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Artificial Intelligence Innovation in Financial Services

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Artificial intelligence technologies are permeating financial services sectors around the world. The application of these technologies in emerging markets allows financial service providers to further automate their business processes and to leverage new and big data sources to overcome obstacles—including the high cost of serving rural and low-income customers and establishing customer identity and creditworthiness—that prevent the delivery of financial services to many consumers. Realizing financial inclusion benefits through the adoption of artificial intelligence relies on its responsible adoption by firms, on competitive market settings, and on continued investment in the necessary infrastructure.

Artificial intelligence (AI) was established as a discipline some 70 years ago, but its applications have accelerated in recent years, supported by an evolution in machine learning and improvements in computing power, data storage, and communications networks. This note defines AI as the science and engineering of making machines intelligent, especially intelligent computer programs (see EM Compass Note 69).[1] AI can therefore be characterized as a series of systems, methods, and technologies that display intelligent behavior by analyzing their environments and taking actions—with some degree of autonomy—toward achieving prespecified outcomes.[2]

Reductions in the cost of Internet connectivity, increased mobile device penetration, and increased computing power over the past decade have helped digital consumers and businesses generate a wealth of new and real-time data through mobile phones and other digital devices. Concurrent advances in data storage, computing power, energy reliability, and analytic techniques have made it cost-effective for businesses to analyze this wealth of real-time and alternative data. As a result, it is now increasingly commercially viable for emerging market financial service providers (FSPs) to begin integrating AI technologies into their service offerings. A recent survey of 151 firms, which was conducted jointly by the World Economic Forum and the Cambridge Centre for Alternative Finance and included both financial technology (Fintech) firms and incumbent banks, suggests that this is indeed happening, with 85 percent of respondents saying they are "currently using some form of AI."[3]

In emerging markets in particular, the need for AI stems from the fact that individuals and businesses are often underserved because they lack the traditional identification, collateral, or credit history—or all three—needed to access financial services. AI can address this problem by providing analytically sound alternatives to determining the identity and creditworthiness of individuals and businesses, based on alternative data collected from mobile phones, satellites, and other sources.

An additional obstacle to emerging market customers accessing financial services is cost—the cost to reach and serve these customers is often too high relative to the size of their financial transactions and the revenue they represent.

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AI can help address this problem, too, by automating various processes—customer service and customer engagement are a few obvious ones—to reduce costs. In this way, AI can enable higher volumes of low-value transactions and, by doing so, begin to turn these formerly underserved individuals into potentially profitable customers and include them in the contestable market for FSPs.

Thus, to the extent that the use of AI by emerging market FSPs results in the extension of services to previously underserved individuals or underfunded businesses, these technologies have the potential to enhance financial inclusion. Yet the pace and extent of adoption, and hence the degree to which inclusion benefits are realized, relies on efforts by government, businesses, and investors to generate institutional and market settings that facilitate the responsible and sustainable integration of AI into financial services. This includes FSPs generating trust by lending responsibly, addressing algorithmic bias and error, managing cyber risk, and striving for informed consent in the use of consumer data. These settings also rely on supervisors enhancing their capacity to regulate algorithms, and authorities continuing to foster a competitive environment for financial services.

This Note explores the early applications of AI in the financial services sector in emerging markets, and canvasses challenges to the responsible and sustainable use of AI by emerging market FSPs. It also outlines what actions investors and development finance institutions like IFC can take to ensure that AI is deployed to maximize financial inclusion.

AI applications: Analyzing New and Complex Data Sets

The first broad application of AI by emerging market FSPs is to analyze alternative data points and real-time behavior to more effectively: (1) improve credit decisions; (2) identify threats to financial institutions and help meet compliance obligations; and (3) address financing gaps faced by businesses in emerging markets.

