



# Use of Big Data in Developing Markets

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## 1 Introduction

Big-data-based FinTech has witnessed spectacular growth in developing markets, as exemplified by the leading players in China such as the Ant Financial, Tencent, and JD Finance. While the FinTech industry has taken innovative approaches to promote financial inclusion by serving traditionally underbanked businesses and households, it remains an open question as to how they prevail especially in comparison with traditional banking. This chapter covers how businesses in developing markets use big data to solve moral hazard and adverse selection problems, increase the efficiency of matching borrowers and lenders, and address liquidity and other concerns.

FinTech comprises large technology firms whose primary business is e-commerce or social media. They have been entering banking in developing markets, which is considered a particular subset of broader FinTech innovations. In the beginning, FinTech firms' entry into banking started with

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payment services. Increasingly, they have expanded their businesses beyond payments into the provision of credit, insurance, and savings products, either directly or in partnership with incumbent financial institutions such as commercial banks (Frost et al. 2019; Buchak et al. 2017).

The main advantage of FinTech firms is their ability to exploit their existing trading networks and the massive quantities of data they generate. This business model quickly took off and has had astonishing growth in recent years. To date, big-data-based FinTech has profoundly changed the way consumers live and has reshaped the financial services industry in developing markets. Their huge success raises a number of important questions. For instance, do FinTech lenders leverage an informational advantage from their unique access to users' data? Or is their advantage technological due to methodological innovations such as machine learning, deep learning, and big-data algorithms that provide credit references and improve the modeling of credit risk? How has the development of FinTech stimulated economic growth? What are the other economic effects of and challenges faced by FinTech firms? What are the future trends in banking due to market competition with FinTech?

The rest of this chapter is organized as follows: In Sect. 2, we summarize how FinTech firms have used financial service instruments and big data to reduce the frictions in financial markets. Section 3 presents how FinTech stimulates economic growth in the aspects of facilitating small business growth, supporting entrepreneurial activities, promoting household spending that lead to financial inclusion and redistribution. We conclude in Sect. 4 with a brief summary and discuss the challenges faced in the era of FinTech and big data.

## 2 How Does Technology Reduce Financial Market Frictions?

### 2.1 Innovation in Financial Service Instruments

To overcome the underbanked issue, the developing world has recently turned to mobile banking after previously focusing on micro-finance. Aker and Mbiti (2010) and Mbiti and Weil (2011) show that a money transfer system via a mobile phone, such as M-Pesa in Kenya, improves individual outcomes by promoting banking and increasing transfers.

In addition, Allen et al. (2013) show that the Equity Bank in Kenya has pursued branching strategies distinct from other commercial banks; it has

targeted underserved areas and poor households. Equity Bank's presence has a positive and significant effect on households' adoption of bank accounts and bank credit, especially for Kenyans with low income and less education and for those who do not own houses. Also, the Equity Bank provides financial services to segments of the population that were typically ignored by traditional commercial banks. In the process of doing so, the bank has generated sustainable profits that show that it is a viable solution to the problem of financial access that has hindered the development of inclusive financial sectors in many African countries.

Furthermore, Gupta et al. (2019) study the positive productivity outcome from the expansion of mobile phone networks in rural India that has facilitated the adoption of high production of a variety of seeds and chemical fertilizers. In addition, they find that areas receiving mobile phone coverage experience higher adoption of these technologies.

The increasing adoption of financial service instruments also has helped to promote financial inclusion of the poor and underbanked areas. Higgins (2018) studies a natural experiment that created a shock to FinTech adoption; between 2009 and 2012, the Mexican government disbursed about one million debit cards to existing beneficiaries of its conditional cash transfer program. How did merchants respond to the consumers' adoption of debit cards? And how did it affect other consumers' FinTech adoption and consumption decisions? The results show that the adoption of debit cards had spillover effects on the adoption of financial technology on both sides of the market. Small retailers adopted point-of-sale (POS) terminals to accept card payments that subsequently led to more consumers adopting the cards. Two years after the government program, the number of POS terminals in treated localities had increased by 18% relative to untreated localities.

