires modern algorithms able to synthesize and analyze the raw information coming off of those digital endpoints.

Neural networks may provide companies with the modern tools that they require to transform their data into actionable insight. In a 2012 computer vision challenge, a team of researchers shattered performance records by using parallel processors to train an unprecedentedly large neural network.[40]

32 https://www.insurancejournal.com/magazines/mag-features/2020/08/10/578302.htm

33 https://www.wsj.com/articles/a-150-000-small-business-loanfrom-an-app-11546002022

34 https://paylater.alibaba.com

35 https://files.consumerfinance.gov/f/201212_cfpb_credit-reporting-white-paper.pdf

36 https://files.consumerfinance.gov/f/201505_cfpb_data-point-credit-invisibles.pdf

37 https://data.worldbank.org/indicator/IC.CRD.PRVT.ZS

38 https://wearesocial.com/blog/2020/01/digital-2020-3-8-billion-people-use-social-media

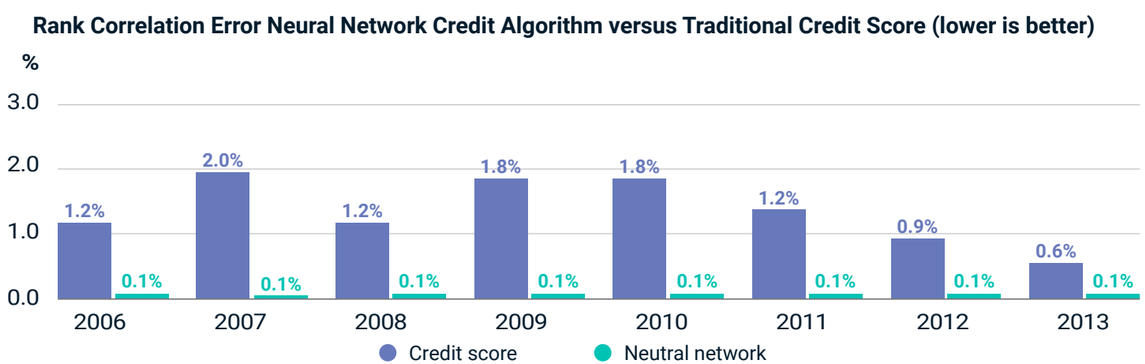
39 See https://aisel.aisnet.org/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1043&context=icis2016 where social media data improves predictions of loan payback performance by 18%.

40 http://www.cs.toronto.edu/~hinton/absps/imagenet.pdf

They demonstrated that large neural networks can solve large problems if you provide them with large amounts of data. This was a tipping point. It has subsequently been demonstrated that neural networks improve predictions and assessments across multiple domains and contexts. Within finance, even when operating on the same dataset as traditional credit scoring agencies, researchers have shown that a neural network seems to outperform.[41] The same tool, supported by data relevant to the specific risk-assessment context, will likely demonstrate even greater outperformance.

Exhibit 7:
Accuracy of neural network models in credit scoring

Source: Predicting Consumer Default: A Deep Learning approach



The long trend in credit and risk assessment has been towards the standardization and abstraction of data to allow for more mechanical underwriting. Lenders, and potential employers, auto insurers and landlords have been reducing datapoints more economically make their lending, renting, employment or insuring choice. Neural network models provide a way to reverse that trend. There is an opportunity for financial infrastructure providers in enabling these digital native companies or to help other entities to transform their business-processes. A WiFi-connected toothbrush company may be well placed to price dental insurance[42] but it won't necessarily have the balance sheet strength required to do so. Companies that provide marketplaces for on-selling these risks stand to benefit as traditional financial institutions seek to fill their balance sheets through secondary markets. Of course, traditional financial institutions are not blind to these new opportunities and their attempts to transition provide business opportunities to software providers, tech consultancies and data aggregation/analysis firms.

41 https://arxiv.org/pdf/1908.11498.pdf

42 https://techcrunch.com/2019/07/09/quip-launches-dental-insurance-alternative-in-nyc/

Conclusion

The confluence of innovation creates more competitive turbulence and muddies the strategic landscape. For a sector full of companies that can boast of a long history and prides itself on long stability, the future has perhaps never been less clear. Fintech companies are likely to benefit increasingly from strategies based on mobile transfer value devices, artificial intelligence, cloud, and blockchain technologies.

MSCI would like to thank ARK Invest for useful discussions and insightful analysis of this megatrend, which have greatly facilitated the preparation of this document.

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