

Innovation and Digitization in Credit

A GLOBAL PERSPECTIVE

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ABSTRACT

Digitization and other forms of technological innovation are dramatically changing credit markets around the world, creating opportunities for consumers and new market participants, but also challenges for traditional financial institutions and regulators. In this report, we draw from a wide range of sources to provide a comprehensive overview of the global digital lending landscape. We survey recent growth trends of peer-to-peer (P2P) and other forms of alternative lending that have been enabled by digitization, and compare and contrast the major digital lending markets around the world. We also discuss applications of new technologies like machine learning and blockchain to lending, and highlight the risks that these developments pose for consumers, firms, and regulatory agencies.



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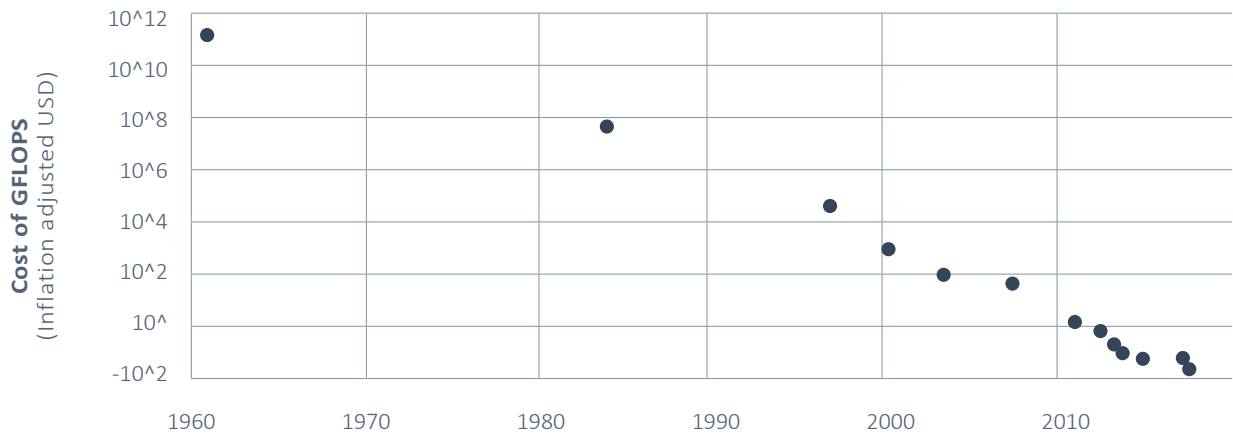


1. INTRODUCTION

Digitization has changed the game. It has fundamentally transformed how we engage, how we do business, and who is on the playing field, effectively rewriting the rules of competition. Pair that with technological innovations like big data, advanced analytics, and blockchain, and we find ourselves in a whole new paradigm.

Much of the shift towards digitization and innovation over the last decade has been driven by the widespread proliferation of internet-connected computing devices coupled with the dramatic reduction in the cost of storing and processing massive quantities of data (Figure 1).

Figure 1: History of GFLOPSⁱ prices



Source: Wikipedia

Broadly speaking, these trends have had three significant impacts on businesses. First and foremost, consumer demands and expectations have changed significantly. Increasingly, consumers are looking for more tailored products, faster delivery times, digital user interfaces that minimize human-to-human interaction, and overall convenience. Second, businesses have access to a wide range of new capabilities that allow for increased efficiency, productivity, and cost savings, amongst other things. A few examples include the use of big data and advanced analytics for improved modeling and business insight extraction, the

ⁱ The number of GFLOPS measures the amount of floating-point calculations (in billions) a processor can compute every second. It is used as an indicator of computer performance.

digitization and automation of processes for cost savings, and the integration of advanced cloud computing platforms for increased agility and scalability. However, these new opportunities are by no means exclusive to incumbent firms and, in many sectors, have dramatically decreased barriers to entry. Ultimately, this has led to a surge in new market entrants who are able to take advantage of current technological advancements and scale up rapidly at a lower cost than legacy firms.

The financial services sector is no exception – consumers are coming to expect vastly different relationships with their Financial Institutions (FIs), investment in and adoption of financial technology (Fintech) solutions have skyrocketed, and the number of non-traditional Fintech firms continues to grow. Although these trends are seen across all lines of business, the credit and lending space has seen many of the most transformative innovations in finance.

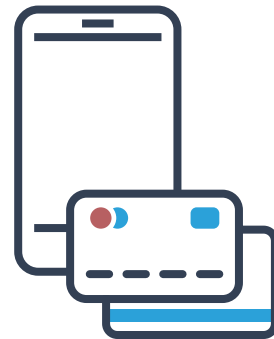
The rapid pace of innovation in the lending business is driven by the confluence of a number of factors. As mentioned, consumer demands have changed with consumers now expecting convenient, fast and cost-effective products from their chosen lender. Changing demographics have played a large role in this shift with the lending consumer base being increasingly comprised of digital nativesⁱⁱ and other tech-savvy people. Moreover, adoption of mobile devices and mobile-based products has grown rapidly in many emerging market populations which are historically under-banked, allowing the lending market access to whole new consumer bases.

New digital innovations have allowed firms to automate nearly the entire lending process. Furthermore, advanced analytics using large amounts of data from non-traditional data sources like Facebook and Google has led to new

credit-scoring methodologies that, when combined with traditional metrics, may provide more comprehensive credit risk profiles for prospective borrowers.

Decreased barriers to entry have led to considerable growth in the Fintech credit industry. Internet-based Fintech platforms have been able to enjoy the cost advantages of not having cumbersome legacy systems or brick and mortar branches as do many traditional lenders. These platforms can also offer the ability to efficiently scale upwards, with customer acquisition costs remaining relatively low. Furthermore, non-deposit taking Fintech lenders are subject to a less stringent regulatory burden- fewer capital and liquidity requirements and lower overall regulatory compliance costs. In addition to these cost efficiencies, traditional lenders' post-financial crisis withdrawal from certain market segments, including small business lending, has left under-served populations and market gaps to be filled by new firms. Finally, the prolonged low interest rate environment has led investors, in their search for yield, to purchase loans generated by Fintech credit platforms, further boosting the nascent Fintech credit industry.

In this report, we present a detailed look at the major trends and innovations in the credit and lending space across the globe.



ii People who have spent their entire lives with access to the internet, mobile devices, etc. and have become accustomed to doing most things online.

2. DIGITAL PRODUCTS

Digitization has transformed how we communicate, shop, book travel, and learn. Online shoppers, for example, can compare prices from competing stores and read other customers' reviews from the comfort of their own homes; many customers now spend 12 or more hours researching and evaluating big ticket purchases.¹ Fueled by demand for increased access to information, lower rates, and faster approval, digitization has also begun to transform the loan market. In fact, the digital lending market is projected to grow by 48%, compounded annually, from 2016 to 2024, reaching a market size of \$898 billion by 2024.² FIs alone stand to gain a 3-5% increase in revenues by digitizing their lending systems and collaborating with lending Fintechs.

With the rise of digitization has come a set of new financing models including peer-to-peer lending (P2P), crowdfunding and digital invoice financing as well as the re-packaging of the traditional balance sheet lending model. (Table 1)

*Table 1:
Types of Alternative
Financing Models*

Alternative Financing Model	Description
Peer-to-Peer Lending (P2P)	Matches prospective borrowers with third-party lenders. P2P platforms generate revenue through origination fees charged to borrowers and by taking a portion of the borrowers' interest payments. Investors receive the remaining portion of the interest payment which can exceed the interest earned through other investment vehicles.
Balance Sheet Lending	Balance sheet lenders source the loan themselves, keeping their loans on their balance sheets.
Crowdfunding	Involves the pooling of funds from a large number of investors to finance a venture. The main difference between crowdfunding and P2P is how investors are compensated (all are discussed below).
Digital Invoice Financing	A form of financing where businesses use future invoices (cash flows), which usually take months to be paid, as collateral for short-term loans.

2.1 PEER-TO-PEER LENDING

Peer-to-Peer lending is amongst the fastest growing sectors in the financial services industry, with a combined market size of \$124 billion globally in 2015 (Table 2)³. The first P2P Fintech platform, Zopa, was founded in 2004 in the UK and was not only resilient during the financial crisis, but saw consistent growth as well.⁴ P2P platforms have since gained broader global traction. In China for instance, the second largest P2P platform, Lufax, is valued at \$60 billion USD⁵, meanwhile in the US, the largest P2P platform has provided financing for over 2.5 million people.⁶

Generally, FIs have taken two approaches to break into the P2P lending market: purchasing blocks of P2P loans to improve diversification in their loan portfolios; and collaborating with P2P platforms by directly funding loans, providing referrals, or partnering with them.⁷

Market Size (in \$million)	2013	2014	2015
P2P Consumer Lending	7,325	23,229	80,307
P2P Business Lending	2,230	10,510	44,194
P2P Business Lending (Real Estate)	258	1,620	7,245
Balance Sheet Consumer Lending	94	715	3,205
Balance Sheet Business Lending	507	1,300	2,961
Invoice Trading	179	728	2,196
Equity Crowdfunding	200	566	2,165
Reward Crowdfunding	577	788	1,790
Equity Crowdfunding (Real Estate)	52	151	666
Donation-Based Crowdfunding	141	188	441

*Table 2:
Market Size of
Alternative Financing
Types*

Source: KPMG and Cambridge Centre for Alternative Finance

2.2 BALANCE SHEET LENDING

Balance sheet lending, the more traditional form of lending in which lenders use existing balance sheet availability to originate loans rather than simply intermediating them, has also gained popularity in the Fintech space. More than 60%, 40%, and 15% of credit Fintech activity in Canada, Australia, and US, respectively, is performed by balance sheet lenders.⁸ Compared to P2P lenders, which focus on intermediation, balance sheet lenders are exposed to both higher risks and rewards as a result of carrying the credit risk in exchange for receiving the entire interest and fee payments. Moreover, in contrast to banks and other traditional balance sheet lenders, which typically finance loans using consumer deposits, Fintech balance sheet lenders are increasingly reliant on capital sources such as debt, equity and securitisations to finance their loans.⁹ For instance in 2016, online lender OnDeck Capital, received a \$200 million revolving debt facility from Credit Suisse to help grow its balance sheet lending operations.