In addition to the studies that focus on practices and developments specific to one country, Demircuc-Kunt et al. (2018) conducted nationally representative surveys of more than 150,000 adults in over 140 economies. These surveys gathered information on the use of financial technology, including the use of mobile phones and the internet to conduct financial transactions. Their study shows that a total of 1.2 billion adults have obtained bank accounts since 2011, including 515 million since 2014. Between 2014 and 2017, the share of adults who had an account with a financial institution or through a mobile money service rose globally from 62 to 69%. In developing markets, the share rose from 54 to 63%. However, women in developing economies were 9 percentage points less likely than men to have a bank account.

Recent technological development has introduced innovation in screening and credit scoring by using machine learning, deep learning, and other

models based on predictive algorithms to improve the traditional credit risk model. Mishra et al. (2019) study the adoption of credit scoring in retail lending by private banks and state-owned public sector banks in India. The paper shows that there is a significant gap in the level of adoption of credit scoring technology between the introduction of the technology and two years later. For borrowers with prior relationships, public sector banks' inquiry rates are lower than those for their private peers who subject virtually all loans to a credit bureau check.

## 2.2 Using Big Data to Improve Credit Provision

In contrast to the government-promoted adoption of credit scoring, the private sector in China took the lead by using the big-data approach in providing banking services to solve moral hazard and adverse selection problems, increase the efficiency of matching borrowers and lenders, and to address liquidity and other concerns.

FinTech credit in China has seen a dramatic increase during the past few years. According to the annual surveys conducted by the *Cambridge Centre for Alternative finance* (Rau 2019), FinTech companies in China have become the largest market for big data lending in absolute terms. There were 2,525 online credit platforms by the end of June 2017. This was roughly 3% of the overall outstanding household credit in China. The average rate of return for investors rose to 9% with the maturity of lending decreasing to 9.5 months. Cumulatively, the industry had 76.23 million participants (investors and borrowers), or about 5.5% of the Chinese population.

Also, the in-house research institution of the Alibaba group, Luohan Academy (2019),<sup>1</sup> shows that digital technology greatly reduces adoption lags and lifts penetration rates for less developed countries and regions that thus enlarges growth opportunities for all. Despite many challenges, a new development paradigm is emerging; one that is inclusive, sustainable, and may not require massive investments up front. For example, as of July 2016, Ant Financial in China, the world's largest mobile and online platform, provided credit lines to more than 2.9 million firms or vendors on its e-commerce trading platform, Taobao.

What are the unique features of big-data-based FinTech lending compared to traditional banking? Does FinTech have an information advantage due to their access to users' data or from technological advantages that arise from

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<sup>1</sup> Luohan Academy Annual Report (2019): Digital Technology and Inclusive Growth.

innovations such as machine learning algorithms to provide credit references and to improve the modeling of credit risk? Chen et al. (2019) show that one clear feature of FinTech is P2P financing, or crowdfunding, that is the collection and acquisition of personal information. E-commerce credit providers have access to a vast amount of information on their clients, such as e-commerce transaction data and online financial and behavioral data that include anonymized records of purchases, payments, online shopping, money transfers, wealth products, house ownership, rental information, and social networks. This information helps reduce the key challenges in traditional financial services—adverse selection and moral hazard problems due to information asymmetries (Stiglitz and Weiss 1981). The use of technology and big data make the provider's information collection much less costly and much more efficient especially for new or small businesses compared to traditional banks.

Another important feature of FinTech lending that distinguishes it from traditional banks is information processing and decision-making through big-data algorithms. FinTech and big data enable the better provision of credit by substituting subjective decisions (made by individuals) with automated decisions based on hard information (e.g., Liberti and Petersen 2019). By replacing soft information in relationship lending with hard information, FinTech makes loan processing much faster, cheaper, and more efficient.