Improving credit decisions. Lenders and credit ratings agencies routinely analyze data to establish the creditworthiness of potential borrowers. Traditional data used to generate credit scores include formal identification, bank transactions, credit history, income statements, and asset value. In emerging markets, underbanked individuals—and particularly women—do not always have access to the traditional forms of collateral or identification that creditors need to extend financial services. By using alternative data sources—public data, satellite images, company registries, and social media data such as SMS and

BOX 1 FarmDrive

Kenya-based FarmDrive is an agricultural data analytics company delivering financial services to unbanked and underserved smallholder farmers, while helping financial institutions cost-effectively increase their agricultural loan portfolios. Using simple mobile phone technology, alternative credit scoring, and machine learning, FarmDrive closes the data gap that keeps smallholder farmers from the financial services that would allow them to grow their agribusinesses and increase their incomes. FarmDrive collects a farmer's data using questions and answers via text messaging. The questions are designed to identify the farmer's location, crops cultivated, farm size, assets such as tractors, and farming activities. This data is combined with existing agricultural data to develop a credit profile. FarmDrive also uses testing to determine the likelihood that a farmer will repay a loan. The aggregate profile is then shared with lending institutions for credit assessment and funding.

FarmDrive's algorithm is currently in its second stage. During the first phase (the pilot), which ran between December 2015 and December 2016, the company collected environmental data (weather and climate patterns and soil data), economic data (income and market data), and social data such as social network information including apps usage and individual data, from participating farmers. The aggregated data is fed into FarmDrive's algorithm, which generates credit scores that can be used by financial institutions.

In its next phase of development, FarmDrive will seek to expand the environmental arm of the algorithm by incorporating more alternative datasets, including satellite imagery and remote sensing data. In addition, FarmDrive plans to use these environmental datasets in combination with crop cycle data to predict seasonal yields and influence agricultural insurance products. When smallholder farmers have access to credit, they can sustainably contribute to economic development while improving their livelihoods.

BOX 2 Branch

Branch is a mobile app digital lender operating in Kenya, Nigeria, Tanzania, Mexico, and India. Since its establishment in 2015, Branch has provided more than 15 million loans to over three million customers, disbursing a total of $350 million.

Branch applies machine learning to create an algorithmic approach to assess the creditworthiness of potential borrowers based on thousands of data points on the individual and the accumulated experience across borrowers. A potential borrower downloads the Branch app, verifies his or her identity, and provides consent for Branch to access the customer's smartphone data. Branch applies its algorithms to data like text messages, call logs, contacts, and GPS, combined with a borrower's loan repayment history, to make a lending decision. The system creates personalized loan options in a matter of seconds, allowing Branch to approve a loan within minutes. Loan durations range from a few weeks to more than a year, with a typical loan of around $50. Underwriting loans of this size would not be viable at scale using traditional credit assessment methods.

messenger services interaction data—AI can help lenders and credit-rating institutions assess a consumer's behavior and verify their ability to repay a loan. For example, Box 1 illustrates how FarmDrive aggregates alternative datasets to build credit scores for smallholder farmers in Africa.

Start-ups like Kenya's mSurvey, a mobile survey platform that drives decision-making for businesses across Africa and the Caribbean, are using mobile phone applications to generate the requisite data needed to feed scorecards and build real-time profiles of local consumers.[4] As the results of consumer scorecards are fed back into a machine-learning system, the algorithms improve, refining which data points are the most predictive in assessing creditworthiness. Once the AI system is in place, predictive scorecards are inexpensive to generate for consumers who have access to mobile phones, which means the addressable market for financial services is greater and the cost and speed of underwriting loans is lower, enabling FSPs to extend services to underserved consumers (Box 2).

Early evidence suggests that predictive scorecards may also help reduce rates of non-performance across loan portfolios. For example, African FinTech MyBucks provides microloans and insurance directly to customers in 12 countries, including Zambia, Malawi, and Uganda, by applying its AI technology Jessie to scrape data from a potential borrower's phone to generate a lending profile.[5] The use of predictive scoring reduced the default rate on MyBucks' loan portfolio in South Africa by 18 percent over the 2017–18 financial year.[6] However, it is too early to tell whether AI will facilitate a net improvement in non-performing loan (NPL) rates, with responsible lending practices by FSPs still critical to market sustainability regardless of whether AI is used to assess creditworthiness.