2.3 CROWDFUNDING

There are three types of crowdfunding modelsⁱⁱⁱ: donation-based, reward-based, and equity-based. Donation-based crowdfunding, which aims to help charitable causes like a cancer patient's medical bills, provides no financial reward to the investor. Donation-based crowdfunding platforms

earn revenue by charging listing and card processing fees. Reward-based crowdfunding offers investors non-monetary rewards commensurate with the amounts they invest. Rewards may include limited editions products, networking sessions, and prototypes. These platforms typically do not charge listing fees, instead taking a percentage of the total amounts raised by successfully funded campaigns.¹⁰ Equity-based crowdfunding, which offers investors equity instead of rewards, is the largest segment of this market. It has seen volumes roughly double over the past few years and some believe that it may even surpass standard venture capital models by 2020.¹¹ This approach is more commonly used for larger funding goals but is also subject to heavier regulation including securities law.¹²

2.4 DIGITAL INVOICE FINANCING

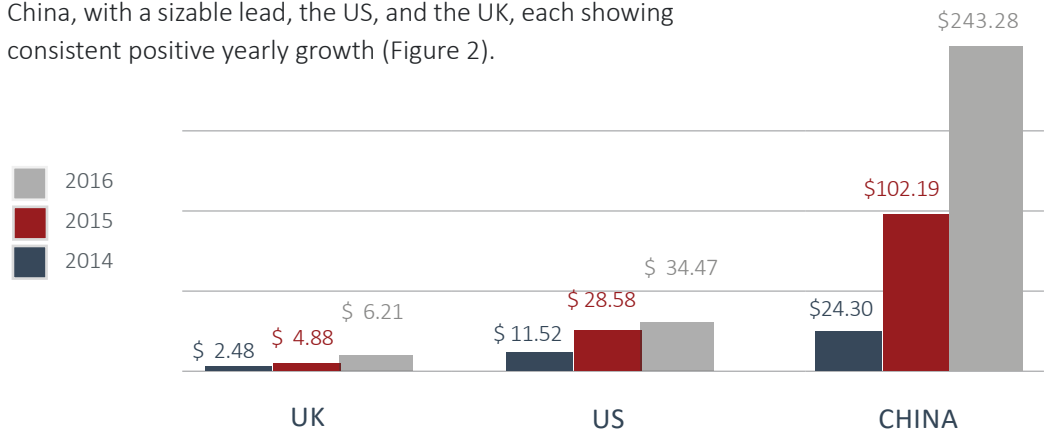
Invoice payment delays have long plagued businesses, particularly Small to Medium Enterprises (SMEs). These delays tie up capital for an average of 72 days, which can reduce businesses' liquidity and impede growth.¹³ Invoice financing to mitigate this problem has long been available, but typically includes high fixed fees and rigid terms. Invoice trading, a new form of digital lending in which businesses auction off their invoices through online platforms, has improved this process by offering cheaper rates, quicker turnaround, and an alternative asset class to third-party investors.¹⁴ Investors can purchase entire invoices or fractions thereof and are paid interest rates commensurate with the creditworthiness of the borrower.

ⁱⁱⁱ It is important to note that crowdfunding is not, strictly speaking, a form of lending. It is, however, growing in popularity as an alternative financing method.

3. INTERNATIONAL LANDSCAPE

Driven by consumer demand for accessible credit, the digital lending market has seen significant growth in both developed and emerging economies. Thus far, the market has been dominated by three key players: China, with a sizable lead, the US, and the UK, each showing consistent positive yearly growth (Figure 2).

Figure 2:
Alternative Financing
Market Volumes
(\$US Billions)



Source: Cambridge Center for Alternative Finance

Looking beyond these three countries at a regional breakdown, Europe and the Asia-Pacific region have the most active alternative financing markets, both estimated at just over \$2 billion USD, followed by the Americas, including Canada and Latin America, and then by Africa and the Middle East. Consistent with the larger market leaders, strong year over year growth has been observed in each region (Table 3).

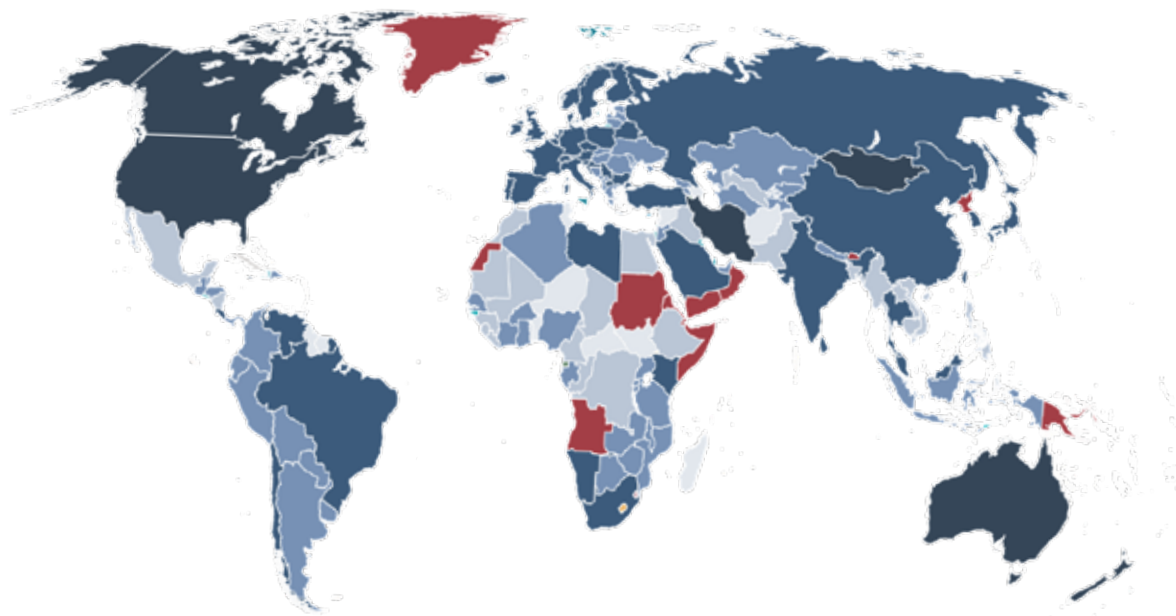
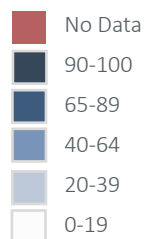
Table 3:
Observed Growth
by Region

Region	2014-2015 Observed Growth	2015-2016 Observed Growth
EU (ex. UK)	72%	101%
Asia-Pacific (ex. China)	312%	79%
Americas (ex. US)	123%	113%
Africa and the Middle East	59%	48%

Source: Cambridge Center for Alternative Finance

The prevailing digital financing model across all regions aside from Africa and the Middle East is peer to peer consumer lending. Based on available data, China’s average loan size on Fintech P2P platforms leads that of any other country or market, at approximately \$55,000 USD per loan. In most other jurisdictions P2P consumer loans are typically in the range of \$5,000 to \$25,000 USD.¹⁵ In the Middle Eastern market, whose financing volumes are driven predominately by Israeli firms, equity-based crowd funding makes up 55% of the alternative financing market. In Africa, donation-based crowdfunding is the most prevalent model at 35% of the market.¹⁶

Figure 3:
Percentage of Adults
with a Financial
Account (2017)



Source: World Bank Group

In the US, institutional investors have long played a significant role in alternative financing, unlike most other marketplaces. Institutions provided upwards of 55% of the total US alternative finance volume in 2016. Over time, there has also been a notable increase in institutionalization in many other alternative financing markets, including the rest of the Americas, which now match the US in the extent institutional financing, and the EU. The Asia-Pacific region still receives the majority of its funding from retail investors, and not institutions.