Moreover, FinTech lending is more effective in both post-loan monitoring and debt enforcement. Traditional bank monitoring relies on public disclosure of firms' financial activities and covenant design, while FinTech lending can utilize real-time and high-frequency data based on the multidimensional metrics of borrowers. Lenders can more accurately evaluate the credit and other operational risks and thus prevent fraud and default (e.g., Fuster et al. 2018).

Huang (2019) studies how contract enforcement affects FinTech lending that is not collateral-based. Using data from Alibaba on online lending to SMEs, he finds that there is a negative relation between FinTech lending and contract enforcement in China. This significantly differs from traditional bank lending which is positively correlated with contract enforcement. Also, firms located in cities with poor contract enforcement are willing to use more FinTech lending and pay higher interest rates as they face more financial constraints in accessing bank credit.

Chen et al. (2019) also find that the enforcement procedures and strategies of FinTech firms depend on real-time models, and they are highly algorithmized. In fact, it is very difficult for borrowers of FinTech lending to default compared to borrowers of traditional bank loans. This is because FinTech

firms can “track” their addresses and locations (based on daily consumption records in the case of Taobao, for example), identify their related parties, and use other various ways to contact them. There are also implicit covenants for borrowers if they fail to repay the debt because of the potential sanctions by the FinTech lender. For example, FinTech lenders also provide platform services to businesses and have access to their payments for goods or their digital wallets, and as a result default is very costly for these businesses.

### **3 How Does FinTech Stimulate Economic Growth?**

#### **3.1 Mobile Payment and Small Business Growth**

Thanks to the rapid development of smartphone and financial technology, mobile payment is another key growth area, especially among major emerging economies. For example, the total amount of mobile payments in China reached 42 trillion USD in 2018, 12 times as large as the value in 2014.<sup>2</sup>

Mobile payments can benefit businesses by reducing transaction costs for both consumers and businesses. Mobile payments cut operating costs for businesses that are particularly relevant for small business creation and growth. For example, mobile payments help small businesses to circumvent the cost of handling cash as well as its leakage due to theft, which erodes as much as 5% of the revenue of small businesses. It deters the entry of small businesses that could have made a positive profit absent such costs. Agarwal et al. (2020) investigate this channel using Singapore as a setting: in 2017, leading banks in Singapore introduced a mobile payment technology that facilitated consumers’ ability to transfer funds to both merchants and other consumers. They use the registry data on the universe of the firms created in Singapore and find that after the introduction of this mobile payment technology, business-to-consumer industries witnessed a higher rate of business creation of 8% per month relative to business-to-business industries. Consistent with the cost-saving argument, the growth in business creation is stronger for mom-and-pop stores and industries with higher costs in handling cash. To further establish causality, they show that tourism areas, which are dominated by foreign tourists and therefore have a lower penetration rate of (local) mobile payment users, see no increase in business creation after the event. Self-employed individuals receive a higher inflow of income from a larger

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<sup>2</sup> Source: People’s Bank of China.

consumption growth during the post-event period. This income reflects the real effect of the technological advance on business owners.

Mobile payments can also improve efficiency by reducing the duration of transactions. This improved efficiency moves customer traffic more efficiently and raises customers' effective demand, mostly in shops involving small transactions. Agarwal et al. (2019b) approach this conjecture by using data on mobile payment transactions and bankcard spending from a representative sample of consumers from a leading bank in Singapore. They find that the 2017 mobile payment technology not only significantly promoted the use of mobile payments but also generated a significantly positive spillover effect on merchants' sales through card payments: small merchants experienced a monthly increase in card sales of 3.5% compared to large merchants after the technology shock, and the sales growth only existed for the merchants who generally received small-size payments. They also find that the sales growth was primarily driven by newly established stores and that merchants were more likely to be patronized by new consumers. These results indicate that the rise in payment efficiency stimulated consumers to explore new stores.