Identifying threats. Financial institutions are vulnerable to a wide range of risks, including cyber fraud, money laundering, and the financing of terrorism. In order to combat these threats, financial institutions undertake know-your customer (KYC) and anti-money laundering and countering financing of terrorism (AML/CTF) compliance activities, among others, to verify the identity of their customers, to understand the purpose and intended nature of transactions between individuals and businesses, to conduct ongoing due diligence to ensure that transactions match customer profiles, and to meet regulatory requirements. Detection of fraud and anomalies is among the most commonly cited reasons for adoption of AI by financial service providers.[7] And risk management is currently one of the most common uses of AI technology in financial services sectors. According to IFC research, more than 250 regulatory technology companies (RegTechs) provide their services worldwide. A strong focus of these technologies is on suspicious transaction monitoring, where AI is used to identify anomalies in user behavior.[8] In emerging markets, KYC compliance is difficult because many individuals lack primary identification documents, registries are often patchy, and there is a lack of confidence in some sources of government data needed for verification. Yet it is critical that emerging market FSP's meet KYC requirements, because they underpin correspondent banking relationships that allow individuals and businesses to send and receive payments across borders. This matters for financial inclusion because remittance flows between markets are now the largest source of foreign exchange earnings in low- and middle-income countries, excluding China.[9]

AI-enabled compliance technology can reduce the cost for FSPs to meet KYC requirements and decrease false positives generated in banks' monitoring efforts by sifting through millions of transactions quickly to spot signs of crime, establish links, detect anomalies, and cross-check against external databases to establish identity using a diverse range of parameters. McKinsey estimates that AI-algorithms can help reduce the number of false reports by 20 to 30 percent, though they also observe that many financial institutions have been slow to adopt these techniques because the algorithmic "black box" is often too difficult to validate for the purpose of meeting supervisory requirements.[10] In addition, to date, the cost of the enabling software is beyond what many emerging market FSPs can afford. However, research conducted by IFC indicates that for emerging market FSPs, the cost can be reduced through shared services arrangements (see IFC EM Compass Note 59, "How a Know-Your-Customer Utility Could Increase Access to Financial Services in Emerging Markets").

The volume of digital financial transactions—remittances, savings deposits, and online purchases—is growing at double-digit rates annually. The growth in the value and volume of these transactions exposes financial services firms to fraud and cyber-attacks, with downside risk to firms' reputations. A 2017 CGAP survey of digital financial services companies in Kenya, Tanzania, Zambia, Uganda, and Ghana found that unplanned system outages due to events like cyberattacks decrease customer trust.[11] Like KYC compliance, leveraging the predictive and learning capabilities of AI through security software to identify and manage cyber threats will help FSPs maintain confidence in the security and integrity of transactions for customers and correspondent banks. However, software-as-a-solution packages to monitor and address cyber and fraud risk are currently prohibitively expensive for many emerging market FSPs, preventing the potential benefits from being fully realized.

Addressing financing gaps: the case of supply chain finance. Globalization has increased the scope and complexity of supply chains. FSPs take on credit risk for supply chain transactions by intermediating the financial instruments such as loans and cash management that enable trade between buyers and sellers. The Asian Development Bank estimates that there is a global trade finance gap of $1.5 trillion, which is driven by the relatively high cost of assessing firm creditworthiness and meeting KYC and AML/CTF requirements, particularly for emerging market small and medium enterprises.[12] The application of AI by originators of supply chain finance (SCF) has the potential to help bridge this trade finance gap.

Originators of supply chain finance now have access to a greater wealth of data about the behavior and financial health of supply chain participants. Machine learning algorithms can be applied to these alternative data-points—records of production, sales, making payments on time, performance, shipments, cancelled orders, and chargebacks—to create tailored financing solutions, assess credit risk, and help predict fraud and detect supply chain threats in real time and cost-effectively.

For example, Tradeteq is a platform that provides investors and SCF originators with the technology to negotiate, analyze, and manage trade finance investments, using alternative data to provide credit analysis and facilitating originators to pool assets, with the objective of reducing the structural costs that drive the trade finance gap.[13] Although costly, the accessibility of services like Tradeteq for FSPs have been improved through software pricing models based on optional use-of-service, rather than upfront capital expenditure models. At the same time, AI solutions in trade finance are limited by the extent to which SMEs along the supply chain have digitalized their operations.[14] Nevertheless, continued innovation to reduce the structural costs that sustain financing gaps in emerging markets, such as trade finance, is a nascent benefit of AI in the financial services sector.