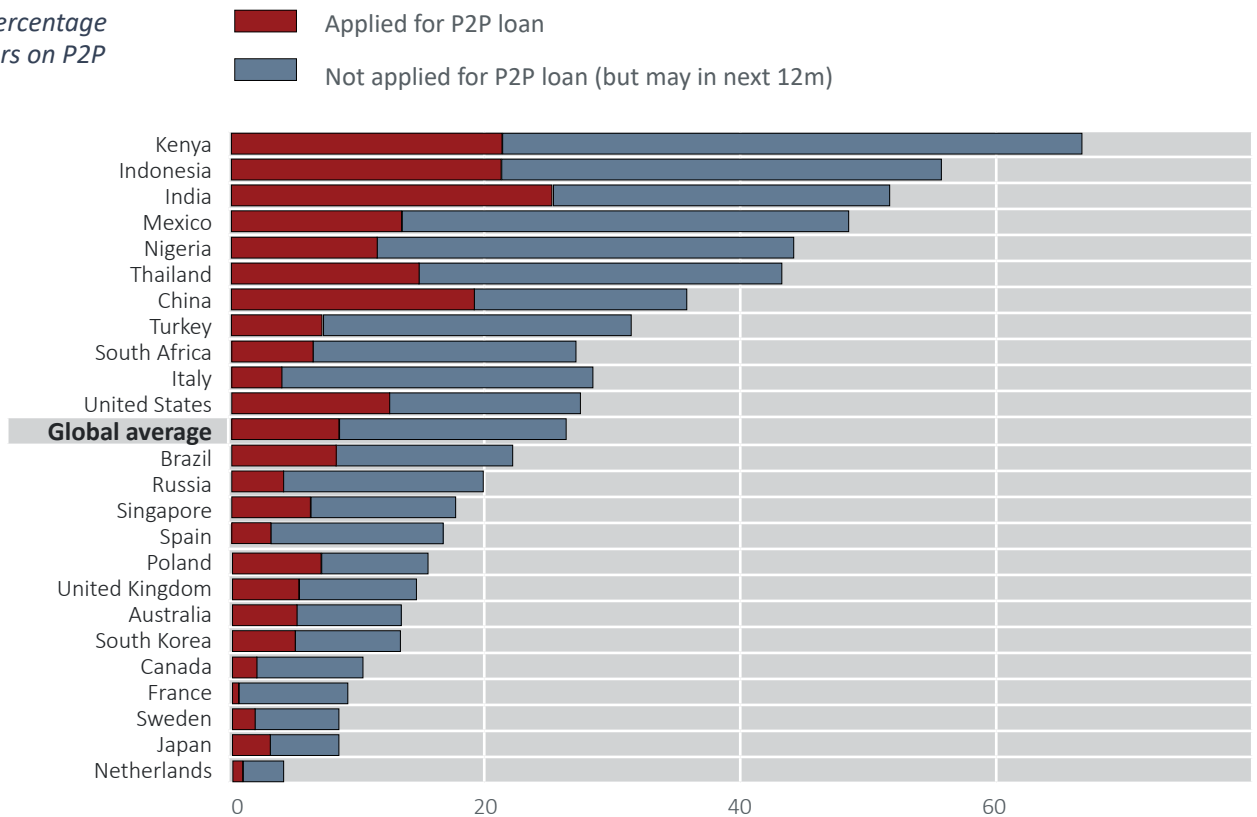
As the digital financing market continues to mature, it has seen a steady increase in domestic competition in many jurisdictions. In the US, for example, increased competition has been consistently cited as the top reason for lenders' decreased profit margin outlook in recent quarters.¹⁷ Paired with scalability issues driven by a limited domestic consumer base, many alternative finance platforms have begun to explore internationalization. It is worth noting that regulatory environments can vary significantly from one country to the next and are not often conducive to cross-border transaction flows. The lack of clear regulations for some digital financing models in certain jurisdictions has allowed for growth in internationalization. (Regulation will be discussed in further detail in the following section.) In addition, the approach to cross-border investing varies from one platform to the next, with certain platforms requiring creditors to be residents, others having few or no investor restrictions, and yet others who are cross-border by nature.

Although the majority of creditor funds appear to be from domestic sources in most regions, cross-border inflows have been increasing. In the EU 77% of alternative financing platforms who participated in the Cambridge Center for Alternative Finance's 2016 survey reported some level of cross-border flows, increasing significantly from 24% in 2015.¹⁸ Africa also presents an interesting case in this respect. Looking at aggregate values for all of the alternative funding to businesses and individuals in Africa both from domestic and foreign platforms, we see that 88% of funding comes from outside of the region. This case highlights the prominence of foreign alternative finance firms in some emerging markets. In terms of cross-border outflows to borrowers, the Americas and Europe are slightly more domestically focused, compared with the Asia-Pacific region, where 50% of the funds raised through equity-based crowdfunding go to businesses located in a foreign country.¹⁹

One of the farthest-reaching implications of alternative financing is its potential to increase the accessibility of financial services for underserved segments of the population. Globally, the financial inclusion rate, or the percentage of adults above the age of 15 with a financial account, sits just under 70%. However, as shown in Figure 3, there still remains a significant number of emerging market economies who have financial inclusion rates far below the global average.²⁰

It is not surprising, then, that the propensity of individuals to borrow from a P2P platform is notably higher in emerging markets than in most developed economies (Figure 4).²¹ Supporting this notion, a survey published by the Association of Chartered Certified Accountants showed that more than half of the borrowers on the Chinese P2P platform PPDai reported that they had no prior borrowing history with a FI. Moreover, the users noted their main reason for the loan was to accumulate a credit history.²²

Figure 4: Percentage of Borrowers on P2P Platforms



Source: Financial Stability Board and Bank for International Settlement

Although alternative lending has been particularly important in improving underbanked individuals' access to credit in emerging economies, it has also played a similar role in developed countries, which still have sizable under-served populations. In the UK, for example, 79% of borrowers in P2P platforms have previously attempted to borrow from conventional FIs but less than a quarter have been successful.²³ Many German borrowers that have used alternative lenders, too, could not obtain conventional bank credit.²⁴ The data in Figure 4 above indicate that alternative lending has played a particularly important role in helping the underbanked obtain credit in the US, where the propensity to use P2P loan platforms is almost as high as in many emerging economies. This may be explained, at least in part, by the prevalence of high-interest payday lending in low-income populations in the US. This market has proven fertile ground for start-ups like Finova Financial, which offer cheaper, more flexible alternatives to traditional payday and car-title loans.

4. REGULATION

The rise of crowdfunding, P2P lending, and other forms of digital finance have created a bevy of new regulatory challenges, both for governments and for market participants. In some jurisdictions, authorities have taken proactive steps to address these issues with new rules and guidelines. In others, regulators have simply applied existing policies to these new forms of lending. Overall, the state of Fintech regulation and the available regulatory support for Fintech companies varies significantly from one country to the next and there remains a large amount of global regulatory uncertainty in the space. That being said, there is clear consensus on one thing: if we hope to achieve a successful Fintech ecosystem, regulators and governments must work together to implement comprehensive regulations that protect consumers while allowing the freedom necessary for firms to innovate.

4.1 REGULATORY FRAMEWORKS

Broadly speaking, alternative lenders are typically subject to many of the same regulations that govern the conduct of traditional banks. In many jurisdictions, though, the regulations that govern lending can differ dramatically across different kinds of activities, and in some markets like the US, regulations can also vary widely across different states and other geographic submarkets. This has created considerable uncertainty for many alternative lending companies—as well as borrowers and lenders that use these platforms—about the set of regulations by which they must abide. In China and the UK, for example, P2P loans to and/or from consumers are regulated, while balance sheet lending is almost entirely unregulated. In the US, alternative lenders that engage in securitization are subject to significantly more regulation than lenders that do not.²⁵ In regions like the EU, where cross-border lending is growing rapidly, this uncertainty is compounded by international regulatory asymmetries.²⁶

The regulatory landscape differs dramatically across the three major alternative lending markets. In China, until recently there were virtually no regulations governing the alternative lending sector. In 2015, however, the People's Bank of China and the China Banking Regulatory Commission, released a set of documents outlining their approaches to the regulation of digital lending and other kinds of internet finance.²⁷ Since then, in response to a rash of P2P defaults and alternative lending fraud, Chinese

regulators have enacted a series of increasingly stringent rules on this sector,²⁸ but many guidelines remain vague.

In the UK, the Financial Conduct Authority (FCA) is responsible for regulating loans to and/or from individual consumers. The FCA has issued a number of statements in recent years clarifying its policy principles concerning platforms that engage in these forms of lending, but has yet to enact concrete rules on many issues. Further, direct, business-to-business (B2B) loans are not regulated in the UK at all.²⁹ The FCA has, however, recently published a comprehensive set of policy proposals that would apply to P2P lenders which focus primarily on investor protection.³⁰

In the US, no single authority is responsible for regulating alternative lenders; depending on its business model, a platform may be required to follow rules issued by a number of federal and state agencies. However, many alternative lenders in the US have gravitated towards securitization as a funding mechanism, and must therefore comply with a wide range of (sometimes onerous) Securities and Exchange Commission (SEC) regulations.