### 3.2 FinTech Credit and Entrepreneurial Development

As the world's largest online retailer and one of the world's largest internet companies,<sup>3</sup> Alibaba enables third-party sellers in China to take their own businesses to the web. Alibaba estimated its China retail marketplaces Taobao and Tmall.com had "contributed to the creation of over 15 million job opportunities with more than 10 million active sellers as of 2015."<sup>4</sup> This growth enables Alibaba to access the vast big data collected from 300 million registered shoppers and 20 million vendors.

By extracting information from big data, FinTech companies can mitigate information asymmetry and provide better credit access to borrowers who are particularly constrained or excluded from the credit market. These characteristics allow FinTech credit to reach micro, small, and medium-sized enterprises (MSMEs), which are more likely to be underserved by traditional banking. Does FinTech credit have a real impact on MSMEs? The consolidated dataset of e-commerce and FinTech credit from Ant Financial serves as a unique laboratory to investigate this question. Hau et al. (2019a) examine

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<sup>3</sup> As of October 2014, Alibaba surpassed Walmart as the world's largest retailer. See "Alibaba Is Now the Biggest Retailer in the World," *The Telegraph*, October 28, 2014.

<sup>4</sup> See "Alibaba Affiliate Ant Financial Raises \$4.5 Billion in Largest Private Tech Funding Round," *Wall Street Journal*, April 25, 2016; "Alibaba Job Boom: Jack Ma Chats with Trump About How to Create 1 Million US Jobs over 5 Years," *CNBC*, January 9, 2017.

whether FinTech credit can promote entrepreneurial growth. To identify a causal effect, they exploit a discontinuity in the probability of credit approval at a particular threshold value of the internal credit score: for businesses just past the threshold, the probability of credit approval increases by 37%. They show that e-commerce vendors with first-time online credit access increase their sales growth by 9.2% in the month following credit eligibility, and the sales growth is entirely driven by credit-constrained firms that use the credit line. Importantly, they show that FinTech can mitigate the geographic disadvantages of an unfavorable firm location: the firms that face a lower supply of local credit or that are far from bank branches rely more on FinTech credit and have larger sales growth after the online approval of credit.

FinTech credit from Ant Financial also reduces sales volatility of e-commerce merchants, as found by Chen et al. (2019). They find that in the three months after access to FinTech credit, firms' monthly standard deviation in the weekly growth rate of total sales decrease by 5.5%. The effect exhibits a countercyclical pattern: the reduction in sales volatility is more pronounced during contractionary monetary policy regimes or in regions with lower economic growth. The reduction in sales volatility also has a real effect: in the three months after the access to FinTech credit, firms experience a reduction in the likelihood of bankruptcy of 15%.

These results reinforce the previously stated two advantages of FinTech credit over traditional banking especially for MSMEs. First, the use of technology and big data allow FinTech lending to better acquire and process information than traditional banking. Due to their shorter history for traditional lenders to effectively evaluate their credit risk, younger firms face a higher level of information asymmetry. Indeed, the effect of FinTech lending on sales and volatility is stronger among younger firms. Second, with the new technology in both monitoring and debt enforcement, FinTech lending circumvents a poor legal environment and weak contract enforcement. Due to the difficulty of debt collection, traditional lenders are less willing to lend to MSMEs in the areas with poor legal protection and weak contract enforcement. FinTech lending, on the other hand, could monitor borrowers using real-time and high-frequency data from the e-commerce platform, and directly adopt sanctions and enforcement. Accordingly, the authors find the effect of FinTech lending is stronger among firms in areas with poor legal protection and weak contract enforcement.

FinTech lending also influences the accumulation of customer capital among MSMEs. Using data from the e-platform Taobao, Huang et al. (2019) find that access to FinTech credit leads to an increase in service rating by 9% in the month following the access to credit. Repeatedly, they find evidence



that indicates FinTech credit can help mitigate the frictions associated with traditional banking: the effect of FinTech credit on customer capital accumulation is more profound for firms in business downturns, poor collateral conditions, and weak legal enforcement.