AI Applications: Automating Business Models to Differentiate Services and Capture Market Share

The second broad application is the use of AI by emerging market FSPs to automate business models and processes to lower the cost of transacting with a wider range of consumers. This includes lower-income consumers and businesses who are benefitting from access to financial products that are tailored to their specific needs through the use of AI.

Increasing access through process automation. AI software helps automate aspects of digital financial services such as customer engagement and customer service, reducing the cost to FSPs of extending tailored support to a wider range of consumers. Juniper Research estimates that banks globally will save $7.3 billion in operating costs by 2023 through the use of chatbot applications.[15] An example is Bank BCP in Peru, which has partnered with IBM Watson to develop a personalized chatbot, Arturito, that facilitates customers in converting currencies, meeting credit card repayments, and accessing 24-hour customer support via Facebook. Similarly, Brazil's Banco Bradesco has worked with IBM Watson to develop a chatbot that answers 283,000 questions a month in relation to 62 products, with 95 percent accuracy.[16]

This tailoring and automation has financial inclusion potential if it facilitates the extension of financial services to individuals and businesses that might have been deterred from accessing financial products due to an inability to transact in their own language or to physically access a branch or banking agent. For example, IFC client MTN in Cote d'Ivoire is working with tech company Juntos to incorporate AI-support into its digital wallet MoMo, so that customers can better understand their financial products and obligations. To date, 95 percent of MTN's digital dialogue conversations have been successfully automated. This use of chatbots and language processing to help address trust and financial literacy barriers for consumers in accessing financial services remains an underexplored application of AI in emerging markets.

Personalized Banking. To date, the high cost of developing personalized relationships with clients has restricted "relationship banking" by financial institutions to large companies and high-net-worth individuals. FSPs are increasingly looking to differentiate their services to attract greater market share by using AI and big data (sets of structured and unstructured data) to automate an assessment of consumer behavior to provide simple savings and investment advice, often for free. Such "robo-advice" has financial inclusion potential if it can automate various processes and by doing so lower the costs of serving customers with low-balance accounts.

To date, the deployment of robo-advisors in emerging markets is largely limited to Brazil, China, and India, where there are significant savings pools. India-based ArthaYantra, for example, aims to circumvent the culture of accepting financial advice from family and friends as well as the commission-based model of existing financial service brokers, both of which result in suboptimal savings outcomes. Instead, the company's AI robo-assistant Arthos analyzes customer data to recommend mutual funds matched to each consumer's risk profile and track financial decisions to generate monthly rebalancing options.[17] Careful analysis of early attempts to automate wealth management advice will help determine if robo-advice provides better savings and investment outcomes for consumers, on average, than human advisors. Unlike chatbots, which are interactive systems conducting a conversation via text or audio designed to simulate how a human would behave, Robo advisors are highly specialized bots mostly employed as automated financial advisor and investment platforms. The system uses a software algorithm to build and manage portfolios.

More Complex AI Applications Are Under Development

These early examples have illustrated how FSPs are integrating narrow AI—such as machine learning algorithms—into their services to reduce business costs and overcome operational hurdles in order to serve more customers. Still under development are more complex AI applications with greater potential to address financial

FIGURE 1 Example of a Chatbot in Peru

"Chatea con Arturito" or "Chatting with Little Arthur" is an automatic response channel working as a chatbot that is offered by Banco de Crédito (BCP), the largest bank in Peru. Its conversations can be followed at https://www.facebook.com/pg/ArturitoBCP/posts/.

Source: Banco de Crédito (BCP), Peru.

inclusion barriers. For example, weather risk transfer contracts are financial tools that protect farmers from climate risk by triggering a payout for predefined weather events.[18] WorldCover is using AI to assess satellite, weather station, and agronomic data to determine the risk of weather "events," and is working on smart contracts that leverage AI and blockchain to trigger automatic payouts.[19] The automatic disbursement of payouts via nonbank payments providers like M-Pesa will allow farmers without bank accounts to access insurance cover. Identifying and addressing barriers to the scalability of insurance solutions such as weather risk transfer contracts will be critical to meaningfully addressing the insurance protection gap in emerging markets, which currently accounts for $160 billion, or 96 percent, of the total global insurance protection gap.[20]

Managing the Risks that AI Poses

Integrating AI into financial services presents sector-specific privacy and algorithmic bias challenges. The International Committee on Credit Reporting (ICCR) has identified a number of risks associated with credit scoring models, including: data inaccuracies; the use of data without informed consumer consent; the potential for bias and discrimination in the design and decisions of algorithms; and heightened exposure to cyber risks.[21] These risks are enhanced in AI models where data is fed back into systems to refine decision making.