Amidst the uncertainty created by these sometimes vague and patchwork regulations, supra-national financial institutions including the International Monetary Fund and the World Bank Group have proposed guidelines to aid regulators in developing their own domestic Fintech policies that ensure financial sector resilience and promote

international cooperation.³¹ Moreover, alternative lenders in these markets have formed a number of associations and trade groups that advocate for their collective interests and issue voluntary guidelines aimed at enhancing the industry's reputation. In China, the Shanghai Financial Information Association (SFIA), which now has more than 200 members,³² provides its members with a variety of guidelines on regulatory compliance, and the information-sharing platform Wangdaizhijia has provided investors with increasingly-detailed information about alternative lenders' performance. In the UK, over 90% of digital lending companies have joined the Peer-to-Peer Finance Association (P2PFA), which aims to "promote high standards of conduct and consumer protection."³³ Similarly, in the US the Responsible Business Lending Coalition has authored a Small Business Borrowers' Bill of Rights, which lays out principles on transparency, fair lending, non-discrimination, and other issues.³⁴

4.2 INVESTOR PROTECTION

Highly-publicized incidents of fraud and embezzlement in alternative lending, such as China's infamous Ezubao scandal, in which investors were defrauded of \$7.6 billion USD in what turned out to be a Ponzi scheme,³⁵ have highlighted the need for regulators to develop clearer investor protection rules for this segment of the market. In developed economies, alternative lending markets are no strangers to these incidents either. US crowdfunding platforms, like Kickstarter and Indiegogo, are rife with fraudulent campaigns small and large.

In China, the extent of investor fraud has led regulators to focus many of the recently-published rules on investor protection. Chinese alternative lending platforms are now required to perform due diligence on information provided by borrowers, inform investors about relevant risks, and ensure that investors satisfy certain criteria like experience investing in risky instruments. Many of these rules are vague, however, and provide little explanation of how regulators will assess compliance.

In the US and UK, disclosure and transparency rules constitute the bulk of investor protection regulations that govern alternative lenders. In the UK, the FCA requires that alternative lending platforms disclose "appropriate, useful information and not to over-burden consumers with too much detail."³⁶ The FCA has recently published proposed policies that lay out, in concrete detail, what information lenders must provide to investors, but these rules have yet to be formally adopted. Additionally, the proposed rules place restrictions on who can invest in alternative loans, requiring prospective investors to pass a verification process and meet a minimum-income threshold.³⁷ In the US, alternative lenders that issue notes to investors backed by borrowers' repayments must formally register these notes as securities with the SEC, and consequently must abide by the stringent reporting requirements of that agency.³⁸ Lenders that issue notes solely to accredited investors may not be governed by these requirements,^{iv} but the definition of an accredited investor can vary across US states.

A second regulatory issue for alternative lending that is closely related to investor protection concerns clearing and settlement. In China, P2P lending platforms must open escrow accounts with traditional banks to keep investor funds separate from platforms' own proprietary accounts. In the US, many platforms also use banks to hold investor funds and process payments. Funds stored with US banks are eligible for FDIC insurance, offering significant protections for investors.³⁹ However, some alternative lenders in the US have turned to automatic bank withdrawals to obtain repayments from borrowers. This behavior is closely regulated by the Electronic Funds Transfer Act, and has raised the ire of consumer protection advocates who argue that it could lead to abusive lending practices.⁴⁰ In the UK, alternative lenders must segregate clients' funds from proprietary accounts, but alternative lending is not covered by the FSCS, the UK analogue of the FDIC.⁴¹

iv Rules 501 and 506 of Regulation D under the Securities Act. "Accredited investor" are (1) most institutional investors and individual investors who have an individual income in excess of \$200,000 (or \$300,000 jointly with a spouse) in each of the two most recent years and have a reasonable expectation of reaching the same income level in the current year, and (2) individuals whose individual net worth, or joint net worth with that person's spouse, exceeds \$1,000,000.

A third related issue concerns bankruptcy and liquidation procedures. In all three major digital lending markets, there are few, if any, requirements for alternative lenders to form agreements with secondary servicers. The UK requires that alternative lenders structure their operations so as to ensure that loan servicing will continue in bankruptcy or liquidation, but the FCA has yet not put forth any specific requirements. In the US, there are no regulations that govern liquidation proceedings for alternative lenders, although some platforms, such as LendingClub, have voluntarily entered into secondary servicer agreements.⁴²

4.3 DATA PROTECTION

As the number of cyber breaches continues to rise and stories of questionable data usage, like that of Cambridge Analytica, continue to come to light, data usage and protection has become an increasingly important area of focus for all participants in the financial services sector. Leading the way, the European Union introduced the General Data Protection Regulation (GDPR) which aims to standardise data privacy laws across industries, promoting transparency and providing EU citizens with the right to protect their personal information. Following GDPR's implementation, the Chinese government put in place a new national standard on personal information protection

which includes detailed new regulations for user consent, as well as how personal data is collected, stored and shared. The US does not yet have a comprehensive national data privacy policy, but does have the Gramm-Leach-Bliley Act, which provides privacy rights to borrowers, requires FIs to implement data security regimes and restricts the sharing of non-public data. This Act, however, does not apply to commercial transactions, which, in the case of digital financing, includes small business loans. In recent, some states, including California, Alabama and Vermont have enacted new, more stringent data privacy laws, while others have strengthened existing laws. Overall, there is significant regulatory fragmentation around the globe when it comes to data privacy, which, given the increasingly data-centric nature of financial services, is making international interoperability a growing challenge.

4.4 FINANCIAL STABILITY

In the aftermath of the recent financial crisis, many financial regulators have paid renewed attention to the role of capital requirements and risk retention in ensuring financial stability and properly aligning lenders' incentives (Table 4). For lenders that do not hold loans on their books, risk retention policies, in particular, can be powerful tools in ensuring that lenders have some "skin in the game."

Table 4: Regulatory Requirements by Region

Country	Minimum Capital Requirement	Risk Retention Requirement
China	Fixed min. capital requirement on balance sheet lenders only	None
UK ⁴³	50,000 GBP, plus a variable amount that is proportional to the amount of outstanding loaned funds.	None
US	None	Platforms that engage in securitization are subject to risk retention rules under Dodd-Frank Act. ⁴⁴ Risk retention requirements are being considered for other platforms as well. ⁴⁵

4.5 OTHER REGULATORY ISSUES

In addition to the concerns highlighted above, there are a wide variety of other regulatory issues that relate to alternative lending. For instance, lending platforms should be cognizant of all relevant reporting requirements in their jurisdictions, particularly those requirements that relate to money laundering enforcement. In China and the US, most alternative lenders are required to comply with traditional FIs' anti-money laundering requirements, while anti-money laundering reporting is not yet required for alternative lenders in the UK, although the FCA has recognized the potential for money laundering on these platforms.⁴⁶ Often, alternative lenders must also abide by usury laws and other restrictions on interest rates and fees. In China, for instance, interest rates above 24% per year are not enforceable in court, and rates above 36% are illegal.⁴⁷ Regulations on debt-collection procedures, as well, may apply to many alternative lenders.

4.6 REGULATORY SANDBOX

Authorities in many jurisdictions have recognized the potential for alternative lending to improve financial inclusion and increase access to credit for underbanked populations, and have begun to enact targeted policies to foster the development of this segment of the lending market. Promoting innovation while maintaining financial stability and ensuring adequate consumer protection can be a difficult balancing act, and the most widely-accepted solution to this puzzle has been the regulatory sandbox. Regulatory sandboxes are structured, controlled environments designed by financial regulators that allow live testing of new innovations by private firms, usually Fintech start-ups. While operating in the sandbox, firms are granted special exemptions or other limited allowances. In this environment, regulators can effectively oversee the firm while allowing the firm more freedom to innovate, aligning compliance and regulation with rapid growth.

The sandbox approach, which was first implemented by the UK's Financial Conduct Authority (FCA) in 2015⁴⁸, has been adopted by regulators around the globe. This includes several in the Asia-Pacific region such as those of the Australian Investment and Securities Commission⁴⁹ (ASIC), the Hong Kong Monetary Association⁵⁰ (HKMA), the Monetary Authority of Singapore (MAS), the Bank of

Indonesia Financial Technology Office⁵¹ (BI-FTO), and the Bank of Thailand⁵² (BOT). In Europe, the Authority for the Financial Markets (AFM) and De Nederlandsche Bank (DNB) in the Netherlands have launched a joint sandbox⁵³, while Finanstilsynet in Denmark hosts the FT lab.⁵⁴ Looking to North America, the Canadian Securities Administration⁵⁵ (CSA) and the Ontario Securities Commission⁵⁶ (OSC) have both launched regulatory sandboxes, and in March of 2018, the state of Arizona announced plans for a Fintech sandbox, making it the first in the US. Sandboxes have also been initiated in financial centers in Africa and the Middle East like the UAE, Saudi Arabia, Bahrain, Kenya, and South Africa, among others.⁵⁷ Taking regulatory sandboxes one step further, the FCA announced the creation of the Global Financial Innovation Network (GFIN) in collaboration with 11 other financial regulators.⁵⁸ The GFIN will work to provide more efficient collaboration between Fintech firms and regulators and will help firms navigate issues around cross-border scaling. In addition, the network will act as a platform for regulators to co-operate and share experiences and approaches.

Authorities in some countries have also used tax incentives to directly subsidize the development of alternative lending. In China, young alternative lending platforms, as well as those that actively engage in the development of new technologies, are entitled to preferential tax treatment.⁵⁹ The UK has used the consumer tax code, instead, to indirectly support the industry by creating a new investment account that confers beneficial tax treatment on interest income from loans made on P2P platforms.⁶⁰ Japan and France have also implemented tax incentives to bolster alternative lending development.⁶¹

5. DIGITAL USER EXPERIENCE (UX)

Customer demand for digital products is rising rapidly, and the financial services sector is no exception; 55% of customers state they would be more likely to apply for financial products if the application process were fully electronic.⁶²

As customers continue to shift towards online products, their primary point of interaction will be the company's website or application, making the digital customer experience of utmost importance. As such, poor UX is a likely source for significant losses in the future.⁶³

To meet this demand, Fintechs and FIs alike have established loan products that offer completely digital onboarding. In keeping with traditional practice, this process requires credit checks and form filling, however, it has the advantage of being done in a much shorter time frame, enhancing the customer experience.