### 3.3 Digital Payment and Household Spending

Digital payment instruments can help reduce transaction costs and bring convenience to consumers. For example, QR (Quick Response) code payments are a digital payment instrument that has received much popularity in emerging countries like China and Singapore. This instrument allows two parties in a deal to fulfill the transaction by simply displaying and scanning the QR code on their mobile phones. Agarwal et al. (2020) use transaction-level account information on 250,000 consumers from a leading bank in Singapore to show that consumers in Singapore significantly decreased their amount of ATM cash withdrawals after the introduction of the mobile payment technology. The convenience of mobile payments encourages consumers to expand the geographic scope of their shopping activities and explore new stores (Agarwal et al. 2019).

On the other hand, mobile payment is a less salient method than cash. For example, cash payment involves the act of parting with hard-earned money that is a more painful and memorable experience than payments that do not involve a physical exchange of money. The subdued salience of mobile payment entails a risk for consumers to miss their budget targets and induce overspending. Agarwal et al. (2019a) investigate this conjecture by using the receipt-level data on customers of a large Indian supermarket chain. This information comprises the receipt amount, payment method, and details of items purchased, and anonymized consumer identification. They exploit the demonetization in India that exogenously forced cash-dependent consumers to switch to digital payments: in November 2016, the Indian government unexpectedly announced the invalidity of the Rs. 500 and Rs. 1,000 notes, which account for 86% of the existing currency in circulation. They find that after the demonetization, cash-dependent consumers decreased their use of cash but significantly increased their total spending. One explanation for this overspending is that consumers switched to more expensive items within a category and became less likely to use promotional offers. However, more evidence is needed on other types of spending and in other markets to comprehensively evaluate the overspending hypothesis.

### 3.4 Inclusive Growth and Redistributive Effects

Technology helps overcome information and operational frictions, a natural outcome of which is financial inclusion and a more balanced growth in the real economy (see the report by Luohan Academy, 2019, and the speech by Spence 2019<sup>5</sup>). Hau et al. (2019b) show that FinTech credit allows a more inclusive entrepreneurial growth by leveling the playing field for the previously underserved sector or regions. Similarly, the effect of mobile payment technology on business creation is more profound for mom-and-pop stores and in poorer communities (Agarwal et al. 2020). Since small firms and less developed communities are more sensitive to the operating cost of handling cash, their results show that mobile payment facilitates financial inclusion.

Another example of technology promoting inclusion is e-commerce. For traditional offline trades, the upfront investment of setting up storefronts in destination cities, along with the information asymmetry between buyers and sellers due to geographic distance impose a significant cost on inter-city trades. These frictions make goods produced in one city less accessible to consumers from other cities. This lack of access leads to inequality in living standards across regions, even within a country. E-commerce may help mitigate the inequality in spatial consumption for two reasons. First, it helps reduce the fixed cost of setting up a brick-and-mortar store that allows firms to reach consumers in cities that they otherwise would not serve. Second, online shopping platforms facilitate the acquisition of information by consumers on goods from distant locations. Fan et al. (2018) provide evidence consistent with these two features. Applying a gravity model for both online and offline trading flows between province pairs, they find that the distance elasticity for online trading is only about one-third of that for offline trading, which indicates online trading is less constrained by geographic distance than offline trading. They also use online sales data at the city-category level from Taobao and find that residents from cities with smaller population sizes and market potentials spend a larger share of their expenditure online and enjoy a larger welfare gain from e-commerce.

However, the redistributive effect of technology hinges on consumers' ability or willingness to adopt technology. Couture et al. (2020) exploit a randomized control trial that facilitates rural parcel delivery and pickup of a large e-commerce platform in China to show how e-commerce influences consumer welfare. The detailed household survey data that cover demographic and spending information allow the authors to explore the

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<sup>5</sup> Speech by Michael Spence (2019): The End of Shareholder Primacy?

heterogeneous effect of e-commerce. They find that overall, rural households experience a reduction in the cost of living due to online purchases, especially for durable spending and for remote rural residents. However, this welfare gain is driven by a small group of consumers (15% of the sample) who are on average richer and younger than non-adopters. Thus, whether e-commerce can benefit the population as a whole remains an open question.