Additionally, early adopters of AI in financial services may be able to leverage their head start to generate ever larger data sets on which algorithms can be further trained and refined. An early mover may get so far ahead, and be able to tailor finely priced offerings so much better than competitors, that it captures an outsized market-share, resulting in a winner-takes-all scenario. This would reduce competition for services, with the risk that consumers lose choice and price competition in the longer term. An alternative scenario is that AI adoption creates new business models that enhance cost-competitiveness among technological suppliers. Avoiding a winner-take-all scenario, through efforts by government and regulators to monitor anti-competitive effects, will be important to maintaining consumer benefits of AI in financial services.

As FSPs adopt AI, they need to attract staff with the right skills to understand how AI technologies, like credit-scoring algorithms, work, so that lending is issued responsibly. Otherwise, there is a risk that AI innovations do more harm than good by increasing indebtedness for vulnerable consumers and eroding consumer trust in the industry, which in aggregate may increase systemic risk. Adopting responsible lending and risk management practices like the ICCR will be important in avoiding overindebtedness for EM consumers.

These risks raised through AI adoption require FSPs to carefully assess and actively govern their operations in terms of data ownership, privacy, security, and biases. This task will require coordination between FSPs and others—international organizations, governments, and industry—to develop robust privacy, data management, cyber security, and supervisory regulations/processes to facilitate AI adoption across the sector.

In contexts where the digitalization of financial services—a prerequisite for AI adoption—still lags, additional efforts are needed by governments and investors to develop the prerequisite settings. For example, CGAP has identified interconnected and open digital platforms, shared market infrastructure and data, and support for public goods like foundational IDs as structural requirements for digital financial services innovation.[22] In addition, government and private sector investors must continue to invest in telecommunications and energy infrastructure to improve the enabling environment for the digital economy. Without this enabling support, there is a risk that digital financial services, whether using AI or not, will continue to be commercially and practically infeasible, leading to a deepening of the digital divide.

As with any process automation, the integration of AI into financial services is likely to displace jobs in EM countries. For example, natural language processing could replace outsourced customer care services, which is an industry that employs thousands of workers in countries like Vietnam, South Africa, and Morocco. Alternatively, some jobs will be created in technology companies and large financial institutions to meet the aforementioned governance, regulatory, and maintenance obligations associated with successfully managing a system using AI. However, there is a question about where those jobs are created, with some EM countries potentially losing out on human capital and knowledge transfers if the jobs are created in company headquarters rather than EM subsidiaries. There are also some jobs required for financial service delivery in lower-income contexts, such as banking agents, that are still largely outside the digital realm and are therefore much further from displacement via technological advancement.

Facilitating Responsible and Sustainable deployment of AI

IFC's digital financial services and fintech practice has invested in and provided advice to over 150 financial services providers since 2007. Through its investment and advisory services, IFC has considerable experience in assessing how new technologies, including AI, can be deployed in the financial services sector to help achieve the World Bank Group's twin goals of ending extreme poverty and boosting shared prosperity. For example, IFC client Yoma Bank in Myanmar has developed a scoring algorithm to provide loans to suppliers and distributors, leveraging their payment and order data to build a loan book that funds micro, small, and medium enterprises (MSMEs). Yoma Bank's nonperforming loan ratio is well below one percent.