One of the last features of the loan application process to be fully digitized is the process of identity verification, as this process must abide by stringent fraud prevention regulations. For example, online bank Tangerine, a digital subsidiary of the Bank of Nova Scotia, still requires individuals to go into a local post office to have their identity verified before opening an account. However, progress is being made on this front. Some banks, including UK-based Monzo, have been able to integrate identity verification on their digital platform. Monzo became one of the first online banks to accomplish this by introducing a selfie feature asking applicants to take a picture of their identification and a video of themselves.⁶⁴

Looking forward, as the adoption of Open Application Programming Interfaces (APIs), a standard that defines how financial data should be created, shared and accessed, becomes more widespread in banking, consumers will be in increasing control of their customer experience. Implementation of these standards has already commenced in the UK with the Open Banking initiative and more broadly in Europe with the Revised Payment Services Directive (PSD2). Similar initiatives are now being considered across the globe.

Through the use of APIs users can allow authorized third party providers direct and secure access to their financial data without having to share any of their account passwords or security details. In lending, web-based portals and APIs allow customers to onboard digitally, sending their data directly to the origination platform and often pre-populating information for existing customers. Open Banking will also lead to Account Information Service Providers (AISPs), which allow customers to join their financial accounts from various institutions into one platform.



6. TECHNOLOGY-DRIVEN AUTOMATION

Banks are no strangers to innovation, but in many ways loan origination is still carried out much like it was decades ago. Despite the advent of automation technologies like Robotic Process Automation (RPA), many banks continue to use manual and paper-based loan underwriting practices. In fact, Moody's Analytics reports that 50% of banks have not automated any of their loan origination processes at all.⁶⁵ However, the potential for cost reductions and increased competition from alternative lenders who have adopted new technologies more aggressively⁶⁶ are incentivizing traditional banks to automate.

The manual loan application process is not only a burden for customers but poses problems for the lender as well. According to a Moody's Analytics poll, 56% of bankers felt that the manual collection of data and subsequent back and forth with clients was the most challenging component of the loan initiation process. This process is not only time consuming, but is also highly susceptible to human error. Human interaction reportedly accounts for 2-5% of errors in the lending process, which causes unnecessary delays, rework, and even compliance issues.⁶⁷ Using automation allows customers to fill in forms online and automatically stores the data into central servers or clouds, eliminating inconsistencies and delays. In addition, for customers with pre-existing data on file, forms can be pre-populated, further reducing onboarding times. Morgan Stanley, who has begun to automate its lending origination, recently invested in a new platform that allows prospective borrowers to apply entirely online, providing them with rate estimates and the ability to upload documents.⁶⁸

Automation tools not only aid in the loan origination process, but also in monitoring loans over the course of their lives to ensure regulatory compliance and overall credit risk management. The process of tracking data to ensure covenants and policies are satisfied has historically been done manually using Microsoft Excel, which can be cumbersome and error-prone. Automated covenant systems have now been developed which send automated notifications when appropriate documents are not collected or if a covenant is not met. They exist within the origination system to ensure data accuracy and efficiency and to avoid rekeying information.⁶⁹

One automation technology gaining popularity across many industries is Robotic Process Automation (RPA) which executes programmed tasks by accessing existing user interfaces and performing the same operations as a human through object and optical character recognition, key strokes, and direct application integration.⁷⁰ It often runs on an organization's server as opposed to an individual's workstation and requires little to no human interaction. It is triggered by an event – a customer opening an account or processing a claim for example – and executes a task as a human would, but in a fraction of the time.⁷¹ It is said to increase staff productivity by 35-50%, create immediate

cost savings of 25-50%, and slash average processing times by 30-50%. Union Bank has introduced the technology to improve its loan process by automating the access and integration of their data into enterprise applications and processes. They claim to have reduced turnaround time by 10 days, migrated 800,000 documents in days instead of months, and deployed a software robot which gathers all relevant loan documents, combines them into a PDF, and sends notifications when files are ready for audit review.⁷²

Other innovations within the loan origination space include nCino, an international leader in cloud banking. nCino offers cloud-based operating solutions to simplify the loan process and increase transparency, efficiency, and profitability. nCino's newest client, Santander Bank, claims nCino will reduce the time it takes to deliver loan decisions by about 40%.⁷³ Other banks using nCino include TD Bank Group and BNP Paribas.⁷⁴

Fraud prevention is another area which has benefited from automation. Software programs are capable of filing through large datasets to identify irregularities within applications. This process leverages behavioural analytics and machine learning to analyze the ever-changing associations between individuals and their devices, locations, accounts, behaviors, and hundreds of other data points to create digital identities for consumers.⁷⁵ When behaviour deviates from the norm, the bank is immediately notified of potential fraud. Recently, a number of companies have begun to offer automated loan prevention systems for banks, such as ThreatMetrix, ID Analytics, and TransUnion.⁷⁶ Alternative lenders have been quick to adopt these technologies, but they have proven effective for traditional banks as well.⁷⁷





7. ALTERNATIVE DATA AND MACHINE LEARNING

7.1 ALTERNATIVE DATA

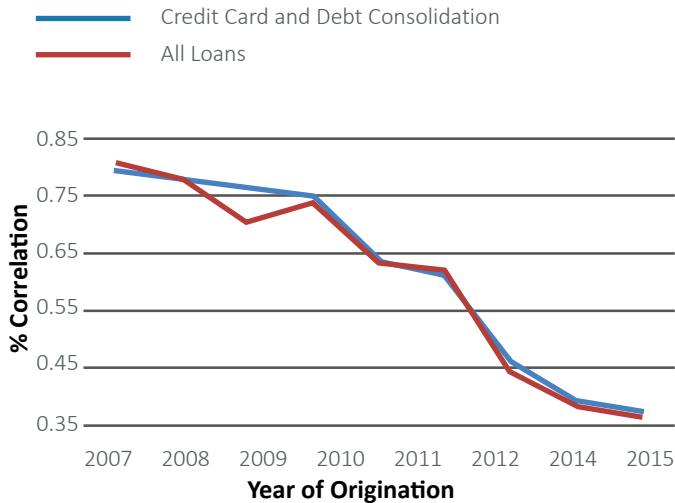
Traditionally, lenders require that prospective borrowers have a record of repaying loans in the past. For the 3 billion adults worldwide, that do not have traditional credit records,⁷⁸ however, this represents a catch-22. Recently, lenders have begun to develop new methods to assess a customer's credit risk without prior credit history, opening up a sizeable new market. Many of these new methods center on using alternative data, such as education level and bill payment history, to estimate a prospective borrower's default risk. In this context alternative data refers to all data that is used to assess creditworthiness that is not directly related to past credit behavior. In other words, traditional data comes from a credit bureau, and alternative data is everything else.

Fair Isaac Corporation (FICO) highlights seven sources of alternative data:⁷⁹

- **Transaction Data:** Data on how customers use their credit or debit cards mined to extract the maximum predictive value.
- **Telecom / Utility / Rental Data:** Essentially credit history data that doesn't actually appear in most credit reports.
- **Clickstream Data:** The manner which a consumer streams through a site (what consumers click on etc.).
- **Audio and Text Data:** Information from customer service or collection calls during credit applications.
- **Survey / Questionnaire Data:** Measuring and assessing psychological behaviour
- **Social Network Analysis:** This entails looking into credit ratings of an applicant's network. This type of data will likely not reach regulatory standards any time soon.
- **Social Profile Data:** Data from Facebook, LinkedIn, Twitter, Instagram, Snapchat or other social media sites. The use of this data is seldom as it would stir much controversy and face regulatory hurdle. In addition, this type of data can be easily manipulated by consumers thus contains flaws.

Fintechs, which often have access to a plethora of such data sources, can use these data to depict a more accurate image of a borrower's habits in order to determine their propensity to repay a loan. FIs seeking to enter this market as well have paired up with alternative lenders to develop better credit scoring techniques. JPMorgan Chase and Royal Bank of Canada, for instance, have turned to Verde International, an expert in automating the underwriting and loan process by using advanced behavioural, econometric, and financial models, to sift through potential borrowers' employment and education histories and determine the risk of lending to them.⁸⁰

Figure 5: Correlation Between Origination FICO and Rating Grade Assigned by Lending Club



Source: Julapa Jagtiani, Catharine Lemieux, (2017), “Fintech Lending: Financial Inclusion, Risk Pricing, and Alternative Information”, The Federal Deposit Insurance Corporation

Studies have shown that on its own, alternative data is a less accurate predictor of one’s ability to repay a loan compared to traditional data. However, when the two types of data are combined, a much more accurate assessment of one’s creditworthiness can be obtained.⁸¹ Lending Club uses both alternative data and FICO scores in its models to determine creditworthiness and assigns ratings of A to G to prospective borrowers. While Lending Club’s grades were initially highly correlated with FICO scores, this correlation has steadily decreased since Lending Club’s inception (Figure 5).⁸² This trend demonstrates that as Lending Club accumulates more data, its algorithms place more weight on alternative data and less on FICO scores. Moreover, Lending Club has assigned steadily higher grades to a larger portion of individuals with credit scores of under 680 (Figure 6) allowing an increasing number of “bad credit” customers access to loans through their platform.