There are also debates on whether technology induces redistribution in such a way that hurts certain population groups or sectors in the economy. One such debate centers on whether e-commerce can hurt traditional retailers in brick-and-mortar stores. The evidence so far is mixed. Some studies provide evidence that e-commerce crowds out offline stores. For example, Chava et al. (2018) investigate this question by exploiting the (staggered) introduction of a large US e-commerce retailer's fulfillment centers into a county. Using sales and employment data for 3.2 million stores, they find local offline retail stores experience a reduction in sales (employment) by about 3% (2.5%). Brick-and-mortar retail stores also show a decrease in entry and an increase in exits, with the exit concentrated in smaller and younger stores. Using a payroll dataset for 2.6 million retail sector workers, the authors also show that the income of workers in the local retail sector drops by 2.4% after the increased accessibility to e-commerce. The effect is mainly driven by a decrease in the number of hours worked.

While the US evidence indicates direct competition between e-commerce and offline retailers and a significant crowd-out effect for the latter, China's experience is somewhat more positive. In particular, e-commerce and offline retail stores enjoy complementarities. For instance, online retailers can hardly offer the shopping experience provided by offline stores. The information consumers acquire from the internet may also reduce the search cost of offline shopping. Chen and Qian (2019) use the world's largest e-commerce shopping holiday, China's Singles Day, to show how large-scale online promotional events influence the sales of brick-and-mortar stores. Using debit and credit card transactions of a large, representative sample of consumers from the country's leading service provider of card payments, they find that consumer card spending at offline stores increases on Singles Day especially among products that depend on the shopping experience. Importantly, the increase in offline sales not only exists among large, geographically close, and established stores but is equally large among small, geographically remote, and new ones for which consumers face higher search frictions. This finding indicates spillover benefits of e-commerce to offline merchants.

## 4 Conclusion

Over the past few years, the innovation in finance technology has reduced the frictions in the financial markets, such as the payment system, bank account, credit reference system, and finally platform lending. The FinTech companies such as Alibaba provide automated credit to millions of underbanked small firms and households in rural and remote areas. In this chapter, we focus on the innovations and real effects of FinTech and big data in developing markets, which are a rapidly rising yet still nascent topic in the literature. Moreover, the FinTech credit in less developed countries is arguably the single source of credit for these small firms and households based on big-data algorithms, hard information, and automated loan process.

Compared to traditional banking, big-data-based FinTech lending has apparent advantages in better information collection, acquisition and accumulation, efficient loan processing, and comprehensive credit risk modeling both for ex-ante screening and ex-post monitoring. By replacing soft information with hard information and substituting human decisions with automated decisions based on numerical data, technology, and big data make information collection and loan decisions cheaper and more effective. Furthermore, FinTech lenders are more efficient and effective in loan monitoring and debt enforcement using real-time data based on multidimensional metrics, and the enforcement strategies are based on highly algorithmized models of credit risk.

Overall, the FinTech in developing markets has streamlined the financial service process and has improved resource allocation that in turn, has boosted business growth and household consumption. The financial technology is also an important driver of inclusive growth.

We would like to close this chapter by pointing to the imminent need to manage several challenges unique to the era of FinTech and big data. The intricacy comes in maintaining a good balance between maximizing the benefits of big data and at the same time delicately dealing with concerns over information monopoly, data privacy, and data inequality as well as the potential bias of the big-data algorithms and the dark side of machine learning. Researchers and practitioners have started to explore those potential issues (Fuster et al. 2018), but the answers are far from clear. Developing markets will remain at the forefront of the development of big-data-based FinTech from which we continue to learn in the years to come.

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