As early as 2015, through a partnership between IFC, Ant Financial, and Goldman Sachs, IFC provided $245 million in financing to Ant to launch a data-driven lending product for women-owned small businesses in China. Although MSMEs account for 90 percent of all Chinese firms and 60 percent of employment, only 30 percent of

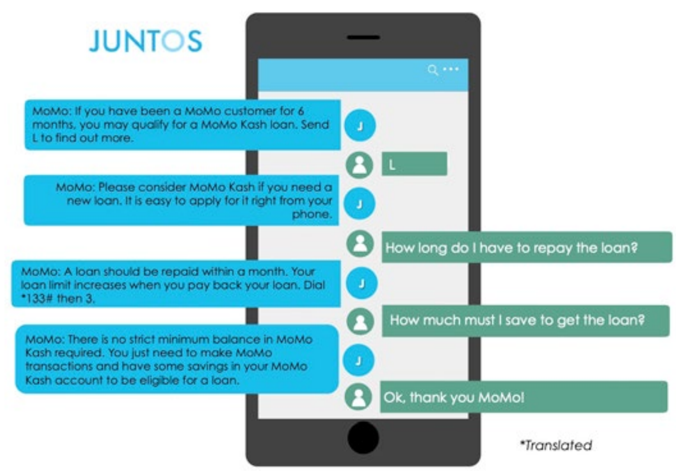

FIGURE 2 Example of an AI-Supported Digital Dialogue

Source: Juntos.

formal banking system loans are disbursed to them. With 560 million people in China connected to the Internet and small firms increasingly operating online, Ant Financial (a subsidiary of Alibaba Group) saw an opportunity to apply machine learning that leverages online transaction data to assess the creditworthiness of loan applicants, even those without collateral.[23] While collateral provides comfort to lenders, relying on it for lending decisions excludes millions of small businesses with high potential. Instead, Ant Financial was able to apply AI to big data to make lending assessments based on actual payment history, enhancing its competitiveness by bringing high-performing small businesses into its customer base at a more rapid pace and at lower cost, which would be hard for traditional banks to replicate. As a result, Ant increased its loan portfolio from $0.5 billion to $4.0 billion over a four-year period.

IFC also helps educate market participants about how to deploy technological innovations responsibly.

- IFC partnered with the Mastercard Foundation in 2017 to publish a handbook on how to apply data analytics to digital financial services, including how practitioners can use data to develop algorithm-based credit scoring models for financial inclusion.[24]
- The World Bank Group, through the ICCR, has developed guidelines on Credit Scoring Approaches that include guidance on the use of AI in credit scoring. These guidelines will soon be published.[25]
- IFC, together with private sector investors, has developed Guidelines for Responsible Investing in Digital Finance, which has been endorsed by over 100 investors and financial services providers, including Branch.[26] The adoption of these practices will be important to financial institutions to maintain consumer trust in digital financial services and to minimize the risk of harmful lending practices.

Looking Forward

Early applications of AI in the financial services sector are helping to overcome obstacles that impede the extension of financial services to underserved individuals and businesses in emerging markets. These obstacles include the difficultly some individuals and businesses encounter in accessing traditional forms of identification, collateral, or credit history needed to secure a loan, as well as the high cost to FSPs of meeting their compliance and regulatory obligations and in managing cyber and fraud risk using existing processes. Instead, AI technologies can analyze new and real-time data sources and further automate business processes to overcome these operational and cost hurdles, with the result that it is now commercially feasible to extend financial services to more people. However, the early use of AI by FSPs is still narrow in scope, with many unexplored opportunities to use the technology to enhance development impact, such as improving consumers' financial literacy. In addition, many of the lowest-income consumers will still remain out of reach of FSPs where there is low smart-device penetration and unreliable Internet connectivity and energy supply.

Investors and development finance institutions like IFC can mitigate risks associated with the deployment of AI by adhering to the Guidelines for Responsible Investing in DFS,[27] an industry standard developed under the leadership of IFC. It requires investees to be certified by the SMART campaign, which is a set of principles for responsible financial inclusion, or endorse relevant guidelines such as the ICCR guidelines. DFIs should also monitor and evaluate projects to generate empirical evidence of how AI is contributing to financial inclusion in different contexts. This includes understanding if the application of AI is reducing nonperforming loan ratios and service costs, improving customer service, and resolving KYC and AML risks. Finally, DFIs must continue to invest in the enabling infrastructure for digital financial services—including telecommunications and energy infrastructure, and human capital skills—to ensure that the three billion people without access to or effective use of digital technologies are not left further behind as the benefits of AI spread elsewhere.[28]

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