Similarly, numerous other lending Fintechs are finding new ways to incorporate alternative data into their models. WeLab in Hong Kong and Kreditech in Germany, for example, use upwards of 20,000 alternative data points to process loans. mPesa and Branch in Kenya provide emerging market credit using mobile data, and Lendable does so using psychographic data.

Figure 6: FICO Distribution by Lending Club Rating Over Time



Source: Julapa Jagtiani, Catharine Lemieux, (2017), “Fintech Lending: Financial Inclusion, Risk Pricing, and Alternative Information”, The Federal Deposit Insurance Corporation



7.2 MACHINE LEARNING

Lenders have long used traditional statistical methods like logistic regression to predict the likelihood that borrowers will repay their loans. These models, which depict linear relationships between borrowers' behaviours and their credit scores, and provide clear guidance to lenders allowing them to convincingly demonstrate to regulators why they have (or have not) granted credit to a prospective borrower. However, as the amount of data on borrower characteristics and behavior increases, there is an increasing incentive to couple data with machine learning techniques to create more accurate credit risk models.

The goal of credit risk modeling is to predict behavior, making it an ideal application for machine learning, which maximize predictive power by systematically evaluating a wide range of potential predictors and forms of statistical relationships. When provided large quantities of data, machine learning can make more robust predictions than traditional statistical methods.⁸³ When applied to credit risk modelling, research indicates that machine learning could reduce losses by up to 10%.⁸⁴

The two most common machine learning techniques for credit risk modeling are random forests (RFs) and gradient boosting (GB), although artificial neural networks (ANNs) are sometimes used as well. Both RF and GB models use decision trees. RF models (Figure 7) use multiple trees that are trained independently, using a random sample of data, and merges them together to get a more accurate and stable prediction. GB (Figure 8), on the other hand, builds trees one at a time, with each new tree attempting to correct the errors made by the previous tree. ANNs (Figure 9) can be thought of as a vast network of connected nodes, similar to the neural network in your brain. In simple terms, ANNs consist of input and output layers and one or more hidden layers that transform the inputs into a meaningful output. They are particularly good at finding obscure patterns that would otherwise be too complex or numerous for a human to extract and program the computer to recognize. Equifax was one of the first FIs to launch a neural network model for credit scoring. The product, called NeuroDecision Technology (NDT), is expected to improve Equifax's predictive ability by 15%.⁸⁵

Coupled with the growing array of alternative data, machine learning has also allowed for the accurate credit assessment of a much wider segment of the population. Lenddo, a lending Fintech, has introduced a machine learning platform which sifts through over 12,000 variables to predict borrowers' creditworthiness. Lenddo's platform has allowed their partners to approve almost 50% more applications. As a result of their growing success, FICO announced they would develop a major partnership with Lenddo to aid FICO's scoring system in India,⁸⁶ where nearly half of adults are underbanked.⁸⁷ FICO is currently engaged in similar efforts across many countries such as US, China, Mexico, Russia, and Philippines.⁸⁸

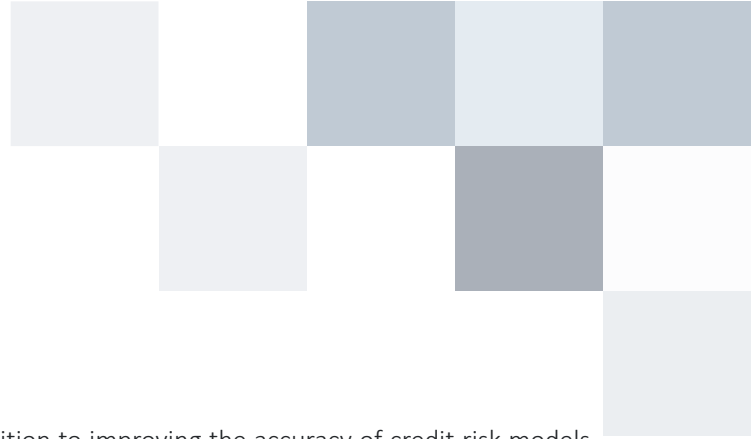


Figure 7: Random Forest Model (RF)

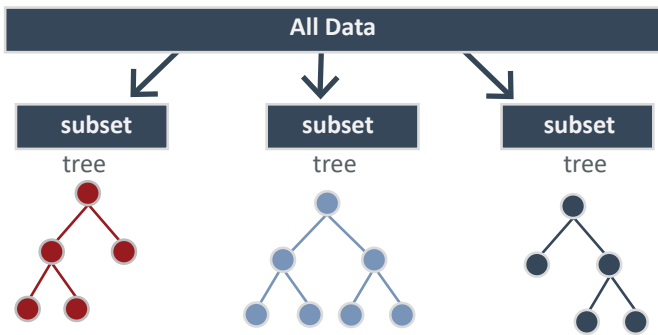


Figure 8: Gradient Boosting Model (GB)

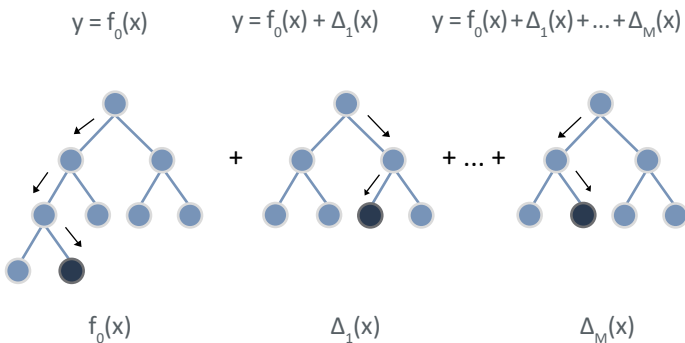
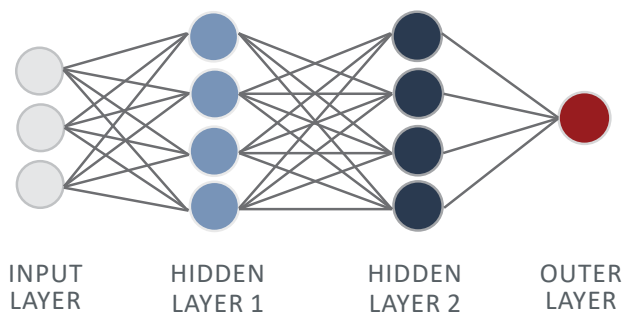


Figure 9: Artificial Neural Network Model (ANN)



In addition to improving the accuracy of credit risk models, machine learning has the potential to significantly reduce credit decision times—and thus operating costs—by using natural language processing (Box A) to parse financial contracts. The process of legal document parsing, i.e. sifting through contracts and extracting relevant information, provides easy access to structured data, reducing processing time drastically. J.P. Morgan has recently introduced a contract intelligence platform, COiN, which uses machine learning to review commercial credit contracts. COiN can review 12,000 contracts in seconds; a significant improvement over manual processing which used to take staff 360,000 hours.⁸⁹

Box A

Textual Data and Natural Language Processing

The digitization of communication and commerce has created vast troves of unstructured textual data. In order to use this data in quantitative models, it must first be mined and processed into a format that mathematical algorithms can recognize. Natural language processing (NLP) is a set computational techniques that attempt to address the ambiguous and imprecise nature of human communication by allowing computers to make inferences about and provide context to language. Or, in simpler terms, NLP is a useful set of tools that effectively train computers to ‘understand’ human language.

In conjunction with alternative data sources, lenders can use NLP to enhance predictive modeling and automate a variety of information retrieval processes. For example, NLP can be used to augment client profiles through the analysis of social media data. These enhanced profiles can then be used to build more robust credit risk models.⁹⁰



8. DISTRIBUTED LEDGER TECHNOLOGY AND BLOCKCHAIN

Traditionally, digital information has been stored in centralized databases and maintained by administrators. Recently, however, distributed ledger technology (DLT) has gained prominence as an alternative method to store and maintain data, particularly financial data. A distributed ledger is a decentralized database that is maintained through replication and synchronization by many individual participants rather than a centralized authority; consensus is required among these participants whenever the ledger is updated with new data. Blockchain is a particular form of distributed ledger technology in which all transactions are organized in blocks that are linked together and secured using cryptography. While the ideas behind blockchain trace back to the early 1990s, it has recently gained widespread awareness across many industries, including lending.⁹¹

One of the most important components of DLT is that it allows storage to be distributed, meaning everyone has a copy of the same database at the same time. The ledger stores the history of activity and is available to be seen by all participants, creating a single source of truth and effectively increasing transparency. Participation can be either open to the public, or made private. In credit, both public blockchains like Ethereum and private proprietary blockchains, whose access is restricted to a select group of trusted members, are being employed. Regardless of which is used, the information contained in the database is immutable and cannot be tampered with.⁹²

Perhaps the most notable application of blockchain in lending is its use in improving loan syndication. In syndicated lending each loan would have a blockchain that would include all transactions associated with that loan. The use of blockchain in syndicated loans has the potential to reduce settlement time drastically, with one platform claiming to have settled trades in as little as three days, compared to one or two weeks for traditional syndicated loan settlement.⁹³ Smart Contracts^v, digital contracts that run on a blockchain with the ability to self-execute when certain conditions are met, play a vital role in the development of blockchain technology and reducing settlement times by transforming a syndicated loan into a digital asset. A smart contract for a syndicated loan encodes the terms of the credit agreement and has the ability to automatically transfer funds in accordance with those terms. Pre-authorized institutions would be able to review the terms and accept them or negotiate. Once an agreement is made, both parties sign the digital contract, causing the borrower's collateral to be automatically assigned to the syndicate members and funds to be transferred from the syndicate to the borrower. Over the course of the loan, funds would automatically be debited from the borrower's accounts while diminishing the outstanding principal on the loan's blockchain. As ownership of the loan changes, the blockchain allows for reassignment of its access permissions.

^v For more information please see our article on [Smart Contracts](#)

Synaps is one of the first companies to develop a blockchain-based loan syndication platform. Synaps is a collaborative venture between Ipreo, a global provider of financial services technology, and Symbiont, a smart contracts platform for financial applications. The benefits of Synaps include its ability to service loans from origination to trading and funding rollovers, T+3 settlement for loan trades and direct access to syndicated loan data for stakeholders.⁹⁴

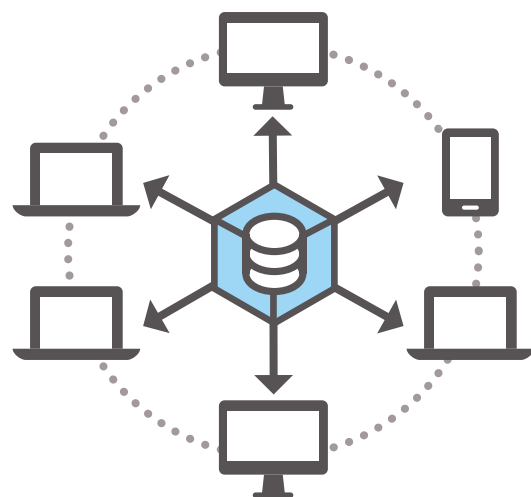
Other institutions have begun to tackle this problem piece by piece. IHS Markit for instance, has begun to develop a blockchain system, Stax, which uses smart contracts to handle the payment portion of syndicated loan trading. Stax will require bank customers to wire money into an old-fashioned account which is then converted into digital tokens on a private network, creating digital wallets, which can then be used to settle transactions.⁹⁵

The syndicated loan industry is valued at \$1 trillion in the US alone, making it a prime target for efficiency-enhancing applications of DLT. However, there are many other lending sectors which have and will continue to see innovative uses of the technology. Like Stax, Salt Lending (Secured Automated Lending Technology) requires borrowers to transfer their currency into a cryptocurrency to create a digital wallet for transacting. In Salt Lending's case, the cryptocurrency used is called Salt, and borrowers use Salt as collateral in exchange for a cash loan. Salt Lending argues that blockchain assets make great collateral because they are transparent and publicly viewable, with efficient transfer, storage, and liquidation.⁹⁶

FIs are not only relying on third parties to develop blockchain solutions, but are investing in-house as well. RBC for instance, recently filed a patent for a credit scoring platform that stores historical and predictive data about borrowers

on a blockchain to generate credit applications and scores, which are continually updated as credit activity occurs. The resulting set of blocks would form a transmittable credit record that can be sent to an interface, enterprise, or external system.⁹⁷

In addition, J.P. Morgan and National Bank of Canada have launched a simulation on J.P. Morgan's Ethereum-based platform, Quorum. The two banks issued a \$150 million USD, one-year floating-rate Yankee certificate of deposit, with a parallel simulation of the issuance on a blockchain. Other investors in the certificate included Goldman Sachs Asset Management and Pfizer.⁹⁸ Although the use of blockchain in lending is still in its developmental stage for J.P. Morgan and other institutions, movement towards the technology is proceeding rapidly and we can expect deeper usage of it in the next five to ten years.





9. RISK

As this report highlights, the digital transformation of, and the technological advancements in, the lending sector have led to a plethora of benefits for both consumers and the financial services sector alike. With these market changes and new technologies come new sources of risk that must be identified, monitored, and managed. For starters, digital lending is likely to amplify cyber risks, and the use of alternative data and machine learning can create new model risks and ethical concerns. Many alternative Fintech lenders, which have pioneered these analytical methods, consider themselves to be tech companies, not FIs, and may, by consequence, not have adequate risk management practices. Moreover, these new players, which have grown rapidly in an era of economic expansion, may fare poorly when the next recession or financial crisis arrives and could pose a new source of systemic risk. Moreover, Fintechs may be more susceptible to the rapidly changing regulatory landscape which could obviate some platforms' business models. Nonetheless, the increase in competition brought on by these new market entrants also presents a growing threat to the market share of traditional lenders.

9.1 CYBER SECURITY AND FRAUD

Cyber risk has become one of the most significant risks in lending as well as the broader financial sector. The number of cyber attacks continues to grow rapidly, with twice as many attacks in 2017 as in 2016⁹⁹ and 2018 is shaping up to be the worst year yet.¹⁰⁰ All FIs are susceptible to cyber attacks due to the sensitive nature of the data they hold, but alternative lenders, whose operations exist entirely online, are particularly vulnerable. Moreover, in addition to the risk of breaches to their own networks, breaches at other institutions also pose risks to lenders; data compromised in attacks of large institutions like Equifax are often used in fraudulent loan applications. To prevent their own data from being breached and to ward off fraud perpetrated with data compromised elsewhere, FIs must adequately prepare protocols from prevention to reaction (Table 5).¹⁰¹

Digital lending and automation may also exacerbate an older form of loan fraud: loan stacking, which occurs when a borrower applies for loans from several different institutions within a short period of time and becomes approved for more than one loan. Lenders may not be aware of a loan stacker's other applications and consequently perceive the fraudster as less risky than they really are.¹⁰² Online loan platforms make it easier than ever for loan stackers to submit many applications quickly, and automated loan processing technologies make it more likely that these applications will be approved before they are noticed by Equifax, TransUnion, and other credit bureaus.¹⁰³

Finally, many alternative lenders have expressed concern about the potential reputational impact of fraud in crowdfunding and P2P lending campaigns.¹⁰⁴ Already, there are numerous highly-publicized examples of fraud at Kickstarter, Indiegogo, and other platforms. Triton, which claimed to have developed a device that could extract breathable air from water, allowing users to breathe while submerged, raised almost \$1 million USD before the science

Table 5: Cyber Best Practices for Lenders

Risk Management Infrastructure	Establish relationships with cyber safety and compliance consultants to help develop and maintain programs. Develop plans to protect against breaches, encrypt data, create decoy data to send attackers astray, and respond immediately to threats.
Educate staff about cyber protection	Help staff understand how to prevent breaches through educational programs which show how data breaches can occur in simple ways such as opening an email attachment, sharing documents via personal emails, or installing a business program on a personal computer.
Detect fraudulent behaviour	Find a balance on security filters to minimize fraud and minimize the number of legitimate applicants that are turned down. Basic protocols should be in place for Anti money laundering (AML), customer identification programs (CIP) and know your customers (KYC).
Prevent Account Takeovers	Activate multi factor authentications for employees and integrate systems with a global intelligence database that flags suspicious logins.
Track multi-device uses	Consumers often access accounts from multiple devices (phone, computer, tablet) thus consumer profiles should allow multiple devices to be added to prevent flagging legitimate transactions.
Small businesses should consider cloud-based platforms	For small companies without in-house IT departments, SaaS or cloud-based software provide many security advantages; these include cutting-edge data encryption and data obfuscation to minimize damage if a breach were to occur.

Source: TurnKey Lender

behind its product came under scrutiny and its campaign collapsed. The biggest example of alternative lending fraud, perhaps, is still ongoing. The video game Star Citizen has raised more than \$179 million USD since 2012 from more than 2 million donors, but has missed every deadline and has yet to deliver even a beta version. The U.S. Federal Trade Commission has begun to investigate these kinds of incidents. In 2015, it settled its first case with the creator of a board game who spent the funds he raised on Kickstarter on himself.¹⁰⁵ If the perception that alternative lending is illegitimate becomes widespread as a result of these incidents, the entire alternative lending industry could suffer. Similarly, growth in alternative lending could wane if these incidents spur regulators to enact more stringent regulations. We take up the issue of regulation risk in more detail below.

9.2 BLACK BOXES, BIAS, AND ETHICS IN MACHINE LEARNING

The combination of big data, and machine learning often yields more accurate predictive models, but it can also be susceptible to biased results. In the context of credit risk modeling, this bias can unintentionally lead to inaccurate

assessments of creditworthiness and discriminatory lending behavior. Moreover, because the determinants of a machine learning algorithm’s predictions are difficult to track—the so-called “black box” problem—identifying the source of the bias may be difficult or the bias may even go unnoticed altogether.¹⁰⁶

Machine learning bias can arise from two main sources: the data used to train the algorithm, and the programming of the algorithm itself. With respect to biased data, this could occur because the data are incomplete or are not representative of the underlying population. In other cases, training data may be representative but reflect a historical source of bias; algorithms trained on these data can perpetuate, or even strengthen, that bias. Finally, the designers of machine learning algorithms can introduce bias in their manipulations of training data, the way they evaluate predictions, and the way they design the process by which the algorithms teach themselves. Through these channels, designers of machine learning algorithms can inadvertently seed their algorithms with their own cognitive biases.

EXAMPLE 1:

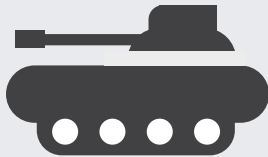
Consider an algorithm which incorporates observed shopping patterns into its decision model. It is possible that the algorithm learns to reject all loan applicants who shop at a particular grocery store because shoppers at those stores are correlated with a high risk of default. However, if these stores are more often situated in minority communities, the algorithm may have an adverse affect of denying credit to credit worthy consumers who shop at this store.



EXAMPLE 2:



One of the earliest uses of machine learning was for photo identification. The military designed a system which correctly distinguished pictures of tanks hiding among trees from pictures of trees with no tanks in them. The system worked 100% of the time when tested but failed in the field. It was revealed that the images used to teach the system were taken on different days, and the system learned to distinguish pictures based on the colour of the sky.



The use of alternative data can cause particularly acute bias and other inaccuracies in machine learning. Many alternative data sources are unverifiable, and self-reported information like social media posts and survey data are easily manipulated by users. In addition to creating bias in machine learning, there are other ethical concerns about the use of alternative data. Many loan applicants are not fully aware of the extent to which non-financial data is used to assess their creditworthiness and do not know how these data are stored. Unfortunately, many Fintechs have inadequate policies on data privacy. In a recent study by CFI Fellow Patrick Treynor, almost half of the 54 digital financial service firms surveyed were found to have no privacy policy whatsoever.¹⁰⁷

Machine learning bias represents a new source of model risk, but it can also create new legal risks. If the biased predictions of their machine learning algorithms lead lenders to discriminate against protected classes of people, even unknowingly, lenders may be held legally responsible. Historically, FIs were not held liable for unintentional discrimination. Recently, however, the U.S. Supreme Court has endorsed the so-called “disparate impact” theory of liability in several fair lending cases, ruling that effect, not intention, matters.¹⁰⁸ In this context, training bias is particularly problematic. Machine learning algorithms that use data that reflects historical discrimination in lending towards certain groups may perpetuate, or even exacerbate, that discrimination. Further, according to the recent General Data Protection Regulation (GDPR), borrowers in the E.U. now have the right to request an explanation of the decision process of automated decision-making systems. Lenders must now be prepared to provide declined borrowers with explanations as to why their applications were declined.

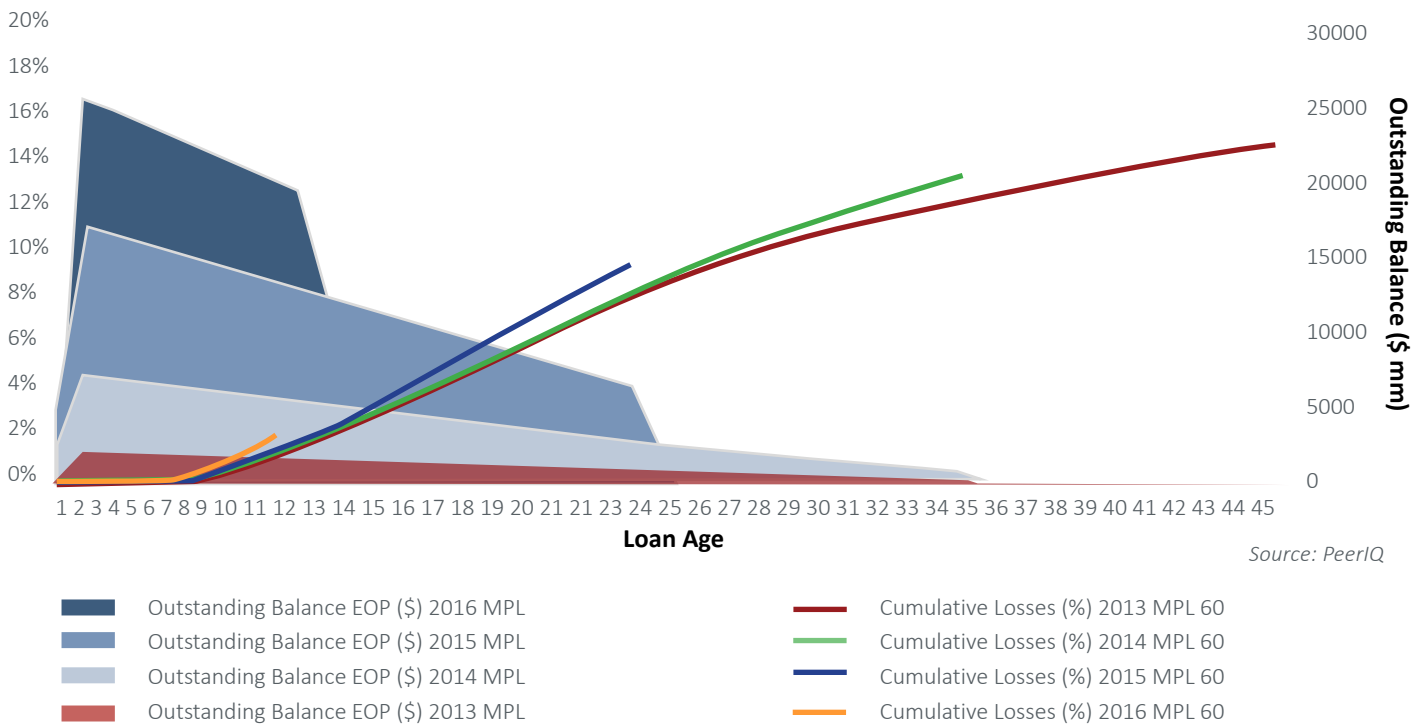
When employing machine learning techniques, FIs should follow these key principles in order to minimize the risks of using such techniques.¹⁰⁹ First, users of machine learning algorithms must recognize these algorithms’ limits and weaknesses when using their output to make real-world decisions. Second, data scientists and other designers of machine learning algorithms must ensure that they construct training datasets so as to minimize training bias. Importantly, they should be mindful that even accurate historical data can be biased, and without proper treatment their algorithms can reinforce this bias. Third, institutions should always consider the proper context when weighing the trade-offs associated with machine learning. Machine learning algorithms are fast and can make incredibly accurate predictions in some circumstances, but traditional, manual decision-making approaches are transparent and often more flexible. Fourth, FIs should develop and test new machine learning algorithms in sandboxes that are segregated from production environments, and should implement formal governance processes for putting newly-developed algorithms into production. Finally, FIs should be proactive in developing privacy policies to inform their customers about the data sources they use and who has access to this data.

9.3 LONG TERM VIABILITY AND SYSTEMIC RISK

Alternative lending has grown rapidly in recent years. This growth, however, has occurred during a period of robust economic expansion, stable financial markets, and low interest rates. As interest rates have begun to normalize, delinquencies on alternative loans have started to increase, raising questions about the risk taking practices and, consequently, the long-term viability of this segment of the lending market. Concern is also growing about how alternative lenders will fare when the next major economic downturn arrives. China, which dominates the alternative lending scene, has a significantly more volatile economy than developed markets like the United States and Great Britain. A financial market crash in China could have a devastating impact on that country’s alternative lenders, and could even spill over into the broader global alternative lending market.

After several years of rapid growth, default rates on alternative loans have begun to rise. Major alternative lenders, like LendingClub and Prosper, have seen increased losses on delinquent loans (see Figure 10 below)¹¹⁰, and have tightened their lending standards in response. These platforms have started to demand better credit scores, charge higher interest rates, and offer shorter maturities to reduce loan losses.¹¹¹ This trend has sparked concern about alternative lenders’ continued growth prospects; as alternative lenders shift away from underserved populations toward low-risk, established borrowers, they will be forced to compete more directly with traditional lenders. As interest rates continue to rise in the years to come, this trend may well accelerate.

Figure 10: Delinquency Rates and Cumulative Losses for LendingClub and Prosper Loans For 60-mo Loans Issued between 2013 and 2016



Rising default rates on alternative loans have also highlighted concerns about alternative lenders' ability to recover lost loans. Traditional lenders typically rely on specialized internal collections departments that enforce contracts, but many alternative lenders have no such operations.¹¹² Growing delinquencies may create a significant drag on alternative lenders' profitability if they prove unable to effectively recoup losses.

The global financial crisis of 2008–2009 raised awareness of how systemic risk and interconnectedness between FIs can amplify economic downturns. While alternative lending currently represents only a small fraction of the overall loan market, its rapid growth suggests that this market segment could become systemically important in the years to come. In fact, a recent study by the Bank for International

Settlements (BIS) reports that alternative lending could amplify systemic risk and reinforce credit cycles in the future.¹¹³ Alternative lending may be particularly vulnerable to financial crises and liquidity shortages; when investors flock to safe assets during the next financial crisis, they will likely pull out of the alternative lending sector well before traditional banks. Moreover, many alternative lenders package their loans and sell them to investors as securitized products. The role of securitization in precipitating the last financial crisis is well known, as is the sudden collapse of the market for securitized loans in the aftermath of that episode. Securitization can increase interconnectedness between FIs, and as securitization of alternative lenders' products proceeds, they will become more tightly intertwined with the rest of the sector.



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